

CLIMATE CHANGE DENIAL:
A CONTENT ANALYSIS
OF SOCIAL MEDIA

by

Audra Bacon, B.A.

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Committee Members:

Chad L. Smith, Chair

Asha Hegde

Bob Price

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DEDICATION

This work is dedicated to my grandmother, Dr. Ann Bacon, whose love for education was unmatched. I am profoundly grateful she created the opportunity for me to attend graduate school. Her legacy lives on through this project.

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LIST OF ABBREVIATIONS

Abbreviation	Description
GHG	Green House Gas
IPCC	Intergovernmental Panel on Climate Change
CTT	Conservative Think Tank
CCCM	Climate Change Countermovement
CC	Climate Change
Pro-CCS	Pro-Climate Change Science
CCLIES	Climate Change LIES

ABSTRACT

Climate change science is strongly supported within the scientific community, yet there is still much public debate on the topic. However, there have been few analyses of the online discourse around climate change denial. The goal of this research is to evaluate online discussions in order to gain a better understanding of the climate change denial countermovement, to assess public reactions on global climate change deliberations and legislation, and finally, to determine how and if public opinions have changed over time. In order to gather information from social media users who both support and deny climate change, two Facebook pages were used in this study: 1) NASA's Climate Change; 2) Climate Change LIES. The main findings of this research indicate that denialist explanations cover a lot of topics but are primarily grounded in politics, personal experience, and how one obtains their sources of news information. Arguments over the authenticity of news sources is central in the climate change debate, as seen in this study. Such arguments commonly included offensive language, which allowed for a new discussion of the social implications on these types of interactions.

I. LITERATURE REVIEW

Introduction

Scientists overwhelmingly agree that anthropogenic greenhouse gas (GHG) emissions are warming the planet (Cook, Oreskes, Doran, Anderegg, Verheggen, Maibach, Carlton, Lewandowsky, Skuce, Green, Nuccitelli, Jacobs, Richardson, Winkler, Painting, and Rice 2016). The most recent data analysis showed a 90-100% consensus among published climate scientists who agree that climatic changes are occurring, are human caused, and that the data present a global problem (Cook et al. 2016). These findings are “supported by multiple independent studies despite variations in the study timing, definition of consensus, or differences in methodology including surveys of scientists, analyses of literature or of citation networks” (Cook et al. 2016:6). Eighty countries have issued statements endorsing the same position in The National Academies of Science (Cook et al. 2016). The 2018 Intergovernmental Panel on Climate Change (IPCC) reported the same consensus: human activities are changing the Earth’s climate. The IPCC report explains how warming the planet by 2.7 degrees Fahrenheit will have significant impacts upon the social and natural world (IPCC 2018). The frequency and severity of extreme weather events will increase, as well as risks to aquatic and terrestrial ecosystems, human health, agricultural production, economic growth, among many other societal-environmental relationships (IPCC 2018).

Although a strong agreement among scientists legitimizes the assertion of anthropogenic climate change, the validity of this consensus and the veracity of climate science is still widely questioned by the American public (Cook et al. 2016). In the United States, climate change denial is more prevalent compared to other developed

nations (Cook et al. 2016). The following literature review provides an analysis on the public perceptions of climate change, the main predictors of denialism, and the political implications of the climate change countermovement, polarization, and conservative echo chambers.

Climate Change Denial: Public Perceptions

Anthropogenic climate change has become a contentious topic in global and national politics (McCright and Dunlap 2011). How to approach climate change has been debated in the United States since the early 1990's, when it first emerged on the political agenda through global deliberations like the Rio de Janeiro Earth Summit (McCright and Dunlap 2000). The 2018 Gallup poll found that only 35% of Republicans agree that climatic changes are anthropogenic, in contrast, 91% of Democrats agree that global climate changes are caused by human activity (Brenan and Saad 2018). Recent annual polls also showed that 69% of Republicans and only 4% of Democrats believe climate change is exaggerated (Brenan and Saad 2018). In general, the Gallup polls show that Republicans are more skeptical of climate change (Brenan and Saad 2018).

Studies on climate change denial have analyzed the main predictors of why an individual might reject climate science. Ample research shows climate perception to be primarily driven by ideological factors, such as political orientation and party identification (McCright and Dunlap 2011a; Hamilton 2011; Lewandowsky, Cook, Lloyd 2018). In the United States, skepticism is stronger among conservatives than among liberals for several critical and compelling reasons. Using data from the General Social Survey from 1974-2010, a study by Gauchat (2012) found that the overall public trust in science has not declined, except among those who frequently attend church and among

conservatives. The study also showed that educated conservatives experience a decline in trust towards science, which “suggests that scientific literacy and education are unlikely to have uniform effects on various publics, especially when ideology and identity intervene to create social ontologies in opposition to established cultures of knowledge” (Gauchat 2012:182).

Extensive research on this topic has been put forth by McCright and Dunlap, who have examined various implications of climate change denialism, including the political polarization and perceptions of climate change (2011b), the conservative movement’s counter-claims (2000) and the impact of this movement on policy reform (2003). Moreover, their research also applies the anti-reflexivity thesis to provide a theoretical explanation for the organization of climate change denialism, “which characterizes the climate change denial countermovement as a collective force defending the industrial capitalist system against claims that the systems causes serious problems” (McCright and Dunlap 2010:78). The theory is further applied in later work (see McCright 2016) and provides an analysis on how to interpret patterns of skepticism within the general public.

McCright and Dunlap (2011b) analyzed data from 2001-2010 Gallup poll surveys, in order to examine political polarization and climate change perceptions. The research showed a substantial political divide among liberals and conservatives on climate change, and consistent with other research, conservatives and Republicans are less likely to agree with the scientific consensus and are less concerned about the environmental implications of climate change, compared to Democrats (McCright and Dunlap 2011b). McCright and Dunlap also assert that the political divide among liberal and conservatives has grown significantly over the past decade (2011b). Other significant

predictors that an individual might adhere to climate skepticism include: regularly watching Fox News (Feldman, Maibach, Roser-Renouf, Leiserowitz 2012), religious affiliation, Evangelical Protestants are more likely to be skeptical compared to other religious or unaffiliated groups (Smith and Leiserowitz 2013), and white males (McCright and Dunlap 2011a) are more likely to be skeptics.

Political Implications and the Climate Change Countermovement

It is pertinent to discuss how conservative skepticism on climate change became the dominant discourse within the political right in the United States. For the past two decades, a climate change countermovement (CCCM) has been facilitated by Conservative Think Tanks (CTT's), trade associations, Republican politicians, for-profit corporations (i.e. fossil fuel companies), and conservative advocacy and foundation groups (McCright and Dunlap 2000; Austin 2002; Jacques, Dunlap, and Freeman 2008; Dunlap and Jacques 2013; Brulle 2014; Farrell 2015). The primary strategy in this movement has been to refute or distort climate science in order to cloud public understanding of the topic (Brulle 2014). This campaign of various actors has been described as the "denial machine" (Begley 2007) and has played a pivotal role in climate skepticism in the general public and political arena (Elsasser and Dunlap 2013).

Meyer and Staggenborg define a countermovement as "a movement that makes contrary claims simultaneously to those of the original movement" (1996:1631). The authors explain three critical features of a countermovement: "first, the movement shows signs of success; second, the interest of some population are threatened by movement goals; and third, political allies are available to air oppositional mobilization" (1996:1635). Jacques et al. (2008) argue that these conditions allow for an understanding

of why the conservative movement launched an anti-environmental countermovement in the 1990's. The 1992 Earth Summit demonstrated a global response to environmental degradation and, as Meyer and Staggenborg (1996) suggest, this represented a growing public and political involvement, and success of the environmental movement (Jacques et al. 2008). The environmental movement also threatened the main tenets of neoliberalism (free trade, open markets, privatization of public utilities, etc.) (Conca 2001), therefore the interests of a select population were threatened (Jacques et al. 2008). Finally, the 1994 Republican takeover of Congress allowed for the mobilization of anti-environmental "allies" (McCright and Dunlap 2003; Jacques et al. 2008). Furthermore, environmental degradation has often been caused as a result of human activities. Pro-environmental advocates started to argue for the need of sustainable development and insisted that modern societies and production practices change in order for global environmental problems to be mitigated (Jacques et al. 2008). This allowed for pro-environmental values to be perceived as a threat to economic growth, which legitimized the emergence of the anti-environmental countermovement, and later, the climate change countermovement (Jacques et al. 2008).

In order to further evaluate the climate change countermovement and the lack of political action in the U.S., it is pertinent to discuss how capitalism might influence the environmental movement. In capitalist societies, economic values take precedent as "the imperative of capitalist accumulation is to expand commodity production and commercial markets" (Austin 2002:77). Austin (2002) argues that capitalism might be considered a threat to the pro-environmental movement in two main ways (Austin 2002). First, the inherent nature of capitalism values profits above social and environmental concerns

(Austin 2002; Gould, Pellow, and Schnaiberg 2015). Second, the fundamental goal to maximize profits “compels capitalists to externalize production costs, a practice that ultimately results in increased environmental destruction and risk to public health,” (Austin 2002:77; Gould, Pellow, and Schnaiberg 2015). External effects or externalities can be defined as the “spillovers (positive or negative) from the production of a good or service” (Matthews and Lave 2000:1390). The basic tenets of capitalism are to value and maximize profits above all other concerns. One can begin to fathom the complexities of the anti-environmental movement which gives rise to the political stagnation on addressing climate change.

The climate change countermovement differs from other anti-environmental movements in a compelling way. As mentioned above, by the early 1990’s, climate change had already been established as an environmental concern and social problem, politically (Earth Summit) and socially (as shown in public opinion records) (McCright and Dunlap 2003). Several environmental case studies—offshore oil drilling (see Molotch 1970 and Freudenburg and Gramling 1974), air pollution (see Crenson 1971), wetland protection and habitat destruction (see Krogman 1996) -- provide evidence of how powerful interest groups, namely fossil fuel companies, have been successful in suppressing environmental issues from entering the political landscape (McCright and Dunlap 2003). Such groups have also been successful in deterring public and political opinions in accepting environmental concerns as problematic or as issues that need to be addressed (McCright and Dunlap 2003). The climate change countermovement is unique in that it attempts to delegitimize an issue that was already established as a problem on the political agenda (McCright and Dunlap 2003). In the U.S., the anti-environmental

position of the conservative movement is a well-established value (see Jacques et al. 2008; McCright, Dunlap, and Xiao 2013; McCright and Dunlap 2003). In regard to conservatism environmental regulation and policy, “studies consistently find conservatism to be negatively related to pro-environmental attitudes and actions among the general public and especially among political elites, such as members of Congress” (Dunlap and McCright 2003:353). The efforts put forth by conservative leaders and politicians to refute the reality of climate change are to be expected, given the historical resistance of the conservative movement towards environmental affairs (Jacques et al. 2008).

McCright and Dunlap (2000) argue that conservative think tanks (CTT’s) have been the most notable source of anti-environmental rhetoric and the most influential countermovement organizations nationally. To determine the nature and content of global warming counterclaims, McCright and Dunlap (2000) examined documents distributed by CTT’s between 1990 and 1997; documents included books, op-eds, CTT magazines and newspapers, speech transcripts, press releases, policy studies, and articles from the World Climate Report. The think tanks analyzed in this research include those that are the most active in the media, have known political ties to Republican administrations, and receive the most funding from conservative foundations (McCright and Dunlap 2000). CTT’s have been key actors in the climate change countermovement by producing a vast amount of contrarian print material, in addition to “making media appearances, providing congressional testimony, giving speeches, and so on to promote conservative positions on a wide range of policy issues, including environmental protection” (Dunlap and Jacques 2013: 701). Authors of content produced by CTT’s usually cite themselves as climate

experts, regardless of their credentials (Dunlap and Jacques 2013). In addition to misguiding the public perception on climate change, conservative politicians and much of the Republican party have been adamant on climate change denial (Elsasser and Dunlap 2013).

McCright and Dunlap's research identified three main counterclaims implemented by CTT's that refute climate change as a social problem (2000). "First, conservatives claim that the evidentiary basis of global warming is weak, if not wrong. Second, conservatives argue that the net effect of global warming would be beneficial should it occur. Third, conservatives argue that the policies proposed to ameliorate the alleged global warming problem would do more harm than good" (McCright and Dunlap 2000). The conservative movement's approach challenged the veracity of climate change science and questioned the legitimacy of risks from mitigation policies, in addition to asserting that negative impacts of climate change policy are definite (McCright and Dunlap 2000). Economic risks combined with ambiguous science are the main doctrines of the climate change countermovement (McCright and Dunlap 2000). The tactic of advancing skepticism has been successfully implemented by CTT's to halt previous environmental protection policies and has allowed CTT organizations to become leaders in the anti-environmental countermovement (Austin 2002).

In the early 1990's very few documents relating to climate change were produced by CTT's. In 1996, however, more content was produced than in all the preceding years combined and the production rate continued to increase dramatically in 1997 (McCright and Dunlap 2000). The increase is consistent with international deliberations on climate change action, such as the Kyoto Protocol conference, which was scheduled to take place

in December of 1997 (McCright and Dunlap 2000). The counterclaims analyzed in McCright and Dunlap's research show the clear mobilization and efforts put forth by the conservative movement in order to halt legislation action of the Kyoto Protocol (2000). In their later research, McCright and Dunlap (2003) expand their 2000 study and analyze how CTT's endorsed counter claims which further impacted global and national climate change policy. The authors argue "that our nation's failure to enact a significant climate policy is heavily influenced by the success of the conservative movement in challenging the legitimacy of global warming as a social problem" (2003:367). The existing literature provides clear explanations on why the U.S. is in the current polarized and inert political position. Questioning the validity of climate science has been used as a political tool to disrupt legislation on mitigation efforts, even though the vast majority of the scientific community has long recognized the basic science of climate change (Cook et al. 2016). For the stalemate on climate change policy to end, U.S. political leaders must first recognize and acknowledge global warming as a serious environmental and social concern. Current and future social and environmental realities of climate change demand political leadership and action in the U.S. and other developed countries.

Political Polarization and Conservative Echo Chambers

One element of the CCCM is the conservative echo chamber. Echo chambers refer to "A common frame of reference and positive feedback mechanisms that reinforce existing opinions rather than foster dialogue and critical reasoning" (Walter, Brüggemann, & Engesser 2018:205). In online social forums, users tend to choose information that confirms their preexisting assumptions (Bessi 2016). Online platforms promote selective exposure, where people can easily access information that is consistent

with their preexisting beliefs (Walter et al. 2018). Echo chambers are often online communities or virtual communities that are “Largely closed, mostly non-interacting polarized communities centered on different narratives, where enclaves of like-minded people consume information in strikingly similar ways” (Bessi 2016:1). These online communities often reassure what a group of people already believe about a particular subject, which can hinder critical thinking and open dialogue (Farrell 2015).

Farrell (2015) argues that regarding climate change, echo chambers are especially problematic. In online conservative networks, where echo chambers are common, the dominant perception is that anthropogenic climate change is up for debate, but, outside of the echo chamber, there is a strong scientific consensus on climate change (Farrell 2015). When political communication is severely biased and lacks so-called “outsider” perspectives in this type of online structure, it leads to perceptions of false certainty and confirmation bias (Farrell 2015). Echo chambers are also formed on conservative online blogging websites, TV, newspaper, and radio outlets (Elsasser and Dunlap 2013). A study by Elsasser and Dunlap (2013) analyzed op-eds published between 2007 to 2010, a period that saw interesting political changes regarding climate change—it was the last two years of the Bush administration and the first two years of a democratically controlled Congress under Obama; this was also during the time when *An Inconvenient Truth* first gained publicity. In order to determine how one media outlet in the conservative echo chamber might contribute to climate change denial, Elsasser and Dunlap (2013) conducted a content analysis on a well-known conservative website, TownHall.com, and analyzed 203 published op-eds from 80 different authors.

A few interesting key findings emerged from Elsasser and Dunlap (2013). Over the four-year period, Al Gore was the leading topic for columnists and was discussed almost twice as much as other topics. He was mentioned in 93 of the 203 op-eds (Elsasser and Dunlap 2013). Al Gore, a former Democratic vice president and continuing climate change advocate, was the main connection conservative columnists used to link skepticism within their rhetoric—the strategy used preexisting political preferences (that disfavored Gore) as a vehicle for designing climate change skepticism (Elsasser and Dunlap 2013). The IPCC was discussed in fifty of the op-eds and was often mentioned when columnists needed a scientific source to discredit. Moreover, the op-eds were more likely to associate Al Gore with climate change than the IPCC, which suggests that the political figure was considered easier to discredit (Elsasser and Dunlap 2013).

Another finding in Elsasser and Dunlap's (2013) work showed that op-eds were often published as response pieces to public events regarding climate change (events that both promoted and undermined skepticism). A significant number of columns were published in months where events providing credibility to climate science occurred, for example, when *An Inconvenient Truth* won an Academy Award for Best Documentary. Similarly, events like Climategate, which encouraged discussions on climate change denial, also provoked an increase in the number of columns published (Elsasser and Dunlap 2013). The most common arguments the columnists put forth on climate skepticism either denied human responsibility or entirely refuted the existence of climate change. Elsasser and Dunlap's (2013) research provides evidence showing how one media segment of the conservative echo chamber had a significant impact on public discourse in climate change denial. It also suggests further methods in which

conservative political strategies were implemented in order to alter public perception on climate change.

A vast amount of research shows that the major driver of climate change denial is derived from these methodical and deliberate strategies, and solely organized with the intent to misdirect the general public, and to halt legislative action (McCright and Dunlap 2000, 2003; Elsasser and Dunlap 2013; Brulle 2013; Farrell 2015, 2016). The research put forth by Farrell (2015) provides a fundamental component to the discussion on the climate change denial and lack of political action. Farrell (2015) analyzed large sets of data over a twenty-year period (1993-2013), including published work by known contrarian organizations (i.e. CTT's, foundations, lobby firms), as well as known persons who participated in the climate change countermovement (2015). Farrell's research provides evidence that "...corporate funding influences the actual language and thematic content of polarizing discourse" (2015:96). His analysis clearly showed that organizations who received corporate funding had a greater likelihood of publishing and disseminating contrarian material (Farrell 2015). This research is imperative regarding the current state of public discourse and policy on climate change and allows for a greater understanding of how ideological polarity is created and maintained (Farrell 2015). It also solidifies how polarization is used as a strategic mechanism to create controversy. Favored by certain political affiliates and stakeholders (as we see in Farrell's research) to hinder progress on environmental policy and reform (Farrell 2015).

Fisher, Waggle, and Leifield (2013) in efforts to further understand political polarization on climate change analyzed data from congressional hearings; building on McCright and Dunlap's earlier work (2003), which analyzed hearings from 1990 to 1997.

The data consisted of testimonials from hearings related to climate change that took place during President George Bush's second term (Fisher et al. 2013). Over three hundred legislative pieces pertaining to climate change were introduced during this time, including amendments and resolutions (Fisher et al. 2013). One main finding from this research shows that polarization is not focused as much on the science of climate change, but more so on the economic implications of policy changes aimed at reducing GHG emissions (Fisher et al. 2013). Importantly "these results contribute to a more nuanced understanding about how the science of the issue is being used by political actors against the regulation of carbon dioxide to stymie progress in the Congress" (Fisher et al. 2018:87). Research by Fisher et al. use political legislation as their sample data and not the general public as seen in previous research, meaning that those who hold the greatest power in terms of climate change mitigation policies are stuck in a political stalemate (2013). According to the authors, comprehensive climate change policies can't be implemented in the U.S. as long as climate science is used as debatable material in efforts to distract policy makers from the real disagreements at hand, which is the economic and political changes associated with legislation (Fisher et al. 2018).

To determine if echo chambers are created in U.S. policy networks a study using survey data from political elite communities that are involved in climate politics was conducted (Jasny, Waggle, and Fisher 2015). Jasny et al. builds on previous studies examining why legislation regarding climate change has been continuously disputed within U.S. policymaking. As discussed previously, climate change denial has occurred due to the role of CTT's in creating a countermovement, and the influence of media outlets and their coverage. Jasny et al. (2015) proposed echo chambers as a tool to

describe how information has become a partisan choice, leading to confirmation bias and false certainty. Jasny et al. (2015) present a more formal operational method in analyzing the components of echo chambers, in efforts to explore how they might be created in public policy. The study conducted by Jasny et al. contributes significantly to this area of research in that it developed a more concrete and advanced description of echo chambers (2015).

The authors surveyed sixty-four political actors who were involved in U.S. climate change politics in 2010—the researchers inquired into their views on human induced climate change and asked where their knowledge and information about the topic is derived from (Jasny et al. 2015). Regarding climate policy, 2010 was an active time in the U.S. as legislation regulating GHG emissions passed in the House of Representatives and was being considered in the Senate (Jasny et al. 2015). Empirical methods used in this study were “exponential random graph (ERG) modelling to demonstrate that both the homogeneity of information (the echo) and multi-path information transmission (the chamber) play significant roles in policy communication,” (2015:783). Results of the study found that echo chambers do occur in the U.S. climate policy network. The political actors who participated in the study obtained information about climate change primarily from the same sources (Jasny et al. 2015). Jasny et al. (2015) present the need for further critical assessments on the main actors involved in climate change policies. Moreover, participants in this study gathered information from limited sources, a stronger and more fluid relationship between scientists and policy makers at the legislative level would be conducive to climate change efforts.

Several main conclusions are shown throughout the sociological literature on climate change denialism. Due to the fundamental economic and social changes that must take place in order to mitigate the impacts of global climate change (for example policy changes aimed at decreasing carbon emissions, reducing fossil fuel extraction and dependence, etc.) a political stalemate has developed among policy-makers (Fisher et al. 2013), as well as a significant degree of denial and political polarization in the American public (McCright and Dunlap 2011b). Empirical evidence, as presented in the literature review, shows that the prevalence of climate change denialism in the U.S. is the outcome of an organized effort and strategic plan implemented by various actors. Since the late 1990's, CTT's, among other political actors in the conservative movement, deliberately disseminated contrarian viewpoints regarding climate change, in a successful attempt to halt legislative action (McCright and Dunlap 2003).

In this literature review, data are presented on climate denialism ranging from congressional testimony hearings, online conservative forums, surveys (i.e. Gallup polls, General Social Survey), op-eds or other various media, and published work by CTT's or other political associations. Sociologists and researchers can bring insight to the complexities involved in climate change denialism. Social scientists are able to demonstrate how social structures like political institutions (see Fisher et al. 2013; Jasny et al. 2015; Farrell 2015; Farrell 2016), race and gender (see McCright and Dunlap 2011a), religion (see Ecklund, Scheitle, Peifer, and Bolger 2017; Smith and Leiserowitz 2013), and education (see Hamilton 2011) operate in climate change denialism. Furthermore, research has also been done on the psychological reasons behind climate change denial (see Gifford 2011; Poortinga, Spence, Whitmarsh, Capstick, and Pidgeon

2011), which provides insight on how social and psychological challenges can reinforce denial and further prevent mitigation efforts.

Gaps in the Literature

Research presented in the literature review details the various actors involved in the climate change countermovement. Though ample research has been conducted on the multi-faceted issue of how climate change denialism emerged, there have been few analyses on social media and the online discourse around climate change denial. Multiple studies show how climate change is framed in the mass media (see Smith 2005; Carvalho 2010; Moser 2010; Anderson 2011), but few have examined social media discourse relating to climate change (Schäfer 2012; Auer, Zhang, and Lee 2014). Kaplan and Haenlein (2010) distinguish six types of social media including: collaborative projects (i.e. Wikipedia), blogs and microblogs (i.e. Twitter), content communities (i.e. YouTube), social networking sites (i.e. Facebook), virtual game worlds (i.e. World of Warcraft), and virtual social worlds (i.e. Second Life). Blogs, microblogs, and social networking sites are social media platforms that are of particular interest for the study of online climate communication. Research on microblogging has developed in the academic literature, though regarding environmental issues in general the primary focus has been to examine the use of microblogs as policy communication tools or as a form of advocacy (Auer et al. 2014). Recent climate change and social media research includes topics such as how the IPCC reports are discussed online (see Pearce et al. 2014; see O'Neill et al. 2015), an analysis of climate skepticism blogs (see Sharman 2014), and the amount and varying content of climate related discussions occurring in different parts of the world (see Kirilenko and Stepchenkova 2014). The available literature lacks an in-

depth analysis of social media and how climate change debates are framed online, how such discourse has changed over time, and the ways in which social media perpetuates (or mitigates) climate change denialism (see Williams, McMurray, Kurz, and Lambert 2015).

Current research is needed to investigate how online communities may influence the public debate around climate change and vice versa. Furthermore, how such debates are shaped politically, especially how the discourse has changed after President Donald Trump's election, is of particular interest. It is imperative for researchers to further understand the public perception on climate change, how such perceptions are supported or dismissed in online networks, and finally, how the public discourse changes before and after climate change related events. The goal of this research is to evaluate how social media users react to such events (described in detail in the following section) and analyze the extent to which online social networks perpetuate or mitigate climate change denial. It's critical to evaluate these online discussions in order to gain a better understanding of the climate change denial countermovement, to assess public reactions on global climate change deliberations and legislation, and finally, to determine how, if, and why opinions have shifted. Considering the polarized political situation and inactive policy efforts on climate change, analyzing public perceptions would provide further implications on climate change denialism. Contrarian literature on climate change will continue to be disseminated to the public. Further analyses of online conservative echo chambers and the ways in which social media shape public opinion, can lead to greater insights on future societal implications regarding climate change.

II. DATA AND METHODS

Research Questions

R.Q.1: How is climate change denial framed in online social media outlets, specifically, how has the content or tone changed?

R.Q.2: What is the general public opinion on climate change represented in social media outlets?

R.Q.3: How have withdrawals from global deliberations, such as the Paris Climate Agreement, shifted public perceptions on climate change, as represented online?

R.Q.4: How have social media users reacted to other climate related events? For example, how have online users perceived the Trump Administration's planned rollback of the Obama Clean Power Plan or the Global School Strike Protest?

The data collected for this study are derived from two different climate change related Facebook pages. In order to gather information from users who both support and deny climate change, the researcher specifically chose two Facebook pages to analyze: 1) NASA's Climate Change; 2) Climate Change LIES. These two pages were selected as they were the most popular and active sites on the topic at the time of this study. NASA's page was launched in 2010, has nearly 1.3 million followers, and climate related posts are shared almost daily. Climate Change LIES (CC LIES) was launched in 2012 and has about 13,500 followers. This page was the most popular denialist page at the time of data collection. On average, each post on these pages receives about ten to twenty comments, though this often varies, and some posts receive zero comments while others can receive thousands of comments. It should be noted that the NASA Climate Change page receives a much higher level of traffic and comments, but both pro-climate change science (pro-CCS) and denialist users frequent both pages.

The selected Facebook pages are available to the general public, allowing anyone access to review the content. The study is comprised of a non-random purposeful sample that reviews content from Facebook users who have chosen to publish information that

can be viewed and accessed by anyone. The conventional content analysis approach was used throughout this study. In this type of research, the study begins with an observation and “codes” are created and defined throughout the data analysis (Hsieh and Shannon 2005). In a content analysis, researchers use a basic coding process to organize large quantities of data (or in this study, textual information) into fewer and smaller categories (Hsieh and Shannon 2005). “Categories are patterns or themes that are directly expressed in the text or are derived from them through analysis,” (Hsieh and Shannon 2005:1285). This process and how the data were organized is discussed in greater detail below. All content published during the three selected time intervals (below) was evaluated using a conventional content analysis approach.

The data collected in this study was approved by the Institutional Review Board (IRB) and the anonymity of respondents will be maintained to adhere to IRB protocols. Although the Facebook pages chosen for this study are publicly accessible, user identities are kept anonymous. The researcher adhered to all IRB protocols and requirements.

CC LIES and NASA’s Climate Change Facebook pages are well-visited websites and contain a significant amount of public discussion on the topic. This method was specifically chosen as it will attempt to: 1) provide further information about the ways in which social media can shape public opinion; 2) describe public discourse on this topic within the forum of Facebook; 3) and demonstrate how climate change denial is framed online. In order to evaluate how social media users have reacted to major climate change related events, the researcher analyzed posts and comments on these pages for the five days before and after the following climate change related events occurred:

1) May 27th – June 6th 2017

- June 1st Trump announces withdrawal from Paris Climate Agreement

- 2) **August 16th – August 26th 2018**
 - August 21st Trump Administration implements the Affordable Clean Energy rule, a rollback to the Obama Administration’s Clean Power Plan
- 3) **September 15th – September 25th 2019**
 - September 20th Global Climate Strike Protest (school strike for climate movement, inspired by Greta Thunberg)

The dates were specifically chosen after the election of President Donald Trump, and the selected sample included data from the years 2017, 2018, and 2019. In order to determine if there was a change in how social media users were reacting to climate change related events over time, it was necessary to obtain data from three consecutive years. The first date, June 1st, 2017, was specifically chosen as it was the day President Trump announced the U.S. withdrawal from the Paris Climate Agreement, which is a global agreement for nations to mitigate the harmful effects of climate change and reduce fossil fuel emissions. In April of 2016, the U.S. (under the leadership of President Obama) and China issued a joint statement declaring that both countries would sign the agreement (Worland 2017). This was an important political moment for the potential reduction of greenhouse gas (GHG) emissions, as both countries are collectively responsible for 40% of emissions (Worland 2017). On June 1st, 2017, at the White House Rose Garden, President Trump announced the U.S. would withdraw from the Paris Climate Agreement, stating that, “In order to fulfill my solemn duty to protect America and its citizens, the United States will withdraw from the Paris climate accord but begin negotiations to reenter either the Paris accords or really an entire new transaction on terms that are fair to the United States, its businesses, its workers, its people, its taxpayers” (as cited in Ustynoski 2019:118). A reporter from Time Magazine stated that President Trump’s withdrawal was “a move that will weaken a key international measure

aimed at fighting global warming and isolate the U.S. on an issue of importance to allies across the globe” (Worland 2017). It was important for the researcher to see how online users reacted to Trump’s withdrawal, in order to gain a better understanding of the public’s perspective.

The second date, August 21st 2018, was used to sample data as it was another key political event for climate change, but at the national level instead of the global level (like the Paris Agreement withdrawal). President Trump created the America First Energy Plan during his first few months in office. “These goals are centered around expanding the extraction of fossil fuels, reviving the coal industry, and ending the Climate Action Plan that was developed under the Obama Administration” (Ustynoski 2019:118). The Affordable Clean Energy rule is a rollback to the Obama administrations Clean Power Plan, which gave each state an emissions cap (Ustynoski 2019). This date was crucial as it is an example of a policy shift at the national level, after Trump was elected president.

The final date, September 20th, 2019, was the date of the recent global climate strike protests, inspired by Greta Thunberg, in which young people across the world went on a school strike to demand political action on climate change. This date was chosen as it was a recent event, it received considerable media attention, and it was the largest climate event in history with protests occurring in most major cities around the world. On September 23rd, the same week of the climate strike protests, the United Nations Climate Action Summit was held in New York City. Greta Thunberg attended and gave an emotional speech, stating that:

“This is all wrong. I shouldn’t be up here. I should be back in school on the other side of the ocean. Yet you all come to us young people for hope? How dare you! You have stolen my dreams and my childhood with your empty words. And yet I’m one of the lucky ones. People are suffering. People are dying. Entire ecosystems are collapsing. We are in the beginning of a mass extinction. And all you can talk about is money and fairytales of eternal economic growth. How dare you!” (as quoted in The Guardian, cited as Thunberg 2019).

The speech was widely covered by the media and went viral after President Trump tweeted about it. This event was particularly important for the climate change movement, as Greta and her followers (several other children activists) announced at this event that they would be filing a lawsuit against countries that are not on track to meet the emissions requirements as they pledged in the Paris Agreement. The emotional speech Greta Thunberg presented at the Summit has over 3.5 million views on YouTube and is certainly a significant moment in the climate change movement.

The researcher for this study identified which websites to collect data from and chose specific dates for the sample. Multiple options for collecting the data from Facebook were considered, however, it became apparent that webpage data scraping was the most efficient and reliable means of data collecting. Data scraping refers to the technique programmers or web developers use to collect online information. For this project, the help of a Texas State University computer science graduate student was enlisted in order to collect the data using this method. A step-by-step explanation of the data scraping process is in the appendix section. This was ultimately decided as the most reliable method of collection due to the amount of comments in the data set. Facebook makes it difficult to simply copy and paste comments, especially in large quantities, without formatting problems. Challenges also occurred when trying to obtain data from

the earliest dates chosen for this study (i.e. 2017). Loading comments on earlier posts proved to be inefficient and faulty, as it would often result in the webpage not responding. Thus, data scraping is clearly the superior method as it assures a full slate of reliable data from the websites. Upon completion of the data scrape, all comments and posts were exported into an Excel spreadsheet that contains the following information: Unique record (webpage source), post date, post author, comment date, comment, comment author, reply date, reply comment, reply author.

Originally, McCright and Dunlap's (2000) counterclaims was a potential framework that could be used to organize the data for this project. However, throughout the data analysis, it became clear that the framework has limitations for this research. This is largely due to the type of data, since the data were extracted online from a social media platform, a different set of arguments and discourse were presented. Although McCright and Dunlap's framework could potentially be applied in some areas (which is briefly discussed throughout the analysis), overall, the counterclaims aren't represented throughout this dataset. As stated, this is largely due to the content being online, and even more so, it being data collected from social media. McCright and Dunlap's (2000) framework was collected from various articles, news outlets, etc., whereas the data here is entirely what people are saying to each other online about climate change (or related content).

To avoid using any preconceived categories, the conventional content analysis approach allowed the categories to flow from the data, which led the researcher to organize them into clusters and eventually themes. Major themes revealed in the data were organized into a color-coding system in order to accurately count the comments,

and the researcher began to work with the data set in Excel. Each major theme identified by the researcher was assigned a color; throughout this research “theme” and “category” are used interchangeably. The researcher then went through the Excel spread sheet and each cell containing the comment that represented one of the identified themes was then assigned the color that corresponds to the theme. Each theme and its corresponding color is stated as follows: 1) Authority = yellow; 2) Alarmism = blue; 3) Ad-hominem = red; 4) Money = green; 5) Political = purple; 6) Posted Media only = orange; 7) Foreign language = light blue; 8) Sustainability (NASA only) = pink; 9) Facebook Administrators = gray. After each cell (or comment) that represented any given theme was assigned the appropriate color, the researcher began to quantify the data. Originally this required highlighting each cell and manually counting and documenting the data, however, this method proved unreliable. Fortunately, Excel includes a function that will automatically count colored cells. This method is more efficient and reliable.

The data collected for this study includes all posts and comments from the CCLIES and NASA Facebook pages that occurred within the designated dates – the summary of this data are captured in Tables 1 and 2 below. In total, the data collected from the CCLIES Facebook page is comprised of 383 comments and 35 posts; NASA’s dataset has a total of 2,347 comments and 25 posts.¹ This resulted in a total of 2,730 comments and sixty posts. Tables 1 and 2 show the sample data coded for this study. A number of comments and posts were excluded from the analysis because they were irrelevant, unclear, or not applicable to the study at hand. Thus, the discussion below

¹ A Facebook post is submitted online by the page’s administrator, in this case, CCLIES or NASA. Whereas Facebook comments include all the content made by social media users in response to the post. Comments are the remarks made in response to the post made by the administrator.

focuses upon the final data coded for the purposes of content analysis: 35 CCLIES posts and 306 CCLIES comments; 25 NASA posts and 1,807 NASA comments. The comments presented in the discussion section are copied verbatim from Facebook posts, comments, and replies and are simply referred to as “User 1” or “User 2,” in order to protect the identities of users and follow IRB protocols. Please note that in order to present the data in an authentic manner, the quotes might include offensive language, incorrect spelling, grammar, capitalization, and punctuation.

Table 1: Coded Comments and Posts for CC LIES Facebook Page Data

Events	Trump announces the U.S. withdrawal from the Paris Climate Agreement (2017)	Trump administration implements the Affordable Clean Energy rule (2018)	Global Climate Strike and the United Nations Climate Summit (2019)	
				Total
Posts	15	5	15	35
Comments	87	23	196	306

Table 2: Coded Comments and Posts for NASA Facebook Page Data

Events	Trump announces the U.S. withdrawal from the Paris Climate Agreement (2017)	Trump administration implements the Affordable Clean Energy rule (2018)	Global Climate Strike and the United Nations Climate Summit (2019)	
				Total
Posts	10	9	6	25
Comments	1,038	298	471	1807

In order to be consistent throughout the data analysis, a coding chart was created to indicate what type of content might fall under each main theme. The most prevalent theme identified in the dataset is called authority. This category was created for comments that indicate the user as a sort of self-proclaimed expert; these comments are not always explicit and often represent the tone of a comment. Comments that express an

authoritative tone are categorized in this theme, but the source of this authority varies and may be associated with scientific, religious, political, or personal experience. The authority theme also includes comments that mentioned climate change as fake news, biased media, a scam, brainwashing, propaganda, or a hoax. Comments representing authority were often found in an argumentative thread, as pro-CCS and denialist users often argue over the validity of news sources (each side claiming their experts). The idea of rational people versus irrational people or the “us versus them” debate was also included as authority, as these discussions often represent polarization. This theme represented the majority of data and accounted for 1,095 out of the 1,807 NASA comments analyzed; and 95 out of the 306 CCLIES comments. Authority is discussed in greater detail in the discussion section, as this was the most prominent throughout the data. Below is a brief description of how comments were analyzed and placed into overarching themes.

An additional theme that emerged is titled climate change alarmism or anti-alarmism. Sentiments describing a sense of urgency or immediate action in addressing climate change (or the opposite) were included in this theme. Comments that included words like “doomsday” or “impending doom” were included in this theme. Alarmism comments accounted for 41 out of 1,807 from the data collected from NASA and 16 out of 306 from CCLIES data.

The data also presented an additional category, ad-hominem, which was created for comments with a hateful, insulting, or sarcastic tone that were directed against a person or group of people. This type of derogatory discourse occurred on both Facebook pages, and often attack an individual who may or may not be involved in the

conversation, as it was common for users to insult an entire group of people. Ad-hominem attacks were found in 115 out of 1,807 NASA comments and 55 out of 306 CCLIES comments.

In various contexts, money was also a subject commonly discussed throughout the data. Comments claiming that climate change is a for-profit scandal created by various global actors including the United Nations, national governments, scientists, and liberal politicians are common arguments represented in denialist comments. Any mention of money being the primary cause on the uproar over climate change was categorized into this theme. Additionally, comments that discuss the economy (from both pro-CCS and denialists users) were counted in this theme.

A “political” theme was created to categorize comments that are political in nature. This category included data focused on party affiliation, global political leaders, how politics should approach climate change, or political ideologies. Comments about economic systems like capitalism or socialism were included in this theme, as these comments were often politically charged. Political comments found in the NASA data amounted to 51 comments out of 1,807; whereas 55 comments out of 306 were categorized as political within the CCLIES data, (or about 18% of overall comments). Comments about political affiliations were categorized here unless the comment was derogatory, in which case it was placed in the ad-hominem category.

The final four themes identified are not as critical to the research questions for this study but were common enough to be categorized. Posted media only includes data that contain memes, emojis, or images. These comments needed to be accounted for as it is common for users to only post this type of media. Posted media only includes 92

comments out of 1,807 (NASA) and 39 out of 306 (CCLIES). The foreign language category includes all comments that were not posted in English, which again was significant enough that it was worth documenting; data included 80 out of 1,807 (NASA) and 4 out of 306 (CCLIES). Facebook Administrators are those in charge of the selected Facebook pages (i.e. NASA and CCLIES). Comments that were made by the Facebook administrators were counted in this theme. NASA's administrator was surprisingly active in responding to argumentative threads. The final theme identified is sustainability and only includes comments from the NASA page. Data categorized in this theme are primarily comments among pro-CCS users that discuss future climate change threats. These comments are all in agreeance about climate change and are discussing the various ways to help mitigate the problem. Table 3 below summarizes the main indicators the researcher used to categorize comments into the main themes.

Table 3: Summary of Identified Themes for Analysis

Main Themes	Indicators	Color Code
Authority	<ul style="list-style-type: none"> • Comments about fake news, what is considered a valid source of information or news reference, accuracy of science/misleading data • Comments that use personal experiences to justify claims • Primarily argumentative threads • Comments that are contrarian in nature • Any mention of the truth or facts • Use of religion to justify claims or make counterarguments • Us versus them sentiments 	Yellow
Alarmism	<ul style="list-style-type: none"> • Comments that are both anti-alarmist and alarmist • “Doomsday” or “it’s too late” sentiments 	Blue
Ad-hominem	<ul style="list-style-type: none"> • Negative comments directed at an individual user • Hostile comments directed at a group of people 	Red
Money	<ul style="list-style-type: none"> • Comments that discuss the economy and jobs • Comments that discuss CC as a for-profit scam/hoax 	Green
Political	<ul style="list-style-type: none"> • Includes how politicians should approach CC • Any mention of a political figure • Comments that are sarcastic in nature but not derogatory (coded under Ad-hominem) about a political party are coded here • Comments about capitalism, socialism, communism, or Marxism • Political affiliation 	Purple
Posted Media Only	<ul style="list-style-type: none"> • Includes memes, graphs, emojis, any content that is not actual letters 	Orange
Foreign Language	<ul style="list-style-type: none"> • All comments that are not in English 	Light Blue
Facebook Administrator	<ul style="list-style-type: none"> • Comments posted by the NASA Administrators • Comments posted by the CC LIES Administrators • Includes comments and reply comments 	Gray
Sustainability (NASA only)	<ul style="list-style-type: none"> • Comments among PRO-CCS users that discuss future climate threats and sustainability • Comments that ask NASA for clarity on science in a non-derogatory manner • How to approach CC deniers • Appreciation/praise for NASA • Debates among PRO-CCS users on how to move forward sustainably, how to approach CC, non-derogatory 	Pink

III. RESULTS AND DISCUSSION

Tables 4-6 indicate the results of the content analysis and the main themes found within the data. As mentioned above, comments from the NASA Facebook page were placed into an overall category of representing argumentative discourse. Arguments among pro-CCS users and denialists occurred primarily on NASA's page. The CCLIES Facebook page rarely contained arguments between users and instead showed data consistent with an echo chamber. In Table 6, the column titled "main themes" shows the overall categories identified within the data, which include: 1) Authority; 2) Alarmism; 3) Ad-hominem; 4) Money; 5) Political; 6) Posted Media Only; 7) Foreign Language; 8) Facebook Administrator; 9) Sustainability. Each of these main themes were identified in both Facebook pages, except "sustainability," which was only indicated in the NASA dataset. Below is a discussion on the five main themes that have been identified: authority, alarmism, ad-hominem, money, and political. The other themes: posted media only, foreign language, Facebook administrator, and sustainability are not included in the following discussion. This is mainly due to the themes being irrelevant to the research questions for this project; what type of data categorized in these themes were discussed in the data and methods section of this report.

Before discussing the five main themes, it is worth noting how social media not only changes the ways we might consider McCright and Dunlap's (2000) notion of counterclaims, but it underscores the notion that argumentative discourse is often the method or delivery system through which the discussion unfolds. Thus, it is worth providing some context for how we might frame argumentative discourse. Counterclaims as laid out by McCright and Dunlap (2000) were originally used as a framework for

interpreting the social media data, however, the data presented new and emerging categories that are not always compatible with this framework. Initially, the researcher began organizing comments under counterclaims as outlined in McCright and Dunlap (2000). Counterclaim one is defined under the premise that the evidence for climate change is incorrect and weak (2000:510). This sentiment is expressed in the data, however, as the analysis continued it became clear that the data represented additional counterclaims that widely contrast McCright and Dunlap's original framework. Arguments around climate change being a myth, political tool, or pseudo-science are certainly still accepted and upheld beliefs by denialists (as shown in the data), but even more apparent is this idea of the truth and credibility of information. The stark difference among pro-CCS and denialist users is their beliefs of what is considered factual evidence and what is not. Denialists continue to assert that scientists are incapable of predicting anything with accuracy, and this is largely seen in the analysis, but again, what constitutes as "the truth" or "undeniable facts" is the basis of most arguments analyzed in this study. These kinds of claims and counterclaims is not necessarily consistent with prior research (McCright and Dunlap 2000), but rather it points to the emergence of a type of discourse that is rampant within social media: argumentative discourse.

Argumentative discourse consists of a specific kind of communication that occurs on the NASA Facebook pages. Argumentative discourse found in the data are difficult to quantify for several reasons. Online arguments often occur among users responding to one main comment that is replying to the post, and in this case, only NASA posts. These response comments, or the "thread" of comments, can have several hundred comments and many different users, making it difficult to determine how the discourse can be

accurately counted and organized. Additionally, due to the nature of arguments, and more generally, social media, it was challenging to establish a unit of analysis, and whether an individual or collective set is appropriate. Arguments on social media are often chaotic with rants and name-calling being common and it isn't unusual for users to repeat claims or start an irrelevant counterclaim (i.e. red herring fallacies as discussed earlier). In sum, argumentative discourse is prevalent throughout the NASA comments analyzed for this study. Each main theme from the NASA data, especially authority, ad-hominem, and political themes, are composed of comments that were likely involved in an argument. The following online communication represents several of the main themes and provides a great example of the common argumentative discourse found throughout the data.

User 1 *“Well aren't you a ray of stupid?”*

User 2 *“You have been reading too much fake science”*

User 1 *“Why are you trolling a science page with stupidity?”*

User 2 *“I notice you have no education in science, so you're obviously here just to be a vapid and very ignorant troll.”*

User 1 *“I'll bet that I have a much more extensive education in science, including meteorology aeronautics and climatology.”*

User 2 *“I'll bet you don't. Since you brought a very stupid right wing source with no evidence or research to back it up.”*

The online communication presented above represent the difficulty in categorizing argumentative interactions among users. For additional clarification on how an argumentative thread might be labelled, the first two comments from User 1 were considered ad-hominem attacks. The remaining comments were identified by the researcher as representing authority, since the main sentiment being expressed in this argument is about one user having more intelligence and scientific knowledge than the

other. Although each comment above could be considered as ad-hominem, since they are derogatory, overall, the users are expressing authority since each user claims to know better than the other. The following research presented below demonstrates how each of the main identified themes are found throughout arguments occurring online.

Table 4: Identified Themes from CCLIES within chosen dates

CC LIES	Trump announces the U.S. withdrawal from the Paris Climate Agreement	Trump administration implements the Affordable Clean Energy rule	Global Climate Strike and the United Nations Climate Summit	Totals
Authority	22	11	62	95 (31.05%)
Alarmism	12	1	3	16 (5.23%)
Ad-hominem	9	2	44	55 (17.97%)
Money	15	1	20	36 (11.76%)
Political	17	6	32	55 (17.97%)
Posted Media Only	8	2	29	39 (12.75%)
Foreign Language	2	0	2	4 (1.31%)
Facebook Administrator	2	0	4	6 (1.96%)
Total	87	23	196	306 (100%)

Authority

Comments organized in the authority theme often indicate the author as a self-proclaimed expert on whatever subject is being debated; an authoritative tone was apparent in topics ranging from science, religion, politics, economics, and media. This can lead to red herring fallacies like the following, “*And why is it warming because NASA keeps sending stuff into space and Hollywood keeps making blowup movies those are your real targets to go after and real enemies of climate change.*” Social media users in this dataset, both pro-CCS and denialist, also use personal experience to justify their claims. Denialist users often refer to the current weather as their main reference for

climate change and uphold the idea that the sun is primarily responsible for causing global warming. Red herring fallacies such as these are not supported by scientific data or accepted in the scientific community, yet users are adamant in that their claims are accurate. Below is a thread of argumentative discourse collected from the NASA Facebook page. The following comments also represent ad-hominem and political themes.

- *“I know i am not Good in science, But This NASA Fooled you, This is fake God knows!”*
- *“Just know [name omitted] that the majority of the deniers of truth on here are employees of the enemy. They are government shills paid to push the so called truth onto the American people and if they deny it they become a target. Shepards dont like their sheep wondering so be safe buddy”*
- *“I love how the hoaxers think they are somehow smarter than the thousands of PhD's who worked on the Apollo project. They have "outsmarted" some of the most genius people on our planet, yet they don't understand basic photography or why they can't see a satellite from 240,000 miles away. SMDH”*
- *“1969, America lands on the moon. 2017, Americans debate amongst themselves over basic facts regarding space.”*
- *“Belief has nothing to do with it. Intelligence does. For some reason, the people shouting "fake, lies" NEVER have any of the latter... Or evidence, for that matter.”*

Undoubtedly the main argument occurring among social media users as represented in this data set is focused on the validity of information. Arguments are about the validity of news sources and where information is obtained from. Comments that discuss climate change as fake news, biased media, propaganda or brainwashing are included as authority; the data expressing these sentiments might be categorized as an “authority of

information” or “authority of press.” This type of communication is interesting for several reasons.

Table 5: Identified Themes from NASA within chosen dates

NASA	Trump announces the U.S. withdrawal from the Paris Climate Agreement	Trump administration implements the Affordable Clean Energy rule	Global Climate Strike and the United Nations Climate Summit	Totals
Authority	756	128	211	1,095 (60.6%)
Alarmism	7	15	19	41 (2.27%)
Ad-hominem	100	6	9	115 (6.36%)
Money	1	1	2	4 (.22%)
Political	26	17	8	51 (2.82%)
Posted Media Only	59	18	15	92 (5.09%)
Foreign Language	73	2	5	80 (4.43%)
Facebook Administrator	1	47	117	165 (9.13%)
Sustainability (NASA only)	15	64	85	164 (9.08%)
Total	1,038	298	471	1,807 (100%)

One interesting finding for this theme is the type of references presented by pro-CCS users and denialists to validate their arguments. Pro-CCS and denialist users will post a link to justify their claims, which is followed by an on-going debate over who presented valid information. In order to examine these sources, the researcher copy and pasted each link that was presented in each of these arguments on to a Word Document. The references, or webpage links, had to be labeled as information being presented by a pro-CCS user or a denialist, therefore each comment within each argument on the NASA Facebook page was read an additional time. Collectively about 225 sources are presented

in the data. Although these sources haven't been further quantified, a few general observations can be made. Some of the sources posted by denialists include YouTube videos (very common), blog sites like WordPress, ClimateDepot.com or Brietbart.com, Forbes, or other Facebook pages. Pro-CCS sources include the NYTimes, The Guardian, the BBC, IPCC Reports, Scientific American, Skeptical Science (a pro-CCS source), Nature.com and PBS. Analyzing these sources is beyond the scope of this research project, but it is worth noting the fact that one's "expertise" is at least in part based upon the sources from which they attain their information. Furthermore, it is not uncommon for the CCLIES page to post articles from The Guardian or other left-leaning news sources, which is followed by a sarcastic or insulting comment from the page's administrators. Followers of this page are adamant that news sources, like The Guardian, are propaganda or biased information. Below are a few comments that represent this sentiment.

- *"Usual Gaurdian Propaganda. Climate and Science is a contradiction in terms. It's pseudo science."*
- *"These leftist rags are laughable in their persistence to push their agenda , ignoring or oblivious to the facts, data, or reality. What person in their right mind would believe anything they print."*
- *"The biased media has much to do with their dementia. BBC World today was almost a hymn of praise for nutty Greta, and the German channel was as bad."*
- *"That Guardian is a laughable rag. Nothing more needs to be said about that "Pravda"."*
- *"The people that write and edit these articles show they are completely out of touch with the world we actually live in." ²*

² Referring to an article from the Guardian

- *“When your propaganda fails bring in the censors and rewrite the history, straight outa the Nazi handbook”*

In comparison to the above statements, pro-CCS users praise NASA for publishing scientific sources on climate change. Pro-CCS users acknowledge that perhaps the biggest problem is being able to critically assess where information is obtained from, as represented below:

- *“You offer no citation so just making an unsubstantiated statement and opinion, not science Even if true, it proves nothing.”*
- *“The world desperately needs your unbiased scientific data, irrespective of the results, facts are healthy for the important discussions ahead.”*
- *“Part of the problem is that the scientifically illiterate don't know the difference between a TV show and peer-reviewed elite natural science journal, or between a journalist and a scientist. Newspapers are NOT where science is conducted.”*
- *“The biggest problem is that too many people have fallen sucker to the propaganda spread by a very expensive, well-funded denialism and climate coverup war waged by the fossil fuel industry that began in the 1950's. One of the best things any of us can do is to raise awareness of that fraud that's been perpetrated, and to counter denialism arguments with good counter-arguments backed up by solid, verifiable evidence.”*

In sum, the most prevalent online arguments between denialists and pro-CCS users almost always involves some type of discourse relating to the credibility of their sources. This sort of rhetoric is extremely problematic. When each side is essentially posing the same argument, it is nearly impossible to find middle ground. Throughout the data analysis, the researcher never came across an argument between opposing sides that came to some sort of intellectual agreement. Although the data are from online sources, and therefore not entirely generalizable (discussed more in conclusion section), the vast

quantity of comments categorized here as authority, implies that it does hold a lot of weight in the debate over climate change. The greater societal implications of this are concerning, especially regarding future political action to mitigate the impacts of climate change.

Alarmism

One of the smaller themes represented in the data are climate alarmism or anti-alarmism. Comments that described a sense of urgency, or not, in regard to climate change were included in this theme. Pro-CCS users on NASA's page are more likely to express that immediate action is needed in order to mitigate the impacts of climate change (41 out of 1,807 comments), whereas with CCLIES, anti-alarmist discourse like "the alarmists have been caught" or "climate alarmism is a farce" were documented (16 out of 306 comments). Data in this section of the analysis could potentially fit into McCright and Dunlap's sub-counterclaim of "global warming is merely a myth or scare tactic produced and perpetuated by environmentalists and bureaucrats." The data in this section might represent a denialist arguing that climate change is a scare tactic, however, this isn't as apparent as the anti-alarmist sentiment. Denialists typically use terms like "fear mongers" or "alarmists" or "fanatics" to describe pro-CCS individuals. From the comments below, one can infer that climate alarmism has become a sort of running joke among denialists, as these comments can be insulting and derogatory. Therefore, some of the alarmists quotes also fit into the ad-hominem and authority categories.

- *"Lying climate fearmongerers, bastards !!"*
- *"This all boils down to hubris. Climate change fanatics want to believe they are so powerful that we can destroy life forever. They also want to believe that they are so powerful that they can solve this "problem". I'd like to point out that life*

on earth "evolved" from much harsher conditions than those predicted by climate change models."

- *"The alarmists have been caught out. They know it. Climates forever changing. It's actually getting cooler. We need a bit of warming to sustain life!!"*
- *"The warm-mongers are out of touch with Science and Reality in general."*
- *"The alarmist narratives nightmare. However, if you're nifty enough, you can always find away to blame any weather event to climate change."*

As stated, users on the NASA page have the opposite reaction to climate change. These comments could also be considered under the authority theme, as they state phrases like "undeniable facts" and also the perspective that humans are "passed the brink of the Earth's tolerance." The comments below express a sense of urgency among users that acknowledge the legitimacy of climate science.

- *"These are undeniable facts, true. On the other hand, we humans are huge contributors also to carbon release, burning fossil fuels for centuries and burning even more to get fresh supplies of fossil fuels is NOT the solution. Everything we do hurts the environment, and it's all for money. So here we are with our huge brains, chasing profit, living like there's no tomorrow, and if we carry on like this, there'll be no tomorrow."*
- *"yes like one say 40 years for fully recover and humans dont have so much time..."*
- *"We need action and FAST!!!!!!!!"*
- *"We are passed the brink of the Earth's tolerance of humans. Our actions to heal her are too slow."*
- *"Earth should be the primary mission."*
- *"It's only gonna get worse, year after year."*

This section is somewhat brief as the number of posts/comments is smaller than the other main themes and the content is repetitive. However, this is an important theme as alarmism and anti-alarmism sentiments give an example of the stark differences among

pro-CCS and denialist users on social media. The general conclusion is a strong contrasting viewpoint between pro-CCS users and denialists users. It is one extreme to another, either the greatest hoax ever conceived by man or the greatest threat to our existence. Either users acknowledge that climate change needs to be addressed now or it is all a scam. Perhaps the larger problem here is that these claims are perpetuating the “us versus them” mentality, and it seems like the task of changing a person’s perspective on climate change is much more difficult than it ought to be. Instead of it being a matter of science, climate change now encompasses an individual’s personal experience, political affiliation, belief in government and institutions, media preference, source of information and education.

Ad-hominem

The data also presented an additional category, ad-hominem, which was created for discourse that are hateful in nature, insulting, sarcastic, or specifically directed towards a person or group of people. Ad-hominem data accounted for a total of 115 comments out of 1,807 total comments, encompassing roughly 6% of the total data for NASA; 55 comments out of 306 total comments, or roughly 18% of the total data for CCLIES. As we can conclude from the numbers presented here, this type of discourse occurred on both Facebook pages. McCright and Dunlap’s (2000) framework does not serve as a guideline for this type of online communication, as these types of discussions are not really representing a counterclaim but are verbal assaults among users. Ad-hominem comments often attack an individual who may or may not be involved in the conversation, as it isn’t uncommon for users to insult an entire group of people, for example the “looney left” or “globalist pigs” or “brainwashed feminist robots.” This new

and emerging type of online communication is problematic for many reasons, but emblematic of the emerging “troll” culture that social media seems to breed.

Ad-hominem discourse occurred on both Facebook pages, but was more apparent on the CCLIES page. It is common for denialists to attack a political person or entire group of people. Individuals commonly insulted include Al Gore, Greta Thunberg, Alexandria Ocasio-Cortez, Paul Ehrlich, Canadian Prime Minister Justin Trudeau, and former president Barack Obama. Denialists strongly dislike such political figures, but especially Al Gore and more recently, Greta Thunberg. They blame Al Gore for creating the climate change scandal and believe Greta Thunberg is brainwashing today’s youth. The first three comments below represent insults directed at Al Gore, in the second and third comment we again see the distrust from denialists towards the United Nations and apprehension towards the “elite left.”

- *“When you die I'm going to make sure your funeral is carbon neutral and the hearse is a modified Prius”*
- *“Gore is such a hypocrite, living a high carbon consumption life of the elite left, asking the peons to live a life of medieval cave man. How many such mansions does he own with wealth inherited from Russian oil deals.”*
- *“He's also flying around in his private jet. He's probably getting a cut from the UN on his BS climate change.”*

As mentioned, ad-hominem comments might be directed at an entire group of people who are not involved in the conversation. The idea to send liberals and pro-CCS people to a socialist country to “let them learn a lesson” is common among ad-hominem discourse found on the CCLIES page. Anti-feminist discourse and the argument that people who acknowledge climate change are “brainwashed” are also apparent in the data. There is clearly some hostility among social media users, but what are the implications of these

comments? Has the level of hostility increased in recent years due to the influence of political figures? An online platform allows users to have a way to express these negative sentiments without any sort of social repercussions. Online communication not only provides a haven for these bigot remarks but is also, arguably, encouraging this type of discourse by means of the echo chamber. Below are a few comments that represent some of these sentiments.

- *“They [liberals] should consider self-extinction to save the planet so others may live”*
- *“Send them [liberals] to boot camp in dark disease ridden third world countries and see how long they last.”*
- *“Fuck the Greens, they all need a bullet.”*
- *“Look at them... worries me they’re part of the future big hairy feminist and feminine men with pink hair. Shouting about stuff theyve been brainwashed with.”*
- *“Well said! They are one ugly bunch of freaks with no brains to think for themselves. Brainwashed feminist robots!”*

It is important to also discuss comments from pro-CCS users directed towards denialists. Pro-CCS users often insult those who have opposing viewpoints with remarks directed at their lack of intelligence. Some of these insults are mild, almost child-like, for examples, “troll” or “bet you can’t read” or “ignorant troll.” Ad-hominem comments are mostly found within argumentative threads and can therefore be difficult to categorize as the comments might better represent one of the other main themes.

- *“Wow, climate depot. That’s like citing the Aryan Nation in a discussion of racial equality.”*
- *“And you’re a worthless right-wing ideologue that allowed your pathetic political system to get in the way of understanding climate mitigation requirements.”*

- *“Drop dead, anti-NASA trolls. Hating on scientists, engineers, and astronauts is a great way to build up some bad karma. Try getting your own lives in order instead of tearing down people smarter and more successful than you.”*

Money

From the CCLIES Facebook data (n=306), money is described in various ways as the reason behind the uproar on climate change; thirty-six out of 306 (about 12%) of comments were categorized as representing the money theme. Only four comments were documented in the NASA data (n=1,807). The claims around this theme vary, but the supporting and overarching claim is that climate change is a hoax created by various actors to gain profit. These actors, as stated by CC denialists, might include academics or scientific researchers, national and foreign governments, liberal politicians, global elites, the United Nations, and other “leftist” entities who are thought to be the perpetrators of the climate change scandal. Common words or phrases that were seen in this section include: scandal, hoax, scam, higher taxes, damaging the economy, money grab or money-making business. The argument that “proposed action would harm the national economy” as outlined in counterclaim three by McCright and Dunlap (2000), was certainly expressed among denialists, but again, most of these claims allow for a different framework.

Any mention of money being the primary cause on the public uproar over climate change was categorized into this theme. Some of the Facebook data could potentially fit into McCright and Dunlap’s counterclaim one or three, which are as follows: “global warming is merely a scare tactic produced and perpetuated by environmentalists and bureaucrats” or “proposed action would harm the national economy” (2000:510).

However, since the data largely showed arguments that specifically explain climate change as a tactical money-making business initiated by global elites, these assertions might allow for a new framework. One can also conclude from the data shown in this theme that there is an underlying sentiment of “us versus them.” The comments categorized into the money theme represent a fear of higher taxes, corrupt governments comprised of left-leaning politicians and the global elite, and media outlets, who all work together to disseminate fake science in order to gain money. Below are comments from the CCLIES page that show some of the overall sentiments expressed in data categorized under the money theme.

- *“Taxation without representation - they want to take YOUR money and transfer it to foreign governments that you have no representation in. Easier to blatantly steal money in a dictatorship than a democracy so we'll just democratically take it and hand it over :P And if you dont agree with the climate "crisis" or foreign aid your a child hating racist.”*
- *“Slow down their money more like it. Shows its all about the money. The climate can look after itself.. After all its been doing it a long time. Its the UN way of making the rich nations pay to benefit the UN and smaller nations.”*
- *“All the Alt Left Democrats and Liberals are in meltdown over is NOT CLIMATE CHANGE it is ALL ABOUT MONEY and taking over countries.”*

Political

The theme “political” is the final theme discussed in this report and includes all comments pertaining to political content. This includes comments on political party affiliation, global politics, political figures, and economic system (i.e. there’s often discussions on capitalism). Political data accounted for 55 out of 306 comments for CCLIES and 51 out of 1,807 for NASA. It was challenging to categorize political comments for several reasons. Primarily this was due to multiple themes that might be

represented within one comment. For example, comments that were discussing a political party or political figure were often derogatory, and therefore, could be labeled as ad-hominem. Comments that praise a political figure were also categorized here. The quotes below represent how this became a challenge throughout the data analysis.

- *“Rep. Rodney Davis, how do you sleep at night ignoring this? How do you look your kids and grandkids in the eye and say that this is normal and everything will be OK? Sounds quite unethical and immoral to me.”*
- *“Not good news, and with an administration denying this data, the people are in for troubles.”*

This first quote could certainly be deemed as representing an ad-hominem comment, however, since the user (pro-CC) specifically states Rodney Davis, a U.S. Congressman, it was coded as political. The second quote also represents the alarmist theme, but again, since it the main subject is about the Trump Administration, it was deemed as a primarily a political comment. If a comment about a political representative was intensely negative (for example the insults directed at Al Gore or Greta Thunberg), then it was categorized as ad-hominem. Determining what the overall content of a comment represented was at the discretion of the researcher, and it should be stated again that categories are not mutually exclusive. The political theme was important to include as there are enough comments that warrant a discussion on how politics plays a role in the debate on climate change. Furthermore, it also shows how political affiliation is still a determinant in how an individual might feel about climate change.

Although Facebook *posts* made by either page were not thoroughly investigated in this research, it became noticeable that CCLIES often posts about political events regarding climate change. In comparison, NASA’s Facebook administrators only post

scientific articles, which supports why there is limited data to refer to for the research questions focusing on political events. The image below is a CCLIES post from June 3rd, 2017, two days after President Trump announced the U.S. withdrawal from the Paris Climate Agreement.



Figure 1. Posted on Climate Change LIES Facebook page, June 3rd, 2017.

User 1 *“Yes but is this an accurate representation of the Paris agreement????”*

User 2 *“Kinda makes it look very lucrative for overseas companies to fund American environment groups”*

User 3 *“I think this is still too complicated for liberals to understand.”*

User 4 *“Great job Mr Obama !”*

When User 1 questions the validity of the post, the inquiry is quickly dismissed. The comments also represent the themes ad-hominem (User 3), money and authority (User 2), and the political theme (User 4). The post is sarcastic in nature and creates an opportunity for users to confirm their existing opinions. Discourse in CCLIES often perpetuates confirmation bias and allows for denialists to confirm their beliefs about climate change.

Additionally, it was noted that one post on the CCLIES page was an article about Trump’s Affordable Clean Energy rule (rollback of the Obama Clean Power Plan).

Response comments to this post were celebrating the decision. Comments like *“Thank God for the Donald”* or *“Well done President Trump”* or *“Winning, vote for the Red tide in November”* represent how denialist users feel about Trump’s political actions towards climate change. This post was the only content found regarding Trump’s rollback plan.

During the 2019 climate strikes the CCLIES page posted an article from Breitbart.com, which stated: *“What we’re witnessing today is the bizarre phenomenon of tens of thousands of school children protesting over an issue which they do not remotely comprehend. And then being applauded for it by adults who—astonishingly—are even more stupid than the kids.”* This post led to verbal insults directed at Greta Thunberg, who is loathed by denialist users that claim the climate strike movement she spearheaded is brainwashing today’s youth. A couple of memes were posted as comments, one of which stated, *“lefties you are an inspiration to idiots everywhere”* and another one *“use the children”* followed by a picture of a child holding an AK47 assault rifle. Comments on this thread were all negative remarks directed towards Thunberg or her followers, and therefore included under the ad-hominem theme.

As stated above, the content of posts created by the Facebook administrators were not thoroughly analyzed in this research. However, it is apparent that the CCLIES page often posts politically charged content regarding climate change, whereas NASA is likely to post scientific content. The limited data from CCLIES that refer to one of the events mentioned in the research questions, do not allow for an accurate representation on how public perceptions of climate change might have shifted. Instead the data indicate how President Trump’s actions have further enhanced the political polarization within the climate change debate. The data suggests that online discussion regarding climate change

related events likely further solidifies the individual’s already existing opinions on climate change. All three events mentioned above created the opportunity for CC denialists to reinstate their perspectives as valid.

Table 6: Theme Totals for NASA and CC LIES Facebook comments

	NASA (n=1,807)	CC LIES (n=306)
Main Themes		
Authority	1,095 (60.6%)	95 (31.05%)
Alarmism	41 (2.27%)	16 (5.23%)
Ad-hominem	115 (6.36%)	55 (17.97%)
Money	4 (.22%)	36 (11.76%)
Political	51 (2.82%)	55 (17.97%)
Posted Media Only	92 (5.09%)	39 (12.75%)
Foreign Language	80 (4.43%)	4 (1.31%)
Facebook Administrator	165 (9.13%)	6 (1.96%)
Sustainability (NASA only)	164 (9.08%)	95 (31.05%)
Total	1,807	306

Although the political, money and alarmism themes are smaller themes represented in the data they are included in this report for several reasons. These themes represent how each side of the climate change debate show one extreme to another. The contrasting opinions on climate change seem to leave little room for compromise or finding a middle ground. These conclusions become even more clear when we look at the insults among users (ad-hominem) that take place in climate change arguments. The ad-hominem data are the worst form of the extreme viewpoints on both sides of the debate and show how using insults are commonplace in online discourse. The five main themes discussed in this report occur throughout the argumentative discourse that is common in online communication on climate change. All themes identified in this research suggest that it is very difficult to find a middle ground between those who oppose or accept climate change. Arguments on climate change are consistently a matter of the credibility

of science and media outlets, which sources of evidence are considered factual, and ideas over what is considered truth.

Limitations

First, it should be acknowledged that since the data were collected from a social media platform, it is not necessarily representative of what the general population thinks about climate change. Instead, the content presents ways in which social scientists and researchers can analyze how people are discussing an important topic, like climate change, online. Online behavior cannot be generalized so much so that it fully portrays what an individual might believe, this was clearly represented in the ad-hominem section of this report. It may, in fact, represent the extremes within the discourse in certain respects. For example, an individual might argue that all liberals should be sent off to a different country and killed, but it is highly doubtful that these sentiments would be expressed in face-to-face interactions. Social media enables people to become desensitized to offensive language.

A few additional limitations were noted throughout the data collecting process. Some users are mentioned throughout various argumentative threads, but their comments are no longer viewable. This could be due to their Facebook accounts being banned by the webpage administrator or are from deleted accounts. In the argumentative threads within NASA's page, when the administrator gets involved during debates, they often delete comments. NASA has an automatic reply that responds to comments that break the rules of the Facebook page and can delete comments that are deemed offensive. This was noticed a few times throughout the analysis, where it felt like a piece of information was missing. Another limitation is regarding how comments were coded, categorized, and

counted. It became clear that many comments are representative of one or more of the overall themes identified, leading the researcher to use her own discretion in determining where the data are most accurately represented. As stated in the data and methods section, comments are not mutually exclusive and therefore multiple themes can be observed in a single comment. Since there was only one researcher who coded the data, this should also be considered a limitation of the study. Reliability of coding increases when more than one person is looking at the same information and coding it independently, and then checking to see if similar conclusions are made. If there is a difference, those specific content would be evaluated and then agreed upon.

IV. CONCLUSION

Framing of Thoughts

In considering the first research question for this project: *“How is climate change denial framed in online social media outlets, specifically, how has the content or tone changed,”* it’s important to note that although this research includes data collected at three points in time (2017, 2018, 2019), data were not collected prior to the presidential election of Donald Trump; therefore, it is difficult to present how the tone of social media users has shifted. However, conclusions can be made about the overall tone or content among users who deny climate science. The data collected for this research shows climate change denial is framed in a way that represents a set of multi-faceted opinions.

Denialist explanations cover a lot of topics but primarily seem to be grounded in politics, personal experience, the validity of science and news, and the claim that climate change is a for-profit hoax. One of the challenges of this research can be described as a part of the “us versus them” debate. Undoubtedly this sentiment is often expressed in reference to political affiliation, but there is also a greater debate among users in regard to their source of news information. Hostility between pro-climate change and denialists users is common and often centered around the fake news debate. Climate change represents a “super wicked problem” (Dunlap 2013), it is intangible and distant for many people in the world and requires fundamental structural change in order for its impacts to be mitigated. From this data set, the researcher can conclude that climate change denial is framed in online discussions as a point of view justified not only by political affiliation, but also personal experience and how the sources from which one obtains their news.

Overall Opinion

The social media data analyzed in this study shows varying opinions on climate change. The second research question is stated as follows: “*What is the general public opinion on climate change represented in social media outlets?*” This question is difficult to answer confidently for several reasons and presents a few of the limitations in this research. First, the amount of data from the CC-LIES page (n=306) is not nearly as abundant as the amount collected from NASA (n=1,807). Therefore, it is hard to accurately and fairly assess the *general public opinion* when the majority of comments were from a pro-climate science page. Second, this research did not fully examine the usernames of the comments posted, which means that it is entirely possible, and likely probable, that multiple comments were posted by the same users on various occasions. Finally, the *general public opinion* is impossible to predict with absolute certainty when collecting data from online social media outlets. It could be easily argued that social media doesn’t represent what an individual truly thinks about a subject, that because an individual is using a computer as their medium of communication, it would be unsound to declare these comments as a *general public opinion*.

This research question was poorly worded and presents an illogical comparison. It is better stated as: “*What is the overall opinion on climate change as presented by social media users on Facebook?*” With these limitations considered, nonetheless, the comments analyzed for this study do present recurring opinions and ideas on climate change. The researcher can confidently assess that, overall, online opinions on climate change are divided. The data showed two types of discourse occurring on the pro-climate science page (i.e. NASA) and denialist page (i.e. CCLIES). The data from NASA was categorized as primarily argumentative discourse, as this is where the arguments among

users over climate change occurred. Pro-climate change science (pro-CCS) users and denialist users comment back and forth discussing various aspects on the validity of climate science, which can produce an argument thread that could be comprised of hundreds of comments. Again, these arguments only occurred on the NASA page.

In contrast to the NASA page, user comments on CCLIES are often in agreement. This page is more representative of an echo-chamber, as there was rarely an argument among users about beliefs different from their own. In sum, the overall opinion as represented in this data set was organized under two main categories—argumentative discourse and discourse that confirms existing beliefs (i.e. an echo-chamber).

Reaction to Key Events

The final research questions for this study were aimed at finding how climate change related events might have influenced perceptions on climate change. The research questions were stated as follows: *“How have withdrawals from global deliberations, such as the Paris Climate Agreement, shifted public perceptions on climate change, as represented online? How have social media users reacted to other climate related events? For example, the Trump Administration’s planned rollback of the Obama Clean Power Plan or the Global School Strike Protest”*? None of these events were discussed or mentioned adequately enough throughout the dataset to be categorized into a main theme. The limited amount of comments that mention either event was almost exclusively found in the CCLIES page and were often more representative of another theme. For example, *“The US is reducing CO2 emissions at a faster rate than any other developed country in the world. Yes it's a fact, they are setting records without belonging to the Paris Accord; without a carbon tax; with less government regulation; and all*

under Donald Trump! MAGA!”³ This comment is better categorized as representing political, authority, or money themes.

The main findings of this research indicate the varying online perspectives of climate change. As stated throughout the analysis, pro-CCS users and denialists are adamant about their beliefs, leaving little room for compromise or coming to a mutual understanding. Perhaps the most problematic finding was found in the data categorized under the authority theme. When each side of the debate is essentially presenting the same defense (mainly regarding fake information), there are greater implications for what this could mean for society. When legitimate science is labelled as “fake news” what does this mean for the future of academia and educational institutions? There must be a common ground on what constitutes validity in society. From this data set, it seems that many people (as seen online) are unaware of the greater implications of their claims. The strong distrust towards government and media are more apparent than ever, and it’s difficult to determine how to approach these opinions in order to find some sort of understanding or middle ground. This was seen constantly in the argumentative discourse, where one user tries to rationalize with another, but the argument was never resolved.

President Trump is known for commonly using the term “fake news” and uses social media as his primary source of interaction with the American public. Knowing this, it should not be too much of a surprise that arguments over the authenticity of news sources is a central discussion point. Moreover, it could be argued that the tone and hateful remarks Tweeted by President Trump has inspired and perpetuated the use of

³ Comment is in response to a post about Trump’s Affordable Clean Energy Rule

offensive, racist, and discriminatory content. When the highest level of government actively uses social media to disparage public officials, media outlets, people of color, women, and developing countries, it implies that it is acceptable to berate people online. President Trump's offensive Tweets are arguably viewed by some as a form of permission. It is likely that online users are emboldened by this type of discourse, despite what the harmful impacts of this kind of language might be. However, the research for this study did not analyze data before President Trump was elected, therefore, these conclusions cannot be justified here. Denialist discourse was consistently more offensive and derogatory than remarks made by pro-CCS users, furthermore, pro-Trump remarks were common from denialists; there was not a single pro-CCS user praising President Trump in this research. It is logical to suggest that Trump, through social media, has inspired not only the distrust of news media outlets, but has also stimulated and approved the use of offensive and abhorrent communication online. The data collected for this research is unique in that there have been few studies on how people are communicating on social media about important environmental topics. The data in the category's authority and ad-hominem show the need to further analyze the new and emerging ways in which social media users interact. Echo-chambers are easily formed among such groups, which is problematic for many reasons, but here it is a problem in the sense that it further reiterates and solidifies a false perspective. We can see this clearly represented here:

- *“When it is cooling it is just ‘climate change’ and ignored, when it is warming it is ‘anthropogenic global warming/climate change’ see how that works? They can have their cake and eat it too. Besides the IPCC's terms of reference does not include “man induced cooling effects” only man's*

influence/introduction of CO2 into the atmosphere, this way they can tax industrial activity. Of course I know people reading this column understands this...”

The research presented here shows the core arguments made by denialists are similar to the counterclaims outlined in McCright and Dunlap's (2000) original framework. However, the disparities between social media and the mainstream approach (news articles, websites, books, etc., as used by McCright and Dunlap) allow for a different structure as these sources of information are inherently different. The denialist movement is further perpetuated online, as we see in the echo-chambers of CCLIES, and although the original counterclaims are still reflected in the data, the discourse in the denialist movement has shifted. For example, it is still argued that the evidentiary basis of climate science is weak or non-existent (counterclaim one), but this has expanded. Not only is the evidence invalid, but it is due to the work of corrupt government institutions and scientists who created the greatest scandal of all time for money, and therefore labeled as “fake news.” This research indicates the need to further explore how online communication can impact an individual's actions. Are there ways in which pro-CCS users can dismantle denialist arguments without it becoming a debate over the validity of information, in other words, is there a way to find common ground, and eventually change an opinion, on climate change.

APPENDIX SECTION

Appendix A

The following is an outline of the steps in extracting user generated content from Facebook pages. First, a script was created to open a web browser to visit the post timeline of the pages of interest. This included the following links:

<https://www.facebook.com/ClimateChangeLIES/posts> and

<https://www.facebook.com/NASAClimateChange/posts>. Given the earliest desired post

date of May 27, 2017, another script was then used to continuously scroll down the

timeline to load older posts into the browser. The script checks the last post loaded onto

the browser and stops scrolling. Second, the entire html contents of the browser are

saved. The html contains all the posts display in a timeline dating back to the earliest

date. Another script loads this timeline html and scrapes the posts in the timeline for the

links to view individual posts. The links were further filtered. Third, links to content

posted within the desired date ranges were collected into a smaller list of individual posts.

For each of those individual posts in the list, the comments thread for a post had to be

loaded onto the browser. These were then manually selected with the option to view all

comments to the post. Additionally, a script was run to expand the comments thread,

which included responses to comments ("See more replies"), and truncated comments

("View More"). Once all user comments were loaded, the html was saved into a file

designated by Facebook page and post date. The above posts were then processed and

saved iteratively by the script. With all the post pages saved, another script iteratively

scraped the pertinent, readable contents of each page. The contents are appended to a csv

file. The elements written into the file were original post dates, post contents, post

authors, comments to the posts, comment dates, commenters, subsequent replies to the

comments, reply dates, and name of replier. The programmer manually inspected the unique style and structure tags of the desired page elements to code into the search function of the script. The pages were processed iteratively. Note with each html save, the programmer also saved a corresponding pdf print view. The toolsets used for the data scraping processes include: Python and Anaconda, Selenium, and BeautifulSoup.

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