Arguing for Argument's Sake? Exploring Public Conversations around Climate Change on Twitter

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Abstract

Audience-facilitated information flow has become the new norm created by a public divergence from traditional media sources. Mobile device advancements and partnerships have changed how audiences view news media and the sources relied upon to obtain information. With these advancements, social media users have become primary information providers and information gatekeepers. Twitter specifically has become a news media platform for some based on its effectiveness in facilitating information flow and triggering reorganization as it provides a platform for collaboration and coordination. Despite widespread acceptance of the threat climate change poses by the scientific community, it is still a topic of contention on social media. Climate conversations are typically approached with an us versus them mindset with us being used as representation of the communities to which audiences belong. The communities one belongs to typically follows social media users social, political and environmental ideologies. Walton's theory of argument or inference schemes served as the theoretical framework for this study. Argument schemes represent common arguments and special context arguments, in this case scientific argumentation. Walton's argument from ignorance was used as a framework for the study. The argument states that if there has been a thorough search through the knowledge base then concrete proof of a fact would exist. The findings indicated social media may be a useful tool when exploring climate change conversations through a sociopolitical lens and additional research is needed to closely examine how political ideologies, global location, and different environmental topics impact issue awareness and beliefs.

Keywords

: climate change, Twitter, public engagement, argumentation theory, climate communication

Cover Page Footnote/Acknowledgements

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Introduction

The negative impacts of climate change on the environment and global economies has attracted the attention of people globally, making climate change a societal and political issue (Kirilenko et al., 2015). Recognition of climate change as a societal and political issue has made it one of the most discussed topics on social media (Pearce et al., 2014). Despite wide-spread acceptance around the world that climate change poses a threat to the environment and global economies, it remains one of the major controversial issues among most Americans due to differences in opinion regarding its causes and mitigation measures (Jang & Hart, 2015). The large amount of climate information readily available with little interpretation leads to an increased flow of information from various sources providing audiences with exposure to diverse and sometimes conflicting information about current scientific events (Kim & Dennis, 2019).

Users' ability to send and receive real-time information with a tap on their screen to encounter and engage with the news has caused a decline in traditional media audiences with social media establishing itself as a trusted public source of news (National Science Board, 2016; Shehata & Strömbäck, 2021). Eighty percent of internet users use social media to seek out information (Whiting &Williams, 2013), highlighting the switch from traditional, fact-based news and science media to what can be obtained quickly on social media platforms (National Science Board, 2016). The instant delivery of information can work both for and against science communication efforts based upon how audiences assess new source credibility (Westerman et al., 2012).

Twitter, specifically, has evolved from being a personal information sharing platform to a platform for sharing what is happening around the world and in various communities (Berland, 2016). Twitter's evolution has created a new gatekeeping system where the power of information production has switched from content producers to content consumers; to obtain information that they seek users have turned from traditional news sources to like-minded community members or sources they deem experts in science communication (Czarniewski, 2015; Haas & Wearden, 2003; Westerman et al., 2014). The power switch has provided users with the opportunity to participate in the information sharing process, which in turn promotes active interaction among users.

Social media platforms, such as Twitter, are often used by Americans as a host for public interactions about climate change between people who believe climate change is real and those who believe it is a hoax (Kirilenko et al., 2015; Pearce et al., 2014). The interactive nature of social media accelerates the spread of both factual and non-factual information presenting audiences with news sources that are not aligned with factual science content (Kennedy & Prat, 2019). Furthermore, the quick contextual cues associated with social media messages coupled with a public that has limited direct experience with certain scientific topics, such as climate change, may influence a lack of trust in science communication (Abrams et al., 2015). Moreover, headlines are often more interesting than the article content leading to audience consumption of half-truths despite the large amounts of in-depth information available (Piotrkowicz et al., 2017). Twitter is known to be effective in facilitating information flow and triggering changes in standard informational structures, as it provides a platform for collaboration and coordination among activist groups (Segerberg & Bennett, 2011). As a result, Twitter has become one of the platforms where people discuss, disagree and reaffirm their thoughts about a myriad of issues including climate change.

The presence of strong associations between political party affiliation and climate change beliefs contributes to bold discussions surrounding climate change as people use it as a tool to defend their identities (Fielding et al., 2012; McCright & Dunlap, 2011; Painter & Ashe, 2012). Moreover, the presence of online communities has also created social factions covering a range of subjects (Bruns & Bahnisch, 2009). Online communities form when enough people engage in prolonged computer-mediated, nonprivate discussions, with sufficient emotion, to develop social relationships with other online participants (Bruns & Bahnisch, 2009). Communities develop over the course of several months or years and social dynamics shift continuously (Bruns & Bahnisch, 2009).

Previous research has linked local weather events with climate discussions on social media (Pearce et al., 2015; Zanocco et al., 2019) with most research aimed at exploring climate change conversations on Twitter based on trending hashtags (e.g. Hamed et al., 2015; Haunschild, et al., 2019; Holmberg & Hellsten, 2015). Zanocco et al. (2019) found evidence that those who have experienced or been impacted by climate events rely less on political ideology or economic standing and more on concrete experiences when interpreting climate change mitigation policies. If this finding holds true for other extreme weather events, and they become more frequent and severe, substantial shifts in public opinion about climate change, particularly among conservatives, will occur (Zanocco et al., 2019).

Research by Hamed (2015), Haunschild (2019), and Holmberg and Hellsten (2015) focused primarily on engaging with Twitter audiences and the communities to which they belong. While valuable, these studies did not wholly describe what causes audiences to engage with a tweet or hashtag, and how different communities receive different messages. In addition, several studies have explored the framing of climate change messages on Twitter (Jang & Hart, 2015; Park, 2020; Vu et al., 2020) yet little research has examined the triggers of Twitter climate change conversations and associated responses from users. During a social media study done by Pearce et al. (2015) it was determined there may not be a single effective way to communicate about climate change in a way that captures and educates all audiences. Researchers highlighted the need for public perception studies where the frame of the message, rather than the messenger, should be studied; however, it can be presumed the messenger's tone and ideologies have just as much of an effect on public perception as the message itself (Jun et al., 2018). In an effort to address these research needs, the purpose of this study was to explore how Twitter was being used to shape public conversations about climate change, particularly in regards to the tone of the messenger in addition to the message they were portraying was examined.

Theoretical Framework

Walton's (1996) theory of argument or inference schemes served as the theoretical framework for this study. Argumentation is viewed as a type of communication aimed at resolving a difference of opinion by critically testing the acceptability of the standpoints of an issue. Walton (1996) used a set of schemes to define different types of arguments. In this study our focus is on the Discovery Arguments schema which contains arguments that are focused on establishing rules. This schema contains the argument from best explanation, argument from correlation, argument from sign, and the argument from ignorance (Walton & Macagno, 2016).

Walton et al. (2008) stated, "Argumentation schemes are forms of argument (structures of inference) that represent structures of common types of arguments used in everyday discourse, as well as in special contexts like those of legal argumentation and scientific argumentation" (p.

1). As such, argumentation schemes elaborate everyday reasoning, or common reasoning, in politics or science (Lumer, 2016). It is for this reason argumentation theory is easily applied to social media and climate conversations where political reasoning has primarily dominated the conversation. Specifically, Macagno and Walton (2016) reported arguments from ignorance can aptly be used to describe the premise of arguments seen on social media. Furthermore, the temporal nature of information available on Twitter prompts users to respond in the heat of the moment, hence, increasing the likelihood for arguments (Lange et al., 2018). The desire for people to make their opinions known forces them to respond quickly while the topic is trending.

Arguments stem from reactions to an idea or issue through discussion (Lange et al., 2018). It is believed individuals always have a goal or objective for introducing a specific issue or idea (Walton, 1995). Therefore, once an idea or issue is presented, an audience analyzes it by evaluating the words and expressions used when conveying the idea or issue to identify its goal (Schneider et al., 2012). Once the audience identifies the goal, the audience then engages in an objective presentation of a justification or challenge toward an idea or issue and not an expression of an individual's opinion based on their position (Lange et al., 2018). However, Lange et al. (2018) indicated that social media arguments are interpreted as a person's reflection of reality and, as such, deemed to be an expression of an individual's position or identity. An individual's engagement in an argument over an issue may affect them and how they feel (Van Eemeren et al., 2014) but an individual's beliefs regarding a specific issue or idea influences their interest and desire to engage in an argument (Visser et al., 2020).

A common argumentative scheme is so frequently and naturally used that people are unaware it has infiltrated their persuasive speech. Therefore, an individual can argue about a specific issue based on their knowledge of the subject matter or based on ignorance. The argument from ignorance assumes there has been a search through the knowledge base that has been deep enough so that if something were there it would have been found (Walton & Macagno, 2016). This mindset represents challenger logic, a theme commonly seen in climate arguments: if climate change is actually a problem then it should have already affected us, therefore, it does not exist (McAdam & Scott, 2005).

An argument stemming from ignorance is closely related to an argument from the best explanation, wherein the non-existence of an entity can be regarded as the best possible explanation of the lack of evidence or knowledge (Walton & Macagno, 2016). The type of language used, whether formal or informal, to express an opinion and the type of analysis that one conducts, whether objective or subjective, is what differentiates an argument from a discussion. Differences exist among and between users of social media on why and how they argue, as well as how arguments are advanced in various social media platforms (Schneider et al., 2012). However, not much is known regarding the motivation behind public engagement in argumentative conversations about climate change on Twitter. Perhaps people engage in argumentative conversation because they have similar views represented by a post or because they want to defend and share their opposing viewpoints and sway the majority. Increased knowledge of the argumentative landscape on Twitter may help agricultural communicators effectively address climate change concerns and improve their communication efforts.

Purpose and Research Objectives

The purpose of this study was to explore how Twitter was being used to shape public conversations about climate change. The following research objectives guided the study:

1. Identify what events were associated with conversations about climate change on Twitter;
2. Describe public comments/reactions toward climate change on Twitter;
3. Examine the relationship between sources of conversation starters and public comments towards climate change on Twitter; and
4. Determinine how tone impacts climate conversation on Twitter.

Methods

A social media analysis was conducted to achieve the research objectives. Social media analysis refers to the practice of gathering data from social media platforms and analyzing the data to help researchers address specific problems in relation to the research objectives (Jeong et al., 2019). Specifically, a qualitative inductive content analysis of tweets on climate change using Meltwater was conducted. The inductive content analysis involved identifying and creating categories from the data based on the research objectives and theoretical framework (Elo & Kyngäs, 2008). During the analysis codes and sub-codes were created which represented different categories. These codes and sub-codes were then used as themes and sub-themes when reporting the results.

Meltwater is a media monitoring and business intelligence software that tracks conversations that people are discussing on various social media platforms all over the world. Using Meltwater, a social media search for the keywords "climate change" was done. Then a custom dashboard utilizing the keywords "climate change" was created. The dashboard consisted of the following five widgets designed specifically for media monitoring: trending themes, hot topic, top location, top social media source, and topic momentum. The trending themes widget showed the current number of discussions about the keywords. The hot topic widget was a heat map that created a visual of the geographical locations primary climate conversations were happening. The top locations widget was used as an accessory to the hot topics widget where the software narrows down the location of conversation by country although tweets only from tweeters in the United States were chosen. Top social media sources included Twitter, Facebook and personal blogs. Twitter was chosen based on Meltwater's categorization of the platform as a top social media source, and on previous literature where its most appealing quality is its ability to connect people who know each other physically or virtually while also providing a multitude of news sources for different issues (Allen et al., 2010; Berland, 2016). In addition, Twitter unlike other social media platforms, provides opportunities for users to engage in conversations (Comm, 2009). In addition, the presence of information seekers and information sources as the major categories of Twitter users, as well as the temporal nature of the information available on Twitter, prompts immediate response from users (Java et al., 2007; Lange et al., 2018) and provides a conversation medium based on the amount of real time conversations, variety of influencers and increased opportunity for conversations amongst users (Comm, 2009).

Due to the numerous climate events and publicity that happened during the previous year, Tweets containing or associated with the keyword's climate change from February 1, 2019 through December 31, 2019 were collected and analyzed. A total of 10 tweets with 10 comments each were collected for each month, which resulted in a total of 110 tweets and 110 comments. Tweets were selected based on potential reach and actual number of comments being greater than 10. Chosen tweets encompassed all levels of climate conversation including those of climate

deniers and questioners. Tweets from each handle were copied and pasted into word documents. The word documents were then uploaded to MaxQDA, a data analysis software.

The data was analyzed in MaxQDA by two coders. Prior to analysis, an intercoder reliability test was run using tweets from the month of January 2019. A Cohen's Kappa of 1.00 was observed for the 10 tweets. This Kappa was above that which was reported in other research where Kappas of .87, .68 and .70 were used to proceed with individual coding (Merzdorf et al., 2019; Shan et al., 2014; Rutsaert et al., 2013). The coders were able to achieve such a high intercoder reliability because prior to the analysis the coders read through all the documents more than once to have a clear picture of the data (Elo & Kyngäs, 2008). After reading the tweets, a code book was developed with input from both coders with respect to the research objectives in addition to developing codes to categorize arguments among users. Among others, the code categories included: Triggers of tweets, origin of tweets, the tone of the tweet and reactions. Triggers of tweets were categorized as public, social, and scientific events that garnered a high amount of media coverage. Origin of tweets highlighted the type of account that the primary tweet came from whether that was a news, personal or nonprofit account. Language used within the tweet was used to determine the tone being portrayed by the primary tweeter. Reactions highlighting the public response to the primary tweet's opinion or information. These categories were modified from a similar study that examined social and traditional media coverage of food crisis (Shan et al., 2014). As such, both coders had a concrete understanding of the codes and their descriptions. Once intercoder reliability was established, the primary coders analyzed the rest of the tweets independently and then merged the results during interpretive analysis. To address the third research objective, code relationships were established between the themes and explored further.

As is the case in qualitative research, it is imperative to reveal any potential bias. In this case both coders have a background in agricultural and environmental issues and believed climate change was real. While both tried to remain unbiased, this perspective may have influenced their data collection process and the resulting analysis. To mitigate this effect, peer debriefing was conducted with several individuals separate from the coding process who agreed with and approved of the analysis and results (Lincoln & Guba, 1985).

Results

Events Associated with Climate Change Conversations on Twitter

During the analysis process five themes emerged regarding events that kickstarted conversations about climate change. The five themes included: climate event, social event, political event, scientific discoveries, and natural disasters. The top three events out of 110 initial tweets were related to political events (42 tweets), social events (26 tweets), and scientific discoveries (19 tweets). Political events included presidential debates, congressional meetings, and climate summits. Social events included protests, rallies, community-specific tweets, and local news. Scientific discoveries covered any scientific discovery caused by, or in relation to, climate change. Table 1 provides a summary of the themes and examples of the tweets from each type of conversation starter.

Table 1

Events associated with Climate Change Conversations on Twitter

Trigger	Example of Conversation	Frequency n (%)
Political Event	State Department analyst Rod Schoonover resigned in protest after the White House blocked some of his testimony on the threat climate change poses to national security (@TheWallStreetJournal) Gov. Jay Inslee unveils his initiative to combat climate change, proposing 100% clean energy standards across three sectors. https://abcn.ws/2ZSOPxh (@ABC)	42 (38%)
Social Event	"Jane Fonda and Sam Waterston arrested in climate change protest https://cbsn.ws/31uoRzU (@CBSNews)" LIVE: Climate activist Greta Thunberg leads climate change rally in Denver. @ABCLIVE: Climate activist Greta Thunberg leads climate change rally in Denver.pscp.tv (@ABCNews)	26 (24%)
Scientific Discoveries	Super-soaked spring soils, unplanted fields, record-rising rivers, runaway barges—this is what climate change looks like for the middle of the US. And it's harming the nation's ability to produce food. (@WIREDScience) Scientists believe that the Amazon's absorption of greenhouse gases plays a crucial role in slowing climate change, but the Brazilian President Jair Bolsonaro has encouraged loggers to deforest more of the rainforest. (@TheNewYorker)	19 (17%)
Climate Event	"June was the hottest month ever recorded. Channai, India, a city of 9 million, is running out of water. Unprecedented heatwaves, floods and wildfires are devastating communities here. The time for incremental approaches to climate change is over. We need a Green New Deal." (@BernieSanders) Storm Barry's threat to New Orleans heightened by climate change: scientists https://reut.rs/2JDXeNW (@Reuters)	15 (14%)
Natural Disasters	'Shocking': Scientists — including Venetians — sound alarm as Venice floods As climate change causes sea levels in Venice — and across the planet — to inch higher, scientists say catastrophic floods could become more severe and more frequent (@NBC News) SUMMER HEAT WAVE: Record-breaking heat had Parisians taking a dip in front of the Eiffel Tower on Friday. Experts say climate change is to blame for the temperature spike https://cbsn.ws/2KMCOW0 · (@CBSNews2)	8 (7%)

Public Comments/Reactions toward Climate Change on Twitter

During the analysis three primary categories emerged in user reactions to tweets about climate change. The three primary reaction categories were Negative, Positive, and Argument. User reactions categorized as an Argument were further divided into three subcategories to describe the type of argument happening; these subcategories are Heated, Moderate, and Unheated. While initial posts about climate change were positive, variations emerged when other users commented. One theme that emerged when analyzing the public comments and reactions toward climate change focused on *type of reactions* which looked at whether the reactions was opposing (negative) or in agreement (positive) towards the ideas expressed in the original tweet.

In the types of reactions subcategory, public comments were primarily negative (751 out of 1210 tweets). The negative comments represented a commenter's disagreement with climate change as being real, or an argument about the source or cause of climate change. However, there were also positive comments that were represented (459 of 1210 tweets) from followers who agreed climate change was real and needed attention. Examples of users' positive and negative reactions to climate change messages can be seen in Table 2.

Table 2

Users Comments/Reactions to Climate Change Messages

Reactions	Examples of Comments
Negative (751)	"Anyone still waiting for the global ice age that Al Gore promised us along with the scientific community? How many ice ages?" (@TheWashingtonPost) "So should we invade China and India? They're causing the most damage and if it's such a huge threat, we should be planning on taking over those countries."(@ChelseaHandler)
Positive (459)	"Anyone denying climate change on here is, of course, a fool. Enjoy the changes coming." (@TheWallStreetJournal) "Elect intelligent politicians who welcome scientific fact and make climate change a top priority." (@WIREDScience)

In addition, a subtheme that looked at the level of argument based on the comments also emerged. These reactions were categorized based on the type of language used whether formal or informal. Comments coded as negative frequently occurred with moderate and heated arguments while comments coded as positive most frequently occurred with unheated arguments and solution-seeking behaviors. Many of the negatively coded segments tended to be unfocused with both parties coming to separate resolutions or questioning why they were arguing in the first place (see Table 3).
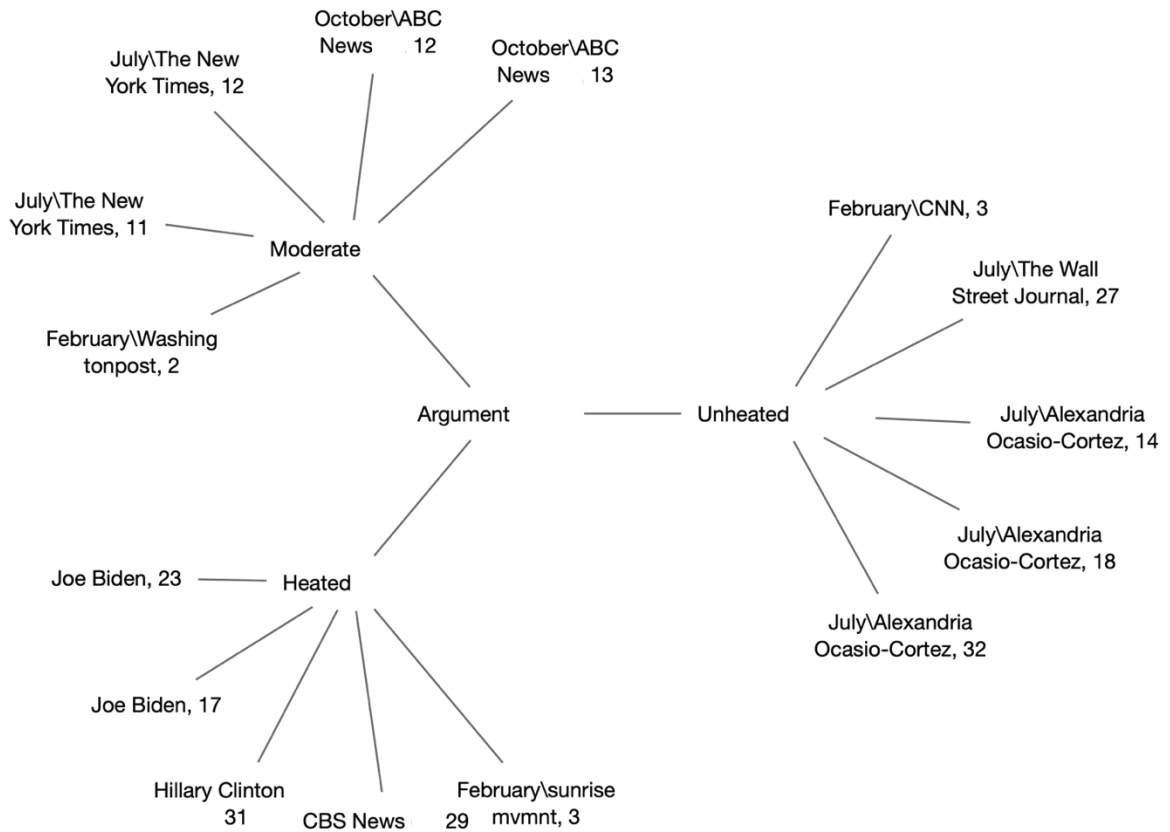
Table 3
Argument Levels of Comments to Tweets

Argument Level	Example
Heated (23)	"You are the complete moron @BernieSanders - speaking as one who has an environment studies degree - "man-made climate change" all junk science...in the 70s & 80s it was the coming ice age - then "peak oil" - then @algore's complete fraud - it's all political opinions not science" (@BernieSanders) "We want change and the folks up in the government won't do shit about it, so we have to take it into our own hands, it's about time that we speak out and have our voice heard, tbh, I'm sick and tired of seeing people like me struggling to find a job and older generations are ½" (@CBSNews)
Moderate (24)	"My favorite parts are where you lie and have strawman arguments" (@BernieSanders) "How much emissions were expended to built that thing and to fly her two crews back and forth to pilot it? She may be young, but she's got a head start on learning climate change elitism's hypocrisy" (@TODAY)
Unheated (86)	There is room for more than one solution. Actually we may need all of them." (@BillGates) "Climate change is also a factor but some problems could have been alleviated through proper planning and good governance" (@BernieSanders)

Relationship between Sources of Conversation Starters and Public Comments/Reactions toward Climate Change on Twitter

Relationships between climate event reporters on social media and the reactions from the audience were then examined. A visualization of the results can be seen in Figure 1 where the level of argument is shown in relation to the original source of a tweet. Tweets relating to political events that came from political leaders attracted heated debates while tweets from news handles in relation to social events and scientific discoveries attracted moderate arguments. To further enhance understanding, the level of argument for each tweet was analyzed in relation to the origin of the tweets, the tone of the tweets and triggers of the conversation. Three themes emerged: the origin of the tweet versus level of argument, tone of tweet versus level of argument, and triggers of conversation.

Figure 1
Relationship between Levels of Argument and Sources of Tweets

Tone of the Tweet versus Level of Argument

Coders thematically categorized frequently seen tones from primary tweeters in addition to analyzing the responses that users had to the original tweet itself and with other users based on the tone used to determine how tone impacted climate conversations. The original tweeters' tone was categorized within the subtheme as: aggressive, blaming, passive, informational or sympathetic. Aggressive and blaming tweets were frequently used to ridicule the action, or lack thereof, that political entities or corporations were taking toward climate change. Passive tweets did not contain aggressive or blaming language and never highlighted specific groups of people as part of the problem. Informational tweets provided updates and breaking news on all issues related to or caused by climate change without bias. Sympathetic tweets were often in reference to events caused by climate change. Coders used the original tweeter's words and syntax to categorize the tweets into the previously mentioned categories. Table 4 shows the tone of tweet and the corresponding reaction from the audience.

Table 4

Comparison between Tone of Primary Tweet and Reactions from Followers

Tone of Tweet	Primary Tweet	User Reaction
Aggressive	"Who will be the new National Security Advisor? Will it be The Hamburglar, or is he better suited to take on climate change? When it comes to horrible options, Trump's bench runs deep. BTW you're paying for the burgers." (@JimCarrey)	"Te amo @JimCarrey! Impeach the #PutinPuppet now!!!" (@JimCarrey)
	"Donald Trump believes climate change is a hoax. Donald Trump is an idiot." (@BernieSanders)	"It is a hoax. Pole shift is real, first they called it Global warming, not very true, now climate change? Yes, with chemtrails and Haarp they have changed the climate. CO2 does NOT cause Global warming this was a blatant lie, proven by science!" (@BernieSanders)
Blaming	"World leaders are failing our future generations on climate change" https://wapo.st/335ully via @PostOpinions (@TheWashington Post)	"But #Republicans like warm, moist weather...just look at their takeover of Florida...." (@TheWashingtonPost)
	"President Trump has failed us on climate change. Preventing scientists from monitoring and reporting on carbon emissions and other climate warning signs is inexcusable. We can't — and won't — wait for Washington to discover reason." Trump Administration Hardens Its Attack on Climate Science. In a significant escalation, policymakers are seeking to undermine or discard research showing the most dire risks of inaction on climate change. nytimes.com (@MikeBloomberg)	"guess it's a new approach to 'tackling' climate change. Just stop measuring it. That'll do it."(@MikeBloomberg)
Passive	"people really out here denying climate change when it's 22 Celsius in NYC in march" (@CodySimpson)	"people really out here shocked when extreme weather patterns happen. people out here say "i wish global warming was real bc im cold" people really be using plastic bags to hold one item they bought at the store" (@CodySimpson)
	"AOC gets it. She sees that fear is dividing us. We can address income	"Perfect. A fake science guy and a fake economist." (@BillNye)

Tone of Tweet	Primary Tweet	User Reaction
	inequality. We can address climate change, if we get together and get to work. #SXSW @AOC" (@BillNye)	
Informational	State Department analyst Rod Schoonover resigned in protest after the White House blocked some of his testimony on the threat climate change poses to national security (@The Wall Street Journal)	"#FactsMatter ...but not to this administration. We need real leadership in Washington DC. We cannot continue to deny the #ClimateCrisis. We need a President with the intelligence and courage to act. #ClimateAction #ClimateChange"(@The Wall Street Journal)
	The people who will suffer most from climate change are the ones least responsible for it. Here's how we can help them: https://b-gat.es/30JC8EM (@Bill Gates)	"The people who are most affected by these changes today are the farming households in South Asia and Africa, they earn their living by raising crops and livestock on small parcels of land. These families have the fewest resources to cope with the many impacts of a warming climate"(@Bill Gates)
Sympathetic	Climate change is one of the toughest challenges facing the world. But don't despair… Scientists and entrepreneurs are working on some innovative solutions. Here are four that I'm excited about: https://b-gat.es/2zJTXaY (@Bill Gates)	"It's a CULT, not a Science!!!" (@Bill Gates)
	One challenge will define the future for today's young generation more dramatically than any other: Climate change. The millions of young people worldwide who've organized and joined today's #ClimateStrike demand action to protect our planet, and they deserve it. (@BarackObama)	"The continental United States is 1.8 degrees Fahrenheit warmer than it was a century ago. Seas at the coasts are nine inches higher. The damage is mounting from these fundamental changes, and Americans are living it. And obviously the acting so called „President" doesn't get it." (@BarackObama)

Discussion

The purpose of the study was to explore how Twitter was being used to shape public conversations about climate change. Overall, the results indicated climate change conversations on Twitter were argumentative in nature rather than for the purpose of confirming previously held beliefs or the sake of pure agreement. In most cases users were commenting to persuade other Twitter users to adopt their side of the argument. These findings are in opposition to Pearce

et al. (2014), who found tweeters were more likely to interact with other tweeters who shared similar views about climate change.

Incivility was found to be high overall in the comments to a tweet that used aggressive or blaming language, especially as it related to tweets from political figures. Arguments (whether unheated, moderate or heated) were seen as the primary response to tweets from personal handles, indicating users belonging to specific communities sought out or exposed themselves to influencers who held opposing viewpoints as a way to argue their viewpoint. The finding implies that, when interacting about climate change, tweeters are attempting to get the original tweeter to either agree or disagree with climate change based on their own motives. As seen in some of the pulled example tweets, Twitter's relaxed posting and content rules allows tweets that include harsh language or blaming tones to be used to incite aggressive conversation through the quote tweet or retweet feature. However, unlike what was seen in previous studies (Bennett, 2012), neither evidence nor reasoned debate swayed emotional orientations in the data obtained.

Anderson (2017) previously indicated a need for communication research to focus on the tonal cues necessary to positively engage with social media users. The findings of this study strived to explore tonal cues finding certain tones positively engaged Twitter users while sarcastic or negative tones turned people away and discouraged further engagement. Many of the source tweets agreed with the threat of climate change. However, if aggressive or blaming tones were used in the source tweets, they elicited sarcastic responses and argumentative comments about the true cause of climate change rather than eliciting science-based conversations for the purpose of education. Discussions surrounding the cause of climate change, and whether an intervention from government was necessary, amassed a high number of accusatory or blaming reactions, even more so when the tweets were coming from political accounts. This finding implies there are strong connections between political beliefs and climate change perspectives/ways of communicating about climate change that should be explored further as science communicators strive to educate about climate change on social media channels.

Additionally, in this case, Twitter users did not engage with people who only agreed with them or had similar views. Java et al. (2007) previously categorized Twitter users as information seekers and information sources. Perhaps in the case of climate change, people are seeking information on Twitter that is not congruent with their own, rather than just confirming their previously held beliefs. Considering social media works through followership, the chances of seeing a tweet from someone you do not follow or have dissimilar interests with is very slim when scanning your new feed. Therefore, these findings confirm the active seeking of information that challenges previously held beliefs mentioned by Java et al. (2007).

Furthermore, the results indicated political events are major triggers of climate change conversations on Twitter with most of the heated conversations coming from posts made from politicians' accounts. This indicated politicians who have a large following can incite debates about climate change to elicit comments from those in opposition deliberately in hopes of facilitating an argument and gaining attention. Perhaps the blaming or aggressive tone frequently used by politicians works as argument bait or challenge for users who not only disagree with climate change, but who disagree with the politicians' overall viewpoints. Even though people trust media stories they get on social media from friends or likeminded peers they perceive to be opinion leaders (Turcotte et al., 2015), this may not always be true when it comes to a controversial issues such as climate change. Therefore, it is important to explore how communication can be used to combat political agendas used as attention getters to ensure the

public is engaged in educated discourse around climate change rather than arguing with those sharing incorrect facts or those not based in science.

Conclusions and Recommendations

The overarching findings from this study uncovered the argumentative nature of climate change conversations on Twitter during the time period of data collection. This is divergent from previous research. For example, Williams et al. (2015) found people tend to talk to others who are like-minded with a minority of users talking to people who share diverse views when having climate change discussions on Twitter. Given the role politicians played as the source tweet for many of the arguments noted during analysis, the findings imply there is a large amount of political influence occurring in the climate change conversation on Twitter being driven by the political agenda. Whether for information purposes, or for the sake of gaining a following/attracting attention, the effort is working because Twitter users are following people with diverse and often opposing views in the climate change conversation.

The conservative end of the personalized politics spectrum is heavy with references to personal freedom and highly emotional reactions in attempts to adjust any opposing ideologies that may be viewed as threats to that freedom; even when that includes science (Bennett, 2012). Given the climate change conversations in this study were largely impacted by the political agenda, it is important to take into account how tweets coming from personal or political accounts can be seen as a threat to a user's freedom based on the tweeter's previous political history and motives when communicating about climate change and climate science. While censorship of political accounts is highly unrealistic, agricultural communicators should think about how to separate science from political ideals to increase trust in messaging.

While agricultural communicators should present science-based information in a nonbiased light on Twitter, the findings indicated the use of attention-grabbing hooks that compete with jarring headlines shared by alarmists are more likely to engage climate change information seekers. Scholars suggest language and iconic visuals that are alarmist in nature, or rely on fear appeals, may raise concerns (Nerlich et al., 2010; O'Neill & Nicholson-Cole, 2009). However, information will not be seen if it does not compete for public attention. Further research examining engagement with nonbiased information presented with basic versus attention grabbing hooks should be further explored to see if this holds true as the climate change conversation continues.

Attitudes associated with source content were also relevant in the findings. Arguments were less likely to occur when tweets came from reported sources that provided links or pictures to back up the information presented. The results indicated political views may shape public discussion of scientific findings and resulting recommendations about climate change. Therefore, it is important for agricultural communicators to pay attention to the language and tonal cues used when communicating about climate change on Twitter, as well as the political affiliation of various climate change advocates they partner with to share their messaging.

While positive and intentional messaging is meant to engage and inform social media users, online spaces also provide an open floor for framing climate change skeptically and activating those with a skeptical perspective of climate change (Anderson, 2017). Therefore, further research determining how political ideologies, global location and living area influence or affect Twitter conversations in relation to climate change is warranted. This study only monitored Twitter conversations in the United States during a specified time period. Given

climate change is a global conversation, examining how climate conversations on Twitter (and other social media channels) vary around the world could further explain these findings. Conducting an analysis of this type is especially important during times of political unrest, or as political priorities shift, because it could assist the global public engage in climate change conversations that result in innovative solutions and the spread of research-based information rather than incorrect or false information.

Finally, there is a myriad of research on this topic that could be conducted on other social media platforms (e. g. Facebook, Instagram, WeChat, Snapchat, Tik Tok) to further explore how conversations around climate change are occurring on social media platforms. Further examining how algorithms work within each platform, supplying users with content that closely aligns with their current interests, and how they alter how users are obtaining and conversing about climate change would further our understanding of public information seeking in this area. Along these lines, some platforms are stricter that others in the way they regulate content. Therefore, studying the impacts of a relaxed communication platform versus a more stringent platform could inform how argumentation theory application is used across social media settings informing those with fact checking limitations and content safe guards. As we strive to combat one of the greatest global challenges of our time, effectively communicating about climate change using science-based information is essential. Additional research in this area will continue to assist agricultural communicators as they develop and create research-based messages that capture attention and improve global climate change conversations on social media.

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