

Climate Change Communication Research: A Systematic Review

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Published August 31, 2020

Abstract

This study is an examination of climate change communication research in which we examine topical, geographical and methodological trends. Using 160 peer-reviewed journal articles as evidence, we assess the field's climate change research to-date and draw recommendations for future directions for research. Our findings illustrate that the majority of surveyed research focuses on public knowledge of and public belief in climate change, draws data from the Global North and tends toward quantitative methodological approaches, although a diversity of methodological approaches are represented. We recommend that future research correct ethnocentric tendencies by studying underrepresented regions such as the African continent, Latin America and the Caribbean, attend more to studies addressing adaptation to climate change impacts and embrace methodologies that address the localized nature of climate change mitigation and adaptation efforts.

Keywords: Climate change communication, climate change, systematic review, environmental communication, communication research trends

1. Introduction

Earth's surface is at substantial risk of changes due to increased greenhouse gas emissions (Nolan et al, 2019) and in many places, climate change is already happening, seen through more heat waves, greater sea level rise, unexpected weather events and other changes that impact human health, natural ecosystems and agriculture (AAAS, 2014). Human societies depend upon the living components of natural and managed systems, and climate change is driving a universal redistribution of life on Earth (Pech et al, 2017).

Within communication, we have seen a significant rise in environmental research, with 'climate change' as the most popular keyword in environmental communication research by a significant margin, empirically marking its importance within environmental communication research (Comfort & Park, 2018). With the increasing salience of climate change as a threat to global well-being and the role communication scholars may play in informing and engaging citizenry (Cagle & Tillery, 2014), it is an opportune moment to review broad trends within climate change communication research.

A systematic examination reveals where a topic of research concentrates as well as the areas that need future attention (Borah, 2011). This reflective act is of particular importance within a topical area that we can expect to grow significantly in the future.

A guidepost for climate change research is the leading scientific findings on the current state of climate change and future predictions of impact. In 2019, the American Meteorological Society released an information statement summarizing how human influence has impacted climate, causing a warming of the atmosphere and oceans, which varies from place to place due to natural climate variations. Projected warming over the next century places global temperatures in a range not seen in millions of years of geologic history. The report concludes with the primary ways to most productively respond to climate change, which are to (1) reduce greenhouse gases produced by human activity, (2) remove existing gases from the atmosphere and (3) adapt to changes in order to ameliorate impacts on human health, society and economy. (American Meteorological Society, 2019)

Future climate change communication research can subsequently orient itself off of these three

recommendations. Table 1 illustrates these recommendations, with six primary questions that may guide future climate change communication research to align the field with the most pressing needs around climate change to optimize relevancy.

| | |
|--|--|
| 1. Reduce greenhouse gas emissions | How can we implement policy that reduces greenhouse gas emissions? |
| | How can we encourage people to engage in pro-environmental behavior that reduces greenhouse gas emissions? |
| 2. Remove existing gases from the atmosphere | How can we implement policy that supports efforts to remove existing gases from the atmosphere? |
| | How can we assist in improving scientific innovation? |
| 3. Adapt to current and future changes | What do societies need to adapt to climate change impacts? |
| | How can we support adaptation to climate change impacts in societies? |

Table 1. Scientific recommendations for climate change responses (American Meteorological Society, 2019) and corresponding questions to guide communication research

With these guiding questions, we can critically examine past and current trends in communication research to measure alignment with modern climate change research needs. There will be a natural and anticipated divergence from these measures in past research, as research needs around climate change have evolved over past decades. This review will provide an understanding of where the field has focused thus far, with the goal of providing clarity for future direction guided by the questions outlined in Table 1. To this end, we conduct an examination of climate change communication research using peer-reviewed journal articles as evidence of trends within the field. Following aspects of similar reviews within communication (Schäfer & Schlichting, 2014; Comfort & Park, 2018), we focus on geographical origins of data, method and orienting goal.

Considering these three areas of focus, we are driven by these three questions:

RQ1: What is the focus of climate change research in the field of communication?

RQ2: In what geographical regions are communication researchers drawing data for their climate change research?

RQ3: What methods are communication researchers using to study climate change?

From these, we assess the field's climate change research and draw recommendations for future directions based on the

most pressing needs we face when addressing the detrimental impacts of climate change on humans and nature.

2. Method

Systematic review approaches are diverse and up to 14 different types of literature reviews have been identified (Grant & Booth, 2009). These detailed differentiations between systematic reviews are drawn from health sciences, where systematic reviews form a core component of their methodological approach. Other disciplines often deploy broader terminology when engaging in systematic reviews, whereby a systematic review is commonly known as a narrative summary (Basu, 2017) that provides a high-level overview of primary research through an exhaustive summary of scholarly literature related to a particular topic (Miller & Brewer, 2003). The meta analysis, alternatively, is generally known to be a statistical tool for estimating the mean and variance of underlying population effects from a collection of empirical studies addressing the same research question (Field & Gillett, 2010; Himmelfarb Health Sciences Library, 2019). Many fields, however, may periodically use systematic review and meta analysis interchangeably, as can be the case within the discipline of communication. This may be attributed to the breadth of meta-theoretical and methodological orientations found within communication, which make the more rigorous categorizations of systematic reviews found within other fields less appropriate or translatable. In this case, the article's purpose is to provide a high-level overview of communication scholars' research on climate change communication, rendering what is commonly defined as a systematic review the appropriate methodological choice.

In borrowing from the health science field's meticulous categorization of systematic review approaches, we would consider this work to be a scoping review, also known as a mapping review (Arksey & O'Malley, 2005; Anderson et al, 2008; Ehrich, 2002), which is a relatively new methodology often used to map existing literature in a given field in terms of its nature, features and volume (Arksey & O'Malley, 2005). Scoping reviews are of particular use when a body of literature exhibits a large, complex or heterogeneous nature not amenable to a more precise systematic review (Peters et al, 2015), making it an ideal selection for the range of meta-theoretical, theoretical and methodological outlooks found within the discipline of communication.

2.1 Search Strategy

Our analysis began with a systematic literature search to identify peer-reviewed studies published before February 2019 that focused on communication and climate change. The search term 'climate change' was used exclusively. While people may colloquially use 'global warming' and 'climate change' interchangeably, global warming is only one aspect

of the broader umbrella term of climate change (USGS, 2019). Within academic and research journals, global warming refers to surface temperature increases, while climate change includes global warming and associated impacts of increasing greenhouse gas amounts (NASA, 2019).

As a parameter for journal selection, we used the National Communication Association's compilation of journals publishing communication research. Their list standards are that the journal (1) publishes communication scholarship in some form or another and (2) are not predatory or pay-to-publish journals (National Communication Association, 2019). Given this criteria, we queried 123 journals (Appendix A) by free text searching with the term 'climate change.' The inclusion criteria required that articles concentrate on climate change as the primary subject of research. Our search protocol generated a sample of 160 abstracts.

2.2 Coding Climate Change Topics

Coding of the climate change research topic was conducted manually and independently by three research assistants and one author of the paper. Initially, two team members selected a random sample of 25 articles and developed a set of codes, guided by the definition of a code as "a word or short phrase that symbolically assigns a summative, salient, essence-capturing, and/or evocative attribute" for language-based data (Saldaña, 2015, p. 3). The authors then compared the codes and negotiated a final set, resulting in five broad topics. They then trained two additional team members on the coding procedure based on the definitions provided below. These additional two team members proceeded to code the entire dataset based on these topics. The climate change topics were defined as the following:

1. *Public Knowledge of Climate Change.* Factors influencing knowledge acquisition of climate change. Factors influencing engagement with climate change informational content.
2. *Public Belief in Climate Change.* Factors influencing public belief in the veracity of climate change. Persuasive rhetoric and techniques to increase public belief in the existence of climate change.
3. *Public Action on Climate Change (Adaptation).* Factors influencing and predicting environmental behavior, specifically adjusting to the impacts (current or future) of climate change.
4. *Public Action on Climate Change (Mitigation).* Factors influencing and predicting environmental behavior, specifically reducing or stabilizing the levels of heat-trapping greenhouse gases in the atmosphere and its subsequent impacts on the environment.
5. *Governmental Communications.* Governmental framing, rhetoric and messaging around climate change as a phenomenon. Analysis of policy debates.

Articles frequently examined several of these topics at once, and each were coded and counted independently. Of the 160 articles collected for this review, 10 articles were not coded in this particular analysis as they were theoretical, historical or esoteric and did not address a generalized topic or the generalized topic was not discernable.

2.3 Coding Geographic Regions

Our third analysis was performed by coding each article by the geographical location/s from which the data was drawn. One of the authors performed the coding, given its straightforward nature. The geographic locations were chosen based on the geographic location of the participants or geographic location of the collected data. Geographic locations were coded by country. Articles that referenced countries but did not draw data from within that country for analysis were not coded. For instance, several articles discussed locations of climate-change summit meetings but did not draw data from within the country where the summit was held. These countries were excluded.

Several of the examined articles included multiple geographic locations, which accounts for the discrepancy between the number of articles analyzed and the number of countries recorded. When data was gathered from multiple countries, all the countries were recorded and each country was awarded its own code. The total number of countries identified amounted to 258, while the number of articles analyzed remained at 160. It should also be noted that 12 articles were excluded from this analysis because they did not draw on empirical data.

2.4 Coding Methods

We performed a final analysis to determine what methods were used in the 160 journal articles that were used as the data source for this analysis. One team member carried out the coding of the methods by compiling all data in a central location, which was reviewed for accuracy by one of the paper's authors. Methods were included only if they were explicitly stated in the text. In a few cases, methods were not specifically stated as the article did not perform an analysis. In these cases, they were given the code "Theoretical" to describe the nature of the text. Each method used in an article was recorded individually. If there was more than one method used, each was counted separately. For example, if an article applied a "Content Analysis" as well as a "Frame Analysis," both are reflected in our data. We were unable to gain full access to three of the journal articles included in our data and only had access to the abstracts themselves. With only the abstracts as a basis for coding, we could not discern what method was used. Thus, these 3 articles are coded as "Unknown".

3. Findings

3.1 Climate Change Topics

Our findings illustrate that *public knowledge of climate change*, defined as studies that examine factors influencing knowledge acquisition of climate change and factors influencing engagement with climate change informational content, is the most popular topic of research within climate change communication. As Figure 1 illustrates, 74 of the surveyed articles, or 46%, address public knowledge. This is followed closely by *public belief in climate change*, defined as studies that examine factors influencing public belief in the veracity of climate change or persuasive rhetoric and techniques to increase public belief in the existence of climate change, which represents 41% of all studies. The third most popular topic is *public action on climate change (mitigation)*, which encompasses studies that examine factors influencing and predicting environmental behavior, specifically reducing or stabilizing the levels of heat-trapping greenhouse gases in the atmosphere and its subsequent impacts on the environment. This topic represents 25% of surveyed articles. Articles addressing multiple topics were coded separately, which is

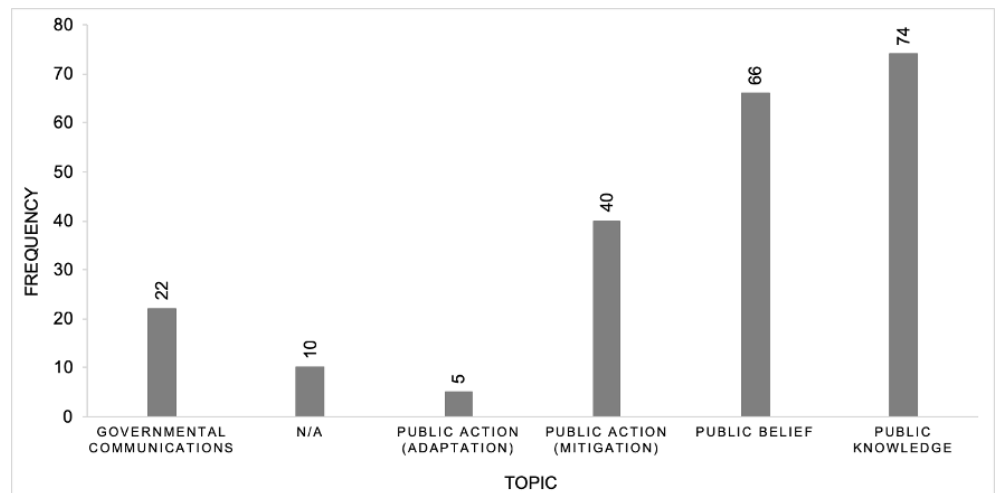


Figure 1. Frequency of Climate Change Topic in Selected Climate Change Communication Articles

Note: Studies addressing multiple topics were coded into different topic sets

why percentages of separate topics do not add up to 100, as many articles addressed multiple topics.

The two least common topics are *governmental communications* and *public action on climate change (adaptation)*. Governmental communications, defined as studies examining governmental framing, rhetoric and messaging around climate change as a phenomenon as well as analysis of policy debates, represented 14% of the surveyed studies. The least popular topic by far, however, is *public action on climate change (adaptation)*, which accounts for studies that examine factors influencing and predicting environmental behavior, specifically adjusting to the impacts (current or future) of climate change. This topic was addressed in only 5 articles, thus accounting for only 3% of all climate change communication research surveyed within this study.

3.2 Geographic Region

Our findings on geographic sources of data are broken down into region, Figure 2, and country, Table 2. Figure 2 illustrates the dispersion of regions, illustrating a stark concentration in North America and Europe. 176 studies draw data from North America and Europe, whereas only 81 studies draw data from the rest of the world. Certain regions, such as Africa, the Caribbean, the

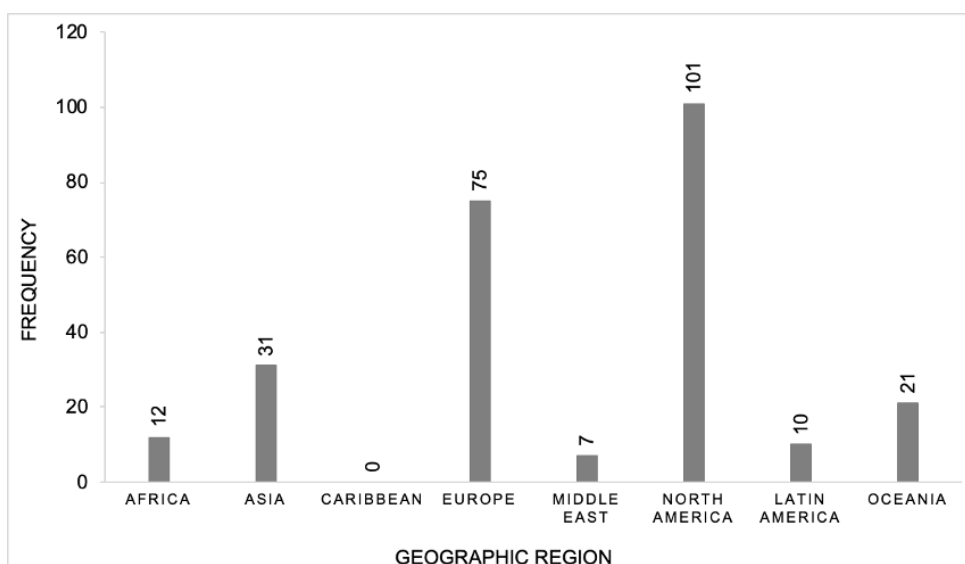


Figure 2. Frequency of Region as Data Source in Selected Climate Change Communication Articles

Note: Studies addressing multiple regions were coded into different region sets

| Country | Frequency |
|----------------|-----------|
| United States | 92 |
| Australia | 17 |
| Germany | 17 |
| United Kingdom | 16 |
| Canada | 9 |
| China | 9 |
| India | 8 |
| Brazil | 6 |
| Sweden | 6 |
| Denmark | 5 |
| Singapore | 5 |
| South Africa | 5 |
| Belgium | 4 |
| France | 4 |
| Finland | 3 |
| New Zealand | 3 |
| Norway | 3 |
| Poland | 3 |
| Argentina | 2 |
| Austria | 2 |
| European Union | 2 |
| Ghana | 2 |
| Russia | 2 |

Table 2. Frequency of Countries as Data Sources in Selected Climate Change Communication Articles

Note: Studies using multiple countries as data sources were coded into different country sets.

Note: Country categories with only 1 study are not listed.

| | |
|-------------------------|----|
| Content Analysis | 38 |
| Discourse Analysis | 32 |
| Survey | 28 |
| Experiment | 22 |
| Theoretical | 12 |
| Interviews | 9 |
| Frame Analysis | 7 |
| Comparative Analysis | 3 |
| Focus Group | 3 |
| Rhetorical Analysis | 3 |
| Empirical Analysis | 3 |
| Textual Analysis | 3 |
| Unknown | 3 |
| Risk Analysis | 2 |
| Field Analysis | 1 |
| Ludology | 1 |
| Multimodal Analysis | 1 |
| Narratology | 1 |
| Opinion Poll Research | 1 |
| Questionnaire | 1 |
| Social Network Analysis | 1 |
| Visual Analysis | 1 |

Table 3. Frequency of Methods Used in Selected Climate Change Communication Articles

Note: Studies using multiple methods were coded into different methods sets.

Middle East and Latin America are particularly underrepresented.

Table 2 captures a more nuanced look at geographic data sources. The table reports on the frequency of a country as a data source. Here, disparities become increasingly stark, with the United States representing the vast majority of climate change communication research data sources. The United States is followed by Australia, Germany and the United Kingdom. The table does not include countries where only one study has been conducted.

3.3 Methods

The survey confirmed Comfort and Park's (2018) suggestion that environmental communication is relatively methodologically open. 160 articles used 22 methods, some of which were used together in mixed-methods studies. Of the 160 articles reviewed, 14 studies utilized a mixed-methods approach. Content analysis, discourse analysis, experiments and surveys were leading methodological avenues for studying climate communication in these articles, with each of them being used in over 20 articles. Three of these (content analysis, experiments and surveys) are methods commonly used in quantitative research, while one (discourse analysis) is commonly associated with qualitative research.

4. Discussion

4.1 Focus of Climate Change Research

To date, climate change communication research focuses predominantly on public knowledge (46%) and public belief (41%). This emphasis means that the majority of research is centered on understanding what factors may

influence public engagement with and acquisition of knowledge of climate change, as well as factors influencing belief in the veracity of climate change and what techniques may influence belief in climate change. Since the 1980s, public opinion surveys began to measure public concern over and belief in climate change and over the 1980s and 1990s there was increasing awareness and knowledge of the phenomenon, where the mid to late 1990s and early 2000s saw a growth and fluctuation in concern over climate change that soon headed toward skepticism and polarization in the late 2000s (Capstick *et al*, 2015). In this historical context, it makes sense that belief in climate change and access to knowledge around climate change were salient and prominent topics within communication, particularly in light of the rise of the digital age and increasing interest in knowledge access during this time.

However, a broad national study of the United States' public in 2018 demonstrated that a large majority of Americans think climate change is happening, outnumbering those who do not by more than 5 to 1, and a majority of Americans understand that climate change is caused mostly by human activities (Leiserowitz *et al*, 2018). Broader global trends reflect the same. Majorities in 40 nations polled by Pew Research Center report climate change as a serious problem, with a global median of 54% believing it to be a very serious problem (Wike, 2016). This new data reveals that today, the question of belief in the veracity of climate change is not as salient as it once was.

It is important to understand communication's role in and influence on public knowledge and belief in climate change, however we are at a pivotal moment. Despite the tensions in national and international political dialogues around climate change, global public belief has shifted in favor of climate change (Leiserowitz *et al*, 2018; Wike, 2016), climate change is considered fact by the scientific community (American Geophysical Union, 2013; American Meteorological Society, 2012) and its impacts are already being documented around the world (AAAS, 2014). Climate change as a phenomenon is evolving and so are its salient research factors. Some 22 articles address governmental communications, or 14% of articles. Of the articles surveyed, 40 address environmental behavior around mitigation, or 25% of the articles. Yet only five address environmental behavior around adaptation, representing only 3% of the articles surveyed.

Now is an appropriate time to reorient toward the scientific recommendations for climate change responses (American Meteorological Society, 2019) and corresponding questions to guide communication research outlined in the introduction. Climate change as a phenomenon is broadly differentiated into two foci: mitigation and adaptation. Climate change mitigation is an act of reducing climate change by reducing the flow of heat-trapping greenhouse gases into the atmosphere (NASA, 2019). It can involve efforts such as using

new technologies and renewable energies, making older equipment more efficient, planning for a new city or converting transportation systems to lower-polluting options (UN Environment, 2019). Adaptation is the act of adjusting to life in a changing climate (actual or expected) and responding to its harmful effects, such as sea-level encroachment, food insecurity, etc. (NASA, 2019). In terms of mitigation, orienting communication research to reduction of greenhouse gas emissions and removing existing gases from the atmosphere can be guiding priorities for research. For adaptation, adapting to current and future changes is another guiding priority.

With only 3% of all climate change communication research surveyed within this study addressing adaptation, we take a moment here to reflect upon the phenomenon and its research orientation more broadly and the potential of communication in this space. Changing climates around the world already impact millions of people (Watts *et al.*, 2017), and as such, adaptation is and will increasingly become a more crucial component of climate change research agendas. Adaptation to climate change is dependent upon a society's particular resources, values, needs and perceptions (Mimura *et al*, 2015). As such, local governments and communities are considered central to the success or failure of climate change adaptation efforts (Barrett, 2015; Remling & Persson, 2015). In a review of a range of responses to climate change, some efforts have damaged resilience (Adgers *et al*, 2011) due to a narrow framing of the problem and lack of consideration of interaction between climate change and other stressors. For instance, culture is central to understanding and implementing adaptation as the identification of risks, decisions about responses and means of implementation are all mediated by culture (Adgers *et al*, 2013) and there is emerging evidence that current policies lead to maladaptive outcomes partly by overlooking cultural dimensions (Raymond *et al*, 2010; Abel *et al*, 2011; Godden *et al*, 2011; Loring & Gerlach, 2009).

As evidence of the increasing attention paid to social factors within climate change research, there has begun to be a growth in actor-centered approaches to adaptation research in climate change (Ekstrom & Moser, 2014; Moser & Ekstrom, 2010; Dow *et al*, 2013; Eisenack & Stecker, 2012; Klein & Juhola, 2014). Actor-centered research focuses on individuals, organizations, citizens, firms or policymakers and once the relevant actors are identified, it proceeds to explain why and under which conditions actions are undertaken or not, or why they should be undertaken and by whom (Eisenack *et al*, 2014). Many barriers to climate change adaptation are related to the actors themselves, and barriers can only be addressed and overcome by actors and actions.

Communication as a discipline is very well-suited to address climate change adaptation and lend its expertise to the effort of preparing and assisting societies to cope with and handle detrimental climatological impacts. Adaptation is

dependent upon society; its resources, values, needs and perceptions (Mimura et al, 2015) and local communities are considered central to the success or failure of climate change adaptation efforts (Barrett, 2015; Remling & Persson, 2015). Communication can offer a breadth of insights through formative research, campaigns, theoretical contributions and more. Societies will need to act both preemptively and responsively to climatological impacts, tailor campaigns and programs to the communicative needs of their citizens and manage resilience, health concerns and resource-management, amongst many other challenges. Within all of these, communication is often the invisible linchpin to success or failure of efforts. With the increasing intensity of climate change disruptions globally and the current lack of climate change communication research in this area, we recommend a future shift toward studies that address a range of initiatives around adaptation.

To conclude, within climate change research, we see increasing attention to social scientific concepts as drivers and influencers on the effectiveness of both mitigation and adaptation strategies (Jorgenson et al, 2019). For instance, the production, consumption, lifestyles and social organizations that give rise to greenhouse gas emissions and subsequent climate change impacts are given meaning through cultural interpretations of science and risk (Douglas & Wildavsky, 1982; Shove, 2003; Hulme, 2008). Recent social scientific research reveals several trends, such as the risk climate change poses to local cultures, the failure of most contemporary responses to address cultural dimensions of climate risk and the ways in which climate change adaptation itself can put important elements of social life at risk (Adger et al, 2013). We encourage an examination of a breadth of topics and an open mind to interdisciplinary work as climate change research moves forward.

4.2 Ethnocentrism in Climate Change Communication Research

Although climate change necessarily impacts all parts of the globe, our meta-analysis revealed that most of the communication scholarship exploring this phenomenon disproportionately focuses on North America and Europe (Table 2). 101 of the articles were focused on North America and 92 of these, constituting over half of the total articles analyzed, focused on climate change in the United States. By contrast, only 6% of the articles studied Latin America and the Caribbean, which are regions that due to their geographical contexts are especially impacted by climate change (Giorgi, 2006). This is increasingly concerning given that research has shown that Latin Americans and sub-Saharan Africans are particularly worried about climate change, whereas Americans and Chinese people, whose countries have the

highest overall carbon dioxide emissions, are less so (Wike, 2016).

With the rising importance of climate change adaptation and an increased understanding of the importance of localized environments, the salience of what geographical regions are chosen for research increases. Additionally, another phenomenon underscores the context-specific nature of climate change; not all geographies are impacted equally by climatic disruptions caused by climate change. For instance, many regions that have contributed little to global greenhouse gas emissions, such as the Caribbean, are particularly vulnerable to impact due to their unique geographies (Giorgi, 2006; UNDP, 2010). Therefore, different nations and regions across the globe experience the impacts of climate change in very different intensities and manners. The impacts of climate change are rarely commensurate with the amount of greenhouse gases a country emits. For instance, the United States has emitted 15% of global CO₂ emissions from fossil-fuel burning and some industrial processes (Boden et al, 2017), yet represents far less than 1% of the entire global population (US Census Bureau, 2019).

This renders the choice of where researchers research an impactful decision, and necessitates a discussion of and reflection upon ethnocentrism. The concept of ethnocentrism has been loosely defined as the universal proclivity for people to perceive their own group as most important in the global sphere, to interpret other social practices from their personal group's perspective and to neglect persons who are culturally dissimilar (Booth 1979; Worchel and Cooper 1979). Researchers have applied this concept to the realm of scholarship to draw attention to the dominance of scholarship from the Global North, both in terms of the nationality of researchers and research settings, as well as in terms of the theories applied to other global contexts. Wang (2010) characterizes ethnocentrism as "a set of views and principles developed on the basis of the European experience yet aspiring and presented as universal...one of the primary factors leading to a serious imbalance in knowledge production"(p. 1). Causes for this have been attributed to the presence of the best-funded universities, the most important publishers, most-cited journals and prestigious conferences being located in the Global North (Sparks, 2018).

This clear disparity of the regions and countries of focus in the analyzed articles reflects a troubling dominance of scholarship originating from and focusing on the Global North. Given the disproportionate impact of climate change on countries in the Global South, this finding exemplifies a broader trend of ethnocentrism in social science research. This polarity in knowledge production may result not only from greater interest in the effects of climate change in researchers' immediate environment, but also from inequities in access to resources and funding. This finding carries implications for scholarship in the field. A limited regional focus impedes

communication researchers from gaining a comprehensive understanding of climate change and its effects in varying global contexts. The dearth of knowledge of climate change communication trends outside of Europe and North America also limits the existence of evidence for actionable climate change policy. Similarly, it creates restrictions on opportunities for data-driven communication initiatives to be developed and implemented in areas that are most impacted by climate change.

Concerns over ethnocentrism in social scientific research have existed since as early as the 1980s (Wiarda, 1981), yet the field continues to combat these tendencies some forty years later, demonstrating the tenacity of the challenge. Until recently, ethnocentrism at large has remained elusive to solve, with few empirical studies demonstrating techniques for reducing ethnocentrism (Keith, 2013). From a practical standpoint when assessing researchers' choice of geography from where to draw data, we surmise that some of the factors increasing ethnocentric tendencies take the form of pressure to publish and lack of funding. With convenient domestic samples in the form of students or local communities, researchers who experience pressure to publish rapidly in order to assure tenure and promotion may opt for local options rather than looking more broadly; even if that would be a better sample. Additionally, lack of funding can often prohibit international research as it is more costly. However, these can be solved. We could strive to seek innovative ways of rewarding more time-consuming international studies in tenure and promotion processes. In terms of funding costs, researchers can look for international partners with whom they can conduct research and create mutually beneficial multinational partnerships that decrease the need for costly travel.

4.3 Method Selection in Climate Change Communication Research

Discourse analysis, focus groups, semi- and unstructured interviews and participant observation are techniques primarily associated with qualitative research (Bryman, 2017). Quantitative research focuses more on structural concepts, utilizing methods such as experiments and surveys to consider the research question (Bryman, 2017; Griffin, Ledbetter, & Sparks, 2015). In the communication discipline to date, research encompasses both qualitative and quantitative research. Prior studies suggest that the field of environmental communication is fairly open regarding methodology (Comfort & Park, 2018). In their meta-analysis, Comfort & Park (2018) found that in studies of environmental communication, qualitative and quantitative works were nearly equally represented. When considering climate change research specifically, the frequencies at which each method was used in our sample reveal that climate change

communication privileges quantitative methods over qualitative. The data suggests that while focused on rhetoric, the majority incorporate quantitative techniques.

Several suggestions can be offered for researchers of climate change communication moving forward. First, employing mixed-methods, rather than focusing on a single methodology, could benefit the discipline by making articles more accessible to various disciplines and developing a well-rounded approach to the issue of climate change communication. While quantitative data is more easily measured and expanded into predictions, it also collects a more narrow dataset and is limited to numerical descriptions rather than detailed narrative. By adding qualitative considerations, communication research could offer a more in-depth understanding of how communication influences how people come to understand, act and manage climate change in a variety of settings.

We would also recommend an increase in the interview as a method for climate change research. To date, interviews reflect only 6% of chosen methods for climate change research. Climate change adaptation is not keeping pace with the ever-increasing need for it, creating an 'adaptation deficit' (Sieber et al, 2018) that is getting wider, thus making it critically important to identify and analyze adaptation barriers in order to identify opportunities to overcome them (Eisenack et al, 2014). Given our increasing understanding of the dependence of climate change adaptation on the nature of localized environments, the interview is an insightful method to gain clarity on the complex realities found within particular social systems. The interview was developed as a method intended to go to the "living source" and considered a more appropriate technique for revealing information about complex subjects or for proving the sentiments that may underlie an expressed opinion (Platt, 2012).

5. Limitations

Communication research on climate change is published in peer-reviewed journals that extend beyond the National Communication Association's compilation of journals. Additionally, climate change research can be found in books and book chapters. We are confident, however, that our findings can be considered largely representative of climate change research conducted within the discipline of communication and may be broadly applied. An additional limitation is that we focused only on English-language journals, representing our own ethnocentric tendencies. There is a vast repository of research in different languages, spanning German, French, Spanish, Mandarin, Hindi and beyond. It would make for a fascinating and enlightening study to understand global, multilingual trends in research and to compare topical selections and methodologies, and we strongly encourage research in this vein in the future.

6. Conclusion

This study is an empirical examination of climate change communication research using peer-reviewed journal articles as evidence wherein we examine topical, geographical and methodological trends. The majority of surveyed research to-date has focused on public knowledge of and public belief in climate change, has been conducted in the United States and Europe and has tended toward quantitative methodological approaches, although a diversity of approaches are represented. There is a dearth of research on adaptation to climate change as well as a significant underrepresentation of research conducted outside of the Global North.

To expand on the findings of the current study, scholars in the future can conduct systematic reviews of climate change studies in Europe and North America to explore the localities within these regions that the research is currently focused on. Scholars may also conduct systematic reviews of the existing research in underrepresented regions to investigate the nature of the paradigms being applied to these contexts, and whether or not they have a eurocentric bias. We urge institutions to provide greater support for research on climate change within underrepresented regions in order to stimulate knowledge production. We also urge scholars to seek more international collaborations with researchers from regions that are underrepresented in research, including the Caribbean, the African continent the Middle East and Latin America. We also encourage reflections on the appropriate methodologies for capturing the complexity of localized impacts of climate change on human behavior and society.

Lastly, climate change is already impacting societies around the globe and will increasingly do so over time. Even in the best case scenario in which we drastically reduce carbon emissions, the climate will continue to change for at least the next several hundred years due to the inertia of oceanic and atmospheric circulation systems (Pachauri et al., 2014). Climate change has evolved as a phenomenon and communication as a discipline is at a pivotal moment in which we can show our responsiveness to the changing nature of this life-altering, ongoing event. We encourage researchers to respond to the scientific recommendations for climate change responses (American Meteorological Society, 2019) and corresponding questions to guide communication research as illustrated in Table 1, primarily investigating how communication can contribute to policy that decreases greenhouse gas emissions and removes existing gases from the atmosphere, engaging the public in pro-environmental behavior, improving scientific innovation and understanding what societies need to adapt and how we can facilitate that adaptation. Climate change is a challenge with degrees of complexity, both scientific and social, that exceed the capacity of any one field or individual to understand and solve. Yet it requires all of our effort and we cannot spare it too much attention, concern and research.

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