PLAYING TELEPHONE: ON THE NEGOTIATION AND MEDIATION OF CLIMATE SCIENCE COMMUNICATION

by

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Dedicated to my family of choice (including those I am related to!).
I would not be here without your support, patience, openness, and love. You give me purpose, meaning, and strength, even when everything else is complicated and feels too heavy to bear for long.

Dedicated also to the community of passionate activists struggling to make this institution a better, more equitable, and more welcoming place. They say the best self-care for frustrated workers is organizing, and you've proven that beyond any doubt.

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ABSTRACT

In this thesis, I investigate the effects of social and political context on the process and outcomes of science communication in two different settings, using Dietram Scheufele's interpretation of science communication as political communication.

In the first setting, I examine the communication of climate tipping points at the United Nations Framework Convention on Climate Change (UNFCCC) using 26 semi-structured interviews and 271 surveys administered to members of the UNFCCC policy community. Survey results revealed that only a small minority (14.3%) of policymakers defined climate tipping points consistently with the scientific community. Interview responses revealed that many policymakers believed they were not responsible for incorporating new scientific advice into their work on negotiations, and that this was the responsibility of scientists. Scientists interviewed expressed frustration that policymakers were not willing to hear scientific information they saw as irrelevant to their work on the negotiations. Policymakers responding to interviews were also unwilling to defy social norms by introducing a topic they saw as "complicated" into negotiations. Interview respondents who believed climate tipping points should be discussed within formal negotiations also noted that they interpreted the effects of climate change as temporally or spatially immediate to themselves.

In the second setting, I examine how the United States print media incorporated discussion of climate change into coverage of the 2017 hurricane season via a content analysis of hurricane coverage in six major US newspapers. Conservative papers and liberal papers displayed significant differences in frequency and directness of references to climate change, as well as a significant difference in the references to climate denial messages, climate consensus messages, and use of proximity cues. However, the conservative paper near a 2017 hurricane consistently displayed significant differences in coverage from the other conservative papers. This paper frequently used social norms in messaging to shift narratives of acceptability of climate change discussion among conservatives. Both conservative and liberal papers near a 2017 hurricane used proximity cues to indicate the effects of climate change are both physically and temporally near at greater rates than elite and regional papers not near a 2017 hurricane.

Taken together, these results reveal that three major factors influenced climate change communication in these two settings. First, power to define direction and content of science

communication explains the lack of communication about climate tipping points at the UNFCCC. Policymakers' hold legitimate power over science communication. This power is codified within UNFCCC structure. Policymakers' expert power is also interpreted as more relevant to negotiations processes than scientists' expert power; meaning policymakers are free to define what information is "policy relevant" and therefore, what is communicated. Second, social norms influenced how and whether communication occurred. Social norms prohibiting behavior disruptive to consensus building influenced policymaker definitions of "policy relevant." Social norms among US conservatives prohibiting serious discussion of climate tipping points were also apparent. Finally, perceptions of climate change as immediate and nearby seemed related to willingness to defy social norms around climate change communication.

CHAPTER 1. INTRODUCTION

1.1 Telephone

When I was in grade school, I frequently played a game called "Telephone" with my classmates. In this game, a group of players would sit in a circle. One person would almost inaudibly whisper a message to the person seated next to them, then that person would whisper whatever phrase they believed they heard to the person sitting next to them, and so on. This continued until the message had been transmitted all the way around the circle. Then, the initial transmitter of the message compared the message they had sent to the message the final listener received. This was the source of great hilarity, as the message received by the last person was almost always wildly different from the message the initial speaker tried to communicate.

In "Telephone," several reasons existed for the failures of communication which made the game so entertaining. The overarching cause of communication failures was the fact that messages had to pass through many different communicators before reaching its final audience. Most players modulated the message incrementally for several reasons. Most frequently, players in the circle could not correctly hear messages because they were whispered inaudibly. Sometimes players became distracted by their surroundings and were not paying attention when the message was transmitted. In some instances, players heard messages correctly, but misinterpreted nonsensical sentences passed to them incorrectly. Often, players deliberately embellished or miscommunicated the messages they were passed to add interest to the game. Additionally, the rules of the game increased the likelihood that the message would be miscommunicated: Message transmitters were not allowed to speak messages loudly enough for others in close proximity to hear; and message recipients were not allowed to ask for clarification or for messages to be repeated. The presence of many players meant that messages passed through many stations before it was eventually received.

1.2 Paradigms of science communication

The practice of science communication has evolved.

In the first model, science communication was a one-way, top-down process in which experts communicated what they conceived of as facts to a public they assumed to be ignorant.

This "information deficit" model informed most science communications through the 1970s; and is still in wide use today (Trench 2008), despite research demonstrating its limited efficacy.

The information deficit model was partially replaced by the dialogue model of science communication, in which communicators strive to engage with their target audiences, to gain a sense of their interests and informational needs. In the dialogue model, the relationship between communicators and audiences is more democratic than top-down as the communicators strive to listen to and solicit information from their audiences. In this model of science communication, communication is a two-way process.

Dietram Scheufele (2014) conceived of a third model for science communication: science communication as political communication. In this model of science communication, communication occurs as a multidirectional process between many stakeholders. In Scheufele's conceptualization, the complex social- and power-dynamics of human relationships complicate the transmission of messages: that is to say, science communication cannot be separated from the social and political context in which it occurs.

It is Scheufele's model of science communication that best explains why "Telephone" works as it does. Let us name the initial transmitter of the message, "scientist," the players seated between the transmitter and recipient, "mediators," and the last recipient of the message, "audience." There are many obstacles that influence the transmission of messages between scientist and audience. Behavioral norms govern both scientist's and audience's behavior in relationship to one another, as well as to the mediators. These norms are formalized in the game's rules. Power dynamics between the players may determine the game's initial settings via the creation of additional "house rules," or popularity may determine who is allowed to be scientist in the first place. The audience and mediators can also influence what messages are initially transmitted, for example, asking that swear words not be part of the initial communication. Other external social norms indicate what messages are acceptable to transmit, and in which ways they are intentionally manipulated for the point of humor. In this way, the context in which Telephone is played has an influence on the process and outcomes of communication; much as sociopolitical context influences the process and outcomes of science communication.

1.3 Producing reality

Science is a systematic methodology through which knowledge about the nature of reality is pursued (Chalmers, 1999). Scientists are those who use the methodology to learn more about the nature of existence. The pursuit of knowledge depends heavily upon observation and measurement (Chalmers, 1999). Each new scientific finding builds upon others that came before it, creating a cohesive interpretation of experience that has been painstakingly and methodically codified, explicated, and justified (Downs, Fawcett 1986).

Two of the dominant lenses through which scientists interpret the practice of science are positivism and constructivism. Positivists assume that there is one objective reality which can be uncovered, while constructivists believe in numerous subjective realities—each shaped by the characteristics of the observer. Positivists strive to transcend subjectivity via the practice of the scientific method. In contrast, constructivists seek to account for the ways in which their own perspectives and characteristics shape the realities they uncover (Alvesson, Skoldberg 2017). Either way, both positivists and constructivists produce knowledge. Practitioners of science, whether they think about it consciously or not, are operating under an assumption that they are uncovering a truth that, through communication, can be shared with others (Asghar, 2013). The practice of science communication, not just the practice of science, has generative power. Our individual perceptions and interpretations of the world—our "fantasies"—are shaped by the mediators and communicators of information with whom we interact. In "Telephone," the messages received and passed on by each player differ, because each player's fantasy of the message communicated differ. For each player, the message they heard was functionally the only message communicated—their fantasy of a message was functionally their reality. The failure to communicate clearly due to game context resulted in divergences of fantasies. These fantasies are only restored when the first player publicly reveals the initial message to the group. As Nimmo and Combs (1990) explain, "for those who share them, fantasies are real, the fantasy is reality." So, through the communication of a message, scientists and science communicators create reality for the recipients of their messages. Communication failures create a divergent set of fantasies.

Mediators are the people and entities that intermediate between producers of knowledge and a broad public. Consuming content that is mediated—either through the media, through trusted others, through societal elites, et cetera—gives the public a way to gain information about the

world around them, beyond the limits of what they can experience themselves. As society has become increasingly globalized, individuals have become increasingly connected to and aware of events outside the realm of personal experience (Mannermaa, 2009). In this way, society has become more reliant on content mediators to create and transmit an interpretable presentation of reality (Ball-Rokeach, deFleur, 1976). Thus, the communication of science becomes necessarily political, as reality is filtered through and created via the ambient sociopolitical environment (Scheufele 2014).

Scientists are a highly trusted source of information in society; and as such, are under tremendous pressure to maintain a public presentation of neutrality and objectivity in their dealings with the public. Accusations of bias, conflicts of interest, and other issues of credibility reflect poorly on the entire scientific community. The suggestion of political motivation from the scientific community—in fact, hints of subjectivity—are often seen as threats to societal acceptance and trust of scientists and scientific expertise (Lackey 2007).

Mediators of content also aim to provide objective, neutral presentations of "truth." Among institutionally-recognized mediators of content, such as the news media, norms of accuracy and objectivity also safeguard communicators' trustworthiness. These norms, like the norm of scientists' abstinence from policy advocacy—exist in order to maintain societal relevance and expert power (French, Raven, 1959), the authority afforded by public trust (Lewis, Weigert, 1985). Like the scientific community, the news media suffers a loss in the power to create and shape shared reality when the public loses trust, cancels subscriptions, or turns off the program. Due to this precarious reliance on audience perceptions, scientists' and mediators' communication processes are shaped by the need to maintain public credibility and expert power. In this way, the social and political context shapes which messages are promoted, and how these messages are modulated as communication occurs.

Communication of science, whether performed by scientists, journalists, or other producers and mediators of knowledge, creates a set of shared fantasies—a common reality—that emerges from the complex, iterative interactions between these entities. All players in this real-world game of "Telephone" grapple with one another for the ability to filter, modulate, and alter the substance of what is communicated, in order to shape the common reality that is created.

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1.4 Motivations for research

In this thesis, I seek to provide insight into the ways in which sociopolitical context shapes the process and outcomes of climate science communication. In what ways is information about climate change shaped by the mediators and recipients of information? When climate science leaves the brains of scientists and the pages of academic journals, what actually happens to it—and what form does it occupy when it reaches and is interpreted by the target audience? I pursue this line of inquiry in order to create a platform from which the practical public and policy implications of the communication of climate science can be explored. This investigation is part of a broad umbrella of social science research produced with the cumulative goal of removing cognitive, social, structural, and political barriers to addressing the ongoing climate crisis. Achieving this end is quite literally a matter of life and death, as climate change poses an existential threat to life on earth; one that is growing more and more difficult to address as time passes. Without engaging in transformative societal and structural change that completely decarbonizes our way of life and bolsters us for the major geophysical and ecological changes that are already beginning, we have little hope of maintaining the Earth's habitability for humans and other species in the far future. Understanding the process and context in which climate change communication occurs is vital for scientists, science communicators, and decisionmakers wishing to communicate effectively. I am hopeful that effective communications will create the opportunity for sound decision-making that is based on an accurate understanding of science.

The first chapter is an investigation of the science-policy interface which exists at the United Nations Framework Convention on Climate Change (UNFCCC), between the Intergovernmental Panel on Climate Change (IPCC), and the policy community. In this setting, I examine the ways in which scientists' and policymakers' conceptions of climate tipping points—a complex topic in climate science—diverge. I use qualitative methods to explore how communications are negotiated, and how power dynamics between stakeholders interacts with science communication. The second chapter investigates the United States print media's coverage of the extreme 2017 hurricane season in relationship to communication of climate change. I use a mixed methods approach to explore the ways in which newspapers of different political orientations, levels of influence, and levels of physical proximity to the 2017 hurricanes discussed (or failed to discuss) climate change within the context of the 2017 hurricane season. In both

settings, I strive to paint a richer picture of how sociopolitical environments influence communications of climate science, and how information transmitted in those environments is shaped by political and social structures, norms, and other factors.

1.5 Research Aims

This research explores the following questions:

- How is the process of climate science communication shaped by the context in which it occurs?
- What social and political conditions influence the communication of climate science in settings where communications are negotiated?
- What contextual factors influence patterns of climate communications in settings where content is mediated?

I use qualitative techniques (open-ended survey questions and interviews) to explore policymaker interpretations of climate tipping points and create a detailed understanding of the science-policy edge in a global governance context. A mixed methods content analysis gives a broad picture of climate change coverage in the context of the 2017 North Atlantic hurricane season.

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CHAPTER 2. NEGOTIATED COMMUNICATION

2.1 Introduction

"Effective science communications inform people about the benefits, risks, and other costs of their decisions…. allowing them to make sound choices." (Fishoff, 2013). The stakes of making sound decisions around the issue of climate change are especially high, where the quality and existence of human society and natural systems are already at risk. However, communication of climate science, and climate-change-related risk is exceptionally difficult, due to the technical nature of the problem, nonlinear effects (Sterman 2011) and high levels of uncertainty about possible effects, their extent, and their timelines (Budescu et al 2009). Furthermore, the global nature of the problem is necessarily reflected by the complicated transdisciplinary approach to its study and governance, which transcends the bounds of normal interdisciplinary and multi-stakeholder interactions.

Climate tipping points are thresholds in earth, climate, and ecological systems at which a small amount of additional forcing will cause a large-scale, self-driving change from one stable state to another (Lenton 2008). Triggering changes that occur beyond climate tipping points would have serious and irreversible consequences (Lenton et al 2008), including intensifying the greenhouse effect and accelerating warming. Several climate tipping points exist at or below levels of global average temperature increase projected to occur before 2100 (IPCC 2018). In fact, some changes associated with passing climate tipping points may have already begun. These include the transition of coral reef ecosystems to colonies of fleshy algae, and the loss of Arctic summer sea ice (Risk 1999; Bathiany et al. 2016; Onarheim, Arthum 2017; Lenton et al. 2019).

Climate tipping points represent one possible framework for understanding and managing climate change-related risk. The publication of articles on climate tipping points in major physical science journals including *Nature, Nature Climate Change,* and *Proceedings of the National Academy of Science* indicate that climate tipping points have been a topic of conversation in the physical science community for over a decade. Lenton et al. (2019) comments that the IPCC's first mention of climate tipping points—then called 'large scale discontinuities'—occurred nearly . However, climate tipping points are a contentious topic of communication. Proponents of the climate tipping point framework believe that communicating the possibility of these large-scale

discontinuities at sensitive points is necessary to generate urgency around the need for an immediate response to climate change (Molina et al 2018). Detractors believe the climate tipping point framework is alarmist and can lead to fatalistic responses in communication recipients (Russill and Nyssa, 2009; Bellamy and Hulme 2011), that climate tipping points could be used to justify risky and untested mitigation technologies (Heyward and Rayner 2013), or that climate tipping point framework inappropriately simplifies socio-environmental dynamics (Nuttall 2012).

As of yet, it is unclear whether climate tipping points are a topic of discussion or concern for policy audiences and decisionmakers, despite their presence in the academic literature. The Intergovernmental Panel on Climate Change (IPCC), a scientific body adjacent to the United Nations Framework Convention on Climate Change (UNFCCC) is responsible for providing the policymaking body with comprehensive reports on the current state of credible climate science. However, before the IPCC's Special Report on 1.5C (released in October, 2018), little mention of climate tipping points was made. Participation in the United Nations Framework Convention on Climate Change (UNFCCC) negotiations is the process by which the global governance community collectively seeks to manage risk related to climate change by limiting global average temperature increase. The landmark 2015 Paris Agreement lists two temperature targets: "1.5C" and "well below 2C." These goals are intended to maintain a "safe operating space for humanity." However, no additional provisions of the agreement make reference to minimizing the likelihood of passing climate tipping points, even though the consequences of resulting changes pose a major threat to society. Therefore, although minimizing the risk of passing climate tipping points is important to manage warming and climate risk, they have not been formally acknowledged by the UNFCCC policy community.

Failure to acknowledge or address the threat of climate tipping points indicates that a communication gap between scientists and UNFCCC policymakers may exist. We use an exploratory mixed-methods approach to investigate the presence and role of climate tipping point discourse (or lack thereof) in the UNFCCC policy community between 2017 and 2019. We focus on the following research questions:

1. To what extent are climate tipping points a topic of discussion among members of the UNFCCC policy community? Do UNFCCC policymakers conceptualize climate tipping points in a way that is consistent with how climate tipping points are conceptualized in the physical science literature?

2. What factors influence UNFCCC policymakers' engagement with the idea of climate tipping points?
3. How do organizational and power structures at the UNFCCC influence the process and outcomes of science communication between the IPCC and the policy community?

2.2 Literature Review

2.2.1 Explicit and Legitimate Power

French and Raven (1959) conceptualize power as a relationship dynamic in which one person has the ability to exert influence on another person, provoking a change in that person. In this interpretation, power is both relational and relative: it depends on the terms of the relationship recognized by both parties in the relationship. French and Raven (1959) identify five distinct types of social power based on the origins of the conditions that give one party in a relationship the ability to influence the other. For the purpose of this research, two of those types of power will be discussed. Legitimate, or positional power, is granted to one actor over another by laws or policy. Expert power is the ability to influence others that stems from specialized knowledge, training or experience (French, Raven 1959).

In the relationship between scientists and policymakers, both scientists and policymakers hold power: scientists hold expert power due to their specialized knowledge of science related to climate change. Policymakers at the UNFCCC hold expert power as well: they have highly specialized knowledge of international negotiations, policy, and law. Policymakers at the UNFCCC also hold a measure of legitimate power that scientists at the IPCC lack. This is due to the fact that negotiations between policymakers produce the rules that govern the IPCC. These rules specifically define the IPCC as an organization adjacent to the UNFCCC policy community meant to give advice that is "policy relevant but not policy prescriptive." There is no reciprocal measure of legitimate power held by the IPCC, as the IPCC cannot do more to influence policymakers than offer advice which policymakers do not have to accept.

2.2.2 Power in science-policy communications

"Knowledge on tap" and "truth to power" are two common dynamics in the relationship between scientists and policymakers in communication with one another. "Knowledge on tap"

refers to a dynamic in which policymakers have nearly complete control over the knowledge that is communicated to them. Policymakers in this situation understand that scientists have some measure of expert power, which is one reason why scientific advice is solicited in the first place. However, policymakers often hold legitimate power that allows them to dictate the terms under which communication with scientists occurs.

One good example of a situation in which a "knowledge on tap" dynamic exists is the relationship between legal professionals and expert witnesses. (Jasanoff 1995, Jasanoff 1998; Lynch 1998; Ward 1997). In the courtroom, lawyers have the power to order expert witnesses to testify. The lawyers, due to the procedural rules that govern how trials are conducted, are allowed to determine exactly what information an expert witness conveys by asking only very specific questions. Lawyers choose what questions to ask based on their interpretations of what information will help them achieve the best outcome for their client, and can choose to keep experts from presenting facts that might be unhelpful or irrelevant. This arrangement is ideal for the lawyer and the client; less ideal for the expert, who might feel that the knowledge they were able to communicate did not provide an adequate representation of reality.

While knowledge on tap dynamics are undoubtedly useful for the actors able to solicit knowledge from scientists, Haas (2004) and Flyvbjerg and Richardson (2002) warn that when policymakers have the sole ability to define "usable knowledge," the ability of scientists to communicate the whole truth is severely limited. Flyvberg (1998) also notes that knowledge solicited by decisionmakers for the purpose of decision-making "blurs the relationship between rationality and rationalization," because the knowledge provided is explicitly and implicitly shaped by the decisionmakers' ability to define their own informational needs. However, it is unclear whether policymakers recognize the ways in which their own power influences the advice they solicit (and therefore receive).(Flyvbjerg 1998).

For this reason, "truth to power" communications can also be valuable to decision-making processes. In contrast, to knowledge on tap dynamics, truth to power dynamics exist when scientists strive to exercise their expert power in their relationship with policymakers during communication. In this type of situation, scientists try to communicate information because they find it important or relevant, rather than because policymakers have requested it. While the truth to power model has some disadvantages, often related to failures to take stakeholder needs and priorities into account it also provides an alternative to a knowledge on tap situation.

2.2.3 Negotiated communications at the UNFCCC

The IPCC exists as a "boundary organization," meaning that it straddles "the shifting divide between policy and science" present at the UNFCCC (Guston, 2001). In order to anticipate the informational needs of the policy community, the IPCC is expected to engage productively with the political sphere of the UNFCCC. However, it must also stay aloof from those politically motivated actors to avoid being influenced by their informational needs (Forsyth 2003). These conditions are directly in conflict with one another, but express two different facets of the policymakers' control of information that is "usable" and "policy relevant."

The IPCC's communications achieve an acceptable level of engagement and freedom from perceived political bias via a process in which openly political actors (each of the Parties to the UNFCCC) engage in formal negotiations on certain aspects of science communication process (Grundmann 2007). For example, the IPCC's primary task in its relationship with the UNFCCC policy community is to produce regular, comprehensive reports meant to convey the full spectrum of credible scientific knowledge on climate science. This process is regulated by external and internal peer review, and results in a lengthy report (usually several hundred pages long) published once every five years. After several rounds of peer review, the draft report is submitted to the Parties and revised, based on the comments and suggestions offered by reviewers (Agrawala 1997).

The second draft is taken to a four-day plenary session in which teams of delegates from each of the Parties collaborate to determine the contents of the Summary for Policymakers, which is a condensed document (usually 20-30 pages) designed to increase the accessibility of the report to delegates directly engaged in negotiations. The Summary for Policymakers is explicitly negotiated to avoid the perception that some Parties unduly influenced its contents (Forsyth, 2003). This, of course, contrasts directly with the system of peer review usually employed by scientists, in that it creates a communication via negotiation: "useful," "relevant," and "appropriate" content is defined as the content which is most mutually agreeable to the numerous political stakeholders at hand.

2.2.4 A history of climate tipping point communication

Tipping points as a concept are not a recent invention: the concept of an abrupt state change resulting from a small additional amount of forcing at a critical point comes from bifurcation

theory, which first emerged in mathematics and chemistry in the 1880s. As a specific term, tipping points were first referred to in the sociology literature in the late 1950s, with Grodzin's use of the phrase "tip point" to describe abrupt shifts in the ethnic makeup of neighborhoods. Use of "tipping points" to describe points at which rapid social transitions occur was repopularized in the 21st century with Canadian journalist Malcolm Gladwell's 2000 book, *The Tipping Point: How Little Things Can Make a Big Difference*, applying the idea of social bifurcation to the marketing of new ideas (Gladwell, 2000). Milkoreit et al (2018) finds that "tipping point" language experienced a resurgence after 2008 in all scientific spheres.

However, the first usage of tipping points in reference to abrupt shifts in geophysical systems did not emerge until 2005. The first application of the tipping point phrase to climate change is often credited to James Hansen, who used it in an address to the American Geophysical Union at its annual conference in 2005. In 2008, Lenton et al used an expert elicitation process to further specify what phenomena scientists associated with the phrase "climate tipping points," identifying a number of possible ecological and geophysical systems prone to abrupt state changes with both regional and global effects. Milkoreit et al (2018) identifies four common characteristics of tipping points; all of which are applicable to climate tipping points as Lenton et al (2008) conceives of them: multiple stable states, abruptness, feedbacks, and limited reversibility. Milkoreit et al (2018) goes on to define tipping points in general as "the point or threshold at which small quantitative changes in the system trigger a non-linear change process that is driven by system-internal feedback mechanisms and inevitably leads to a qualitatively different state of the system, which is often irreversible."

Since 2008, a number of alternative frameworks expressing the possibility of geophysical and ecological climate-related bifurcations have also emerged: Rockström et al (2009) expresses the idea of planetary boundaries as nine specifically-quantified levels of forcing in different systems that, when transgressed, would likely cause "major human-induced change on a global level." Unlike the climate tipping points framework, the planetary boundaries framework also addresses changes related to human activities other than greenhouse gas emissions (Rockström et al 2009). Leach et al (2013) also proposes social boundaries as a complementary framework to planetary boundaries, in which social and physical effects are linked. Leach et al (2013) suggests that transgressing social boundaries may lead to an "unjust pathway for human rights." It is possible that the existence of these alternative frameworks, (which incorporate both social and physical

concerns not necessarily related to greenhouse gas emissions), may create confusion about climate tipping points (which are recognized as solely geophysical or ecological phenomena).
In the context of the UNFCCC, mention of climate tipping points prior to 2018 are sporadic and inconsistent. When climate tipping points are mentioned, they are mentioned in reference to degrees of global average temperature increase. Additionally, the phrase "climate tipping points" does not occur as a heading for the concept of nonlinear discontinuities: instead, references to the consequences of transgressing climate tipping points are listed as 'instabilities," (Vellinga and Swart, 1991) and "large scale discontinuities," (o'Neill et al 2017).

2.3 Methods

2.3.1 Interviews

Twenty-six hour-long semi-structured interviews with scientists and representatives from various national negotiation delegations (including both negotiators and representatives from NGOs and the private sector working within delegations) were conducted. Four of the twenty-six interviews were joint interviews with two interview respondents. Four trained survey administrators (including the investigation's principle investigator, two collaborators, and a graduate research assistant) conducted interviews in person and via Skype, beginning in May 2017 and concluding in December 2017. Interviewees were selected purposively, through previous professional connections, through interactions with intercept survey respondents, and via email invitations to those listed in the published list of registered attendees at COP22. The interviews encompassed topics ranging from preferred global temperature goal, role in the negotiations, tipping point knowledge, and personal perception of tipping point-related risk (See Appendix A for interview guide). Responses from interviews were transcribed and used to provide qualitative data for analysis.

2.3.2 Surveys

A survey of four multiple choice questions and four open-ended questions was developed from the results of the initial interviews performed in the spring and summer of 2017. These surveys included items measuring opinions, beliefs, and knowledge about temperature targets, goalsetting, and climate tipping points. Surveys responses were collected in Bonn, Germany at COP23 (11/2-

11/12/2017; n=126), and the following subsidiary session SB48 (4/30-5/6/2018, n=74); and during the COP24 negotiation sessions in Katowice, Poland (12/3-12/9/2018, n=71). Surveys were conducted in order to gain a sense of the average level of awareness and knowledge the UNFCCC policy community had about climate tipping points. One multiple choice question and three open-ended questions were analyzed for the purpose of this study. See Appendix A.

Negotiators and other diplomatic delegates were targeted for this survey via a nonprobability sampling method. Conference attendees who were attending the conference as part of a diplomatic party had pink conference nametags, so these nametags were used to identify potential survey attendees. However, this system meant that some attendees who were not policymakers (such as NGO participants, scientists, and members of the private sector) but were attending the conference via professional or organizational connections with a delegation were also included in the sample.

Researchers conducting the survey approached as many respondents as possible in common waiting areas, such as the cafeteria, the atrium, hallways, coffee shops within the conference grounds, and UNFCCC-provided shuttles between the two sites of the conference. When individuals approached were in a group, survey administrators approached group members not actively engaged in the group's conversation. Starting from the initial person approached, administrators asked each person in the group if they would be willing to take the survey, until a group member accepted. Often, those who declined to respond cited a language barrier, as the survey was only conducted in English.

2.3.3 Data Organization and Classification

Survey responses from those who self-identified as policymakers (members of national delegations) were also categorized into negotiation alliances in order to examine the relationship between political priorities at the negotiations and tipping point knowledge.

Negotiation alliances are loosely organized blocs that share negotiating priorities, into which Parties to the UNFCCC arrange themselves. Alliances often share a common geographical region (eg. the Arab Group; or the Alliance of Small Island States (AOSIS)), common interests and priorities (eg. the Umbrella Group or the Environmental Integrity Group (EIG)), a common level of development (eg. the Least Developed Countries (LDC)) or pre-existing political or legal alliances (eg. the European Union (EU)). These blocs are not mutually exclusive: membership in multiple alliances is very common.

To avoid complications in analysis arising from national membership in multiple alliances, a hierarchy for alliance membership was developed. Using alliances as alternate units of analysis makes sense because formal political groupings indicate a high level of consistency between actors along the lines of negotiation goals and issue priorities. For this reason, in this scheme, alliances between economically similar nations and between nations with strongly-unified issue platforms were given priority over alliances grouped primarily by geographic similarity, and broader alliances. For example, membership in the Least Developed Countries (LDC) group was prioritized over membership in the African Group, meaning Mozambique would be categorized as an LDC country instead of an African Group country, though in actuality, Mozambique is a member in both groups. This is because Mozambique's desired outcomes in the negotiations are more similar to other non-African LDCs than to, for example, South Africa. Likewise, membership in BASIC (large developing countries with rapidly growing economies Brazil, South Africa, India, and China) was prioritized over membership in regional alliances and LMDC (group of Like-Minded Developing Countries); membership in AOSIS (Alliance of Small Island States) was prioritized over membership in G77 (Group of 77) or LDC (Least Developed Countries).

Responses from non-delegate attendees were not sorted into alliances; instead, they were classified by role. This is because alliance priorities only influence policymakers' priorities, not necessarily the priorities of other actors. Respondents in non-policymaker roles included several other categories: Scientist/researcher; NGO (nongovernmental organization) representative; IGO (intergovernmental organization) representative; UNFCCC Secretariat member; and private sector representative. We also found it important to track non-policymaker responses in order to track whether stakeholders with different roles and priorities understood climate tipping points differently.

2.3.4 Coding Framework

2.3.4.1 Conceptualization of tipping points

Survey data were coded for themes and correctness of response using NVivo. The codebook was developed using a discourse analysis approach. Two questions intending to measure the level of knowledge respondents had about climate tipping points were analyzed: "Please define climate tipping points," and "Please give one or two examples of climate tipping points." Thirty percent

of the survey data were selected at random for the purpose of generating intercoder reliability scores. Two coders used the above framework to code that 30% subsample, then resolved coding discrepancies where possible. Recoding generated a Cohen's kappa of 0.98, indicating an extremely high level of intercoder reliability.

Due to the fact that no formal, all-encompassing definition of "tipping points" exists in the literature, a framework for determining the "correctness" of a given response to the question "Please define climate tipping points" was developed, based on Lenton et al's "policy relevant" definition (Lenton et al 2008), which was generated from an expert elicitation process; and on (Milkoreit et al 2018)'s meta-analysis of usages and characteristics of the phrase "tipping points" across academic disciplines. The four characteristics of tipping points identified as most central to academic usages of "tipping points" by (Milkoreit et al 2018) were 1) multiple states, 2) abruptness, 3) feedback loops, and 4) limited reversibility. These characteristics were adopted into the coding framework due to the fact that these four characteristics are revealed as being the characteristics of tipping points around which there is the strongest academic consensus and the most frequent common usages. Lenton et al 2008 informed the framework of features specific to *climate* tipping points described below and in Table 2.1)

Table 2.1 depicts the codebook developed for analysis of survey responses. Codes are listed in the leftmost column; definitions for each code are listed in the center column; and a citation for each definition is listed in the rightmost column

Characteristic	**Definition**	**Citation**
Abruptness	Nonlinearity: outsized responses to small stimuli, temporal quickness or lags	Milkoreit et al 2018, Lenton et al 2008
Feedback loops	Self-perpetuating changes and effects; self-driving; feedbacks; spirals; snowballs	Milkoreit et al 2018; Lenton et al 2008
Multiple stable states	A shift from the current function of a system to something new and persistent	Milkoreit et al 2018
Irreversibility	Limited reversibility on human timescales	Milkoreit et al 2018, Lenton et al 2008

The first characteristic under the proposed framework is the idea of "multiple states." This code, documented by Milkoreit et al 2018 as one of four most-common characteristics of a "tipping point," includes Lenton's idea of bifurcations; and the existence of multiple stable states of a given system. Examples of items coded with "multiple states" included "thresholds; new normal; or large-scale shift," as well as longer phrases clarifying the idea of a state change.

"Abruptness" refers to Milkoreit et al's category marking outsized responses to small stimuli, as well as the Lenton characteristic of nonlinearity- small noise at a critical point leading to large shifts. The "abruptness" code also encompasses the idea of hysteresis (time lags and temporal nonlinearity), noted as a secondary characteristic of tipping points in Milkoreit et al, and a characteristic of climate tipping points noted in Lenton et al 2008. Phrases which received an "abruptness" marking were also sub-coded into "hysteresis" and "disproportionate output," to add an additional level of granularity to the analysis. However, since both themes fall under the umbrella of "abruptness" as it is defined in the framework and are additionally supported by metadefinitions and the working policy-relevant scientific definition, both are counted as elements of a "correct" response

"Positive feedback loops" accounts for Milkoreit's and Lenton's inclusion of the idea of self-driven or internally dictated nature of large-scale transitions. Examples of items coded as "positive feedbacks" were phrases such as "spirals," "feedback loops," as well as the example of "accelerated warming."

"Limited reversibility" is the final characteristic included in the correct-response framework. Lenton does note that it may be possible that some transitions to new regimes can be reversed over a very long timescale, "limited reversibility" and "irreversibility," are treated as interchangeable terms, due to the fact that long timescales necessary to reverse state changes would by far exceed human lifespans and horizons considered "policy relevant." See able 1.1

2.3.4.2 Thresholds for "correctness"

Responses to the question "Please define climate tipping points" were first divided into two categories: physical or social. If answers referenced group, social, political, or individual activity around climate change, answers were deemed "social." Social responses included all references to *social* landmarks or conditions, such as those that referenced landmarks moments in international cooperation, adaptation, or human behavior. These responses included "the Paris

Agreement," "reaching an emissions peak," and all responses related to collective action. If answers referenced climate systems, ecology, or warming, responses were coded as "physical," and were further analyzed to determine whether the response was consistent with definitions of climate tipping points in seminal works of that field, including Lenton et al 2008 and Lenton et al 2011.

A response alluding to two or more of the four characteristics identified above, without the inclusion of any other scientifically inaccurate information was coded "correct." (see Table 2.2) A response that was counted as "partially correct" included either insufficient information to determine whether a tipping point definition aligning with Milkoreit and Lenton was given (such as the word "thresholds," without any further clarification); or sufficient information to determine correctness but the additional inclusion of inaccurate information about tipping points (such as incorrect examples of tipping points or otherwise inaccurate information). An "incorrect" response included either no characteristics of climate tipping points identified in the Milkoreit/Lenton framework, or if one of two additional themes was mentioned: first, referencing a temperature goal or passing a certain degree of warming (such as "anything beyond the 2°C benchmark") and second, listing effects of climate change that cannot be identified as specific to climate tipping points (such as "sea level rise," or "changing weather patterns"). "Don't know" responses and nonresponses were coded separately from "incorrect" responses, accounting for the fact that some respondents remarked that they chose to skip questions due to limited time, a lack of interest, or fatigue ("I am too tired to think this hard."). If participants verbally stated "I don't know" to the survey technician, they were encouraged to either make their best guess, or to write "I don't know" in order to minimize nonresponses. For this reason, nonresponses cannot be counted as "don't know."

2.3.4.3 Analysis of tipping point examples

The second question, "Please list one or two examples of a climate tipping point," was coded according to list of hypothesized tipping points in Lenton et al 2008 and Lenton et al 2011; along with the additionally theorized tipping points in the appendices of those papers. Those that appear in the survey dataset include melting of the permafrost, release of seabed methane, changes to the Atlantic Meridotonal Overturning Current (AMOC), melting and collapse of ice sheets such as Greenland land ice and the West Antarctic sea ice; coral reef dieback; loss of

arctic summer sea ice; changes to El Nino Southern Oscillation (ENSO); destabilization of the Indian summer monsoon, and loss of alpine glaciers. Any response that referenced these theorized tipping points by name (such as "melting Arctic sea ice") or by effects specific to a certain tipping point (such as "changes to albedo due to melting Arctic ice") was counted as a correct response. Responses that list the general (not tipping-point related) effects of climate change (or effects of tipping points that could not be separated from general climate effects, where additional references to tipping points were not made) were coded as "general effects."

Table 2.2 Depicts the codebook used for analysis of survey responses' consistency with scientific definitions of climate tipping points. The leftmost column lists parent codes; the middle column lists child codes, and the rightmost column provides a description of inclusion criteria used during coding

Code	Subcode	Description
Correct		Two or more characteristics listed, no incorrect information
Partially correct		One or more characteristics listed, some incorrect information
Incorrect		Zero characteristics listed, incorrect information
	Physical Definition	Defines tipping points in terms of physical effects, such as carbon emissions, sea level rise, or other geophysical conditions
	Social Definition	Defines tipping points in terms of social conditions or interactions
Don't know		Response stating "I don't know."
Nonresponse		No response given

2.3.4.4 Analysis of tipping point examples

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2.4 Results

2.4.1 Climate tipping points as a topic of discussion

When interviewees were asked whether or not climate tipping points were a topic of discussion within the negotiations community, it became clear that some types of actors in the negotiations community did discuss climate tipping points, while others did not. A dominant theme that emerged from the data was that climate tipping points are not a topic of discussion in general, either within their delegations or within formal policy negotiation streams. These respondents frequently gave outright "no" responses. One interviewee who was a delegate mentioned that the interview was their first exposure to the topic. Two interviewees also noted that although climate tipping points are not currently topics of negotiation, they may become more central in the future. One respondent commented,

> "No, it's not a topic [of discussion among negotiators] because…even in the IPCC, it's only that it's coming very strongly in the next cycle [the 2018 Special Report on 1.5]. Yeah, the IPCC certainly is going to talk about that."

Another policymaker from a Pacific Island nation responded that climate tipping points are not yet a topic of discussion, although they should be:

> "Apparently it's not yet. Because it is quite new in the discussions. And I believe it should be highlighted more because it has really-- to me, I believe it has an impact. It has really significant bearing in the future in the negotiations."

Some respondents (n=4) indicated that climate tipping points were already a topic of conversation among the UNFCCC scientific community, especially in conversations concerning the IPCC's 2013 Fifth Assessment Report (AR5)

> "It has definitely been [a topic of discussion at the IPCC] before…especially when the IPCC Fifth Assessment report came out."

> "Yeah, it would have been some stuff that has been at several IPCC events...I would be very surprised if it at least hadn't been mentioned [in negotiations], because it would also be a quite standard question to ask [how much we know about climate tipping points] when the AR5 came out."

The AR5 specifically listed climate tipping points under its "Reasons for Concern" section, though it did not consistently use the term "climate tipping points."

Other respondents indicated that climate tipping points were a topic of conversation only among negotiators from small island states. One respondent noted that tipping points were included in conversation because of the consequences passing a coral reef tipping point might have on island life:

> "Among the Pacific Island negotiators, this [climate tipping points] is a really important point because the ocean for the Pacific Islands, they are all large ocean states…dependent on what we call the blue carbon area, which is the mangroves, the coral reefs."

Another respondent stated that this conversation occurred in reference to differentiating between the two temperature goals outlined in the Paris Agreement:

> "Well, it's [climate tipping points are] definitely part of the loss and damages discussions and also has been one of the key points of interest for the islands in the IPCC work, especially now with the 1.5 report where we wanted to see an investigation into whether 2 or 1.5 would safeguard certain tipping points."

In conclusion, while the UNFCCC scientific community is already engaging in extensive discussion on tipping points, negotiators and other members of the policy community are not. This is mainly due to unwillingness to challenge or further complicate existing agreements and

governance structures. The exception to this are members of AOSIS, due to the fact that avoiding certain tipping points (specifically the coral reef tipping point) likely to occur under the stated temperature targets of the Paris Agreement is crucial to maintaining their way of life.

To determine whether interviewees believed climate tipping points were not a topic of conversation among negotiators because of ignorance, or because of a belief that climate tipping points *should not* be addressed in these conversations, interviewers asked interviewees whether climate tipping points should have a specific governance response.

Two delegates, one who self-identified as a scientist, and one from a Pacific Island state, believed that climate tipping points deserved a governance response. Other interviewees believed that introducing tipping point governance to negotiations conversations would violate descriptive and prescriptive norms in the policy community around maintaining existing agreements and consensus. One interviewee, a diplomat, stated,

> "Our conversation now…is centered around the long-term goal of the Paris Agreement. I don't think we're there yet to actually start talking about tipping points."

Since other policy members were not talking about climate tipping points, it would not be appropriate to bring tipping points into the conversation. Another mentioned that although they personally believed there to be value in adding tipping point governance to the discussion, maintaining agreements was of greater importance:

> "If we are talking of climate change and we're talking of the convention and agreement, then we should not go beyond that. And I would say that personally…I see a lot of logic for this [creating a governance response to climate tipping points], but then we can't go beyond what is on the paper."

Those who were opposed to the inclusion of climate tipping points in negotiations discussions argued that tipping points should not be given a specific governance response, citing the belief that involving the concept of tipping points in the negotiations would disrupt the process of consensus-building, becoming *"a massive bone of contention which could snarl up the process,"* or would add unnecessary and confusing complexity to the conversation:

> "It's an extra sort of layer of complication. It's, in a sense, further down the cause-effect chain…it's becoming, in a sense, more abstract…I think it's quite important to keep things quite concrete."

Another respondent added:

> "From the perspective of non expert negotiators, it's preferably most effective to continue negotiating under the existing trademark."

2.4.2 Similarity of climate tipping point conceptualization

When asked to define climate tipping points, only 4.41% of survey respondents were able to give detailed responses consistent with climate tipping point definitions in the scientific literature (see Methods for an explanation of our operationalization of determining "correct," "partially correct," etc. responses). Almost 10% (9.9%) were able to give a definition that was somewhat correct; while 28.31% gave definitions that were completely inconsistent with scientific literature. An additional 16.4% gave "don't know" responses; while 40.8% of respondents did not respond to the question. Cumulatively, 85.66% of respondents did not define climate tipping points in a way that was consistent with scientific literature; while 14.4% of those surveyed were able to. This suggests that the majority of survey respondents did not conceptualize climate tipping points in the same way as the scientific community (see Figure 2.1).

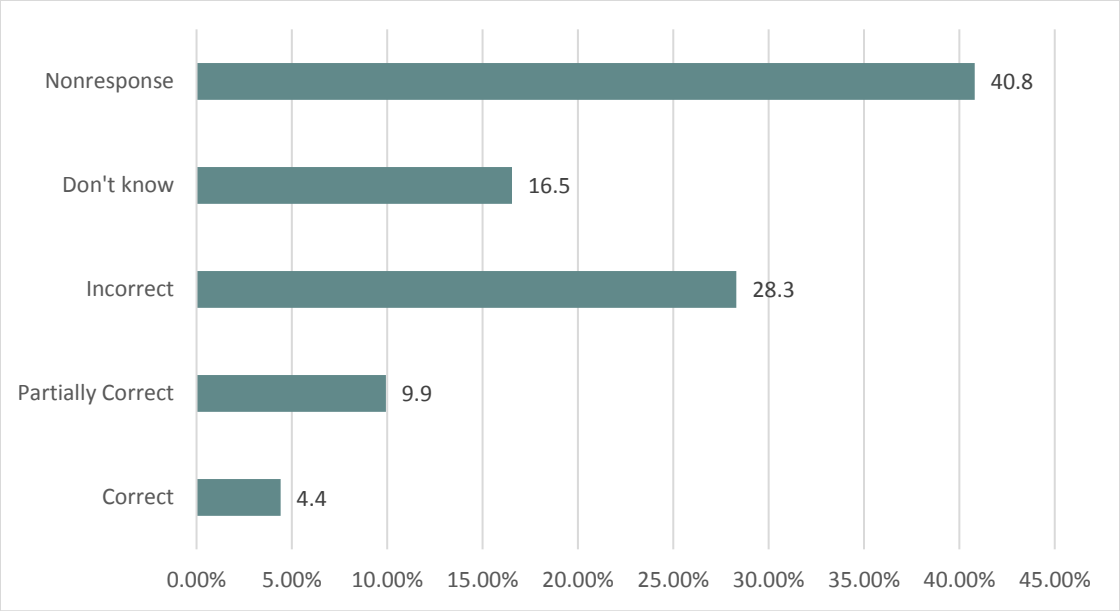

Figure 2.1 Depicts the percentage of survey responses falling into each coding category of consistency with scientific definitions of climate tipping points cited in the literature. Each percentage represents a proportion of the total 271 survey responses collected.

Among those respondents who did give definitions of tipping points consistent with the scientific community's conceptualization, not all remarked on the same characteristics of climate tipping points. Respondents who gave correct partial or detailed definitions of climate tipping points used several characteristics as descriptors: abruptness; feedback loops and cascading processes; the existence and transition between multiple different, stable states; and limited reversibility on human timescales. The idea of limited reversibility was revisited most frequently by respondents (n=52) and described in language such as "*no return," "irreversible," or "can't go back to previous states."* The next most frequently referenced characteristics were multiple stable states (n=23), described by respondents as a *"change in status/stage from one stable state to another,"* or a shift to a *"new normal*."

Some respondents (n=2) also analogized passing a climate tipping point to *"falling over a cliff*," where the top of the cliff and the bottom are two different stable states. Some respondents (n=16) also referred to climate tipping points as *"thresholds*." Feedback loops were the next most commonly referenced characteristic (n=16); and were described as "*positive feedbacks," "reinforcing," "self-perpetuating," and "snowballing.*" Comments on the timescale and abruptness of changes related to climate tipping points were the least-frequently identified (n=12), and were most commonly described as "*abrupt" or "rapid*."

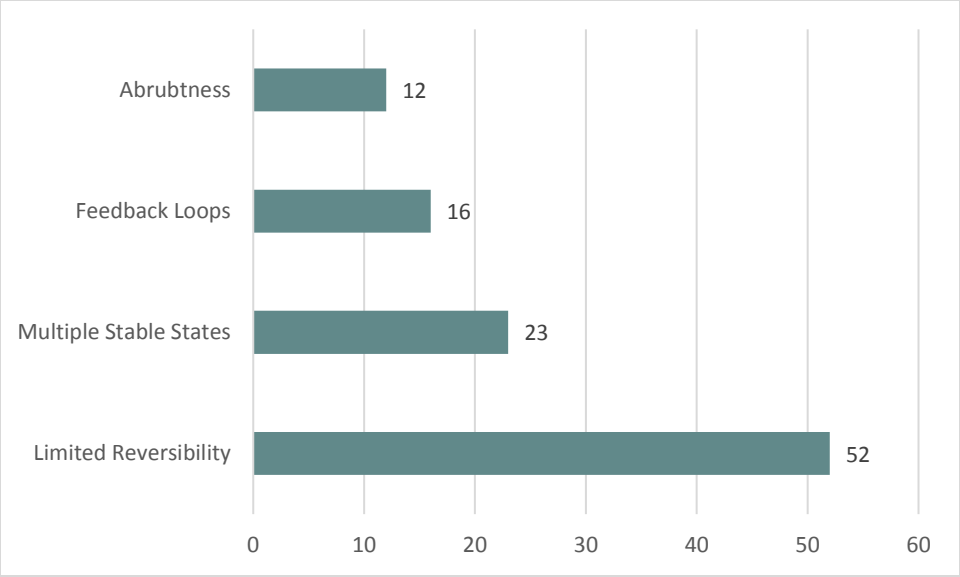

Figure 2.2 Depicts the number of survey responses that referenced specific characteristics of climate tipping points.

No survey respondents identified hysteresis, or time lags between the time at which a climate tipping point is passed, and the time the effects are felt. One respondent used the word "nonlinearity" to describe the temporal dynamics of climate tipping points. Only one interviewee (not included in totals presented above), a scientist, identified hysteresis, stating, *"In the climate community, tipping points can happen over 10,000 years."*

The fact that limited reversibility is predominantly identified, while hysteresis and lags were not is consistent with the perception that one interview respondent (a scientist) had of the way tipping points are frequently thought of in the policy community:

> "There's a communication gap. I'm sure there's people that work on it who will have a good understanding...But if I just look at the general discourse-- when tipping point is mentioned, it's usually mentioned in a catastrophic sense, sort of an apocalypse sort of disaster-type thing which is probably not the way that tipping points would happen in reality.

In support for that statement, the phrase, "point of no return," appeared in 8.4% of survey responses (n=23), and one survey respondent from the policy community even noted a sense of dread around the phrase "climate tipping points:"

> "In [my country], we are afraid to talk or even think about this word."

While only 14.4% (n=40) of survey respondents gave definitions consistent with scientific definitions of climate tipping points, over twice as many respondents (n=84) were able to identify the same tipping points identified by the scientific community (see Figure. 2.3). The most commonly referenced climate tipping points were the thawing permafrost (n=18), and the melting of a major ice sheet (n=18). The next most commonly referenced, was the coral reef tipping point (n=9).

When survey respondents could not provide a definition similar to one used by the scientific community, their responses frequently indicated they conceptualized climate tipping points as *social,* rather than geophysical effects. 18.75% of survey respondents (n=51) conceptualized climate tipping points as social effects, while 9.56% (n=26) defined climate tipping points in terms of other physical conditions, such as specific temperatures, specific carbon concentrations, and general effects of climate change. The examples of tipping points given that did not correspond to climate tipping points recognized by the scientific literature closely resembled the breakdown of "incorrect" definitions. (See Figure 2.4).

Nonresponses and "don't know" answers constituted a majority of the type of response given by those respondents failing to provide a correct example of a climate tipping point (n=90; 33.1%) However, other types of incorrect examples of tipping points also occurred: 12.5% of all responses given (n=34) gave an example which denoted a social change: either a change in attitudes, norms, or policy, rather than a change in a natural system. Some examples given that were categorized as "social" tipping point responses included transformative change were "*learning to do all the things in a different way—processes and consumption patterns—everything"; "increasing the ambition of Parties in order to close the mitigation gap of NDCs [nationally determined commitments]";* and *"redirections [of] our attitude towards climate change action."*

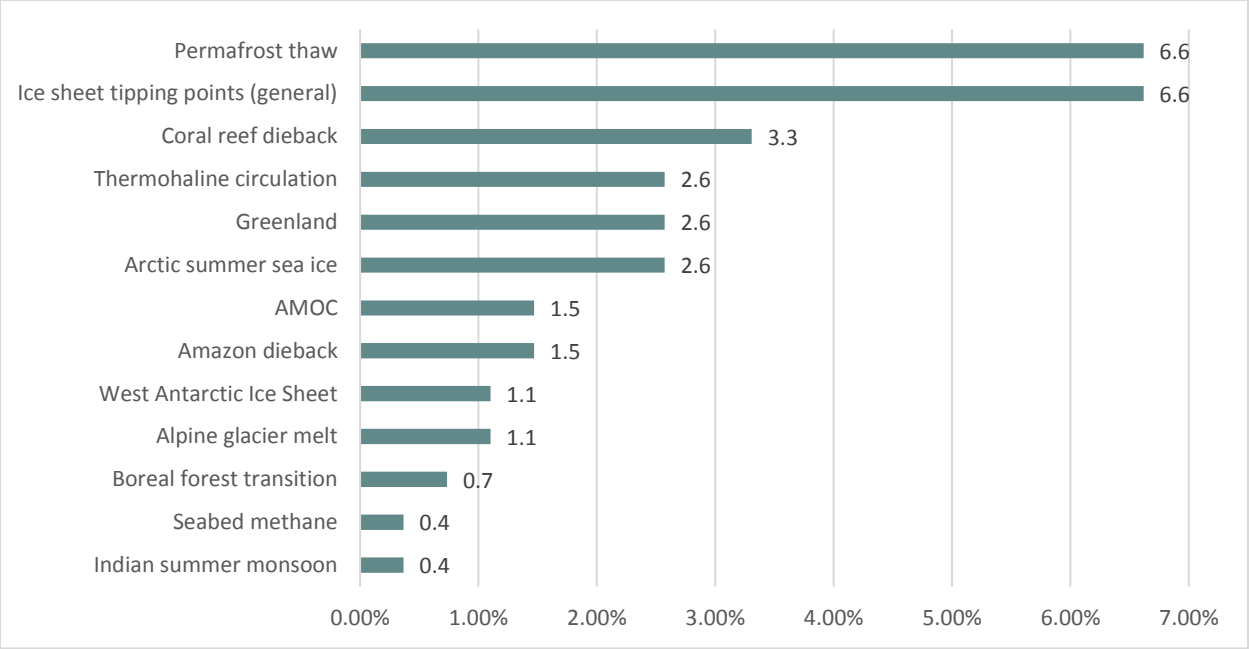

Figure 2.3 Depicts the percentage of survey responses listing a specific example of a climate tipping point also identified in the scientific literature.

The next most frequent type of incorrect example given was a statement listing the type of forcing in which a tipping point might occur; or a specific level of that type of forcing where a tipping point might exist. 10.66% of respondents (n=29) fell into this category, citing specific temperatures such as 1.5C and 2C; specific concentrations of CO2 equivalent (e.g. “350 ppm” or “400ppm”); or certain levels of ocean acidification (e.g. “oceans too acidic”). Of those that cited specific temperatures as tipping point examples, only one respondent gave a response citing a temperature below 1.5C; also specifically noting that we had “passed the tipping point.” Other incorrect examples of climate tipping points included possible effects of passing a tipping point that could not be differentiated from more general effects of climate change. These included extreme events (n= 18; 6.62% of respondents), such as droughts, storms, floods; and their secondary consequences, such as disruption to agriculture. Sea level rise was also frequently and incorrectly cited as an example of a climate tipping point (n=15; 5.51% of respondents), rather than a consequence of passing climate tipping points.

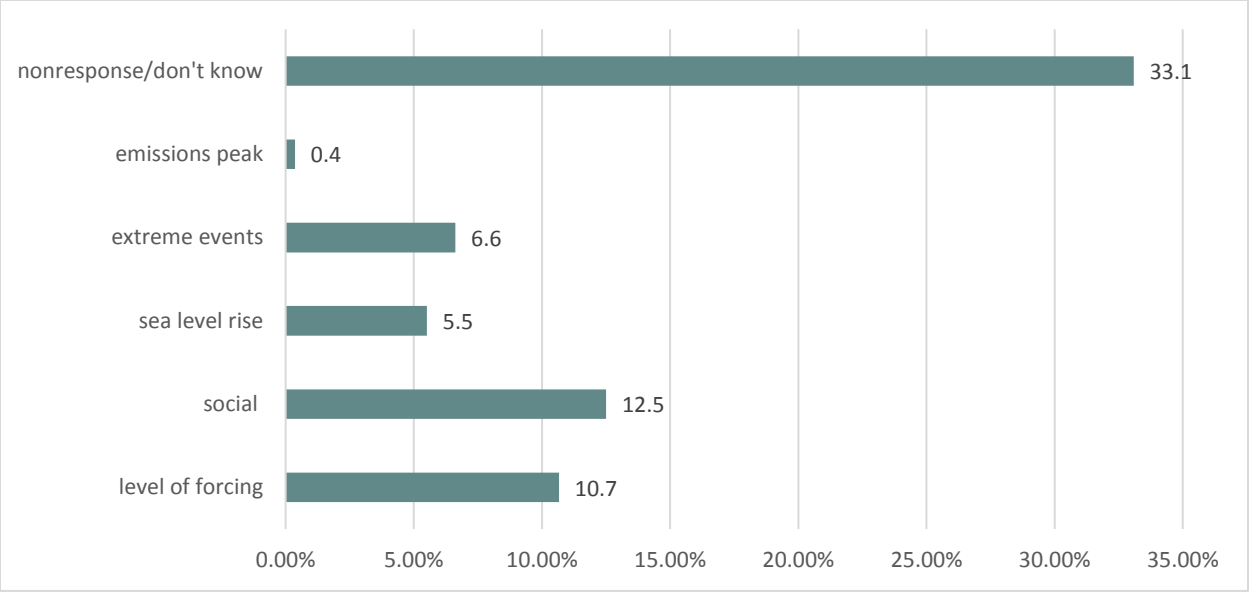

Figure 2.4 Depicts a breakdown of incorrect responses, by thematic type. Percentages represent proportions of the total 271 survey responses collected.

2.4.3 Factors influencing engagement with climate tipping points

Some interviewees noted that the specialization of jobs and separation between the scientific and policy communities played a significant role in their knowledge about and discussion of tipping points. Evidence of this theme was also present in survey responses:

An interviewee who was a national delegate from a country with a major emerging economy that was part of the LMDC alliance also cited a lack of capacity that, along with specialization, made dissemination of tipping point knowledge difficult:

> "I don't think there are scientists within [my] delegation…While there are several entities within our government who's working on the scientific issues, somehow their knowledge on the negotiation is quite different. So there's a distinguish [sic] between the capacity of doing the scientific work and also the capacity to do the negotiations.

One delegate with a physical science background noted that policymakers without science backgrounds might avoid familiarizing themselves with the topic of tipping points because they seemed too complicated:

> "I think this tipping point subject seems for people which are not coming from climate science, seems to them too technical, and it should be made more tangible, more accessible."

This sentiment was echoed by a number of survey respondents who volunteered (as part of an "I don't know" response) that it was *"too technical,"* Another rationale given for a lack of familiarity with climate tipping points was that this fell outside the scope of policymakers' role within their delegation. For example,

"I don't know. Climate adaptation and mitigation are all I'm here for."

Another example was, *"I don't know. I'm a member of the diplomatic team that will provide the delegation with logistical and protocol support."* In addition, several non-scientist survey respondents had to be prompted by the survey administrator to participate in the survey, giving the rationale that talking to a scientist from their delegation would be more appropriate. In the interviews, one policymaker from the Umbrella Group, who was jointly interviewed with a scientist from his delegation, deferred to the scientist when asked to define climate tipping points, saying, *"That's more a [question for the science delegate] than a 'me' question."* Notably, only policymakers gave this type of response: scientists interviewed and surveyed nearly universally weighed in on temperature targets and other negotiation topics.

This possibility is supported by the fact that diplomats did not answer tipping points consistently with scientific definitions as frequently. When survey responses were sorted by role, diplomats gave scientifically "correct" definitions of tipping points at some of the lowest average rates across the three conference sessions (November 2017- May 2018), while scientists, perhaps unsurprisingly, had the highest levels of definitions consistent with scientific literature.

Another factor by which levels of knowledge significantly varied was by alliance. When broken down by alliance, BASIC, ALBA, the European Union, AOSIS, and the Umbrella Group had relatively high frequencies of correct responses. The LMDC had an intermediate frequency of correct responses, while the Arab Group, the Least Developed Countries, the African Group, the Environmental Integrity Group, and AILAC had low frequencies of correct responses (see Figure 2.5)

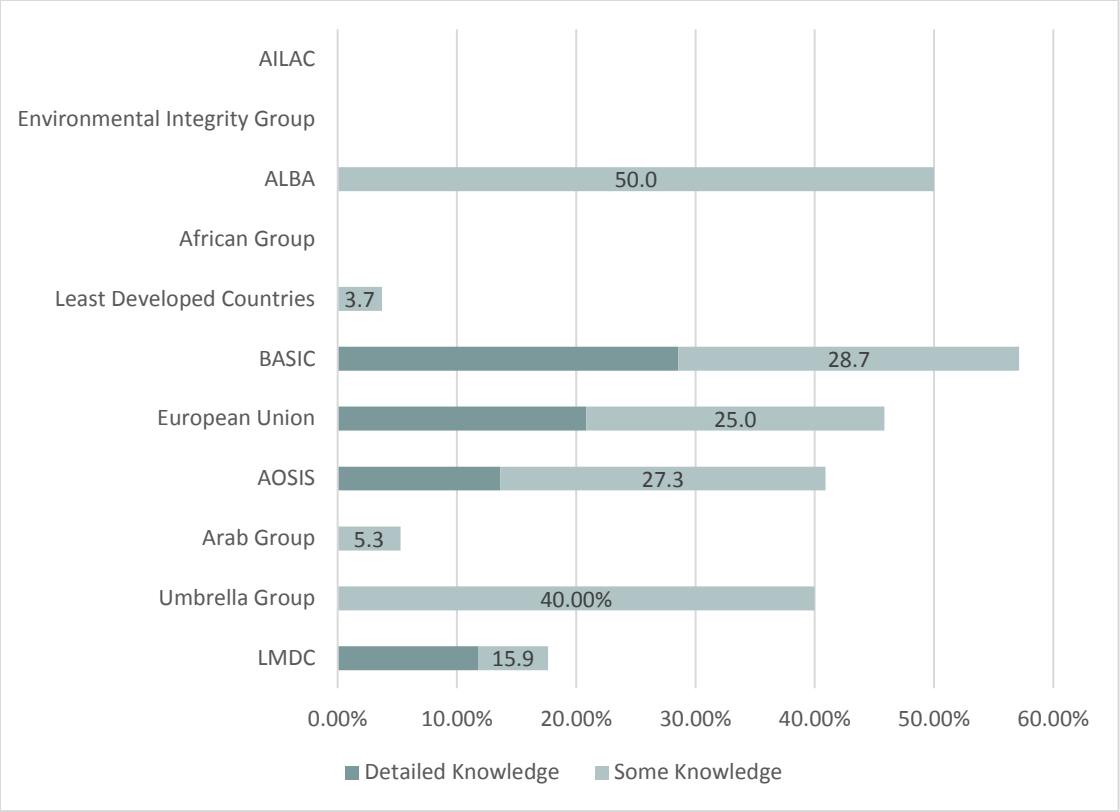

Figure 2.5 Depicts the percentage of respondents from each negotiating alliance who were able to define climate tipping points consistently with the scientific literature. Percentages represent the proportion of respondents from that alliance, not from the total 271 survey responses.

2.5 Discussion

Our results suggest that failures in the communication of climate tipping points is multifold: Power, organizational structure, cognition, and inconsistent use of language may all play a role in the inconsistent treatment and conceptualizations of climate tipping point among members of the UNFCCC science and policy communities.

2.5.1 Inconsistent language

To begin with, it is clear that policymakers do not conceptualize climate tipping points in the same way that scientists do: Scientists at every session defined climate tipping points as bifurcations, abrupt and irreversible state changes. Many of the policymakers able to provide definitions defined climate tipping points as social effects; such as shifts in attitudes, lifestyles, commitments, and governance instruments. Scientists were also able to more consistently give

examples of climate tipping points that corresponded not only to examples given in the scientific literature. These responses were also consistent with the tipping points referred to as "tipping points" in the IPCC's October 2018 Special Report on 1.5, as well as the "large scale singular events" mentioned in the burning embers diagram, and under the heading "Reasons for Concern" in the IPCC's 2013 Assessment Report 5. This supports the idea that a failure in communication between the scientific and policy communities is present on the topic of climate tipping points: policymakers are not putting together the concept of "climate tipping point" with "policy-relevant" risks, such as the other consequences of climate change laid out in the IPCC reports.

Policymakers were more able to correctly identify examples of climate tipping points consistent with those identified by the scientific literature than they were able to give a definition of climate tipping points consistent with the one used by the climate science community, and that an inconsistent use of language describing tipping points in official IPCC documents (such as "large scale singular events" and "thresholds"). This suggests that climate tipping points that have been commonly addressed without the label of climate tipping points—climate tipping points with catastrophic, vivid, and apocalyptic (such as the loss of the Arctic Summer Sea Ice, the West Antarctic and Greenland ice sheet collapses, and the thawing of the permafrost) are more familiar to policymakers, while a deeper understanding of what is actually happening when a climate tipping point is crossed is not present. Many policymakers who did not identify climate tipping points consistently with Lenton's conception of climate tipping points gave responses that indicated they might be thinking of tipping points under an alternative scientific framework, such as Rockström et al.'s planetary boundaries: some respondents directly referenced the phrase "planetary boundaries;" while others gave examples of one of the nine planetary boundary identified by Rockström et al., such as ocean acidification.

2.5.2 Vulnerability to climate effects

Differences in conceptualization of tipping points between alliances may also point to the difference in priorities between national actors and alliances. Those from developing and least-developed countries are most immediately vulnerable to the effects of climate change (Muller 2002), and therefore prioritize risk reduction measures differently than other negotiators and actors. This suggests that negotiators from these countries have priorities that align most closely with those of the IPCC. If this were true, we might expect policymakers from these alliances to

conceptualize tipping points more similarly to scientists. However, this is only partially reflected by our data: delegates from the Least Developed Countries had the lowest overall levels of knowledge of climate tipping points; and were most likely to define climate tipping points in a social, rather than a physical context. This might be explained by the fact that less-funded delegations are still at a concrete disadvantage: If a delegation has fewer negotiators, that means each are responsible for more tasks, and must therefore carry a greater cognitive burden. Negotiators operating under conditions of high cognitive load therefore must also rely on heuristics and top-down processing, basing decisions and judgments on heuristics and information already in their minds, rather than on new and unfamiliar information. However, delegates from AOSIS, another alliance from which one would expect negotiators to be cognitively burdened, conceptualized tipping points more consistently with scientific definitions than the LDCs and other developing country alliances. This is perhaps because delegates from the Pacific Islands and other AOSIS countries are already directly experiencing the effects of climate change, including sea level rise, coastal erosion, and reef die off.

2.5.3 Power and priorities

The presence of recurring "not my department," answers in both surveys and interviews indicates that organizational structure and power dynamics shape science communication at the UNFCCC. Our findings demonstrate that policymakers take a narrow view of their role in shaping conversations based on scientific knowledge. Instead of defining their responsibilities as interdisciplinary, policymakers choose to define their roles as legal, policy, and diplomacy experts. In other words, policymakers see themselves expert at moving along the *negotiations* process, rather than at making risk management decisions.

This reveals another issue: the goals of policymakers and scientists at the UNFCCC are divergent. Scientists see their role as providers of information that can help policymakers make responsible risk management decisions. On the other hand, policymakers see their role as being successful in the bargaining process of negotiations. This is reflected in our findings, where one delegate discussed the stark division of science and governance discussions in negotiations:

> *"They don't talk about [climate tipping points] because in the discussions, it is only legal. They talk about legal issues. It is basically a financial and economic fight between developing vs the other countries. They don't go into too much of science of what is going to happen."*

Additionally, negotiators' rationale for excluding climate tipping points from negotiations also revealed this divergence in goals. Negotiators who prioritized successful negotiations rationalized that climate tipping points should not be introduced to negotiations because they would complicate the process. However, policymakers who prioritized risk management argued that climate tipping points should be included in negotiations, regardless of the effect on the negotiations process.

Agrawala (1997) posits that the divorce of scientists from the negotiations themselves is due to the involvement of the developing world early in the process of the UNFCCC's formation. In 1988, the IPCC was initially conceived of as a negotiating body as well as a scientific advice-giver by its creators. The developing world protested, as they, realized that the United States (and therefore the interests of fossil fuel corporations shaping the United States' policy agenda) would be disproportionately represented in this body.

Therefore, the IPCC was designated as an advisory body to a community of policymakers, rather than as policymakers themselves. This designation placed scientists below policymakers in a hierarchy of legitimate power at the negotiations. Also implicit in this decision was that the decisionmakers, as policymakers first and foremost, would not be technical experts; and a hard division would likely exist between negotiators and scientists. This created a point of divergence between the two organizations' self-identified roles and responsibilities. This is reflected in our findings: One delegate interviewee stated that

> "*In political meetings, whatever is said, every word is calculated in terms of legal burden or weight that it carries. So you don't get a real picture of what is going on if you are not an expert in law, and if you don't know all of the references they make. It is relatively difficult for …most negotiators to follow*."

Because climate science is not law or policy, negotiators see it as beyond the scope of their expertise. By indicating that seeking out relevant scientific knowledge is not their job, policymakers remove themselves from the process of determining what climate science is important for decision-making. However, the IPCC lacks the legitimate power to influence policymakers' decisions on what information is policy relevant. Although the IPCC can produce reports to advise policymakers, there is no guarantee that the policymakers will receive or take to heart the reports' contents.

2.6 Conclusions

The current failures in the communication of climate tipping points are occurring for a number of reasons. Our findings show that many UNFCCC policymakers see their roles as defined by the rules they themselves have (collectively) created, and see themselves more as creators of a governance instrument than as managers of risk. When the objective of decisionmakers is to reach an agreement that is acceptable to the collective, it makes sense that the function of that mechanism must be secondary, even though that is technically the point being negotiated. Climate tipping points do not lend themselves to the achievement of "successful negotiations," and we cannot necessarily guarantee that we will avoid passing climate tipping points even if we achieve the Paris Agreement goals. However, there is still value in the communication of climate tipping points as well as the maintenance of existing processes of negotiations.

While the IPCC has taken major steps to engage delegates in the production of communications that are not only credible and complete, but also accessible and relevant to a professional policy audience, there is still work to be done in filling cracks in climate risk- and science communication.

Climate tipping points are difficult to illustrate and communicate, by nature of their nonlinearity, their long timescales and their uncertainty. However, it remains necessary for policymakers to learn about their consequences and forcing mechanisms in order to make sound risk-reduction judgments. To understand the UNFCCC policy community's perspective is to accept the Paris Agreement as a major political success: it is, in fact, the only successful global agreement to limit climate-related risk via greenhouse gas emissions reductions to have emerged from nearly thirty years of concentrated effort. However, understanding the scientific community's perspective means admitting that climate tipping points are a serious threat worth addressing.

Many of the delegates interviewed believed that introducing a new topic into negotiations would detract from the success of the current agreement and halt progress in the negotiations. Therefore, it is equally important for scientists to find a way to relate climate tipping points to the language of the agreement in which policymakers must speak. Here, it is important for negotiators to accept that power is defining the types of knowledge that must be produced; that policy-relevance is produced by the powerful and is used to rationalize and reinforce decisions that are political, rather than purely rational.

To help policymakers, scientists, and science communicators more successfully navigate the complex interaction between politics, power, and structure, that have allowed communication of climate tipping points to fall through the cracks, we suggest a few changes to the status quo. First, consistent language around climate tipping points should be used in science communication products. If the phrases "large scale singularity," "planetary boundaries," "bifurcations," "thresholds," "regime changes," and others are all used to describe phenomena we refer to as "climate tipping points," a commitment to one of these terms should be made. At the very least, explanations of how the terms relate to one another should be provided in any context where one or more of these terms are used. This language should be explicit in delineating geophysical and ecological tipping points from social and political tipping points.

Second, we recommend the creation of supplementary educational activities designed to help policy audiences understand how reducing the risk of passing climate tipping points fits into their existing negotiation tasks using Paris Agreement logic. Such an activity would ideally be memorable and experiential; would providing policymakers with a clear understanding of the relationship between temperature forcing, the temperature targets, and the dynamics and consequences of climate tipping points. Serious gaming, virtual reality, simulations, or other creative activities would not only be compelling and intrinsically motivating activities that would stand out from the types of tasks involved in day-to-day negotiations, but would give negotiators a chance to engage with climate tipping points in a way that would make the physical and human consequences of their political actions clear.

Finally, diplomats, scientists, and UNFCCC officials at the climate diplomacy edge must engage in a closer re-examination of the ways in which scientific and policy community members' goals diverge from scientists', and in what ways policy and governance structures are shaped by power. Critical self-reflection and a recognition that knowledge and heuristics used to structure agreements and reality are socially constructed and are bound up in formal and informal power structures—must be performed by all members of the UNFCCC community.

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CHAPTER 3. MEDIATED COMMUNICATION

3.1 Introduction

The media serves an important role in the communication of natural hazards and disaster. It alerts the public to risks at hand, communicates logistical information during disasters, and alerts the rest of the world to conditions in affected areas before, during, and after disasters. Media coverage of natural disasters readily supplies answers to the questions "Who, what, where, and when?", but it remains unclear if the "whys" of disaster are consistently addressed. Why do natural hazards materialize in the forms that they do? And why does disaster sometimes follow exposure to natural hazards? To some extent, especially in the wake of catastrophic disaster, where human systems are overwhelmed and rendered incapable of self-repair, media coverage delves into underlying vulnerabilities, such as infrastructure and planning failures, policymakers' poor emergency management choices, or socioeconomic conditions (Ploughman 1995). However, the United States press appears to be inconsistent about evaluating and explicating one significant "why" of the planet's changing natural hazards: anthropogenic climate change (Battistoli et al 2017). For example, Church et al 2019 finds that both the national elite press and agricultural trade publications failed to utilize the 2012 Midwestern drought as an opportunity to create a connection between extreme natural hazards and climate change.

Media consumption is a main source of climate information for the public (Butler, Pidgeon, 2009; Nelkin, 1987; Hargreaves et al 2003; Wilson, 1995). The frequency, type, and content of the media one consumes predicts concern, behavioral intentions, and actions around climate change (Cabecinhas, 2008). It follows that if the media is ineffective at communicating climate risk, it is therefore likely that consumers of media will not see climate change as a serious threat.

Though awareness of climate change is higher in the United States than in many developing countries, residents of developing countries who were aware of climate change were far more likely to perceive climate change to be a serious risk to themselves and their families (Lee et al 2015). A 2019 public opinion survey of climate beliefs, attitudes, and risk perceptions found that United States residents' perceptions of their personal risk of experiencing the impacts of climate change were relatively low: 53% of US residents believed in anthropogenic climate change, and only 42% believed climate change would affect them personally (Marlon et al 2019).

These perceptions do not reflect the climate-related risks US residents will almost certainly face. In fact, many will experience (or are already experiencing) abnormal, extreme, and destructive climate-related events, such as intense droughts and heat waves; frequent extreme flooding; abnormally large and intense wildfires; coastal erosion and inundation; sunny day flooding; and an increase in the frequency of intense hurricanes (USGCRP, 2017). But despite inaction on climate mitigation and preparation, US residents and policymakers do respond to risks of natural disaster by taking preemptive actions such as evacuating flood-, fire-, and hurricane-prone areas when natural hazards are occurring or predicted to occur.

Failure to recognize climate change as a clear and present threat will prevent the public from adequately preparing for climate-related natural hazards, presumably increasing the financial and personal costs of climate-related hazards. With the dual goals of risk management and harm reduction in mind, it is crucial that we gain a robust understanding of the role that the US media plays in the communication of the risk of natural hazards related to climate change.

The 2017 North Atlantic hurricane season was unprecedented in terms of levels of precipitation, wind strength, hurricane frequency, and damages caused, reflecting trends in tropical cyclone patterns predicted by climate scientists (Mann, Emanuel 2011). At the annual meeting of the American Geophysical Union in December of 2017, nearly ninety posters were submitted to a last-minute session on the 2017 hurricane season, entitled "Late-Breaking Research Related to the 2017 Hurricane Season in the Americas (Harvey, Irma, Jose, Maria)." Many of these focused on the connections between storm trends, characteristics, and climate change, a connection also noted in the National Climate Assessment: "Recent increases in activity are linked, in part, to higher sea surface temperatures in the region that Atlantic hurricanes form in and move through" (USGCRP, 2017). We examine the 2017 Atlantic hurricane season as a case study for the American online print media's treatment of natural hazards in respect to climate change. Our work builds upon the findings of Church et al (2019) and Battistoli et al (2017) to explore the dimensions and dynamics of national and regional newspapers' coverage of the 2017 hurricane season in order to answer the following research questions: Does the United States media link extreme weather events—specifically hurricanes—to climate change? If so, what factors influence the frequency at which the climate-hurricane connection is made, and the ways in which climate change is discussed?

3.2 Literature Review

3.2.1 Issue Attention cycle

The content of news articles on a given issue shifts with fluctuations in public attention. McComas and Shanahan (1999) find that during the "alarmed discovery phase" of the issue attention cycle (Downs 1972), newspaper coverage of climate change focuses on the adverse effects of climate change. Stories about climate-change related controversies predominate in the maintenance phase, and economic costs of addressing climate change predominate in the attention drop off phase (McComas, Shanahan 1999).

Agenda setting and issue attention have important implications for policymaking and policy-level change: An increase in issue salience is related to changes in public opinion strength and polarization, level of knowledge, and behavior. (Weaver, 1991). Mazur also asserts that public and policy action responds to changes in quantity and salience of issue coverage, suggesting that the more an issue is covered, the more likely it is to reach the top of policy agendas (Mazur 2006). Quantity of coverage theory, an expansion of agenda-setting theory, states that the noticeability and quantity of exposure to an issue matters more than the specific content of coverage of the issues (Mazur 2006). This is supported by Sampei and Aoyagi-Usui's 2008 finding that the Japanese public's concern about climate change increased during times of heightened media attention to climate change, but quickly dropped off as media attention to climate change faded. suggesting that increased coverage of climate change may amplify climate risk—if only temporarily.

3.2.2 Psychological Distance

Construal level theory indicates that the perceived distance of some object or matter determines the level of abstraction people use when considering that object (Trope, Liberman 2010; Bar-Anan et al 2006). The further away an object appears—that is, them more psychologically distant it is—the more abstractly it will be considered (Trope, Liberman 2000, Bar-Anan 2006). Psychological distance occurs across multiple dimensions, including spatial distance, temporal distance, social distance, and hypothetical distance.

Proximity cues are indicators of an object's nearness or distance, and can help readers establish psychological distance from objects they are reading about. The use of proximity cues in

messaging is an emerging topic of interest in the field of risk communication, because psychological distance influences perceptions of risk (Smith, Wilson 2000; O'Sullivan 2015) For example, in one 2016 study, subjects were exposed to localized messages about climate change designed to reduce psychological distance along social and spatial dimensions. Exposure to this messaging increased perceptions of climate risk to people similar to the respondents. It also resulted in increased perceptions of climate risk to geographic regions nearby, and increased levels of concern about climate change in general (Jones et al 2016). Lowering psychological distance has also been found to increase perceptions of vulnerability to climate change (Brugger et al 2015; Witte 1992), and concern about climate change in general (Spence et al 2011). Localized messaging can also increase behavioral intentions to engage in climate mitigation (Jones et al 2016; Scannell, Gifford 2013), though this may differ between populations (McDonald 2016; Schuldt et al 2018).

Reporting of climate change in the press can increase perceptions of nearness of climate stories to audiences (Carvalho, Burgess 2005). However, it is unclear how frequently or consistently proximity cues indicating climate change's nearness to audiences are used in media coverage. In a 2008 study of climate- and global-warming-related articles in *The Houston Chronicle* between 1992 and 2005, Liu et al (2008) found climate change was frequently discussed as a spatially distant concept: as a national or international issue, rather than a local issue. Additionally, Lejano et al (2014) found that local and personal implications of climate change are not usually highlighted through techniques used to maximize personal connections between audiences and the material.

3.2.3 Experience of natural hazards and perceptions of climate change

Physical vulnerability to certain overt effects of climate change (such as sea level rise) can lead to increased perceptions of climate risk. However, less obvious patterns such as droughts and flooding do not correspond to similarly increased risk perceptions (Brody et al 2008, Whitmarsh 2008). In contrast, a 2011 study found that personal exposure to flooding increased concern about climate change and decreased uncertainty about climate change in respondents (Spence et al 2011). Additionally, Zanocco et al (2018) suggests that while not the most important factor shaping respondents' views of climate change, experience of harm related to extreme weather might play

an important role in developing mental associations between changing trends in natural hazards and climate change.

There have been mixed findings on whether extreme weather events act as drivers for media coverage of climate change. A 2014 study of international newspapers found that in some national contexts such as India and Australia, extreme weather did not appear to drive news coverage of climate change (Schaefer et al 2014). However, in Germany, an unprecedented flood precipitated media to make connections to climate change (Schaefer et al 2014). In their coverage of an extreme drought in the American Midwest in 2012, agricultural trade publications in the United States did not frequently mention climate change (Church et al 2017). A subsequent study also found that climate change was not a dominant part of the United States print media's coverage of the same 2012 drought (Church et al 2019). Likewise, Battistoli et al (2018) found that climate change was not a major role in the media coverage of hurricanes. However, Carvalho and Burgess (2005) found that the 2003 European heat wave and floods in the United Kingdom in 2000 were prominently linked with climate change in the British press and by policymakers. In contrast. social and political events (such as intergovernmental climate conferences) have been consistently found to increase coverage of climate change (Schaefer et al 2014; Liu et al 2008; Church et al 2019).

3.2.4 Normative influence

3.2.4.1 Media norms

The transmission of climate messaging and news through the press is also complicated by journalistic ethical standards and norms, which are integral to news production. Professional norms such as personalization, dramatization, novelty, accuracy, and objectivity affect issue selection, source choice, content, and content framing. (Boykoff, Boykoff 2007).

The journalistic norm of objectivity is the perceived obligation of journalists to provide unbiased, "balanced," coverage by publishing multiple contrary opinions on a news story or contentious issue (Boykoff, Boykoff 2007). Since providing "balanced" coverage means invoking both sides of an issue, climate denial perspectives receive a disproportionately large amount of media attention, compared with the prevalence of that perspective among credible sources

(Boykoff Boykoff 2004). “Balanced” coverage on this issue creates a sense that climate denial perspectives are credible although they are not.

The inadvertent promotion of (false) denial beliefs comes in conflict with another journalistic ethical norm concerning the accuracy of coverage. However, in recent years, this conflict has been alleviated by a shift in the manner in which climate denial perspectives are portrayed. Bruggemann and Engesser (2017) suggest that coverage of climate denial perspectives has shifted from provision of unqualified statements toward weight-of-evidence reporting. When using weight of evidence reporting, media communicators provide context about the credibility of each of the statements they provide, suggesting that denial perspectives have only minimal supporting evidence. Koh et al (2016) finds that weight of evidence reporting can also help decrease heightened perceptions of uncertainty that arises due to exposure to conflicting claims.

In addition, consensus messaging, a technique in which climate change is described as being an issue around which experts, scientists, and the public has formed a consensus, creates a clear picture of a descriptive norm around belief in climate change. Consensus messaging has been found to increase public acceptance of climate change (Hamilton 2016; Goldberg et al, 2019), especially among conservatives otherwise resistant to accepting climate change (van der Linden et al, 2018).

3.2.4.2 Social norms and climate change

The cultural theory of risk states that individuals from differing cultural backgrounds form differing perceptions of risk that reinforce and are reinforced by those backgrounds (Douglas, Wildavsky 1982).

People from different cultural backgrounds form opposing opinions of what experts believe (Brahman et al 2012). They also systematically overestimate the degree of support that exists for the issue stances they are culturally predisposed to accept (Kahan et al 2011), such as those promoted by others they see as similar to themselves. An important consequence of the politicization of climate change is the tendency to favor partisan elites as sources at the expense of scientists. A 1996 content analysis of US newspapers that determined scientists were used less frequently as sources in news articles as politicization of climate change increased (Trumbo 1996). Further research shows that under conditions of politicization, weather extremes and communications of climate science originating with scientists have little effect on public opinion,

while political communications from elites and advocacy organizations have a greater impact on concern about climate change (Brulle et al 2012). Merkely and Stecula also find that as of 2018, Republican party elites were only infrequently used as sources for quotations on climate change, while Democratic party elites' pro-science quotes about climate change occurred frequently (Merkeley, Stecula 2018). This presents a potential problem, because in a media environment in which the party identification is strongly linked with individual identity (and views on climate change are linked strongly with party identification), these trends may cause Republicans to reject climate science because it appears to be championed by Democratic elites (Unsworth, Fielding 2014) .

The association of climate change denial perspectives with conservative identity has been associated with the efforts of the climate change countermovement (Brulle 2013), and translates into low perceptions of climate risk among conservatives (Howe et al 2015; Marlon et al 2018). Social norms theory refers to situations where an individual wrongly believes that the opinions, attitudes, or beliefs of their peers are different from their own (Berkowitz, 2004). In the case of climate change, social norms theory applies to the prevalence of climate denial perspectives among US conservatives. While climate denial perspectives exist at higher rates among political conservatives than in other groups, not every conservative is a climate denier. However, the perception of a climate denial norm may lead conservatives into climate denial beliefs because they believe their peers deny climate change. Unsworth and Fielding (2014) suggest that using norms-based messaging may be one avenue to decrease perceptions of a climate denial norm among conservatives, essentially delegitimizing denial perspectives.

3.3 Methods

3.3.1 Newspaper Selection

To test the influence of three factors on hurricane coverage, three different criteria were used to choose newspapers from which to sample: elite status, partisan lean, and proximity to a major 2017 hurricane. Elite or non-elite status has been found to influence styles and types of coverage due to increased availability of resources. Elite newspapers play a key role in setting news agendas and are more likely to cover international news while nonelite or local papers are more likely to rely on local sources (Carpenter 2007) and play a role in communication of local

news (Carpenter 2007). Elite papers' focus on issues applicable to a large, often international audience, may therefore lead to framing of localized issues in the context of larger problems relevant to a wider audience, such as climate change. Elite papers were defined as elite according to Carpenter (2007) and McCombs (2004) for their agenda-setting abilities (McCombs 2004, Vargo et al 2018). These include the New York Times and the Wall Street Journal.[1] Nonelite papers included in the study were the Houston Chronicle, the Columbus Dispatch, the South Florida Sun-Sentinel, and the Seattle Times.

Political orientation of papers was selected as a factor for investigation because newspapers orient articles' framing to maximize readership and revenue from advertisers and funders (Gentzkow Shapiro 2010). In the United States media, climate change is a deeply politicized issue: public and elites' views on climate change follow partisan lines. Liberals, Democrats, and the political left have higher levels of belief in climate change and higher perceptions of climate risk than conservatives, Republicans, and the political right (McCright, Dunlap 2011). Political bias in newspaper coverage may also originate from news consumers' perceptions that sources which confirm their prior beliefs are more accurate, in order to increase perceptions of the newspapers' accuracy. (Gentzkow, Shapiro 2005). A study of liberal and conservative newspapers in Chile found that liberal newspapers published roughly twice as many articles about climate change than comparable conservative papers. The liberal papers' coverage also included more thematic diversity and illustrations (Dotson et al 2012), suggesting that political orientation of news sources influences the dynamics and content of climate coverage. Papers' political orientations were determined by the ratings of two independent online news evaluators: AllSides, and Media Bias Fact Check. These sites both clearly stated the methods used to determine partisan orientation. AllSides uses a blind bias survey, credible third party research, and community feedback (allsides.com 2019), while Media Bias Fact Check uses an approach that evaluates newspapers based on the bias of wordings and headlines, source choice and quality, story choices, and political endorsements to determine bias ratings (mediabiasfactcheck.com 2019) Papers with partisan orientation rankings consistent between both bias rating sites were selected, and categorized as conservative or liberal (according to their bias ratings) for the purposes of this study. Papers rated

[1] Note: The Wall Street Journal is an economic and financial trade newspaper commonly selected by other scholars for analysis due to its status as a conservative, elite paper. We acknowledge it is conceivable that orientation towards a financial audience may have an effect on the style of coverage hurricanes receive in relationship to climate change.

"conservative" include the Wall Street Journal, the South Florida Sun-Sentinel, and the Columbus Dispatch; "liberal" papers include the New York Times, the Houston Chronicle, and the Seattle Times.

Nearness to a 2017 hurricane was selected as another factor to investigate, because lived experience plays a role in perceptions of risk, where those who have personal experience with certain hazards are more likely to have higher perceptions of those risks. Therefore, local coverage of climate-related hazards (and attribution of those hazards to climate change) may be an important factor in association of personal experience with events such as hurricanes, to climate change. Two proximate papers were selected: the Houston Chronicle, and the South Florida Sun- Sentinel. The Houston Chronicle is located in Houston, which suffered a direct hit from Hurricane Harvey in 2017; while the South Florida Sun-Sentinel (which serves the Fort Lauderdale area and Broward County) suffered a direct hit from Hurricane Irma. The remaining papers were all from regions that did not encounter a major hurricane in 2017.

Table 3.1 C ontains a list of newspapers, and the categories into which they fall. The leftmost column lists the three binary categories—elite status, partisan orientation, and proximity to a 2017 hurricane. The six columns to the right list the names of individual newspapers included in the study.

	New York Times	**Wall Street Journal**	**Houston Chronicle**	**South Florida Sun-Sentinel**	**Seattle Times**	**Columbus Dispatch**
Elite Status	elite	elite	non-elite	non-elite	non-elite	non-elite
Partisan Orientation	liberal	conservative	liberal	conservative	liberal	conservative
Proximity to a 2017 hurricane	distant	distant	near	near	distant	distant

3.3.2 Sample

To reflect potential changes in trends of hurricane coverage before and after the 2017 season, a sampling frame including the June 1 – October 31 hurricane season plus one month prior to the season, and three months after the season's close, bringing the total coverage examined to a span of nine months: May 1, 2017 – January 31, 2018. A constructed week sample is a stratified random sample of coverage designed to give a complete picture of newspaper coverage, accounting for

fluctuations in coverage that routinely occur by day of the week, with advertising schedules and readership (Riffe et al 1993). While Luke et al (2011) find that six constructed weeks are sufficient to reflect an entire year of print newspaper coverage, others find that four to eight constructed weeks are necessary to reflect a year of online newspaper coverage (Conolly-Ahern et al 2009; Hester, Dougall 2007). Since online versions of print newspapers were used to create the sample, nine constructed weeks for a nine-month sampling frame were created, in order to exceed both guidelines from the literature. From each month in the sampling frame, one of each day of the week was randomly selected. Of the nine months' samples, this means sixty-three individual days were sampled from each newspaper (nine Mondays, nine Tuesdays, et cetera). This process was repeated for each of the six newspapers, yielding a total of 378 days of coverage. For each sampled day, the entire population of articles in each of the six newspapers selected was subjected to a keyword search, using the single search term, "hurricane." All resulting articles were included in analysis.

3.3.3 Data cleaning

Articles identified as including the word "hurricane" that did not include any reference to a storm were then excluded from analysis. Examples of articles exclude include those which referenced the word "Hurricane" or "Hurricanes" only in the context of a sports team such as the Carolina Hurricanes or the Miami Hurricanes were excluded from the sample; or articles that included recipes for a "Hurricane" cocktail. Duplicate articles (where the same newspaper published the same article text under a different headline: a common practice in sources of news online, but an uncommon practice in print) were also excluded from further analysis. Another round of article exclusion also occurred at the first stage of content analysis—coders identified whether articles' focus was on hurricanes, whether hurricanes were mentioned only tangentially (articles about other topics made brief reference to hurricanes—for example an article about a robbery that begins with "In the wake of Hurricane Irma," and does not otherwise relate to the hurricane), or did not mention hurricanes (also excluded from the sample: sometimes these articles were flagged by the databases' keyword search due to advertisements or unrelated links to other articles with "hurricane" in the title, for example). A few examples of articles excluded on the grounds of being tangential are: Once the data cleaning process was complete, 86 articles from the

initial sample were excluded, 340 articles were marked as only tangentially related to hurricanes, and 1057 articles were subjected to content analysis.

3.3.4 Content Analysis

3.3.4.1 Coding framework

The sample was analyzed via a mixed methods coding process, in which articles were treated as the unit of analysis. The codebook was developed in two phases: first, codes meant to give a broad picture of the type of coverage and themes used frequently were developed. These codes, once finalized, were applied to all articles included in the sample. During this process, articles that were marked with codes indicating they made reference to climate change were coded using a second, more specific set of codes. The additional codes were designed to give a more detailed understanding of how these articles used discussion of climate change in the context of hurricane disaster coverage.

3.3.4.2 Codebook development process

The initial coding framework was developed through an iterative group process with nine participating coders. First, an initial draft codebook was developed inductively from a reading of 50 articles identified by the keyword "hurricane" from within the sampling frame, but not from the actual sample. Emerging themes were adapted into codes. Then, each coder received a copy of the draft codebook and the same 10 articles identified from the same keyword search, but from days not selected in the constructed week sample to code. They coded these articles individually, then were assigned a partner and reconciled codes. Then the entire group of coders reconvened, and revised the codebook based on which codes each partner-group could not reach consensus on, or consistently needed to reconcile. This process was repeated three more times with the same set of articles. Then the process was repeated twice more with two different sets of ten articles. Intercoder reliability scores were calculated in NVivo. A Fleiss' kappa of 0.75 was reached, above the satisfactory 0.7 level (Viera 2005). The lowest Cohen's kappa score for an individual coder was 0.68. Systematic errors in that coder's work were identified; those were called to the coder's attention and remedied.

A similar iterative process was used to develop the coding framework that was applied only to articles that referenced climate change. Initially, an automated content analysis was performed on the sampled articles to identify articles that would be used and to which a climate-specific coding framework would be applied. The automated content analysis was performed in R, using climate-related keywords. The list of keywords used was intentionally broadened beyond explicit statements of the phrase "climate change" in order to reflect articles with subtle references to changing climactic trends. Keywords included *climate change, climatic change, changing climate, warming climate, climate variability, weather variability, environmental change, global change, global warming, greenhouse gas, unprecedented, extreme weather, extreme event, unusual weather, abnormal weather, adaptation, resilience, resilient, sustainable, sustainability, green development*

Initially, 10 climate-related articles from the sample were identified, and coded by 7 individuals. Coders reconvened in a large group to discuss coding choices and revise the codebook. This process was repeated five times. The fourth iteration included a new set of 10 articles; and the fifth iteration included another new set of 10 articles. After the fifth iteration, a Fleiss' kappa of 0.69 was reached. The two coders with the lowest individual Cohen's kappa scores were excluded (and therefore did not go on to code any articles), yielding a Fleiss' kappa of 0.76.

3.3.4.3 Codebook contents

Our coding framework was created to give a broad-stroke picture of the ways in which the 2017 hurricane season was covered, as well as more specific insight into the coverage of hurricanes that included reference to climate change. Main codebook categories included actions performed around the hurricanes, such as short- and long-term preparations as well as responses to the hurricane. Themes such as human health, economic impacts, justice implications, vulnerability, geographic risk, changes to home and family life, and property damage were also coded. Additionally, the presence of implicit or direct mention of climate change in the hurricane-related articles was coded. See Table 3.2 for codes referenced in this analysis. See Appendix B for full codebook.

Once articles were identified as having reference to climate change, they were also coded for attribution of hurricanes, attribution of climate change, climate adaptation and mitigation, perspectives on climate change, descriptions of extreme events, and spatial and temporal proximity

cues. Seven of the nine coders involved in the first stage of codebook development coded all articles for broad themes, while five coders coded articles referencing climate change for these more specific characteristics. Two of the initial seven coders were excused from climate articles' coding process due to systematic inability to identify spatial and temporal proximity cues.

Table 3.2 An abbreviated sample of the codebook used to classify the thematic material of news articles. The left column lists the code name; the right column provides a description of inclusion criteria for that code

Code	**Description**
Economic	References economic effects of hurricanes
Infrastructure damage	References damage or threats to infrastructure and/or delayed provision of services due to hurricanes
Property damage	References damage of public and private property due to hurricanes that is not infrastructure.
Health	References morbidity, mortality, and health implications due to hurricanes
Changes to home life	References changes in household status or living situation due to hurricanes
Justice	References any disproportionate effects of / vulnerability to the hurricane as they relate to the unfair or unequitable effects on disadvantaged groups
Environment	References destruction of or threats to the natural environment related to hurricanes
Geographic vulnerability	References people who are vulnerable to the effects of climate change and/or hurricanes by nature of where they live.

Table 3.3 An abbreviated sample of the codebook used to analyze articles identified as having implicit or explicit reference to climate change. The leftmost column lists parent codes; the center column lists child codes, and the rightmost column lists a description of inclusion criteria.

Code	**Subcode**	**Description**
Climate		
	Present-explicit	One or more of the phrases climate change, global warming, global change, changing climate, or warming climate is mentioned
	Present-implicit	Discussion of changing frequency and intensity of hazardous weather, reference to changing temperatures that do not include the phrases climate change, global warming, global change, changing climate, or warming climate.
Climate perspectives		
	Denial	Any reference to climate change denial perspectives
	Fact	Explicit statements that climate change is definitely happening, climate change is a fact, or that a consensus of scientists agree that it is happening.
Spatial proximity cues		
	Spatially near	The effects of climate change are nearby to a US reader
	Spatially distant	The effects of climate change are far away from a US reader. References climate change impacts that occur outside the continental United States
Temporal proximity cues		
	Temporally near	The effects of climate change are happening now. This includes any present- and past-tense description of climate change
	Temporally distant	The effects of climate change will happen in the future

.

3.3.4.4 Statistical analysis

Chi-squared tests were used to compare the frequencies of codes between elite and nonelite papers, proximate and nonproximate papers, and liberal and conservative papers in all cases where minimum frequency requirements for Chi-squared tests were met. For comparisons where minimum requirements were not met, Fisher's exact tests were performed instead. Papers that were most similar along elite- and proximity- characteristics were grouped together, and compared with the groupings of papers most similar along one of the two characteristics—elite status, or nearness to a 2017 hurricane. One liberal and one conservative paper was included in each grouping. For example, the Wall Street Journal and the New York times are both elite papers not proximate to a 2017 hurricane. They were grouped together as "elite" papers. The Columbus Dispatch and the Seattle Times are "nonelite" papers which were also not proximate to a 2017 hurricane. These two groups were compared. For comparison along the political dimension, all three liberal papers were grouped together, and compared to the remaining three (conservative) papers.

3.4 Results

3.4.1 Article Themes

Among the 1057 total articles coded, the three most commonly referenced themes were property damage, damage to infrastructure, and effects on the economy, a pattern which held true across elite, regional, proximate, nonproximate, liberal, and conservative groups (see Figure 3.1).

However, elite, proximate, and conservative papers referenced economic and infrastructure themes at greater frequencies than regional/nonproximate and liberal papers. Hurricane-related morbidity and mortality was the next most frequently coded theme, though the frequency of references to morbidity and mortality was greater in elite, proximate, and liberal paper groups than in regional/nonproximate and conservative groups. The next-most frequent theme, hurricane-related changes to home life, were referenced most frequently by elite, proximate, and liberal papers as well.

Conservative, proximate, and elite papers referenced geographic vulnerability at greater frequencies than liberal and regional/nonproximate papers. Elite papers included greater frequencies of environmental and justice themes than regional papers, though no remarkable difference in frequencies of these themes occurred across other paper groups. (see Figure 3.2)

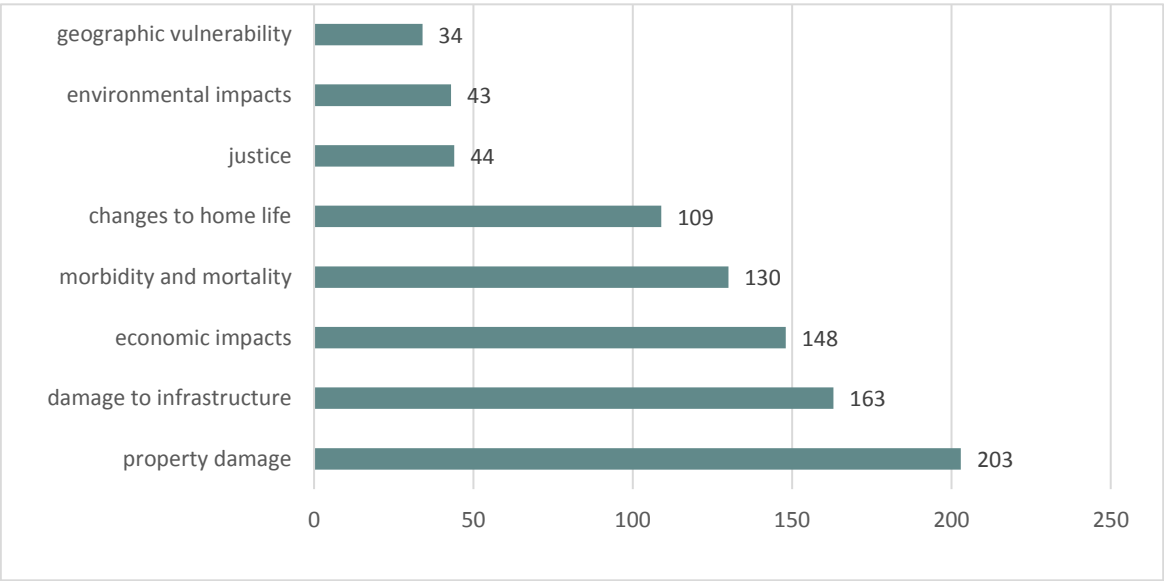

Figure 3.1 Depicts the number of articles referencing each theme across all papers and articles sampled

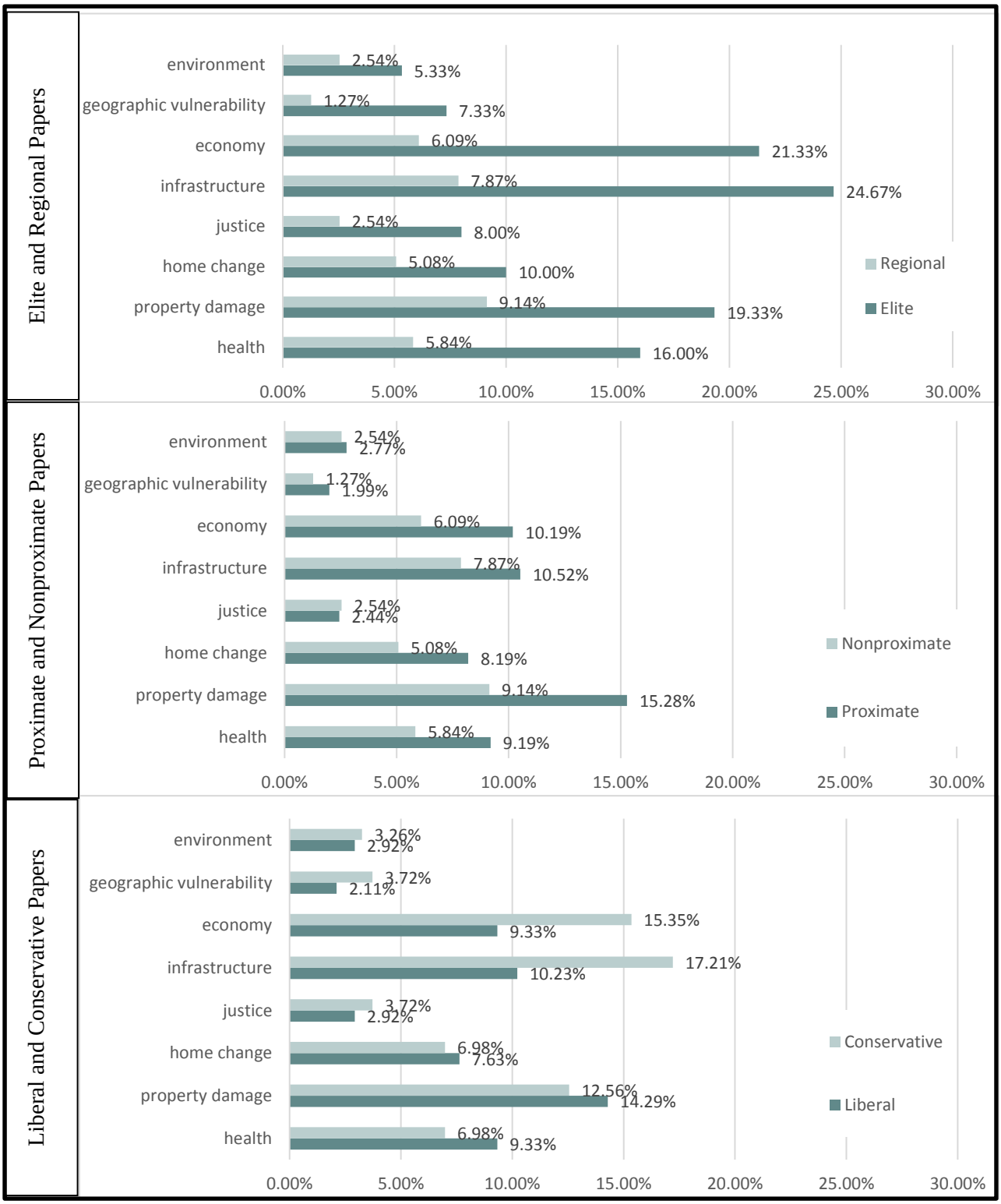

Figure 3.2 Depicts the frequency of themes referenced by each paper in each of the three binary characteristic categories. Frequencies are listed as percentages of the total number of articles in each characteristic category, not the total 1057 articles coded

3.4.2 References to climate change

Of the total 1057 articles coded, 21.6% made implicit or explicit reference to climate change. Significant differences in frequency of articles referencing climate change existed for each of the three groupings of papers (elite and regional papers, proximate and nonproximate papers, and liberal and conservative papers). Of these groups, elite papers, proximate papers, and conservative papers had the highest frequencies of articles referencing climate change (see Table 3.4)

Table 3.4 Lists the number of articles coded in each characteristic group, and the frequency of articles which contained reference to climate change. This frequency includes both implicit and explicit references. The rightmost column contains a p-value obtained from chi-squared tests used to compare frequencies of references to climate change between binary characteristic group

Characteristic	Total articles coded	Percentage of climate change codes (%)	p-value
Elite	113	30.1	<0.001***
Regional	283	14.1	
Proximate	661	23.3	<0.001***
Nonproximate	283	14.1	
Liberal	898	20.8	<0.001***
Conservative	159	25.8	
Total	1057	21.6	--

Of the conservative papers examined, the Columbus Dispatch, a nonproximate, regional paper, had the highest frequency of climate change-referencing articles (38.9% of a total 18 articles). The South Florida Sun-Sentinel, a conservative, proximate, non-elite paper, had a comparable frequency of climate change references to the Columbus Dispatch, but a larger article total (n = 26, 35.6% of 73 total articles). The Wall Street Journal, a conservative, non-proximate, elite paper, had the lowest frequency of climate change references (n=8, 11.8% of 68 total articles).

Among liberal papers, the New York Times, an elite, non-proximate paper, had the highest frequency of climate change references of any newspaper sampled (n=26, 57.8% of 45 total articles), though the Houston Chronicle, a regional, proximate paper, had the highest number of

climate change references, but a lower frequency of references (n=128, 21.8% of 797 total articles) than the New York Times, the South Florida Sun-Sentinel, and the Columbus Dispatch. The Seattle Times had the lowest frequency of climate change references among liberal papers (n=33, 12.5% of a total 265 articles.

3.4.2.1 Temporal distribution of climate change references

The percentage of articles about hurricanes that included either explicit or implicit references to climate change fluctuated over the course of the hurricane season. Among elite papers, both the conservative and liberal elite papers experienced a noticeable spike in the frequency of articles about hurricanes referencing climate change during the hurricane season. The Wall Street Journal (elite, conservative) and the Columbus Dispatch (regional, nonproximate, conservative), experienced spikes in the frequency of climate change references in August, after Hurricane Harvey. The New York Times (elite, liberal), and the South Florida Sun-Sentinel (proximate, conservative) experienced spikes in the frequency of climate references in September, following Hurricanes Harvey, Irma, and Maria. The Houston Chronicle (proximate, liberal) and the Seattle Times (regional, nonproximate, liberal) did not experience any sharp increases in the frequency of climate references during time period examined (see Figure 4.3).

The frequency of references to climate change also increased sharply for the New York Times (elite, liberal) and the Columbus Dispatch (regional, nonproximate, conservative) in December, following the meeting of the United Nations Framework Convention on Climate Change's negotiations conference. Slight increases in the frequency of climate references occurred in the Wall Street Journal (elite, conservative) in November (preceding the UNFCCC meeting) and the South Florida Sun-Sentinel (proximate, conservative) in December. No remarkable increases in the frequency of references to climate change occurred during November or December in the Houston Chronicle (regional, liberal), or the Seattle Times (regional, nonproximate, liberal).

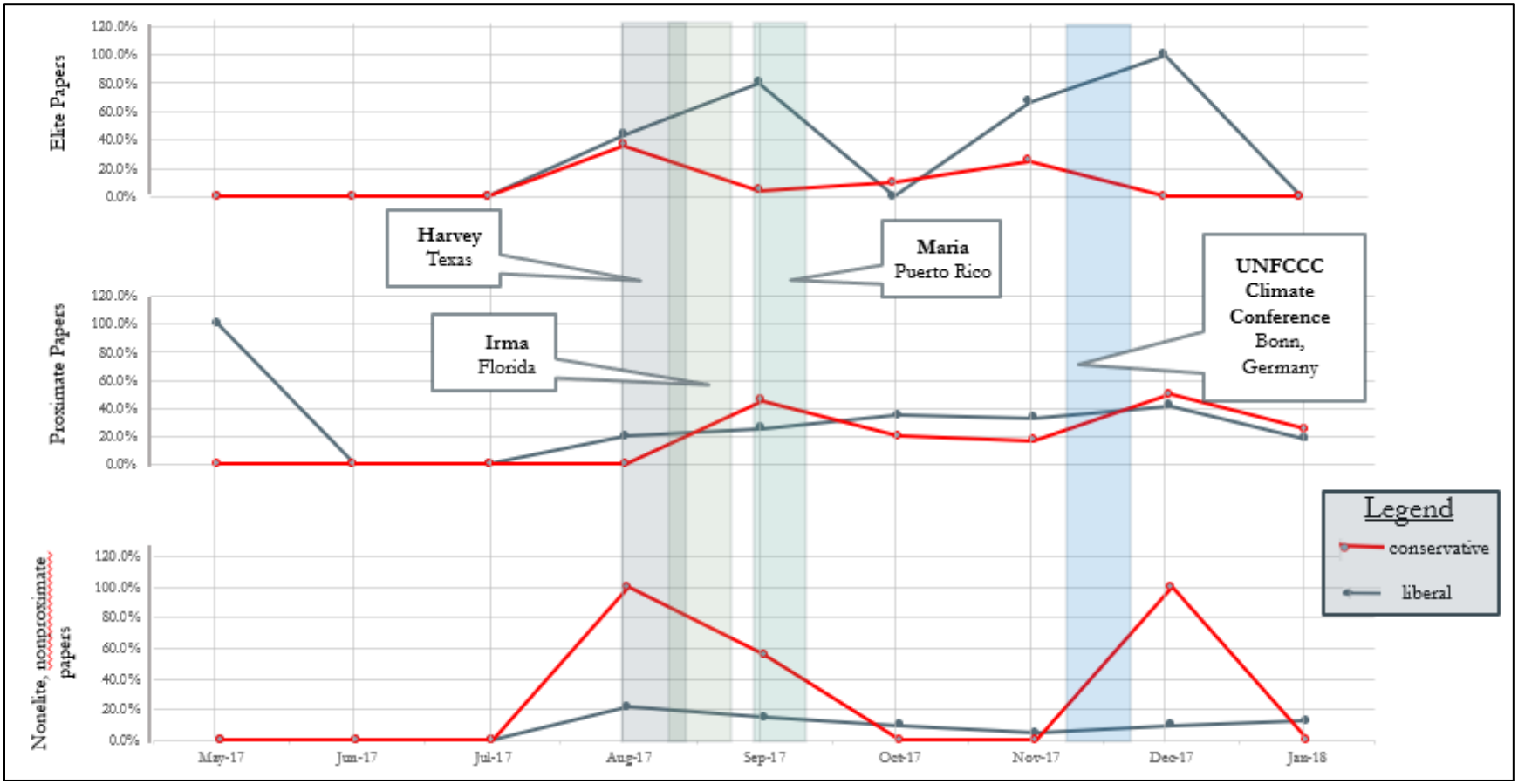

Figure 3.3 Depicts the temporal distribution of references to climate change in each characteristic group. Frequencies are shown as the percentage of articles from each paper each month that referenced climate change. Contrast between conservative and liberal papers are highlighted. Vertical shaded bands represent time periods in which relevant events occurred during the sampling period: Hurricanes Harvey, Irma , and Maria; and the UNFCCC climate conference .

3.4.2.2 Explicit and implicit references to climate change

The frequencies of implicit and explicit references to climate change did not vary significantly between aggregated groups of elite and regional papers; between proximate and nonproximate papers; or between liberal and conservative papers. However, when de-aggregated, three individual newspapers had significant differences in implicit and explicit reference frequencies from other papers with which they shared one characteristic (see Table 4.3) The New York Times had a significantly different frequency of explicit references to climate change than the Wall Street Journal (conservative, elite).

The Wall Street Journal's frequencies of implicit and explicit references were also significantly different than the other nonproximate conservative paper (the Columbus Dispatch), and were also significantly different from the aggregated group of the other conservative papers. The Wall Street Journal had fewer implicit references to climate change than other conservative papers, and no explicit references to climate change at all.

Notably, the South Florida Sun-Sentinel's frequency of implicit and explicit climate references varied significantly from other conservative papers' frequencies. The South Florida Sun-Sentinel (proximate, conservative) included more explicit and fewer implicit references to climate change than other conservative papers, but did not differ significantly from the Houston Chronicle (proximate, liberal).(See Table 3.5).

Table 3.5 Compares the frequencies of implicit and explicit climate references between individual papers and other papers in the same characteristic groups. The rightmost column contains p-values from chi-squared tests (where frequencies exceed n=6 for all categories) and Fishers' exact tests (where frequencies do not exceed n=6 for one or more categories

Paper	Characteristics	Total articles	Frequency of any climate code	Climate subcode	Frequency of articles with climate subcode	p-value, by comparison grouping	
New York Times	elite, liberal	45	26	Implicit	3.8	Elite, conservative:	> 0.001***
				Explicit	96.2	Regional, liberal:	> 0.001***
						Other liberal:	0.0011**
Wall Street Journal	elite, conservative	68	8	Implicit	100	Elite, liberal:	> 0.001***
				Explicit	0	Regional, conservative:	0.026**
						Other conservative:	0.0013**
Houston Chronicle	proximate, liberal	588	128	Implicit	49.2	Proximate, conservative :	0.200
				Explicit	50.8	Nonproximate, Liberal:	1.000
South Florida Sun-Sentinel	proximate, conservative	73	26	Implicit	34.6	Proximate liberal:	0.200
				Explicit	65.4	Nonproximate, conservative:	0.686
						Other conservative:	0.025**
Columbus Dispatch	Regional/ nonproximate, conservative	18	7	Implicit	42.9	Regional/ nonproximate, liberal:	1.0
				Explicit	57.1	Other conservative:	1.0
Seattle Times	regional, nonproximate, liberal	265	33	Implicit	48.5	Regional, nonproximate, cons.:	1.0
				Explicit	51.5		
						Other liberal:	0.561

3.4.3 Perspectives on climate change

With the exception of elite papers (which referenced climate-as-fact messages more frequently than denial messages), all groups of papers (regional, nonproximate, liberal, and conservative) referenced climate change denial perspectives more frequently than they made references to climate change as uncontroversial or factual. Differences in frequencies of climate denial perspectives were significant between liberal and conservative groups. Differences in frequencies of perspectives describing climate change as fact were also significant between liberal and conservative groups. Conservative papers had higher frequencies of references to both climate change denial and climate change as fact than liberal papers. (See Table 3.6)

Table 3.6 Compares the frequencies of fact and denial messages present in each characteristic group using chi-squared tests (where frequencies exceed n=6 for all categories) and Fishers' exact tests (where frequencies do not exceed n=6 for one or more categories).

Paper Characteristic	Code	Number of articles referencing code	Frequency of articles (in %)	p-value
Elite	Denial	5	13.2	1.00
Regional		6	13.6	
Elite	Fact	8	21.1	0.102
Regional		3	6.8	
Proximate	Denial	32	17.6	0.655
Nonproximate		6	13.6	
Proximate	Fact	26	14.3	0.218
Nonproximate		3	6.8	
Liberal	Denial	29	13.6	0.0250**
Conservative		14	25.0	
Liberal	Fact	25	11.7	0.0424**
Conservative		12	21.4	

When paper groups were disaggregated, significant differences remained between the South Florida Sun Sentinel (proximate, conservative) and the Houston Chronicle (proximate, liberal) in the frequency of references to climate change denial. Significant differences between frequencies of references to climate change as fact existed between the South Florida Sun-Sentinel

(proximate, conservative), and the Houston Chronicle (proximate, liberal); as well as between the Wall Street Journal (elite, conservative) and the New York Times (elite, liberal). (See Table 3.7)

The frequencies of denial perspectives referenced in conservative newspapers not proximate to the 2017 hurricanes (the Wall Street Journal and the Columbus Dispatch) are also worthy of remark: the Wall Street Journal (elite, conservative) made no references to climate change denial, nor to climate change as fact. However, the Columbus Dispatch (regional, conservative) included reference to climate denial in 28.6% of articles referencing climate change, but also made no reference to climate change as fact.

Table 3.7 Compares the frequencies of fact and denial messages present in each paper using chi-squared tests (where frequencies exceed n=6 for all categories) and Fishers' exact tests (where frequencies do not exceed n=6 for one or more categories).

Paper Characteristic	Political Lean	Code	Number of articles referencing code	Frequency of articles referencing climate change also referencing code	p-value
Elite Regional	Liberal	Denial	5 4	17.9 12.1	0.720
Elite Regional		Fact	8 3	28.6 9.1	0.0545*
Elite Regional	Conservative	Denial	0 2	0.0 28.6	0.200
Elite Regional		Fact	0 0	0.0 0.0	1
Proximate Nonproximate	Liberal	Denial	20 4	15.2 12.1	0.653
Proximate Nonproximate		Fact	14 3	10.6 9.1	0.789
Proximate Nonproximate	Conservative	Denial	12 20	38.7 28.6	0.806
Proximate Nonproximate		Fact	12 14	38.7 0.0	0.160
Elite	Liberal Conservative	Denial	5 0	17.9 0.0	0.564
	Liberal Conservative	Fact	8 0	28.6 0.0	0.159
Proximate	Liberal Conservative	Denial	20 12	15.2 38.7	0.0100**
	Liberal Conservative	Fact	14 12	10.6 38.7	>0.001***
Regional/nonproximate	Liberal Conservative	Denial	9 2	12.1 28.6	1.00
	Liberal Conservative	Fact	11 0	9.1 0.0	0.105

3.4.3.1 Journalistic interpretation of denial perspectives

Across all papers examined, references to climate denial perspectives most frequently occurred in the context of noting public figures' opinions. In general, references to climate denial perspectives were very critical of denial perspectives, though several articles in the Columbus Dispatch (regional, nonproximate, conservative) and the Houston Chronical (liberal, regional, proximate) did not specifically refute climate denial perspectives. Additionally, several articles in the Columbus Dispatch provided no reference to climate However, no articles in any paper specifically endorsed climate denial perspectives as factual or scientifically credible.

The South Florida Sun-Sentinel, a conservative newspaper proximate to Hurricane Irma, included the highest number of references to climate change denial of any newspaper sampled. In several articles, it reprinted large sections of the transcript from a popular conservative radio show, in which the host suggested that hurricanes were intentionally created by the government in order to create public panic around climate change. However, these passages were immediately followed by a direct criticism of the comments, which included a metaphor suggesting climate denial perspectives are "fake," cancerous, and deadly:

> "More broadly, Limbaugh's bad advice reveals the metastasizing nature of "fake news" attacks on the press, which have been led by President Trump. How did we get from Trump's claim that he has 'never seen more dishonest media than, frankly, the political media" to the idea that weather reports are phony, too?' " [2]
>
> *The South Florida Sun-Sentinel, September 8, 2017*

Demonstrations of climate change denial perspectives as contrary to local needs norms was also a trend in articles where climate change denial was referenced. Another article from the South Florida Sun Sentinel, also published on September 8, 2017, devotes the entire article to criticism of Florida governor Rick Scott's failure to acknowledge the predicted impacts of climate change on Florida. Sources quoted as being critical of Governor Scott's lack of climate policy were mainly elite Floridian conservatives, such as former Republican governor of Florida Charles Crist, Steven Adams (one of Crist's cabinet members); and Eric Buermann, general council to the Florida Republican Party. Buermann's comments were especially notable as they placed Scott's denial of

[2] Note: boldface type in quotations is my own editorial addition, added for emphasis.

climate change and resulting policies in the context of disagreeing with mainstream Floridian Republicans:

> "'I'm a Republican. He's a Republican. He's a nice guy. There's nothing negative I have to say about the human being. It's just that the policy is 180 degrees off course.'"
>
> *Eric Buermann, quoted in the South Florida Sun-Sentinel, September 8, 2017*

An August 30, 2017 editorial in the Houston Chronicle (proximate, liberal) also used an elite conservative source to suggest climate change must be addressed:

> "As former secretary of state and life-long Republican George P. Shultz has argued, the greater the chance for devastating results from climate change, the more incentive there should be to 'take out an insurance policy.' He favors 'significant and sustained support for energy research and development' and 'leveling the playing field so that costs imposed on the community are borne by the sources of energy that create them, most particularly carbon dioxide.' "'
>
> *George P. Shultz, quoted in the Houston Chronicle, August 30, 2017*

3.4.4 Description of relationship between hurricanes and climate change

Another trend in the communication of the connections between hurricanes and climate change was repetition of the statement that while climate change is not fully responsible for any single extreme weather event, climate change contributes to trends of increasing frequency and intensity of extreme weather. One example of this type of quotation comes from an August 30, 2017 article in the Houston Chronicle, which stated,

> "Climate change didn't cause the hurricane. But today's warmer water and more humid air provided it with rocket fuel, making it more intense, and humanity did conjure those conditions."
>
> *Houston Chronicle, August 30, 2017*

Yet another August 30th, 2017 article from the Houston Chronicle directly tied a trend in unprecedented Houston floods to climate change using the same technique:

> "While scientists caution against blaming specific weather events like Harvey on climate change, warmer air and warmer water linked to global warming have long been projected to make such storms wetter and more intense**.** Houston, for

example, has experienced three floods in three years that statistically were once considered 1-in 500-year events."

Houston Chronicle, August 30, 2017

3.4.5 Use of proximity cues

Frequency of proximity cues indicating nearness along spatial and/or temporal dimensions did not differ significantly between elite and regional, proximate and nonproximate papers, or liberal and conservative papers. However, frequency of spatial and/or temporal cues indicating distance differed significantly. See Table 3.8. When comparison groups were disaggregated, the South Florida Sun-Sentinel (proximate, conservative) was found to have significantly different frequencies of proximity cues indicating nearness from other conservative papers and from the Houston Chronicle (proximate, liberal). The South Florida Sun-Sentinel (proximate, conservative), also had significantly different frequencies of proximity cues indicating distance from other conservative papers and from the Houston Chronicle (proximate, liberal). See Table 3.9.

Table 3.8 Compares frequencies of near and far proximity cue use between paper comparison groups. Chi-squared tests' p-values are indicated in the rightmost column.

Paper Characteristic	Code	Number of articles referencing code	Frequency of articles (in %)	p-value
Elite	Spatially or temporally near	20	55.6	0.741
Nonelite		22	55.0	
Proximate	Spatially or temporally near	87	53.4	0.865
Nonproximate		22	55.0	
Liberal	Spatially or temporally near	104	53.9	0.955
Conservative		25	54.4	
Elite	Spatially or temporally distant	7	19.4	0.529
Nonelite		6	15.0	
Proximate	Spatially or temporally distant	44	27.0	0.080*
Nonproximate		6	15.0	
Liberal	Spatially or temporally distant	38	19.7	0.002**
Conservative		19	41.3	

Table 3.9 Compares frequencies of near and far proximity cue use between individual papers. P-values indicated in the rightmost column are derived from chi-squared tests (where frequencies exceed n=6 for all categories) and Fishers' exact tests (where frequencies do not exceed n=6 for one or more categories).

Paper Characteristic	**Code**	**Number of articles referencing code**	**Frequency of articles (%)**	**p-value**
Proximate, liberal	Spatially or temporally near	36	27.6	0.005**
Proximate, conservative		15	55.5	
Proximate, liberal	Spatially or temporally near	36	27.6	0.093
Other liberal		25	39.6	
Proximate, conservative	Spatially or temporally near	15	55.5	<0.001***
Other conservative		1	5.3	
Proximate, liberal	Spatially or temporally distant	25	19.2	p<0.001***
Proximate, conservative		16	59.2	
Proximate, liberal	Spatially or temporally distant	25	19.2	0.398
Other liberal		9	14.3	
Proximate, conservative	Spatially or temporally distant	16	59.2	p<0.001***
Other conservative		2	10.5	

Other trends in proximity cue use among the newspapers studied were also worthy of note. When proximity cues indicating spatial nearness of climate effects were used, both the Houston Chronicle and the South Florida Sun-Sentinel chose sources with low degrees of social distance from local audiences. Proximity cues indicating a large spatial distance of climate effects from local audiences most frequently occurred within the context of demonstrating the widespread nature of the effects of climate change (see Table 3.10). Finally, proximity cues indicating a high degree of temporal distance were often accompanied by cues indicating high levels of hypothetical distance (uncertainty) (see Table 3.11).

Table 3.10 Examples of near and distant spatial proximity cue usage from liberal and conservative proximate newspapers in a 2017 hurricane.

Paper Characteristics	Subcode	Quotation	Comments
Proximate, conservative	Near	"'I am persuaded that global climate change is one of the most important issues that we will face this century,' Crist said in his initial State of the State address. 'Florida is more vulnerable to rising ocean levels and violent weather patterns than any other state.'"	Places the effects of climate change near to local readers referenced Low social distance: elite conservative source chosen
Proximate, liberal		Brian Streck, 62, a retired Galveston firefighter, has watched high tides creep into the streets around his house at the edge of West Galveston Bay, where he has lived for 37 years. He has no patience for climate-change deniers who doubt seas are rising. "I've witnessed it," Streck said.	Places the effects of climate change near enough for local readers to directly observe Low social distance: longtime resident of Galveston
Proximate, conservative	Distant	" 'A broad consensus of scientists also warn of the influence of the warming climate on extreme weather events. Hurricanes Harvey and Irma, the enormous wildfires in the Western United States and widespread flooding from monsoons in Southeast Asia are potent reminders of the cost of ignoring climate science.'Whitman, a former New Jersey governor who was President George W. Bush's first EPA administrator, is a Republican."	Depicts the effects of climate change as spatially widespread, rather than solely near or distant to readers
Proximate, liberal		Harvey is yet another of several recent weather disasters marked by such shocking staying power, punishing whole regions for days or weeks on end - and longer. Others include a massive 2010 heat wave over Russia and flooding in Pakistan; the Texas drought of 2011 and the California drought that began around the same time and continued through this year; and the flooding last year in Texas's neighbor to the east, Louisiana.	Depicts the effects of climate change as spatially widespread, rather than solely near or distant to readers

Table 3.11 Examples of near and distant temporal proximity cue usage in liberal and conservative proximate newspapers near a 2017 hurricane

Paper Characteristics	Code	Quotation	Comments
Proximate, liberal	Past, present	"Additionally, higher sea levels — due to climate change and to human disturbances like oil drilling that have changed the sea and land levels — created more devastating flooding as the storm caused waters to rise."	Places effects of climate change—specifically sea level rise—in the past and present
Proximate, conservative		" …The National Academy of Science and recent peer-reviewed literature continue to show that some of today's extremes have climate change fingerprints on them," said University of Georgia meteorology professor Marshall Shepherd."	Places effects of climate change in the present
Proximate, liberal	Future	"As ProPublica notes, climate change will likely cause more devastating storms in coming years. Harvey underscores the need for flood resilience, especially in cities that are home to millions of people."	Places effects of climate change in the future High hypothetical distance: uncertainty of future climate effects is noted
Proximate, conservative		"Like Trump, Pruitt has expressed skepticism about the predictions of climate scientists that warmer air and seas will produce stronger, more drenching storms."	Places effects of climate change in the future

3.5 Discussion and conclusions

Our results support a number of other researchers' findings and theories in regard to agenda setting and issue attention; associations between extreme weather events, and the politicization of climate change. However, our results also demonstrate that these patterns hold true for coverage of catastrophic natural disasters. Instead of documenting patterns in articles about climate change, we captured references to climate change in articles about hurricanes, natural disasters not consistently associated with climate change by the lay public. Inclusion of climate change references in articles about hurricanes means that those who might not normally opt to read articles about climate change may still be exposed to news about climate change—and may be given the tools to appropriately associate increasingly intense hurricanes and floods with climate change.

3.5.1 Proximity and direct experience

The South Florida Sun-Sentinel (proximate, conservative) differed significantly from other conservative papers frequently. For example, it used more frequent references to climate change overall, and included more explicit references to climate change than other conservative newspapers. Its frequencies of implicit and explicit references to climate change did not differ significantly from its liberal counterpart, the Houston Chronicle.

In fact, the South Florida Sun-Sentinel was consistently different from the other conservative papers in its patterns of coverage. The South Florida Sun-Sentinel included more references to climate denial than both other conservative papers, and far more references to climate change as fact. Additionally, the South Florida Sun-Sentinel used proximity cues significantly differently than both the Houston Chronicle (proximate, liberal) and the other conservative papers. The South Florida Sun-Sentinel also used proximity cues to indicate the spatial and temporal nearness of climate effects more frequently than both the Houston Chronicle and the other conservative papers. This suggests that in some cases, proximity to climate-related natural disasters such as hurricanes, may lower barriers for climate change communications in conservative-leaning media sources. However, other variables may also be at play, such as proximity to overt climate-related hazards. South Florida is highly vulnerable to sea level rise and

sunny-day flooding, two signs of climate change found to influence climate risk perceptions of climate risk disproportionately to other, less-obvious effects of climate change (Brody et al 2008).

3.5.2 Issue attention and agenda-setting

In four of the six papers studied, the frequency of climate change references in articles about hurricanes responded to the occurrence of one or more hurricanes. It did not appear that the elite media set the agenda for references to climate change within articles about hurricanes: the New York Times' (elite, liberal) peak frequency of references to climate change occurred after several regional papers' frequencies of references to climate change peaked. Frequencies of references to climate change peaked following hurricanes. Interestingly, other peaks in the frequencies of references to climate change in articles about hurricanes also occurred in four papers between November and December of 2017, during the 2017 meeting of the UNFCCC. This supports the findings of Schaefer et al. (2014) and Liu et al. (2008) that climate change coverage is responsive to political events. We find that the coverage of other natural disasters, such as the 2017 hurricanes, may play a role in the placement of climate change on the news agenda.

3.5.3 Social norms and interpretive journalism

In general, conservative papers' treatment of climate change in hurricane-related articles differed significantly from liberal papers. This was somewhat expected, given the presence of a climate denial norm among US conservatives. Conservative papers used fewer explicit references than implicit references to climate change while liberal papers included more explicit references and fewer implicit ones. Conservative papers included a greater frequency of references to climate denial than liberal papers, and included a greater number of proximity cues indicating that the effects of climate change are spatially or temporally "distant." This corresponds to the existence of a social norm of low concern for climate change among United States conservatives. United States conservatives

Notably, the South Florida Sun-Sentinel (proximate, conservative) used interpretive journalism to challenge the idea of a climate-skeptical norm among conservatives. It did so most prominently by frequently using elite Republicans as sources for pro-climate messages. Elite Republican sources were also used to criticize other Republicans for climate change denial and

inaction on climate change. Weight of evidence reporting was also used to challenge denial messages, suggesting that the journalistic norm of objectivity was used with greater concern for message accuracy than in previous cases.

3.5.4 Conclusions

Linking personal experience of disaster to climate change may be one way to improve negative attitudes and misinformation about climate change. Coverage of natural disasters through the lens of climate change may reinforce the beliefs of those who already have high perceptions of climate risk and positive attitudes towards climate change (as per the theory of motivated reasoning (Kunda, 1990), while allowing those who have not previously formed strong attitudes about climate change to engage in experiential learning about the effects and implications of climate change. Proximate papers reaching conservative audiences might also have more success in utilizing social norms in order to create a more serious sense of climate risk. Conservative papers close to climate-worsened disasters also have the opportunity to promote the use of existing strategies for disaster management as a form of climate adaptation, potentially increasing conservatives' efficacy perceptions around climate change; allowing them to shift from the fear-control response that exists under high threat/low efficacy conditions to a danger-control response that exists under high threat/ high efficacy conditions (Witte, 1992). However, more research is necessary to further explore the dynamics of consensus messaging, mitigation and adaptation communication, and efficacy messaging in elite, regional, and proximate papers' coverage of climate-related natural disaster; and whether messages in the news about the relationship between disaster and climate change have any real-world impact on participation in adaptation or mitigation behaviors.

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CHAPTER 4. CONCLUSION

Science communication does not occur in a vacuum. The process and outcomes of science communication efforts are influenced greatly by social, political, and physical contexts (Scheufele 2014). In this section, I will provide an analysis of the factors which shaped the communication of two topics in climate change at the UNFCCC and in the 2017 US print media.

4.1 External factors that shape science communication

4.1.1 Power dynamics

The surveys conducted in Chapter 2 revealed that few members of the UNFCCC policy community had substantial knowledge of the phenomena referred to by physical scientists as climate tipping points. Qualitative data from the scientists and policymakers interviewed revealed that power dynamics present at the UNFCCC likely had some effect on the transmission of climate tipping point knowledge.

4.1.1.1 Legitimate and expert power

Policymakers' responses to interviews did not directly acknowledge the ways in which they exercised legitimate power over the science communication process, although it was clear that legitimate power shaped the process through which communications occurred. A few policymaker interviewees acknowledge that they frequently consulted the IPCC reports. One interviewee, who identified herself as a "science delegate" attending with a national delegation to provide scientific advice expressed frustration at the presence of a knowledge on tap dynamic in her delegation. In this dynamic, policy-focused negotiators could solicit specific information from the science delegate, but would not listen to the science delegate when she tried to inform them about topics she believed to be relevant. In her delegation, policy delegates exercised legitimate power granted by their role as negotiators in order to control the specifics of the science communication process. Other interviewees who identified themselves as policy delegates, confirmed the presence of a knowledge on tap dynamic in their delegation by acknowledging that

national scientific bodies outside their delegation existed solely to provide advice for negotiators, when negotiators solicited advice.

The exercise of expert power by negotiators affected the process of climate tipping point communication also played an important role in the story of why so few negotiators had substantial levels of knowledge about climate tipping points. Many policymakers surveyed and interviewed indicated that understanding climate science beyond what they recognized as relevant to negotiations was not their place, nor their responsibility.

4.1.1.2 Functional silo syndrome

Ensor (1988) describes the functional silo syndrome as a situation where hierarchical structures of management, highly-specialized roles within an organization, and a "high-confrontation, legalistic focus on narrow issues," leads to the creation of a divide that prevents members from seeing their work in an important greater context. This division causes the organization to become dysfunctional and reactive: organizational members within *silos* (specialized technical roles isolated from one another) wait for management to point out existing problems and threats only visible above silo boundaries, rather than having the necessary information to address them proactively. This may present an especially difficult problem to manage when no actors have legitimate power over siloed "management level" actors, each of whom have some measure of expert power within their given roles. The conditions are right for the formation of functional silos within the UNFCCC not only between the policy community and the IPCC, but also within the policy community (between alliances and Parties) and potentially within delegations themselves (between specialized delegates). This is because the UNFCCC policy community, has the power to shape and define not only their own roles, but also the roles of scientists. This minimizes the opportunity of scientists to engage in truth to power communications.

4.1.1.3 Implications and recommendations

In order to overcome the functional silo syndrome in other organizational contexts, the introduction of interdisciplinary activities and experts trained as communicators between silos is often recommended (Jacob, 2015). In the context of the UNFCCC, these suggestions could be

implemented by adding more trained science communicators within delegations to help assess and balance the communication priorities of both scientists and policymakers. Giving scientists more opportunities to speak truth to power in settings in which it would be more likely for their communications to be received by policymakers might also help scientists communicate topics of importance that do not fit within current negotiation conversations. These could be plenaries at COP meetings in which the IPCC presents a list of scientists' main priorities and findings from the assessment reports, independent of the content of the policymaker summaries. Finally, science communication trainings could be made available to policymakers in order to help them avoid the dangers of a knowledge on tap dynamic in which information important to scientists is systematically neglected.

4.1.2 Norms as barriers to communications

The norm of environmental multilateralism (NEM) is defined by Dimitrov (2005) as "the collective expectation that governments address global ecological issues in a collective, multilateral manner." Dimitrov suggests that the NEM prevents policymakers and national-level actors in international negotiations from taking actions that would be counter to the idea of cooperative environmental management (Dimitrov 2005). Such actions would include pulling out of ineffective negotiations. Our findings in Chapter 2 suggest that another action the NEM may be influencing negotiators' behavior in another way: Negotiators are unwilling to introduce new topics into negotiations if they believe those topics will disrupt the day-to-day process of building multilateral consensus. Most UNFCCC policymakers we interviewed believed it would be inappropriate to create a global governance response to climate tipping points because doing so would interfere with the process of negotiations. This was true even after interviewers defined climate tipping points and interviewees discussed global risks associated with those tipping points. In other words, it appears that the negotiators interviewed prioritized successful *bargaining* over successful *problem-solving.* If this is representative of the priorities of the rest of the UNFCCCC policy community, it poses a serious problem for global governance as well as science communication.

4.1.3 Norms as aids to communication

4.1.3.1 Professional norms

Previously, adherence to the journalistic norm of objectivity was found to create a "false balance" between climate denial perspectives and perspectives of climate change as a fact. This occurred because journalists interpreted the professional norm of objectivity to mean that all viewpoints on the issue of climate change be presented, to avoid bias in reporting. Functionally, this meant that climate denial perspectives were presented as opinions equally valid to the scientific consensus on climate change (Boykoff, Boykoff 2007). While it appears that presentations of climate denial perspectives still exist, our findings from Chapter 3 show that in most cases, denial messages are critically evaluated within the context of the article. This supports Bruggeman and Engesser's (2017) and Koh et al's (2016) findings that a shift towards weight of evidence reporting is occurring. This means that a reinterpretation of the journalistic norm of objectivity may be occurring: By providing context around levels of evidence supporting various perspectives on climate change, journalists' use of the norm of objectivity shifts from creating a "false balance" to creating a more nuanced, accurate picture of the reality of climate change.

4.1.3.2. Social norms

In Chapter 3, source choice was also a notable feature of references to climate change denial and climate change as fact. Prominent Republicans were frequently chosen to present messages of climate change as fact, while other prominent Republicans (such as Florida governor Rick Scott, President Donald Trump and former EPA administrator Scott Pruitt) were frequently cited as deniers of climate change. Climate change denial perspectives are popularly associated with United States conservatives, conservative funders, and conservative think tanks (Brulle, 2014). However, presenting dissenting opinions on the reality of climate change from within the Republican party demonstrates that a climate change denial norm among conservatives is not universal. Unsworth and Fielding (2014) suggest that the use of social norms-based messaging could be an effective way to diminish the prevalence of climate change denial. They suggest using elite Republican sources to voice messages of concern about and belief in climate change in order to rectify mistaken perceptions that climate change denial among Republicans is universal.

4.1.3.3 Implications and recommendations

When utilized correctly, norms can be a driver of behavioral change (Ajzen, 1991). Alternatively, norms can act as barriers to positive behaviors, especially in cases where a minority of actors believes that a positive behavior or perspective is counter normative to their peer group (Berkowitz, 2004). Therefore, to maximize the efficacy of science communications, scientists and science communicators should consider how social norms and perceptions of social norms may be influencing how their communications are received.

Though eliminating the influence of the NEM over the global governance process would be very difficult, as it is central to the structure of international environmental negotiations (Dimitrov 2005) it may be possible to use the NEM to promote more effective science communication at the UNFCCC. This could potentially be accomplished by redefining what it means for a negotiation to be "successful." The NEM suggests that actions taken that jeopardize the success of multilateral environmental negotiations process are considered counter normative. If the success of the process is also defined by its ability to manage climate-related risk, behavior that precludes risks from being addressed in negotiations becomes counter normative. Presently, policymakers do not see learning about and interpreting climate science that is not directly related to the negotiations process as part of their roles. However, redefining "success" to include management of present and emerging risks would make scientific expertise more central to the negotiations process and would create more space for "truth to power" communications by scientists.

Similarly, reframing professional journalistic norms could benefit the accuracy of climate communication, especially in reference to presentations of climate denial perspectives. Likewise, techniques for effective messaging using norms to promote attitude change should be considered by science communicators and mediators of science communications, especially in cases where perceptions of norms around false or extreme beliefs exist.

4.1.4 Proximity to climate change

Construal level theory states that the level of abstraction increases with distance, and decreases with nearness. Both chapters found evidence that actors for whom climate change was

most concrete (and psychologically near) engaged with climate communication differently than did actors for whom climate change was more abstract and distant.

In Chapter 2, we found that the actors most willing to say climate tipping points deserved a governance response (regardless of the difficulties introducing climate tipping points to the negotiation process might have for reaching consensus) were those we could expect to have the lowest psychological distance from the immediate and obvious effects of climate change. These included scientists, who are immersed in climate science on a daily basis, and policymakers from the Pacific Islands, who have already begun to see the effects of rising sea levels and increasingly frequent and intense storms on their homes. These actors believed that climate tipping points deserved a formal governance response, regardless of the impact of their introduction on the progress of the negotiation process. This was in stark contrast to interviewees from areas and professions farther removed from the hazards and immediate evidence of climate-related disaster.

In Chapter 3, we found that the types and frequencies of references to climate communication were significantly different in areas that directly experienced a climate-related natural disaster. Papers closer to a 2017 hurricane had higher frequencies of explicit references to climate change than their counterparts from other regions not directly affected. Furthermore, papers in regions that experienced a 2017 hurricane used "near" proximity cues more frequently than other papers, and "distant" temporal cues less frequently. The conservative paper from a region that was affected by a 2017 hurricane used interpretive journalism to criticize climate denial perspectives, and used norms-based messaging to challenge perceptions of climate denial acceptance among conservative American elites, even though this type of editorial choice may have been unpopular with conservative readers. This is interesting because conservative papers run the risk of alienating conservative audiences by presenting perspectives that do not align with a conservative base of readers and advertisers.

4.1.4.1 Implications and recommendations

Kahan et al (2012) concisely summarizes Douglas and Wildavsky's cultural theory of risk (1982) by explaining that "for an ordinary individual, the most consequential effect of his beliefs about climate change is likely to be on his relations with his peers…Given how much the ordinary individual depends on peers for support—material and emotional—and how little impact his beliefs have on the physical environment, he would likely be best off if he formed risk perceptions

that minimized any danger of estrangement from his community" (Kahan et al. 2012). Kahan presents this statement in the context of a paper finding that high levels of science literacy increases the polarization of climate risk perceptions along cultural lines, suggesting that psychological distance, not expertise or science literacy, is a key factor in the willingness to transmit and receive climate communications. Likewise, this thesis suggests that there may be some connection between personal perceptions of climate change as an immediate threat and perceptions of engagement in behaviors that promote communicating about climate change at the risk of backlash from other stakeholders.

4.2 Conclusions

This research supports the idea that science communications occur in the context of many contextual factors, and that these factors—especially norms, power, and personal experience—are all related to the success or failure of climate change communications. As scientists and science communicators, we must understand and consider our audiences when communicating our research. By understanding our audiences' ingroup dynamics, experiences, and norms, we can learn how better to tailor our messages so that they will be heard and accepted. Though communicating science through sociopolitical space may still feel like a game of "Telephone," having a deep understanding of our communications' context will help us play by the rules, and, when necessary, know how to change them. However, more research is necessary into the decision-making process and consideration of tradeoffs involved in "risky" climate communications. Furthermore, investigation into whether actors who act against current ingroup social norms around climate communication are ostracized by their peers. It is currently unclear whether, for example, a Pacific Island delegate introducing climate tipping points into a negotiation stream would be sanctioned in any way; and it is unclear whether the South Florida Sun-Sentinel lost subscribers due to the ways in which climate change was covered. It is also unclear whether scientists who try to engage in "truth to power" communications when others are not, are ostracized by their audiences, or by other scientists. However, as public opinion shifts towards acceptance of urgent climate action, perhaps truth to power communications by climate scientists will also gain acceptance.

4.3 References

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APPENDIX A. CHAPTER 2 SUPPLEMENTARY MATERIALS

SURVEY INSTRUMENT

Research Project – Gaming Climate Futures – Dr. Manjana Milkoreit, Purdue University
IRB Study Number: 1704019028; Document version 1 1

MINI SURVEY – Climate Tipping Points & Global Temperature Targets

This survey is part of a research project at Purdue University: *Global Temperature Goals to Avoid Climate Tipping Points – A Serious Game to Support Serious Decisions*. Your participation in this study is completely voluntary and anonymous. Filling out this mini-survey indicates permission to use your responses in our analysis. If you have any questions, comments or concerns, please contact Manjana Milkoreit at mmilkore@purdue.edu or +1 (602) 600-5768.

1. What is your current role in the climate negotiations (please select all that apply)?

- o Diplomat/Member of a Party Delegation
- o Representative of a Civil Society organization (NGO)
- o Representative of the Private Sector/Business Community
- o Scientist (IPCC or observer)
- o Member of the UNFCCC Secretariat
- o Representative of an Intergovernmental Organization
- o Other: Please Specify: _____

2. What is your nationality? _____

3. How do you define climate tipping points?

3a. Please offer one or two examples of a climate tipping point.

1. _____

2. _____

4. What is the most appropriate global temperature goal?

- o Less than 1.5C
- o 1.5□C
- o Well below 2C
- o 2□C
- o More than 2C

Research Project – Gaming Climate Futures – Dr. Manjana Milkoreit, Purdue University
IRB Study Number: 1704019028; Document version 1 2

5. What does “well below 2C” mean?

6. What were the reasons for including 1.5C in the Paris Agreement? Please select all that apply.

- o Scientific advice
- o Insight that 2C does not prevent dangerous interference with the climate system
- o Results of the 2013-2015 Periodic Review
- o Solidarity with small island states
- o Opening the door to geoengineering as a potential solution
- o Rationality: the benefits of pursuing 1.5C outweigh the costs;
- the net benefits of pursuing 1.5C are also higher than for pursuing 2C
- o Other:

_____

6a. Please add any comments you might have concerning your selections for question 6.

_____

THANK YOU!

INTERVIEW GUIDE

Gaming Climate Futures

IRB Application for Phase 2

Manjana Milkoreit

March 31, 2017

Interview Protocol for Negotiators and NGO representatives

Phase 2, Gauging Information Needs and Desires

Goals:

- Understand existing beliefs about temperature goals, tipping points and their relationship
- Gauging information needs and desires (what do they want to learn about?

Part 1: Tipping Points

1. How do you define climate change tipping points?

If their definition is radically different, introduce a basic definition of climate tipping point: abrupt, large-scale change events that are driven by climate change and can qualitatively alter the nature of an environmental system with major implications for human wellbeing (e.g., the 'dieback of the Amazon)

2. Which potential tipping points (in this scientific sense) are you aware of?
3. Which potential tipping points are you most concerned about?
    a. Why? *(Invite a discussion of the consequences/impacts of passing a tipping point.)*
4. Do you think there should be a governance response to tipping points?
    a. What could that look like?
    b. What are potential obstacles to addressing climate tipping points?
5. Is this a topic of discussion among negotiators?

Open to a structural responses (i.e., this happens in this negotiation stream), to substantive response (what part of the problem is discussed) and to alliance-related response ("The island states talk a lot about this."). Need to probe for all three dimensions.

6. How did you learn about tipping points?

Part 2: Temperature Goals

1. What is your country's/organization's position (negotiation goal) with regard to the global temperature goal?
   If possible, come prepared with some knowledge about the country's official position.
2. In your personal opinion, what is the most appropriate global temperature goal?
   a. Why?
3. How does that relate to your country's position on the temperature goal? Can you elaborate on the differences?
4. Do you believe that 1.5°C is a ***feasible*** goal? Please distinguish between the theoretical feasibility (i.e., the possibility to model a 1.5C outcome) and the practical feasibility of achieving this goal.
5. If yes, are there different pathways towards 1.5°C, and do you have a preference for one?
6. Whether or not the goal is feasible, what were parties' reasons for supporting the inclusion of the 1.5°C goal in the Paris Agreement?
   a. Do you have doubts about the sincerity of the commitment of some parties to this goal?

If they answered 4 with yes, don't ask 7.

7. Do you think 2°C is feasible?
   a. *If the response is no:* Why is this the central shared global goal of the negotiations?
   b. *If the response is no:* What temperature goal is feasible?
8. If you imagine your home town in the future, what would be the major differences between a 1.5°C world compared to 2°C world?
   a. How would 2°C compare to 4°C?
   b. *Possible follow up*: What about the world in general rather than your home town?
9. Regardless of the global goal, what is your best estimate of how much warmer will it be in 2100?

10. How do you learn about temperature goals and their achievability?

Part 3: Relationships between Tipping Points and Temperature Targets

1. Is there a relationship between climate tipping points and certain global temperature goals, i.e., how are these two things connected?
2. Thinking in particular about [*the person's key tipping point of concern - see question 3*], what is the relationship between tipping and the global temperature goal?
3. Do you feel that you understand this relationship well enough?

Part 4: Knowledge and Learning Needs & Desires

1. Do you (or your delegation) have any learning/information needs concerning these topics (tipping points, temperature goals and their relationships) to help inform your work in the negotiations?
2. If you had the opportunity to learn more about climate tipping points,
    a. Which specific tipping points would you like to learn most about?
    b. What would you like to know or understand?
3. If you had the opportunity to learn more about global temperature goals,
    a. Would you be interested in more information about a specific goal?
    b. What would you like to know/understand?
4. Would you like to learn more about the relationship between tipping points and temperature goals?
5. Which questions would you like to be able to answer?

APPENDIX B. CHAPTER 3 SUPPLEMENTARY MATERIALS

CODEBOOK

Level 1: Broad Coding Framework

For this level of coding, code the full article with as many codes from each category as apply, unless otherwise noted. If article is coded 1.a, Hurricane Focus, proceed to the rest of the codebook. If article is coded 1.b. Tangential, or 1.c. Exclude, DO NOT proceed with the rest of the codebook. However, if you mark code 1 as 1a. Hurricane Focus, **you need at least one code for every number 1-5 for**

1. **Article Relevance-** Code each article with ONLY ONE of these. You MUST use this code.
    a. **Hurricane Focus –** article's significant/substantial focus is about hurricanes: the majority of the article is about hurricanes, or has a dedicated section that focuses only on a hurricane or hurricanes. Example: article about Harvey recovery, article about impending hurricanes, article about hurricane parties. If article gets this code, PROCEED TO REST OF CODEBOOK.
    b. **Tangential –** if the article has only a tangential or passing mention to hurricanes and is mainly about something else. For example, an article about sports teams briefly mentions that a game was rescheduled due to hurricanes; or an article about subway tunnels mentions briefly that a hurricane caused some damage to the tunnels. DO NOT PROCEED TO REST OF CODEBOOK
    c. **Exclude-** if the article does not actually pertain to hurricanes (eg. A place called Hurricane Ridge; a Hurricane cocktail; personality like a hurricane; etc). DO NOT PROCEED TO REST OF CODEBOOK

2. **Article type:** AS MANY OF THESE AS APPLY. You MUST use this code.
    a. **News piece:** the article is a piece of journalism that has one main focus and covers a distinct story. It should not have any marking denoting it an editorial, a briefing or recap, or an opinion piece.
    b. **Composite article:** this is an article that is comprised of many short pieces that are each descriptions of other stories, not necessarily all related to hurricanes. Includes articles marked as daily briefings, weekly reviews, highlight reels, or recaps. Mutually exclusive with 2.a. News Piece.
    c. **Opinion:** If the article is marked Opinion, or Community Voices, or something like that. Excludes anything where affiliation with the publication's staff is noted (ie, editorials, editor's note, etc)
    d. **Editorial:** If the article is marked Editorial, editorial board, editorial contributor, etc. This does not include articles especially marked "opinion." The difference here

from "opinion" is that the prose piece is affiliated with the publication's editorial board.

e. **Wire / news service piece**- if the article's byline is from The Associated Press, Bloomberg News Service, or another news / wire service. Also use this if the article is "borrowed" from another paper- for example, the FSS borrows articles from the Orlando newspapers; the Houston Chronicle uses Washington Post articles, etc.

3. **Storm**: AS MANY OF THESE AS APPLY. You MUST use this code. Only use 3.f. if no other codes 3.a-e apply
   a. **Harvey**
   b. **Irma**
   c. **Maria**
   d. **Other 2017 hurricane:** Includes hurricanes **Franklin, Gert, Jose, Katia, Lee, Nate, Ophelia; and tropical storms Arlene, Bret, Cindy, Don, Emily, Philippe, and Rina**. The typhoons you'll probably hear about (if any) would be: Noru, Nesat / Gorio, Banyan, Hato/Isang, Sanvu, Talim / Lannie, Doksuri/ Maring, Khanun/Odette, Lan / Paolo, Damrey / Ramil, Tembin/Vinta. Include them as well.
   e. **Past hurricane**: Includes Katrina, Sandy, Andrew, Ike, etc.
   f. **General hurricanes:** hurricanes in a general sense but never otherwise mentions hurricanes (ie, "hurricanes caused damages," or "hurricane season is nearly here")

4. **Timeframe**- AS MANY OF THESE AS APPLY. You MUST use this code.
   Note: if article is about multiple storms,"during/after" will most likely apply consistently to them all. However, if this is not the case, code with both codes if needed.
   a. **Before**- article published before storm makes landfall
   b. **During/after**- article published after storm made landfall

5. **Climate Change** – Mutually exclusive- only code one. You MUST use this code.
   a. **Absent**: No implicit or explicit discussion of climate change in the article.
   b. **Present- Explicit**: Only if one or more of the phrases climate change, global warming, global change, changing climate, or warming climate is mentioned.
   c. **Present- Implicit**: This includes discussion of extreme events (only if frequency changes are mentioned?), discussion of changing frequency and intensity of hazardous weather, reference to changing temperatures that do not include the phrases included in 2.b. Increasing / changing climate variability would also fall under this category. abnormal, unusual, exceptional, first-time ever, never before- Climate has always been variable is excluded from this

6. **Actions around hurricane**- Code as many as apply. You might not need to use this code.
   If multiple storms are referenced, using multiple codes is acceptable, and you do not need

to differentiate which code applies to which storm. If people are not doing any kind of preparation for or response to the hurricane(s), do not use any of these codes.

a. **Short-term preparation:** preparation that occurs in anticipation of a specific storm, in the timeframe between when it is first forecasted to when it makes landfall. This includes making physical changes to structures (such as putting boards over windows), declaring an emergency before a storm, stockpiling food, water, and food, evacuating, or so on. This refers to *reactive adaptation*- people are reacting to an imminent crisis. So, stockpiling food in preparation of Hurricane Irma would apply as short-term preparation, while stockpiling food in preparation for the hurricane season would count as long-term preparation.
b. **Long-term preparation:** any type of preparation for a hurricane that occurs before the hurricane season, that is not preparation in advance of a specific storm. Includes getting insurance, changing financial structures, elevating structures, changing/ reinforcing seawalls, changing/reinforcing infrastructure, not building in floodplains, city planning, environmental restoration (eg planting mangroves or restoring wetlands), improving technology for advance detection or improving warning systems. This refers to *preemptive adaptation*—people are responding to the possibility of future crises.
c. **Response and Recovery**: any response to a hurricane or recovery from the effects of / damage of a storm during or after the storm. This includes everything from descriptions of rescues to financial bills being proposed/passed in Congress. The only thing that really is necessary for inclusion here is the fact that the actions occur during or after the storm is over.

7. **Impacts:** Code as many of these as apply. You might not need to use this code. **Only use 7.i. if no other codes 7a. -h. apply.**

This refers to impacts of the hurricane or hurricanes: situations that arise as a consequence of the hurricane. While most of these effects are negative, if a positive impact is included (such as clearing invasive species from the natural environment), it still counts as an impact.

a. **Economic:** article references economic effects, such as economic slumps, price gouging, prices for goods and services going up or down, changes in investment, shortages of goods or services, lost productivity (meaning lost days of work including for public sector employees and military personnel and delayed deployments but NOT lost days of school or delayed provision of services), and insurance. Does not include federal financial aid, which would be under 6.c, response/recovery instead.
b. **Human Health**: article references morbidity and mortality or threats to human health- health implications resulting from the hurricane. This includes things like total death toll, mental health issues, mold-related illness, deaths from flooding, illness from waterborne diseases, chainsaw accidents, gunshot wounds, missing

persons, and compounding of illness and death due to shortages of medicine and medical care. Also includes general reference to events being "deadly"

c. **Infrastructure and/or delayed provision of services**: article references damage / threats to infrastructure and/or delayed provision of services. This includes destruction of and damage to power grid, water main breaks, sewer malfunctions or destruction, destruction of railroads and ferries, and destruction or damage to roads and interstates, disruption to or delay of trash pickup and cable/ internet provision, lack of drinking water, and long lines for fuel. Also includes children missing days in school but NOT teachers or other people missing work (which would be economic).
d. **Property Damage**: reference to property damage or threat to property that is NOT infrastructure. This includes public and private property, such as businesses, farms, schools, aquariums, libraries, homes, cars, non-ferry boats, crops, and other objects. Also includes livestock and pets. Excludes property that also functions as public infrastructure (eg, power lines, water mains, internet and cell towers, roads, phone lines, etc)
e. **Environmental**: references to destruction or threats to the natural environment due to the storm itself, subsequent flooding, or pollution resulting from property damaged in the storm. This includes inorganic physical features such as coastal erosion, as well as organic features such as mangroves, ecosystems, or species and wildlife / plant communities.
f. **Justice**: article references any disproportionate effects of / vulnerability to the hurricane as they relate to the unfair or unequitable effects on disadvantaged groups. Groups considered disadvantaged for the purpose of this exercise are: the elderly, children, physically or mentally disabled people, the poor, communities of color, and communities from developing nations (such as Bermuda, the Dominican Republic, Haiti, etc). Articles about Puerto Rico do not automatically fall into this category; however, articles about failure of federal agencies to manage crises in Puerto Rico or articles about how Puerto Rico does not have the funding to make adequate preparations does fall into this category. Articles that mention disadvantaged groups but do not mention disproportionate effects are not included (for example, "fireman rescued elderly person from flooding" would be excluded)
g. **Geographically vulnerable:** references people (not land) who are already geographically vulnerable- due to living on the coast, living in an area already hit by hurricanes, or in low-lying areas.
h. **Change in home status:** references people having changes in the status of their households or disruption to family life. This includes homelessness, having to permanently or temporarily move, migration, staying in shelters for extended periods of time (more than a month after the hurricane), changing schools, and separation of families.
i. **General destruction:** if article says that hurricane is destructive or devastating, but does not mention any further or more specific effects.

Level 2: Climate Specific Codebook –

This is the codebook for only the articles that have been marked as having implicit or explicit mention of climate change. Code the entire article. Use as many codes as apply, unless otherwise noted in the code subheading.

8. **Abnormally extreme events-** Descriptions of extreme events. *Code as many as apply.*
    a. **Abnormal hurricanes and/or abnormal related flooding**- This includes unusual weather events related to hurricanes and the resulting floods. For example: weather that has never happened before, [events] of an unprecedented scale, historic flooding, thousand-year event, hundred-year event, extreme events, etc. Also include snow hurricanes (which are themselves abnormal) and abnormal typhoons .
    b. **Other abnormal extreme events**- reference to other exteme/abnormal/anomalous weather events or weather-related natural disasters. Include wildfires, drought, blizzards, floods, etc not caused by/related to/ attributed to hurricanes. Include abnormal snowfall in the South and/or Southwest. Also use this code if "abnormal" or "anomalous" events are mentioned, but no specific type of event is mentioned. For example, " The United States has experienced a large number of weather anomalies since 1990"
    c. **Biblical metaphor-** If biblical language or metaphor is used to describe the severity or abnormality of an event(s) in either quotations from interviewees, or in the main text. Note: this excludes mention of people praying or reading the Bible or other religious text, unless it is specifically used to reference the extreme nature of an event or events.

    Include but don't mark as subcodes:

Noah and the Ark	"the Flood," "biblical flood," "antediluvian,"purging the earth," reference to a rainbow at the end of a storm, reference to a dove or doves returning to some location
Judgement Day	horsemen of the apocalypse, "judgement day," "end times," "blood red," "revelations," trumpets, atonement, or divine judgement.
Plagues	locusts or grasshoppers, frogs, lice, gnats, flies, plague or "plagues," or "angel of death."
general biblical metaphor	includes the word "biblical" or "of biblical proportion," "Exodus," "Leviticus," "Old Testament," etc.

9. **Climate change attribution-** References to what causes climate change. You must code at least one. Code as many as apply. No Attribution (2d.) is mutually exclusive to all other codes in this section.
    a. **Humans-** people are specifically noted as being the cause of climate change. This includes "anthropogenic," "human-caused," but also more indirect reference to behaviors related to human activity, such as "burning fossil fuels," "cattle burps," "industrial activity," etc.
    b. **Natural cycles**- attribution of climate change to El Nino, natural cycles, natural fluctuations, for example.
    c. **Supernatural-** climate change is attributed to a god or god(s), or some other supernatural power, such as "the universe" or "Mother Nature."
    d. **No attribution-** no attribution for climate change is noted.

10. **Hurricane attribution**- References to what causes and/or influences hurricanes. You must code at least one. Categories are mutually exclusive.
    a. **Climate change attribution-** the qualities of a storm is explicitly mentioned as being related to or due to climate change. For example, "climate change is the key explanation for Hurricane Harvey's unprecedented levels of devastation." Also, use this code if climate change is acknowledge as responsible for changing trends and patterns. For example, "climate change is likely responsible for an uptick in devastating hurricanes." Also include more indirect attribution of climate change to hurricane trends, such as "Climate change strengthens El Nino, and El Nino strengthens hurricanes—meaning we're seeing hurricanes of unprecedented intensity even for El Nino years."

    b. **Other attribution-** hurricanes are attributed exclusively to other things, such as El Nino, or specifically to currents and atmospheric conditions, etc, where these conditions are not themselves attributed to climate change

    c. **No attribution-** Article does not attribute hurricane to anything.

11. **Perspectives on Climate Change:** Code as many as apply
    a. **Explicit Denial:** Climate change is not happening, climate change is a hoax, climate conditions occur at random with no patterns or trends, etc. The article itself may or may not endorse this perspective, but some source in the article must explicitly deny climate change.
    b. **Climate as fact-**explicit statements that climate change is definitely happening, or that a consensus of scientists agree that it is happening.
    c. **Future is unpredictable-** Climate change discussion is couched in a narrative that states the future is unpredictable, or that the effects / implications of climate change are partially or completely unknown or unknowable. "Even if the climate changes, we cannot predict what will happen in the future." Includes words like "uncertainty" or "error" when they are used as synonyms for skepticism.

d. **Climate change is overstated-** Climate change is not directly denied, but is qualified with language that suggests the risks or effects of climate change are overstated, or that extreme events should not be attributed to climate change.
e. **Model uncertainty**- uses words like "error" or "uncertainty" or "variability" specifically in a science context. For example, "Model uncertainty," "within a narrow margin of error," etc.

12. **Temporal Effects of Climate Change –** References to when climate effects will be felt**.** Code as many as apply
    a. **Present –** the effects of climate change are happening now. This includes any present- and past-tense description of climate change. For example, "already beginning to occur," "happening," "have become a problem," "has been occurring,"
    b. **Future--** the effects of climate change will happen in the future. This includes any future tense: "will happen," "may happen," "likely to happen," "will happen within our children's lifetime." If no other cues are listed, code future tense descriptions of climate change as "Future."

13. **Spatial Effects of Climate Change-** References to where climate change is occurring, and what regions are feeling or will feel the effects. Code as many as apply
    a. **Near –**the effects of climate change are nearby to a US reader (Note: climate change effects may be implicitly or explicitly labeled as climate effects) such as "in our backyard," "close to home," "nearby," "closer than you may think," "here," "within this region," "in the United States." Watch for "we" and "us" language. Include reference to climate-attributed migration, for example, formation of a "Little Haiti" in Miami due to Haitian refugees fleeing climate-related crop failures or storms.
    b. **Far-** the effects of climate change are far away from a US reader, or only references climate change impacts that occur outside the continental United States. Watch for "they" and "them" language, especially in quotations from interviewees. For example, "Impacts are felt broadly across the developing world."
    c. **Widespread-** the effects of climate change are widespread or universal: "across the globe," "global problem," "universal threat," "far-reaching impacts," "widespread" etc. Watch for linguistic cues such as "everyone," and "all of us"

14. **Adaptation –** References to measures being take for the sake of coping with climate change**.** Code as many as apply.
    a. **Occurring**- makes specific mention of changes that are being or have been made for the sake of adaptation to climate change, whether related to hurricanes or not. This could include adaptation to future conditions such as extreme flooding and/or

storms. Also include or trends in adaptation that are expected as future conditions change.

b. **Failure**- explicit reference to the fact that people are adequately not adapting or planning for changing future climate conditions. This does not include there being no explicit mention of adaptation, though it does include items such as "People are not planning ahead." or "Cities are unequipped to make the investments necessary to fortify against increasingly intense future hurricanes" "While some efforts to de-pave the city have been taken, Houston has not done nearly enough to plan for future flooding."

c. **Proposed**: adaptation measures that have been proposed, but are not necessarily used yet, or have not begun being implemented. Allocation of funding towards adaptation and proposed policy (such as rezoning to discourage floodplain settlements) count.

d. **Specific measures**- These refer to the type or types of adaptation that is occurring, should occur, or has been proposed. Code as many as apply.
    a. **Green Approach-** encompasses approaches to adaptation that "rely only on nonstructural measures that reduce the potential adverse consequences of flooding," such as green infrastructure, rezoning, moving out of floodplains, decreasing paved surfaces, ecosystem restoration for flood management, elevating homes, buying better insurance, etc
    b. **Tech Approach**- encompasses approaches to adaptation that rely on structural and technological management flood strategies. These include building seawalls, pumps, or levees.

15. **Mitigation**- Use this code if climate mitigation is referenced, even only briefly. Include carbon emissions reductions, geoengineering technologies, policies to reduce carbon emissions, the Paris Agreement or international negotiation. Also include calls to engage in mitigation. Also include comments on how current mitigation efforts are not sufficient, or comment on how mitigation is not being done or thought about.