

CREATING GUIDELINES FOR EFFECTIVE WEATHER COMMUNICATION: A
QUALITATIVE ANALYSIS OF MESSAGE STRATEGIES THROUGH THE LENS
OF METEOROLOGISTS

by

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DEDICATION

This is dedicated to my family and friends who supported my dreams, from my community college days, to the “stardom” of a small-town girl who somehow got into an Ivy League, and to Wysocki, who always listened to me ramble about my thoughts on weather communication when I was a young undergrad back at Cornell. You always told me, “You’ll figure it out, kid.” This thesis is another step towards that destination, which you always inspired me to run towards.

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ABSTRACT

CREATING GUIDELINES FOR EFFECTIVE WEATHER COMMUNICATION: A QUALITATIVE ANALYSIS OF MESSAGE STRATEGIES THROUGH THE LENS OF METEOROLOGISTS

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From agriculture to economics, aviation to daily commutes, the role of meteorologists can be felt within the life of every individual. Therefore, it is important that meteorologists communicate forecast information effectively and in a way lay audiences can understand. This thesis explores the literature on weather, science, and risk communication, presenting four main goals of effective communication: message understandability, memorability, sharability, and actionability. The barriers and solutions to these objectives were analyzed through the context of meteorology, with strategies presented and qualitatively analyzed through semi-structured interviews with meteorologists who use social media. In result, this thesis produced and revised a checklist product and informational booklet to be used by meteorologists to better meet their communication goals on social media.

INTRODUCTION

It was late January of 2015 when a blizzard was forecast to slam 2 feet of snow onto New York City, creating a domino effect of warnings, transit, and school closings. A Google search of Winter Storm Juno, as it was named by the Weather Channel, brings numerous headlines, with writers wondering how they awoke to clear roads when the forecast seemed so drastic and the subway system was closed for inclement weather for the first time in 110 years (Flegenheimer, 2015). It appeared that a lapse in communication had occurred among meteorologists, decision makers, and lay stakeholders.

Messaging tactics have been analyzed in the context of science and risk communication. However, there has not been a specific product made, in the context of meteorology, to provide recommendations on improving their messaging strategies. Given the situation with Winter Storm Juno and countless other weather events, this thesis will provide a checklist product that meteorologists can follow to improve their messages with four goals in mind: understandability, sharability, memorability, and actionability.

The importance of these goals can be seen in the context of extreme weather events. For instance, message understandability is important, so the audience can understand the impact and timing of a severe weather event, which can impact their

decisions during the event. Sharability also holds importance, such as for meteorologists wanting to spread information on how to adequately prepare for a tornado threat.

Meteorologists may want audiences to remember a message, so they know what to do during a weather event when they may lose access to technology. Actionability would be important in cases of urgent and imminent danger, such as explaining the potential impact of an anticipated flood and why it would be safest for a threatened community to evacuate.

The product will focus on creating messages for social media, since 69% of American adults use social media (Pew Research Center, 2017). Specifically, the recommendations will be crafted with Facebook in mind, since it is the most popular medium of social media, and allows users to post text, videos, and photos (Pew Research Center, 2017). Government and private sector meteorologists both use Facebook as a way to communicate to lay stakeholders, since Facebook is available 24/7 and allows direct communication between the audience and the meteorologists, making weather information more personal by giving users a chance to directly comment on posts and ask meteorologists questions, gaining more insight into weather events and stories through the process (Ferrell, 2012). Social media is more immersive than the normal one-way communication model of television forecasts or weather summaries found on the sites of the National Weather Service.

This thesis will be divided into chapters that focus on various sectors of academic research that will build the checklist communication product for meteorologists. To start, Chapter 1 will begin with an analysis on the importance of meteorologists and explain the

focus on this specific field of science, emphasizing the importance of why that communication needs to be improved. The goals of applied meteorology will be established as a prerequisite for the communication goals in Chapter 2, along with the barriers meteorologists face in communicating with lay stakeholders. This step is important, as the research process will see if the goals and barriers stated in this chapter are mirrored in the communications of meteorologists, which will be found through the interviews.

The second chapter will overview literature regarding science communication in general, particularly science incorporating risk. What do scientists prioritize naturally when communicating science? What should they keep in mind that they may not intuitively do? This chapter will overview the role of setting, mental models, and the role risk plays. This holds importance in giving context for how to approach communicating science in general, of which meteorology is a specific subset with unique challenges. The chapter will be organized through the four goals of message understandability, memorability, sharability, and actionability, in reviewing the literature based on barriers that hinder communication from accomplishing those objectives.

Chapter 3 will review the relevant literature on science communication and risk communication, bringing together aspects that relate to message structure that will provide the foundation for the checklist. The first section of Chapter 3 will incorporate the importance of social media when creating messages – and why the checklist will provide recommendations on using Facebook over other environments, such as television or mass media. This thesis will examine scientific messaging strategies, drawing from

scholars such as Heath and Heath (2007) on general best practices, Milkman and Berger (2014) on the science of sharing, and Ratner and Riis (2014) and on creating memorable and sharable science messages. This work will also tie in risk communication, such as Miller's (2001) work in audience analysis and research by Rowan, Botan, Kreps, Samoilenko and Farnsworth (2009) with the CAUSE model. These examples will provide the foundation for a checklist this thesis aims to create, recommending the characteristics a message should have if it aims to be effective in garnering understandability, memorability, sharability, and actionability. Some messages may hold a multitude of those features, which will also be considered within this instrument.

Chapter 4 will introduce the checklist structure, as it will follow recommendations created by Gawande (2010) in his work *Checklist Manifesto*. This chapter will also outline the qualitative methodology that will be used to improve the checklist, in order to quantitatively analyze it within this thesis or a future project. This will entail recruiting meteorologists to review the products and conducting semi-structured interviews with the participants to understand what they find to be useful or incorrect. Questions will also be asked about their overall communication goals, to ensure the checklist adequately reflects those values. Chapter 5 will examine the results and discussion, with Chapter 6 containing concluding thoughts and the future direction of this research. Overall, this thesis aims to create a theory-informed message checklist specifically for meteorologists to help them meet their communication goals.

CHAPTER ONE

Why Meteorologists?

From agriculture to economics, aviation to daily commutes, the role of meteorologists can be felt within the life of every individual. Their information can be found on smartphones, through the voices of radio and the screens of televisions. Meteorology also encompasses a plethora of roles, including theoretical atmospheric research, climate modeling, and numerical weather prediction (Janković, 2015). For the sake of this thesis, I will be focusing on the role and importance of applied meteorology, which Janković defines as, “an area of research where weather data, analyses, and forecasts are put to practical use” (2015, p.98). This practical use includes the scenarios listed above: Do we allow a plane to fly this route? Will a large-scale freeze impact our apple orchard? Do we take an umbrella with us to work today?

Applied meteorology focuses on the accuracy and timely consumption of weather, water, and climate information (Janković, 2015). The importance of those two factors can be seen in the numbers; the benefits from forecasts and weather warnings brings in an annual \$31.5 billion to the United States (Janković, 2015, p.109). Weather forecasts assist in lowering costs from natural disasters, which Janković (2015) found to have cost the U.S. \$96 billion between 1980 and 2009. Therefore, “accurate and timely weather,

water and climate information and products have critical importance in world economies...” (Janković, 2015, p.98).

However, the importance of meteorology is not only a factor in large-scale, world economies, but also in personal safety and decision making. Wilson (2008) discusses the Oklahoma tornado outbreak of 1999, where the death toll was significantly lower than the cost of destruction (see also Henson, 2000), which was attributed to the forecasting and dissemination of information to viewers by both the National Weather Service and local broadcast meteorologists. Their short lead times of information to the event, coupled with “saturation coverage” from local news teams helped save lives that day (Wilson, 2008). The role of an applied meteorologist, then, can impact decisions as minor as a choice to bring an umbrella to work, and as large as life-saving decisions during high-impact weather events.

Wilson (2008) emphasized that meteorologists, especially those employed in the private sector and in broadcasting, “may be one of the only reliable sources for weather, and science information in general, that the public may have access to on a consistent basis” (p. 73). Due to this accessibility, as well as the importance of the overall work done in applied meteorology, this thesis will focus on creating a science communication “checklist” for meteorologists to use when communicating with the public. The next section will discuss the particular reasons why meteorologists may need to improve their communication, due to the specific challenges the field faces.

The Communication Challenges Meteorologists Face and the Need for Improvement

Despite the meteorological success Wilson (2008) and Henson (2000) discussed in the 1999 tornado outbreak in Oklahoma, there are still around 629 weather fatalities each year in the United States (Janković, 2015, p.109). This represents the existence of a disconnect between weather information from meteorologists and individuals' understanding and taking action from those guidelines.

According to the literature in weather communication, the goals of meteorologists communicating weather information to lay stakeholders involve forecast accuracy, time, and intended recipients receiving and reacting to the message (Ripberger, Jenkins-Smith, Silva, Carlson, & Henderson, 2014). Effective weather communication is also defined as the audience being exposed to the information, paying attention to it, and understanding it (Lindell & Perry, 2012). Since this thesis is focusing on message structure, I will analyze the need for messages to be understood by audiences, the influence of time on forecast messages (that is, what are the differences among urgent, imminent, and long-term forecast threats), and why weather messages in those contexts aim to instill a specific behavioral response within recipients.

First, why would a message recipient not pay attention to a weather message? A barrier for meteorologists for this goal could be the audience's trust within the forecast and the meteorologist themselves. Trust is defined by Renn and Levine (1991) as, "the generalized expectancy that a message received is true and reliable and that the communicator demonstrates competence and honesty by conveying accurate, objective, and complete information" (p.179). After all, Renn and Levine (1991) note that

communication to “impress the audience” or “influence their attitudes” relies heavily on trust and source credibility (p.175). If an audience does not believe a forecaster or even the forecast, they will not pay attention to it. This has been seen in flood response research conducted by Wachinger, Renn, Begg, Kuhlick (2013) where they write, “individuals may feel more at risk if their trust in experts is lacking or damaged” (p. 1053). Audiences may also not believe a risk will occur, may see themselves as not having enough time to respond, or may simply not know what to do, which can impact their willingness to take action (Mileti & Peek, 2000).

In terms of message understandability, attributes of a forecast may be difficult to understand. For example, an audience member may not understand why a broadcast meteorologist relies on a specific weather model for a forecast over another, or why they may forecast a 50% chance for rain while another broadcast meteorologist may forecast a 40% chance of rain. The disparities in forecasts can be contributed to what is known as forecast uncertainty, which meteorologists have difficulty in communicating to the public (Winkler, 2015).

Forecast uncertainty is defined by NOAA as restrictions in absolute forecast accuracy due to limitations in atmospheric observations as well as scientific limitations. In more lay terms, forecast uncertainty can be thought of as differences between forecasts for the same event. For example, if a snow storm is approaching and one meteorologist forecasts two feet of snow while another forecasts six inches, there would be high forecast uncertainty due to the stark difference between those two predictions. However, if those forecasts were one inch versus a half an inch of snow, that would hold lower

forecast uncertainty because the two forecasts aren't that different. Simply put, meteorologists are unable to measure observations perfectly, which means forecasts will always incorporate some aspect of error and will never be completely accurate.

These issues will lead to limitations in forecast accuracy and varying forecasts between meteorologists. While there is little research analyzing lay perceptions of forecast uncertainty, the idea that several wrong or different forecasts between meteorologists would lead to a decrease in forecast trust among intended audiences appear to be a reasonable conclusion. That's especially pertinent, since meteorologists do not know how to consistently and effectively convey forecast uncertainty information (Demuth, Morrow, & Lazo, 2009).

Timing of forecast information holds importance as well, as the specific situation may prioritize different communication goals. For example, the 1999 tornado outbreak analyzed by Wilson (2008) and Henson (2000) would be an example of an urgent threat, where immediate action needs to be taken. In this context, the forecaster may want to prioritize quick information dissemination. However, in imminent weather risks, such as what occurred in Winter Storm Juno, lead time is available for forecasters where, while they may still want their forecasts and messages to spread at a fast pace, may also incorporate information on weather preparedness, versus an urgent context. In a long-term threat context, a forecaster may prioritize planning initiatives over an actual forecast. This can be seen in the National Weather Service's "Turn Around Don't Drown" campaign.

Lastly, audience motivation to take action based on a weather message can incorporate many aspects, including socio-economic factors (such as lack of access to transportation or fear of losing jobs over evacuation), health, and obligations to family and friends (Eisenman, Cordasco, Asch, Golden, & Glik, 2007). However, sources of information, understanding the information, and risk perceptions were also found to influence decisions to evacuate from a weather warning (Eisenman, Cordasco, Asch, Golden, & Glik, 2007). These factors will be further discussed in the barriers of actionability communication goals in Chapter 2.

From this analysis, the main barriers found to impede forecasts and weather messages focus on establishing and maintaining audience trust, along with lay understanding of forecast uncertainty, and motivating audiences to take action. For example, looking back at the decisions made with Winter Storm Juno, not only were forecasters required to raise awareness of the potential threat, but they also needed to conquer the challenges of motivating people to take precaution, along with convincing the public to place their trust in them. A specific example of this mishap would be of Gary Szatkowski, a meteorologist at the National Weather Service (NWS) in Mt. Holly, New Jersey. He was praised for his confidence and insistent communication of the forecast's severity regarding Superstorm Sandy in 2012, with NJ.com writing, "[Szatkowski] issued some of the strongest warnings that anyone in the weather community had seen from a meteorologist in his position. He went from warning people about the potential dangers of the storm on that Tuesday to practically begging them to evacuate five days later..." (Casey, 2015). Yet, when the forecast changed suddenly for

New York City, the backlash was critical enough that Szatkowski tweeted, “You made a lot of tough decisions expecting us to get it right, and we didn’t. Once again, I’m sorry” (Casey, 2015). Despite having the forecast right that potentially saved many lives in one instance, the public’s trust in him diminished enough to where he felt compelled to publicly apologize, despite portions of his Juno forecast being accurate for other areas in his region (Casey, 2015). This lack of public understanding of forecast uncertainty can affect audience trust in forecasts.

In general, this thesis chapter evaluated the importance of applied meteorology, along with the barriers faced when communicating weather information to lay stakeholders, and how that was seen within the situation of Winter Storm Juno. Due to this information, the checklist product this thesis will produce will focus on techniques that aim to earn trust between the audience and the message, along with ascertaining clarity in forecast uncertainty for message understandability, in order to avoid a situation as Silver (2012) discussed. After analysis of this specific event (e.g., Winkler, 2015), the focus now needs to shift towards finding better ways to convey weather forecasts and the uncertainties within them. In the field of meteorology, this has continued to be a challenge, but it highlights the need for atmospheric, even climate scientists, alike, to focus on effective message strategies, particularly in times of potentially dangerous weather events. That is where the “checklist” product within this thesis will play a role in improving those communication strategies and will merge the specific goals of weather communication with that of science and risk communication, to focus on four main goals

of message understandability, memorability, sharability, and actionability, which will be discussed further in Chapter 2.

CHAPTER TWO

Defining Science and Risk Communication

Science communication has been conceptualized in a plethora of ways throughout the literature. A review by Burns, O'Connor, and Stocklmayer (2003) found definitions ranging from “the public’s understanding of science” to “scientific literacy” which can result in an “unfortunate lack of clarity” when it comes to establishing the goals of science communication (p.183). Therefore, the authors compiled these multiple definitions to provide a “unifying” and “contemporary” definition, writing that science communication is defined as, “the use of appropriate skills, media, activities, and dialogue to produce one or more of the following personal responses to science: Awareness, Enjoyment, Interest, Opinion-forming, and Understanding” along with engagement (Burns, O'Connor, & Stocklmayer, 2003, p.183; Bell et al., 2009).

The field of science encompasses a variety of topics, from biomedical research to the physics of gravity. While research in a plethora of science topics involves little to no risk, certain subjects bring a need for personal and collective efficacy, in part to instill a particular type of response or action. Applied meteorology would be one of those fields, due to the objective of encouraging specific action due to a weather forecast, whether taking a certain route over another to avoid a risk of flooding or evacuating a home from a potential hurricane.

Due to the characteristic of risk involved within meteorology, especially in situations of weather crises, defining risk communication is important to provide further context for the checklist. In terms of risk communication as a discipline in general, Bier (2001) attributes the potential objectives of this subfield as:

...building trust in the communicator, raising awareness (e.g. of a potential hazard), educating, reaching agreement (e.g. on a particular strategy for cleaning up a hazardous waste site); and motivating action (e.g. encouraging people to practice safe sex or reduce the levels of radon in their homes). (p. 139)

The objectives of risk communication differ slightly from those of science communication in that the audience are stakeholders in risk communication, which means they have a “vested interest in a particular outcome” – a two way communication model that both depend upon the other, versus science communication, which deals with the public as “every person in society” (Burns, O’Connor, & Stocklmayer, 2003, p.184). There are also differences in message strategies, as science communication aims to emphasize enjoyment and understanding, as noted by Burns, O’Connor, and Stocklmayer (2003), while risk communication, as Bier (2001) writes, focuses on message trust and motivating action. Meteorologists communicate with goals established by both the science communication literature as well as in risk communication and will be touched upon within the following communication goals and barriers.

Defining Communication Goals from a Weather, Science, and Risk Perspective

Understandability

The first goal is understandability, where the receivers of the message understand the content being presented. This idea of prioritizing an audience's understanding of a topic has been analyzed in Rowan, Botan, Kreps, Samoilenko and Farnsworth's (2009) work on the CAUSE model. The "U in CAUSE" focuses on "understanding" and overcoming confusion, where emphasis is placed on being mindful of lay perceptions and misconceptions (p.177-178). This is especially important for science topics that may be difficult to explain, and weather hazards tend to be a topic not only difficult in understandability, but with the potential for many social costs as well (Riebsame Price, Diaz, & Moses, 1986).

Memorability

Messages are not only created to focus on understandability, but to incorporate attributes of memorability as well. Memorability describes the individual's ability to remember guidelines of a message (Ratner & Riis, 2014). This could be important within the context of meteorologists, because of their role in emergency situations, where information needs to be accurately disseminated in a timely fashion (Manoj & Baker, 2007). Ratner and Riis (2014) describe the importance of memorability as a "necessary criterion for an effective guideline because, in order for people to do a newly prescribed action, they must first remember what that recommended action is" (p.13634-13635).

Sharability

A message's sharability is another goal of the checklist product, which focuses on the likelihood that an individual will share the messages with others (Milkman & Berger, 2014). This holds importance, especially for a meteorologist aiming to spread awareness about weather hazards on social media, such as the differences between flood watches and flood warnings.

Actionability

The last goal focuses on actionability, which entails how likely an individual will take action based on seeing a message (Ratner & Riis, 2014). As noted in Chapter 1, motivating audiences to take action during severe weather events is an issue meteorologists face. This is an especially important goal within urgent (i.e., happening now) and imminent (i.e., happening in the next 24-48 hours) weather threats, since the overarching goal of weather forecasts is, as Demuth et al. (2012) puts, "saving lives and reducing harm" (p. 1135).

The Barriers to Understandability, Memorability, Sharability, and Actionability

After reviewing the literature, several barriers exist for meteorologists in achieving these communication goals. While there is some overlap between the goals, each section will highlight the barriers most essential for the checklist product to overcome, with the solutions analyzed in the messaging strategies in Chapter 3.

Understandability

When it comes to communicating science, the literature presents several barriers to a message's understandability due to a scientist's communication approach, which

involves prioritizing the wrong strategies, using the deficit model, and not utilizing a mental models approach.

Scientists, including meteorologists, may have communication goals that do not align to a message's best interest. For example, Dudo and Besley (2016) conducted research with the American Association for the Advancement of Science (AAAS) to determine what factors scientists consider most when communicating with an audience for themselves and for their colleagues. Their results found that scientists tend to prioritize defending science from misinformation, followed by informing the publics of their science, exciting their audiences about science, building trust with their audience, and ranking strategic messaging as their last objective (Dudo & Besley, 2016, p.8). When it came to how they viewed their colleagues' communication goals, the objectives were mostly in the same order, with building trust as the last priority (Dudo & Besley, 2016, p.8). Respondents significantly viewed themselves as having these goals prioritized at higher levels than did their colleagues (Dudo & Besley, 2016, p.8).

The reasons behind this ranking of objectives could be due to several factors. As Dudo and Besley (2016) note, for example, scientists have challenged the media in how they communicate science, especially in matters of condensing and simplifying the science correctly, which is incredibly important for an audience's understandability in science (Nelkin, 1995; Besley & Nisbet, 2013; Maibach, 2009). It also makes sense that scientists aim to inform their audiences, since that has long been the traditional approach in communicating science to audiences (Dudo & Besley, 2016).

However, scientists only informing their audience of science should not be the sole priority in their communications, as it follows the idea of the deficit model, which is described as, "...the public that are assumed to be 'deficient', while science is 'sufficient'". The public's doubts about the value of scientific progress or fears about new or unfamiliar innovations...Lacking a proper understanding of the relevant facts, people fall back on mystical beliefs, and irrational fears of the unknown" (Sturgis & Allum, 2004, p.57). This approach has been favored by scientists (as seen in Dudo & Besley, 2016), since they hold all the "required" information and can fill the "vacuum" in scientific knowledge of lay stakeholders (Miller, 2001, p.116). However, a plethora of criticism has challenged the usefulness of this model, as Sturgis and Allum (2004) point out, ranging from its assumption that the public "lacks a proper understanding" when there are multiple reasons why an audience may perceive such information and associated risks, such as cultural or ideological beliefs, to biased asynchronous measures used within past research to measure a public's scientific understanding (p.57). Essentially, the deficit model is flawed due to only considering an audience's knowledge of a scientific topic instead of understanding that one might pursue a range of goals in science and risk communication, such as encouraging people emotionally.

This leads into the importance of scientists using a mental models approach instead in understanding how an audience views a topic, and how scientists can correct or build upon that lay understanding to enhance understandability. Scientists must have some awareness of what an audience understands about their science, so they can connect their work to what their audiences already know. When trying to comprehend what lay

stakeholders may know of a topic, Bostrom, Morgan, Fischhoff, and Read's (1994) work on climate change is a great first step in understanding lay mental models, which are how people view a specific topic due to their preconceived ideas. Their approach constituted a three-step process, which should start with an "empirical assessment" of what people already know, followed by understanding what information individuals are missing that are crucial to their decisions (Bostrom, Morgan, Fischhoff, & Read, 1994, p.959). Their first study focused on the understandability of climate change vocabulary, followed by a study utilizing a more direct approach to those same vocabulary questions in a questionnaire format, ending with another mental models interview study. Overall, the goal was to thoroughly map out how lay individuals understood global climate change, using protocols based on the "expert decision model" to better understand how lay individuals may make decisions based on their existing perceptions (Bostrom, Morgan, Fischhoff, & Read, 1994, p.960). It would be important for meteorologists to utilize a mental models approach to overcome understandability barriers dealing with forecast uncertainty, as outlined in Chapter 1, since meteorologists do not effectively confront or describe the problem within their forecasts. Tactics for using explanatory text (as described by Rowan, 1988) that build upon an audience's knowledge will be described in Chapter 3 as part of the messaging solutions.

Memorability and Sharability

These two goals have similar barriers in that both require an understanding of an audience's personal connection to the science information and even the science communicator. In order for an individual to remember a science message and/or share a

science message, as Milkman and Berger (2014) and Ratner and Riis (2014) point out, the scientist needs to take into account behavioral motivators. As noted in Dudo and Besley (2016), exciting audiences about science and using strategic messaging were both found to be the least prioritized by scientists, most likely because it falls out of their comfort zones. Using a strategic component to a message, such as incorporating emotion as Milkman and Berger (2014) recommend, may feel unethical for a scientist to do (Dudo & Besley, 2016).

The importance of utilizing science communication in this manner, however, allows individuals to have a personal connection to otherwise abstract concepts that may not appear as useful. As Fischhoff (2013) writes, “When science communication succeeds, science will give society the greatest practical return on its investment” (p.14038). Overcoming this discomfort scientists, including meteorologists, have in connecting their science to lay stakeholders holds importance in overcoming barriers in creating memorable and sharable messages.

Dudo and Besley (2016) also highlight research supporting the idea that positive, high-quality communications with scientists leads to more positive views on the science (and the scientists as well), which indicates the need for scientists to use audience-centered messaging approaches. This can be especially implemented through communication on social media, since websites like Facebook and Twitter allow for a two-directional communication model (Hughes, Rowe, Batey, & Lee., 2012). That is, instead of a one-way approach as seen with broadcast meteorologists on local news, social media allows users to ask meteorologists questions, can bring a more personal

appeal to messages, and can impact message memorability and sharability, since, for example, individuals share messages to “enhance social bonds” (Milkman & Berger, 2014, p.13643). Strategies meteorologists can use to become more comfortable in making weather messages more memorable and sharable are outlined in Chapter 3.

Actionability

In creating messages to instill a response among an audience, mental models, source credibility, and building trust among an audience holds importance, which has been researched extensively in the risk communication literature.

Mental models also play a role in instilling action because this objective requires the goal of understandability to be met as a prerequisite, since decision support requires an audience to understand the risk they are in before they can make a decision. This is reflected in work by Fischhoff (2013) where the author details a list of four tasks in communicating science dealing with risk: Identify the relevant science, determine what people already know about the topic and their perceptions of personal impacts, design communications to address that through interviews and surveys, and then evaluate those efforts (p. 14034). The importance of this process can be seen through the lens of climate change.

Spence, Poortinga, and Pidgeon (2012) write that the psychological distance of climate change has been a deterrent in mitigation efforts. However, it is important that lay stakeholders know (and care) about the science behind climate change, since the impacts are already being noticed and felt within the United States (Parmesan & Yohe, 2003). For example, if one wanted to communicate the options homeowners have for flood

insurance, one should make sure the lay stakeholder understands the role climate change could play in that decision. Fischhoff (2013) recommends beginning with incorporating the relevant science to the decision, so in this case, we would emphasize the relationship between climate change and flooding patterns, as well as sea level rise. Then, we would figure out what our audience already knows (do they know about the link in climate change and sea level rise? What are their feelings about climate change in general? Are there any ideological or political barriers?). Identifying an audience's "mental model" of the science, understanding their behavior, and discussing the adverse impacts (in this case, climate change), would be a way to fill in that "critical gap" as Fischhoff (2013) says, between the psychological distance and the personal relevance of the problem. From there, the audience can make sound decisions, and the communicators should make sure their efforts were successful through the last task of evaluation (Fischhoff, 2013). Was the information communicated really required for this situation? Was it easy for the audience to access? Could they comprehend it? All these questions play into the evaluation procedure, and Fischhoff (2013) emphasizes the importance of the process, as he writes, "A communication is adequate if it contains any information that might affect a significant fraction of users' choice" (p.14037).

This is an area of controversy among researchers, given that recognizing what an audience understands can be ambiguous and difficult. Burningham, Fielding, and Thrush (2008) analyze this challenge through the scope of flood awareness, where they analyze The United Kingdom's Environment Agency and how its use of the deficit model has been "met with extensive sociological criticism" (p. 4). The authors note how the

agency's goal was to simply educate their audiences about flood risks (Burningham, Fielding, & Thrush, 2008). Instead of treating citizens as "passive" players, the authors recommend a "contextualist perspective," where the publics understand information through past experience rather than being inactive in gathering information (Burningham, Fielding, & Thrush, 2008, p. 4). Focus should turn away from regurgitating information to the publics, then, and instead, emphasizing connections that the publics can relate to, such as past experience, that can be improved through a mental models approach (Burningham, Fielding, & Thrush, 2008, p. 4; Bostrom, Morgan, Fischhoff, & Read, 1994).

One function of science communication is to assist a lay stakeholder in decision making (Fischhoff, 2013). This can be accomplished through utilizing explanatory strategies, which takes into account the goals and audience of a particular message (Rowan, 1988). In the case of communicating about forecasts, the information is communicated as "informative discourse" meaning the primary goal of the message is to communicate the reality of the situation, with a secondary goal of connecting the information to an audience's needs (Rowan, 1988, p.32). However, when communicating about weather hazards (where information may not be as easily understood), the communication is "explanatory discourse" where further explanation is needed to help the audience reach the awareness needed to understand the message. This relates to the need for understandability as a communication goal.

Nevertheless, for explanatory writing within weather hazards to be effective, trusting the communicator, or a meteorologist in this case, is essential in having the

intended audience to be open to understand and trust a forecast or a weather warning, and therefore, take action based on that forecast or warning. Trust has been analyzed in the context of environmental and weather risks. For example, Peters, Covello, and McCallum (1997) identify four elements of achieving desired trust in environmental risks, which are committing to a goal and “fulfilling fiduciary responsibilities,” having competence, caring about the issue, and showing predictability (p. 4). They went on to create a survey regarding the perceptions of chemical risks in six communities to quantitatively test the idea of trust (Peters, Covello, & McCallum, 1997, p. 4-8). From their experiment, they found three predictors that caused variations in trust and credibility: “knowledge and expertise, honesty and openness, and concern and care” (Peters, Covello, & McCallum, 1997, p. 18). Prioritizing these factors can help build trust between the communicator and the intended audience by demonstrating competence and care of the issue, as noted in the definition of trust by Renn and Levine (1991).

Demonstrating concern and care about individuals is a factor of trust that scientists, including meteorologists, need to improve in their communications. Priest, Bonfadelli, and Rusanen (2003) analyzed the “trust gap” hypothesis, which means differences in perceived levels of trust between communicators, in the context of biotechnology acceptance among populations of different countries. The authors found that, “consumer responses appear to be the result of considered judgements about which social actors are most to be relied on” (Priest, Bonfadelli, & Rusanen, 2003, p.765). More specifically, this entails the importance of understanding cultural and ideological influences that may affect decisions made by lay stakeholders, when communicating,

scientists may not necessarily prioritize, as seen in Dudo and Besley (2016). Even if the appropriate steps are taken to communicate accurate information in a timely and organized manner (as scientists often do), research has shown that science communicators, especially when involving situations of risk, must emphasize and consider societal factors, such as ability to evacuate, to instill trust and efficacy among an audience. This was also found by Wachinger, Renn, Begg, and Kuhlicke (2013), as well as Mileti and O'Brien (1992) in that personal factors, such as friends, relatives, and trust in authorities, had a strong impact on risk perception (2013, p.1052)

Establishing source credibility is an important factor in risk communication, as Renn and Levine (1991) note the importance of credibility in “impress[ing] the audience or even influenc[ing] their attitudes” (p.175). Since meteorologists produce forecasts to influence behavior, source credibility is an important factor of their goal on actionability.

Credibility is defined by Renn and Levine as, “the degree of shared and generalized confidence in a person or institution based on their perceived performance record of trustworthiness” (1991, p.179). Credibility is important for an audience to first accept the information that the message is presenting. The challenges Heath and Heath (2007) present in dealing with the credibility of messages focus on the audience’s “personal learning and social relationships” (p.134). Simply put, past experiences and perceptions can influence how an audience trusts a message. For example, if a member of the audience has had a bad experience with police officers, their view of a message from the police department would not seem as credible as someone who trusts them at a higher level.

This idea can be directly applied to meteorologists. An article for the *New York Times Magazine* by FiveThirtyEight.com writer Silver (2012) dubbed “The Weatherman Is Not a Moron” looks at the issue meteorologists face in maintaining credibility, in which he writes, “people don’t mind when a forecaster predicts rain and it turns out to be a nice day. But if it rains when it isn’t supposed to, they curse the weatherman for ruining their picnic.” Silver (2012) attributes some of the distrust in meteorologists concerning forecasts to the private sector, where he writes:

For many years, the Weather Channel avoided forecasting an exact 50 percent chance of rain, which might seem wishy-washy to consumers. Instead, it rounded up to 60 or down to 40. In what may be the worst-kept secret in the business, numerous commercial weather forecasts are also biased toward forecasting more precipitation than will actually occur. (p.7)

This is an example of the barriers in communicating forecast uncertainty, in that lay stakeholders may see a decrease in credibility when seeing consistently different forecasts from meteorologists without the proper context. The fact that broadcast meteorologists have to create forecasts under an economic model of bring in advertisers can bring in “potential bias” and with diminished trust, audiences may be less likely to act (Sutter, 2013; Mileti & Peek, 2000). The following examples in the next section of this chapter will look at the communication problems found within different types of specific weather risks, that illustrate the communication barriers in the aforementioned goals, especially in terms of trust and source credibility.

How Communication Barriers Have Impacted Weather Communication

“A primary challenge in responding to both natural and man-made disasters is communication” (Manoj & Baker, 2007, p.51). Most research within meteorology that deals with weather risks and disasters, though limited, focuses on analyzing past events and how to prevent similar situations from occurring. Others use both qualitative and quantitative methods for analyzing lay stakeholders’ opinions and thoughts on what to do during a certain weather event, such as the survey approach used in the Hurricane Katrina analysis by Eisenman, Cordasco, Asch, Golden, and Glik (2007), and the interview-styled research from a study on the hurricane risk system by Demuth, Morss, Morrow, and Lazo (2012). I will analyze specific circumstances, which involve Winter Storm Juno, Hurricane Katrina, as well as review the communication factors of flood risks.

Referring to the January 2015 blizzard, or Winter Storm Juno as the Weather Channel named it, Winkler (2015) attributed the backlash to a lack of forecast uncertainty communication, not the forecast inaccuracies themselves (p. 351). This “fear” of uncertainty in communicating forecast uncertainty, which is defined by Aven and Renn (2009) as the perception of “likelihood” of a certain event or reaction, in communicating forecast uncertainty stems from what Winkler (2015) calls a “cry wolf” scenario, where different media outlets often exaggerate a forecast to gain viewers, but, as a result, end up possibly losing the trust of that audience instead (p. 351-352). Instead of strictly focusing on forecast accuracy, then, Winkler (2015) recommends emphasizing the fact that the forecast will probably change, writing, “communicating and thinking about uncertainty explicitly can lead to creative thinking and actions that balance minimizing risk (e.g.,

protecting the public) with reducing the potential of taking extreme actions (such as closing the subways) unnecessarily” (p. 351-352). This example of the role forecast uncertainty plays within blizzard forecasts presents an example where the goals of understandability, memorability, sharability, and actionability could be applied to better help audiences understand, remember, share, and act on what meteorologists are communicating in these situations.

Perhaps the area with the most risk-centered research in dealing with weather hazards is the arena of hurricane forecasting, which shows the importance of scientists as effective communicators and the need for them to work with other entities (such as emergency management) within the communication process. Demuth, Morss, Morrow, and Lazo (2012) write about the importance of effective messages, as, “...people’s responses to hurricane risks are interconnected with the risk messages they receive” (p. 1133). In their analysis, they analyze the hierarchy of the Hurricane Warning System, which entails three main divisions with their own objectives, which are: the National Weather Service (NWS) who “characterize and convey hurricane threats;” local emergency managers who “help protect the public from hurricane risks and inform the public about protective actions;” and local TV and radio media who “synthesize and communicate hurricane information” (Demuth, Morss, Morrow, & Lazo, 2012, p. 1135). Within this process, meteorologists encompass two of the three divisions, so no one piece can fully work without the effectiveness of communication by meteorologists. The local emergency managers are tasked as the “translators” of hurricane risks given by meteorologists, into “risk-reduction” actions, to which the media (and broadcast

meteorologists) communicates to the targeted audiences (Demuth, Morss, Morrow, & Lazo, 2012, p. 1136). In examining the challenges of communicating hurricane risk, Demuth, Morss, Morrow, and Lazo (2012) mentioned issues that can occur at each level, hindering the overall effectiveness of the message (p. 1138). They attribute some problems to the density of National Weather Service forecasts (which could take a long time for emergency managers and the media to read and assimilate), the time constraints emergency managers face (which can be difficult for forecasters to meet), and the constant need for new and updated information from the media, which can be difficult for a forecaster or emergency manager to consistently provide since they have multiple priorities (Demuth, Morss, Morrow, & Lazo, 2012, p. 1138-1141).

Hurricane Katrina was an example of how meteorologists, while needing to be effective science communicators themselves, must work with others to instill the most action, as noted in the communication process by Demuth, Morss, Morrow, and Lazo (2012). For example, Eisenman, Cordasco, Asch, Golden, and Glik (2007) found that evacuation messages presented by broadcast meteorologists were often “ambiguous” lacking specific directions for audiences to follow in terms of evacuation procedures (p.112). In fact, the authors noted that individuals were more likely to evacuate due to “emotional appeals” from family and friends (Eisenman, Cordasco, Asch, Golden, & Glik, 2007). However, Comfort (2007) argues that the issues with Hurricane Katrina were not due to “a lack of communication” but more so an issue with “cognition of the risk posed by the storm” (p.190). This means that lay stakeholders didn’t fully understand the level of risk associated with Hurricane Katrina, which could impact

decisions to not evacuate if they didn't perceive the risk to be as bad as it turned out to be.

This problem has also been seen in risk communication research in terms of how lay stakeholders understand warnings about natural disasters. Mileti and O'Brien (1992) note the process of understanding risk information as, "hear-confirm-understand-believe-personalize-respond" (p.41). Flood risks exemplify where this process can go wrong and appear to be the most studied out of all the weather phenomena. This is probably because they are the most frequent, as out of 67 weather-related disasters from 1980 to 2005, over half of them were flood-related (Bell & Tobin, 2007, p. 302). Bell and Tobin (2007) analyze this through their article on the "100-year" flood policy and the debate on its effectiveness in the United States, cautioning, "its use may emphasize risk dichotomies and mask the irregularity and uncertainty associated with both the timing and consequences of flooding" (p. 303). Flood risk communication not only deals with communicating the risks of the event itself, but also conveying the risks of its occurrence as well, given that "sources of flood risk may be locally invisible" or that the "threat of flooding may seem irrelevant in the context of other risks or benefits associated with living close to a river or to the sea" as properties near the water are deemed more "desirable" (Burningham, Fielding, & Thrush, 2008, p.29). The "invisible" nature of flood threats impact the "understand-believe" portions of the process by Mileti and O'Brien (1992).

Overall, not only must meteorologists focus on communicating a forecast accurately, but they must also understand how to personally connect their science with

lay stakeholders and communicate the level of risk threat successfully as well, which incorporates aspects of the understandability and actionability goals due to the need of audiences to understand the information and to act upon it. These weather risks situations show examples of where the four goals of understandability, memorability, sharability, and actionability can improve the outcomes of weather risks. The next chapter looks at the importance of social media as the environment for the effective message strategies the checklist will describe, and the message strategies that act as solutions to the barriers mentioned in this chapter.

CHAPTER THREE

The importance of meteorologists and science communication have been detailed thus far, but how do meteorologists utilize science and risk communication to effectively connect their information with lay stakeholders? Beyond using verbal communication through broadcasts on local news and videos posted to the regional National Weather Service websites, meteorologists can also communicate to a mass audience using social media, where they can post messages about upcoming forecasts and weather risks (Carter et al., 2014). It is important, then, to analyze message strategies on their own, for meteorologists to utilize within this context. Therefore, this chapter will begin with an overview of the importance of social media as the setting for the checklist, with the second half focusing on effective message strategies discussed within the literature.

Why Social Media?

Effective messages are not solely determined on their characteristics, but through the setting they are presented in as well. In targeting meteorologists, television appears to be the avenue through which these scientists most often connect with lay stakeholders, but only in terms of broadcast meteorologists (Wilson, 2008). However, since 69% of adults use social media, along with the fact that social media, Facebook specifically, is used for sharing and discussing news, of which 42% of that news being local weather, this thesis will focus on that medium regarding the creation of the checklist product (Pew

Research Center, 2017; Mitchell, Kiley, Gottfried, & Guskin, 2013; Perrin, 2005; Hermida, Fletcher, Korell, & Logan, 2012). Social media use by scientists is high, as research by Van Eperen and Marincola (2011) found that 77% of life scientists use social media to communicate about their research. While meteorologists may not be life scientists specifically, many professionals in the field use social media, as most broadcast meteorologists and regional offices of the National Weather Service appear to have Facebook and Twitter pages. Therefore, the next few paragraphs will analyze the importance and describe why social media should be a prioritized channel for messages constructed by meteorologists.

Social media creates a space for individuals to connect through the sharing of ideas, which can allow for communities and social bonds to form (Carter, Thatcher, & Wright, 2014). Kaplan and Haenlein (2010) define social media using multiple characteristics; however, a distinguishing trait of social media allows for user generated content (UGC), which is described by the authors as, “the various forms of media content that are publicly available and created by end-users” (Kaplan & Haenlein, 2010, p.61). This idea is reiterated by Hyvärinen and Saltikoff (2010), who illustrate social media as, “services through which users can report details of their life and experiences and browse other users’ experiences, which are often sorted by tags and themes” (p.3175).

Why should meteorologists prioritize message effectiveness on social media? To start, social media is the ideal medium to directly connect with a multitude of people in a timely manner (Hermida, Fletcher, Korell, & Logan, 2012; Imran, Castillo, Diaz, & Vieweg, 2015). Social media, then, can also allow messages to quickly extend social

networks. In other words, messages can go “viral” (Miller & Lammas, 2010). In terms of messages about weather, the most likely forms of social media posts to be shared based on weather topics revolved around weather alerts and images of weather phenomenon, like that of tornadoes and flooding. (Carter, Thatcher, & Wright, 2014). For example, if an operational meteorologist wants to clarify the differences between tornado watches and tornado warnings before tornado season begins, posting on social media and having other users “retweet” or “share” the information can spread that information and could potentially save lives.

Social media is also a source and medium for discussing daily and critical weather information. For example, 42% of news seen on Facebook by users is about local weather (Mitchell, Kiley, Gottfried, & Guskin, 2013). Research by Finch et al. (2016) found Twitter to be effective in users communicating about natural disasters in short periods of time. The use of hashtags and geotagging on Twitter allowed for users to communicate about dangerous conditions during a EF5 2013 tornado outbreak in Oklahoma, which gave valuable information to National Weather Service officials who were observing the posts (Chatfield & Brajawidagda, 2014). In short, social media allows for the quick sharing of weather information and allows information to be geotagged and categorized under hashtags, which can assist in meteorologists gaining critical information to which they can communicate as a reliable source through their own accounts.

The life-saving aspect of being able to quickly communicate on social media, as Carter, Thatcher, & Wright (2014) note, is important within crisis management (p.1968). For instance, Bird, Ling, and Haynes (2012) surveyed individuals from communities

affected by the 2010-2011 floods in Queensland and Victoria of Australia and found that 74% of respondents said they accessed Facebook during the flooding event. The most popular responses in terms of the rationale behind checking Facebook during the crisis was to find out “information on my community,” followed by checking on their family’s and friend’s communities, as well as to share information and to offer help (Bird, Ling, & Haynes, 2012, p.30). This follows results found by Imran, Castillo, Diaz, & Vieweg (2015) and Gao, Barbier, and Goolsby (2011) in their overview of social media in mass emergencies, where users can share about their experiences and what they observe in real-time.

However, within social media, communication challenges can arise from incorrect perceptions, false information, and challenges in message credibility that can occur from quickly sharing information. Referring to the idea of message virality, Miller and Lammus (2010) point out that message creators can potentially “lack control” of how a message spreads (p.5). The authors reference an example of a viral ad-campaign by Johnson and Johnson on pain relief recommendations for mothers who use slings to carry their babies, which was perceived as “sarcastic” and suggested that, “moms who ‘wear’ their babies cry more than those who don’t” which resulted in negative responses on the “denigration of motherhood” (Edwards, 2008; Miller & Lammus, 2010, p.5). The backlash was strong enough to influence the company to issue an apology (Edwards, 2008). A planned message, then, can be spread and have lasting effects that may be difficult to reverse.

Not only can viral messages result in misconstrued perceptions from a place of well intentions, but they can also be factually incorrect. The spread of misinformation has been a catalogued issue in dealing with emergency events, with social media allowing for the dissemination of “outdated, inaccurate, or false information” (Lindsay, 2010; Kata, 2010; Bessi et al., 2015). False information, such as sharing information that was not a part of the event and sharing outdated material, was mentioned as a barrier in Gary (2011) on an Alabama tornado outbreak, in Sutton et al. (2008) for Southern California wildfires, and in the 2010 earthquake in Haiti analyzed by Keim and Noji (2011). False information can be spread in malicious ways, as noted by Lindsay (2010). It’s important, then, for meteorologists to utilize social media to correct misinformation, since incorrect information can “hinder or slow response efforts” (Lindsay, 2010).

Source credibility is an important factor for individuals to believe messages, and then, for people to act based on that message’s content. This is especially true for social media, as the vague role of “gatekeeping,” which is, “the process through which content creators decide what stories will be covered and reported, and this, what information is released to consumers” makes it difficult for users to determine what posts are credible (Westerman, Spence, & Van Der Heide, 2014, p.173). This can be seen in contemporary contexts, as in election cycles and information found in YouTube videos (Munger, Egan, Nagler, Ronen, & Tucker, 2017; Ho, McGrath, & Mattheos, 2017). Instead, users are forced into a situation called “gatewatching,” where users must determine for themselves what information is accurate, and promote what information appears credible to them (Bruns, 2008; Westerman, Spence, & Van Der Heide, 2014). This can foster an

environment of spreading information that is inaccurate and can influence decisions based on misinformation.

This is especially important within disasters, as Manoj and Baker (2007) point out the difficulty audiences have in who to place trust in within unfamiliar circumstances. For example, during a line of tornadoes that ripped through Alabama on April 27, 2011, Gary (2011) details the difficulties the Alabama Emergency Management Agency had in correcting misinformation perpetrated by social media, where “many people simply retweeted everything they say on Twitter without thinking about whether it was accurate” (p.3-4). A goal for meteorologists, then, should be to be that trusted source of information, reiterate the facts, and help to correct misinformation about weather hazards and outcomes.

It is important to note that these message strategies will be directed towards use on Facebook, since Facebook is available 24/7, is the most popular and used social media site, allows for long-form posts with videos and photos, and allows for users to ‘like’ and ‘comment’ on content posted by users (Ferrell, 2012; Hughes, Rowe, Batey, & Lee, 2012). This would be the preferred medium for weather communication using the checklist, as Twitter, while also used by meteorologists, limits interactions to only 280 characters, and confines the number of photos and videos that can be shared within a single tweet (Hughes, Rowe, Batey, & Lee, 2012).

Characteristics of Effective Messages

Message effectiveness has been analyzed specifically within several subfields of communication, including strategic communication (Dillard, Shen, & Vail, 2007), health

communication (Maibach & Parrot, 1995; Rimer & Kreuter, 2006), and science communication (Ratner & Riis, 2014; Milkman & Berger, 2014), to list a few. This illustrates the importance in communication scholarship of understanding how audiences connect to messages, which meteorologists can use when posting to social media. This section will overview the literature on effective message strategies to provide context for the specific constructs and examples that will be used in the checklist product, and to provide solutions to the communication barriers mentioned in Chapters 1 and 2.

On messaging strategies in general, *Made to Stick* by Heath and Heath (2007) begins with a commonly told fable called The Kidney Heist. The authors write, “The Kidney Heist is a story that *sticks*. We understand it, we remember it, and we can retell it later. And if we believe it’s true, it might change our behavior permanently” (Heath & Heath, 2007, p.11-12). This example illustrates how using message strategies can assist in having a message be easily comprehended, remembered, shared, and potentially, lead to actions being taken.

Understandability

Communicating science has become more complex than simply a “one-way, top-down communication process” as Miller (2001, p.116) notes, and should consider audience beliefs and measures to overcome those barriers of perceived risk that often accompany scientific topics. One such strategy, described by Rowan, Botan, Kreps, Samoilenko and Farnsworth (2009) as the CAUSE model, looks at establishing Confidence, Awareness, Understanding, Satisfaction, and Enactment from employed communication strategies (p.173). These tactics can be useful when approaching a

scientific topic that have distinct risks towards an audience, which includes weather risks, with the goal of persuading action (Rowan, Botan, Kreps, Samoilenko & Farnsworth, 2009).

One way to overcome barriers associated with incorrect or misconstrued lay mental models is to provide an “elucidating explanation” (Rowan, 1988). This approach entails four steps that “illuminate” what is essential to a term’s meaning and makes a distinction as to what is not, which includes describing what a concept does not mean, then saying what it does mean, giving a multitude of examples, and giving a false example to illustrate and explain how it could be misperceived (Rowan, 1988, p.36).

Another type of explanation that Rowan (1988) describes is the use of quasi-scientific explanations, which focuses on the use of visual cues such as titles, headings, previews, italics, white space, and summaries, along with utilizing narratives and analogies. As shown in research, using these tactics has been found to improve understandability, as noted in a study by Loman and Mayer (1983), where they found an increase in student understandability on the material for the ones who read the structurally cued passages (Rowan, 1988). The structure of narratives also helps make understandability easier due to their simplicity and need for a resolution after a problem has been stated (Rowan, 1988). Lastly, analogies help connect information an audience may already know to a concept that may not be so familiar, allowing them to better understand that new knowledge (Rowan, 1988).

The final type of explanation Rowan (1988) focuses on are transformative explanations, which addresses an audience’s pre-existing knowledge, or erroneous lay

theories, to help them understand new information or change their preconceived notions. This form of an explanation may be difficult to execute, mostly because it assumes the audiences' "social and emotional conditions" will support the learning experience (Rowan, 1988). This type of explanation could be utilized during major weather events, where social and emotional barriers have been found to play a role in taking action, such as in evacuations (Eisenman, Cordasco, Asch, Golden, & Glik, 2007).

The last principle mentioned in Heath and Heath (2007) refers to the use of narratives, which could fit under multiple goals, but assists in message understandability. The power of a story, the authors say, involves the stimulation of knowledge and the encouragement to motivate (Heath & Heath, 2007). Narratives can bring a "lifelike" framework to messages that may appear abstract (Heath & Heath, 2007). Referring back to the Kidney Heist story, the fable found success and continues to be shared because it invokes emotions that are relatable – what if that had been me? It can also lead to behavior change, acting as a reminder of what could happen when we accept drinks from strangers (Heath & Heath, 2007). Narratives have been researched in the context of health advocacy. Namely, Clarke, Niederdeppe, and Lundell (2012) analyze the characteristics and outcomes of using narratives to communicate a variety of health issues. The authors found that the success of narratives may hinge on how well an individual "identifies" with aspects of the story, such as the characters and understanding the health topics themselves (Clarke, Niederdeppe, & Lundell, 2012). The need for simplicity within the story is reiterated by Rowan (1988), where the author underlines the importance of story structure (the stating of a problem and a solution, for example), since

narratives ease understandability due to their simplistic structure. This brings attention to the necessary components of the story without the need for the audience to understand any complexities dealing with the topic (Rowan, 1988).

Memorability

To make a message memorable, Ratner and Riis (2014) recommend simplicity. They write about the “Friends Don’t Let Friends Drive Drunk” campaign created by the Ad Council, which focused on one simple idea instead of incorporating complex details and led to 68% of Americans saying they stop individuals from driving if they have been drinking (Ratner & Riis, 2014). Simplicity is also important for promoting actionability, as Ratner and Riis (2014) write, “people tend to defer choice and action when they face excessive complexity” (p.13636). This echoes arguments by Heath and Heath (2007) about prioritizing the “core,” or the main takeaway, of the idea, without “burying the lead” (Heath & Heath, 2007). A concept familiar to journalism, Heath and Heath (2007) define the lead as, “contain[ing] the most essential elements of the story” (p.48-49). Journalism finds its success through its “inverted pyramid” structure, which prioritizes the lead at the beginning of the story, which draws the audience in through a headline that is simple (Heath & Heath, 2007). By prioritizing the core of the message, Heath and Heath (2007) write that messages can avoid too much complexity since we, as humans, tend to value all material, but forcing prioritization keeps the message compact (Heath & Heath, 2007).

Memorable messages can also be promoted through an ease of visualization, since Ratner and Riis (2014) write, “material that is represented pictorially is easier for people

to recall later” (p.13636). This can include both physical images, as well as semantic cues, which can create mental images like those established by concrete over abstract words (Ratner & Riis, 2014). A classic example from meteorological communication would be “Safe Rooms Save Lives,” which emphasizes the importance of a safe room when in a tornado warning (Ratner & Riis, 2014). Visualizations can help foster actions as well, especially when the images help individuals picture themselves doing the action correctly (Ratner & Riis, 2014). This connects well with the recommendations laid out in the concrete principle in Heath and Heath (2007), where the authors write, “abstraction makes it harder to understand an idea and to remember it” (p.102). For example, a word such as “car” is much easier to visualize than the more abstract concept of “transportation.” When talking about issues of transportation, then, it would be much more likely to be remembered if it related to a specific object that the audience can easily picture, and therefore, remember.

The last two recommendations are to embed triggers within the message and to chunk the message into distinct, separate pieces. Embedding triggers, which means to place cues within the message to promote memory recall for the audience, can help promote memorability (Ratner & Riis, 2014). For example, the authors reference a campaign promoting vegetable and fruit consumption, in which the study found that the phrase connecting the action to a trigger, being a tray (“Each and every dining-hall tray needs five fruits and veggies a day”), increased fruit and vegetable consumption by 25% (Ratner & Riis, 2014). Embedding triggers can also assist in promoting actions, such as posting a sticker under a light switch reminding an individual to save energy and turn it

off (Ratner & Riis, 2014). Chunking is the last recommendation Ratner and Riis (2014) detail for memorable messages. For example, chunking telephone numbers into distinct words (such as 1-800-FOR-SALE), as Ratner and Riis (2014) note, is much easier to remember than 180003677253.

Sharability

Milkman and Berger (2014) analyze the characteristics of science messages that were viewed as the most sharable. From their experiment, they found that messages that appeared more interesting, useful, and emotional were the most likely to be shared (p.13643). Interesting and useful messages hold criteria for a person's "self-enhancement," as described by Milkman and Berger (2014). Simply put, individuals are more likely to share messages about scientific information that are useful and interesting because it gives the appearance that they are "smart" and "in-the-know" (Milkman & Berger, 2014).

Emotional messages were one of the principles of "sticky" messages as defined by Heath and Heath (2007), and Milkman and Berger (2014) reiterate the importance of creating messages within that context, for, "sharing emotional content is one way to enhance social bonds" because it produces a "shared experience" (p.13643). This sharing allows the audience to bond with others through a shared experience of empathy, such as sharing a story about how an animal survived through a tornado.

Actionability

As for actionable messages, specifying when to act and using subjective norms can assist in promoting action based on message content (Ratner & Riis, 2014). For

example, the “Turn Around, Don’t Drown” campaign by the National Weather Service indicates that, if an individual sees flood waters on a road, then they should turn around and take a different route. This follows the suggested “if—then” implication strategy that Ratner and Riis (2014) recommend, since that gives precise directions for what an individual should do in a particular situation (p.13637). Subjective norms, which Ratner and Riis (2014) define as, “the anticipated reactions from others” can lead to others engaging in an action if they perceive others to be doing it as well (p.13637). Doherty and Webler (2016) note that how we perceive what others would do in similar situations greatly impacts our “private-sphere” behaviors, such as the decision to litter or to recycle. If one’s entire neighborhood recycles weekly, then they may feel obligated to do the same as their peers.

Overall, the checklist product will provide short meteorological examples for each of the communication recommendations under each goal. However, it is important to note that an instructional booklet will also be provided with the checklist, to give further insight into how to correctly apply these strategies through sample Facebook posts. This is discussed in further detail at the beginning of the next chapter. The goals are summarized in Table 1 with accompanying definitions and a summary of the strategies listed throughout Chapter 3.

Table 1

The Message Goals, Definitions, and Strategies

Goals	Definitions	Strategies to Encourage Goals
Understandability	How easy a message is to understand.	<ul style="list-style-type: none"> • Elucidating explanations • Quasi-scientific explanations • Transformative explanations
Actionability	How clear the guidance of a message is and how one can take action from it.	<ul style="list-style-type: none"> • Simplicity • Visuals • Specifying when to act • Subjective norms • Reaffirming credibility
Memorability	How memorable a message is for the audience.	<ul style="list-style-type: none"> • Simplicity • Visuals • Chunking info • Embedding triggers
Sharability	How sharable a message is for the audience.	<ul style="list-style-type: none"> • Message is interesting for the audience • Message is useful for the audience • Message has an emotion component, preferably a positive emotional approach

CHAPTER FOUR

The goal of this thesis is to develop a checklist product to efficiently help meteorologists communicate more effectively. The checklist structure follows recommendations from Gawande (2010), who analyzed the effectiveness of checklists within hospital and surgical procedures and found the introduction of these products to have reduced major complications from surgical errors (p.154-155). For the context of meteorologists, the checklist will follow the “READ-DO” format Gawande (2010) discusses, where the list will act “more like a recipe” in that the recommendations will be parts of the four main goals – they will be choices. For example, if a meteorologist wants to focus on creating a message that will be more sharable, they can choose what aspects they want to incorporate into their message without having to use every recommendation. The checklist will also be “simple and exact,” with the most efficient and essential recommendations, and will fit on one page (Gawande, 2010, p.123-128). While Gawande’s (2010) recommendations focus on using a checklist in the high-pressure environments of medical emergencies and surgeries, meteorologists communicate in sometimes tense and hasty circumstances, especially in situations dealing with imminent weather risks. Therefore, the product will be created to be a quick and simple tool that meteorologists can implement when creating their social media posts. A draft of the checklist structure can be found in the Appendix.

Methods

I will create a checklist based on the four goals of message understandability, memorability, sharability, and actionability. Under each of these goals, I will provide recommendations and a short example of the recommendation applied in a meteorological context. For example, I will reference the “Turn Around, Don’t Drown” flood campaign by the National Weather Service as an example of how to specify when to act, which is found under the “How to Make a Message More Actionable” recommendation.

In his research, Gawande (2010) had hospitals provide instructional videos and PowerPoint slides to show doctors and nurses how to use the checklists. Thus, I will create an instructional booklet to accompany the checklist, to teach meteorologists how to effectively apply the recommendations to their Facebook posts. The instructional booklet will focus on applying the checklist to an extreme snow event, since Winter Storm Juno showed the consequences of ineffective communication during these events. In the booklet, sample Facebook posts will be crafted to show how to use the checklist in an urgent context (i.e., shelter in place), an imminent threat context (i.e., the weather event is likely to hit), and a long-term threat context (i.e., here’s how to prepare for similar weather events in the future). The three contexts will be analyzed separately since each may prioritize different goals but are all part of the communication reality of a meteorologist.

For this study, 5 participants were recruited. All were meteorologists who used social media to communicate their forecasts to lay stakeholders. 4 were from the private

sector, with a majority having a position at a broadcasting company. 1 participant was from academia. All were meteorologists from the United States, and 4 of the participants were men and 1 a woman. Interviews took place over Skype or phone call and were audio-recorded to be transcribed. On average, the interviews lasted around 47 minutes. The researcher, who is the author of this thesis, conducted semi-structured interviews, going over questions of communication goals and barriers, followed by questions that were specific to the checklist product and instructional booklet. Participants were asked to review the materials before their interviews and highlight in green what they liked or found useful in the products and highlight in red what they found confusing or did not find to be useful.

Codes and themes were found in a similar manner to a code mapping approach, as detailed by Anfara, Brown, and Mangione (2002). Interviews were transcribed, and initial codes were found, followed by larger patterns in the second read-through. Those themes will be discussed in more detail in the next chapter.

CHAPTER FIVE

Results

What the Participants Liked About the Products

The checklist. All participants had favorable views of both the checklist and the instructional booklet. When asked about their overall impression of the products, Participant 2 (P1) responded, “very good” (p. 100). Participant 3 (P3) noted how they applied the checklist to the instructional booklet, “I actually used your checklist, and thought they were all easy, like understandable” (p. 120). The color coding of the checklist that corresponded to the pages in the instructional booklet were also mentioned by P3 as easy to understand (p. 120).

In terms of the specific goals chosen, Participant 4 (P4) agreed with the communication objectives, saying, “...generally speaking, breaking it down into those different categories, like the understandability, actionability, memorability, and sharability, I think all of those are really important for an effective post” (p. 127). Most participants had similar views, comparing those goals to examples they had used within their own communications on social media. That will be discussed more in the Discussion section of the thesis.

The instructional booklet. The booklet also had a favorable impression within the participants. P3 noted how several pages had a “magazine” feel, “where you could

almost flip through it and just read it casually” (p. 122). Several participants specifically noted how they liked the goals being defined on the very first page, with P2 stating, “You have to define the goals, and I think you defined the goals very well” (p. 111). P4 liked how the weather threat contexts were defined, since they note, “...that’s something we totally focus on...” (p. 128).

Each participant would then point out the steps of the goals they liked on each of the pages and would give an example of when they used that certain goal. For instance, Participant 5 (P5) said when speaking about quasi-scientific explanations, “Analogies too – a simple analogy, if I can think of anything, how tornadoes form, something like an ice skater pulling their arms together...that type of thing” (p. 144-145). P2 recalled a more specific example when speaking about transformative explanations and how she helped her viewers understand the reality of flood risks:

The misconception is my truck is huge and it’s gonna come through the water no matter what....So, yea, I showed a ruler on air and I was like, “How many of you have this in your backpack? The kids take this to school every day. It’s a ruler. This much water is going to sweep your car away.” To kind of put that misconception to rest.... Everyone knows how big a ruler is. Everyone has used one at some point in their life. So, I took a ruler on TV and was like, “Half of this is not the whole thing. That’s going to sweep you away, it’s going to sweep your car away.” (p. 108)

The participants would often connect with the example and give their own in response. That was done for all the explanation examples; the specifying when to act, subjective

norms, using visuals, and credibility under the “actionable” page; the chunking and embedding triggers on the “memorable” page; and using emotion on the “sharable” page. They also liked how the characteristics for each message strategy in general was laid out in a chunked manner, which, as P3 noted, “...they are big and they stand out, so it makes it easy to focus on and not get lost in the text” (p. 122). Participant 1 (P1) agreed, saying, “I really like the steps you have set up” (p. 100).

As for explicit examples, P3 liked the elucidating explanation, saying, “you took the Nor’easter, you said what it is, what it isn’t, and you used an actual piece that someone could directly relate to, like, as a forecaster” (p. 121). Several participants specifically pointed out the quasi-scientific and transformative explanations, with P2 and P4 pointing out the vernacular for transformative explanations where the message acknowledges the misconception of the audience. “That’s really important” said P4, “[because] whenever you’re trying to change someone’s opinion on anything, you’ve got to sort of meet them in the middle ground and identify, ‘Hey, I see where you’re coming from, I get it’” (p. 129). The same went for the “Turn around, don’t drown” examples, as multiple participants noted how they had used similar graphics in their flood posts. Several participants pointed out how they enjoyed the chunking of the image on the “memorable” page. P3 noted specifically, “I really liked the part where you actually threw in the scientific support behind it, about the Rebecca and Jason thing” (p. 122). Several participants liked the choice of the image for the first example on the “sharable” page, noting they had actually seen it on social media themselves. In terms of the threat contexts, numerous participants liked how the message strategies used in the posts were

pointed out in a bulleted fashion. Several highlighted the “imminent” image as a favorite, with P2 even stating, “I just love it. I might steal it” (p. 116).



Figure 1. The “imminent” example.

What the Participants Thought Could Be Improved

The checklist. The checklist itself did not receive many critiques. Often, the participants would elaborate on specific points, or would add a clarification. For example, P2 asked:

So, on the checklist I noted where it says, “I used visuals in my message,” that’s where I kind of noted, “okay, are they non-weather visuals?” Meaning, is it a picture of flooding, or is it the picture of a flood warning? Is it a polygon or is it a car going through water? I think that matters. I think what the visual is matters. Visuals are great, but if you have a really crappy visual, that’s not helping. (p. 111)

P2 also highlighted the importance of not only defining weather terms, but defining weather advisories, watches, and warnings as well. P2 and P4 brought up in their discussions of understandability how they ask non-experts to review their graphics, with P2 saying:

I like to do a non-weather person check of my graphics sometimes. If I’m unsure about it, I check with someone who is not a meteorologist, because I know I’m seeing with this blinder of science on, well, two-blinders, one, because it made sense to me because I made it, and, you know, I-made-it-blinder, and I-understand-science-better-than-everybody-else-blinder, you know? So, I like to check with my anchors who are not degree meteorologists, who are regular people, and who didn’t make the graphics. (p. 110)

Too much information was also pointed out as an issue hindering simple messages. In their interview, P4 mentioned, “if you’re trying to convey too much information all at once, like if the graphic is too busy, and there is not really a focal point, then too much information can be a bad thing too” (p. 126). This was also echoed by P3:

As forecasters, I believe that many forecasters are numerically inclined. They are data driven, so I feel that it’s easy to put too much numerical data information on a forecast graphic. I feel that it’s easy to use too much text to describe a scenario. You want to be thorough, but if you write an essay, who is going to read it, especially on social media? (p. 119)

On the “sharable” page, multiple meteorologists highlighted emotion as a good tactic, but only in certain situations. P5 stated, “...especially during severe weather...you gotta stay calm. You still have to be kind of a rock. So, if you’re showing too much emotion, you can easily get the viewers in a panic” (p. 144). P2 and P5 also brought up examples of when meteorologists simply ask their viewers to “Please share” a post, with P2 saying:

At the [American Meteorological Society’s 2018] conference, I sat in one of those social media lectures, and one of the broadcast [meteorologists] said in really urgent situations, like I saw her do it when they had a moderate risk for severe weather in her area, put in caps, “PLEASE SHARE.” ...and she had said it, too, you can explicitly put “please share” – and I think there were some irresponsible meteorologists that can overdo that, right? You don’t want to do that, but I think

when you have that very urgent situation of a high-risk tornado situation, high risk flood, just being explicit I think helps. (p. 115)

Therefore, for the final version of the checklist, the “understandability” section of the checklist was revised to add a row for defining weather watches, warnings, and advisories, as well a row for asking non-experts to review messages. The “actionable” and “memorable” sections were revised to encourage the use of “concise” visuals. Simplicity recommendations in both the “actionable” and “memorable” guidelines were changed to also remind the reader to not incorporate too much information in a single post. Lastly, in the “sharable” guidelines, the recommendation of emotion was revised to be “appropriate for the situation.” There was also an addition of meteorologists writing “Please share” in messages within urgent contexts.

The instructional booklet. Most improvements that were suggested were about particular image choices. For example, several participants highlighted in red example 3 from the “actionable” page, with several saying it was “too busy” and had “too much text” (P4, p. 126; P3, p. 119). That photo was removed in the final version. On the “sharable” page, the second image was changed given that the first image had similar characteristics, as pointed out by multiple interviewees. The revised image was also chosen for the threat context, as several participants said emotion should be used in a different manner within more “urgent” threat contexts.

Another image underscored was the example for the “urgent” threat (Figure 2), which, P2 argued, didn’t define what a “red flag warning” was appropriately (p. 106). P4 also said the graphic was too textual (p. 132). That image was replaced with a different

example (Figure 3) that incorporated more chunking and showed a post that did define the weather warning mentioned.



Figure 2. The original example for the “urgent” threat.

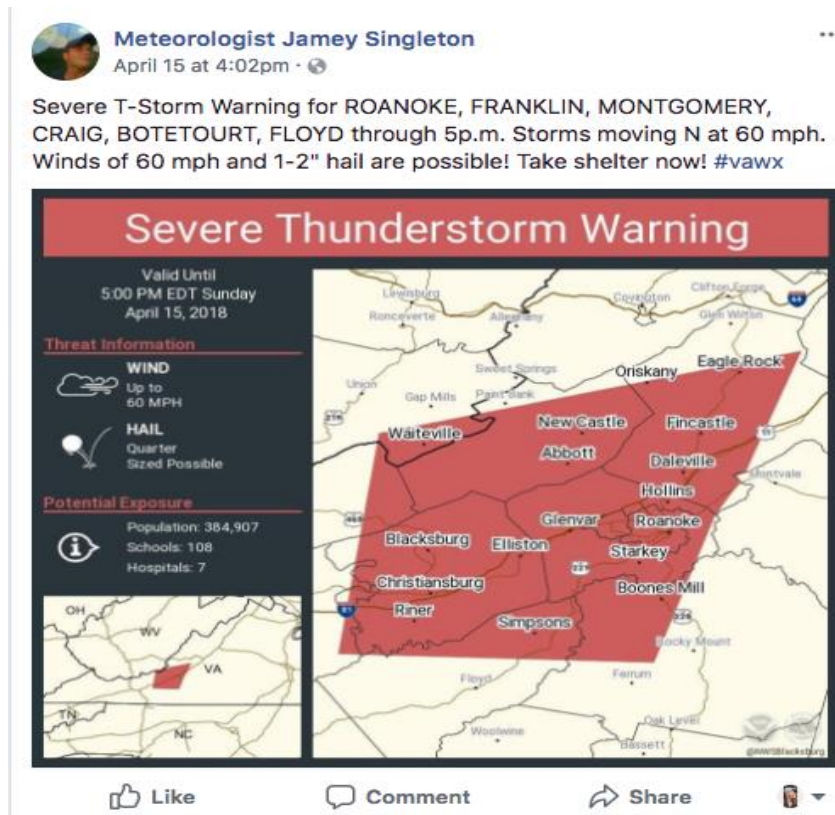


Figure 3. The updated example post for the “urgent” threat.

The “long-term” threat image was also replaced after the original image was also noted to have “a lot of words” and was “lengthy” (P2, p. 116; P5, p. 147). The new image incorporated more simple information that was chunked more appropriately. The transformative explanation was also changed due to P2’s example, which was a more effective example than the one listed in the booklet.

In terms of vernacular and appearance, the first page of the instructional booklet was completely revamped since it appeared “text-heavy” (P3, p. 120). Since multiple interviewees mentioned speaking to non-experts to review their posts, that was added as a comment at the bottom of the “understandability” page. The “actionable” page was also re-structured given the same comment. “Imminent” was also changed to “short-term” after several participants highlighted that it sounded too similar to “urgent.” That was done to differentiate the amount of preparation time audiences have between “urgent” and the other two contexts.

Several participants gave tips on communication that did not necessarily fit into the four main communication goals focused on by the products. Building a connection with the audience was mentioned by several participants, as well as time-stamping posts, given the issues with Facebook’s algorithm. Those themes will be discussed more in the next section of this thesis, but those tips were added on to the last page of the instructional booklet. Screenshots of the draft and final versions of the products can be found in Appendix A.

Discussion

Participant's Weather Communication Goals and Barriers to Understandability

Multiple interviewees explicitly stated that, not only do they inform their audiences of the weather, but they want to make sure their audiences can understand their messages. P4 said, “The keys to being an effective weather communicator is, I guess, figuring out how to incorporate verbal and visual cues that people can understand” (p. 125). P2 also stated, “...being able to clearly communicate [your information] so people can understand what you're saying is a big key of it” (p. 118).

While the main purpose of the Results section was to analyze the products for improvements, the interviewees were asked about their weather communication goals when using social media. The barriers they faced were discussed under the context of understandability, with many matching what was found in the literature review. However, there were several that were not researched in the same depth. All goals and barriers that emerged as common topics among the participants will be discussed in detail below.

Informing audiences and understandability. All participants noted in some form that informing their audience was a main weather communication goal they had, along with making sure their audiences stayed safe during severe weather. Several gave more explicit examples, such as making sure to connect the information to the audience in a way that is “relevant to people's daily lives” (P3, p. 118). As P3 noted further, “...it's one thing to make a forecast, but it's only worth something if people can get something out of it as it relates to them” (p. 118).

Several mentioned having similar communication goals during “benign” and severe weather in order to maintain trust, which can be summed up by P4’s response:

...in order for viewers to trust you during severe weather, they have to trust you during benign weather. If they don’t trust you when it’s sunny and 70 out, then they’re not going to trust you when there’s a tornado warning. (p. 131)

P5 mentioned competition as an influence in communication goals, which is interesting to note given the nature of the broadcasting sector in meteorology, which relies on advertiser support and may leave an opening for “potential bias” (Sutter, 2013).

P2 recalled an instance where this was a barrier:

I actually complained to the sales people because they were putting logos on my radar, and I told them, “No, when we have a tornado warning, I need the weather experts at the top, not Honda of the Ozarks.” (p. 113)

Consequently, informing audiences of weather information may be impacted by several factors, such as audience safety, relatability of information, and competition. Very few mentioned competition, and those that did were in the broadcasting community, which have different environments they must work under than meteorologists who work for the public sector (Sutter, 2013).

Giving too much information and/or emotion. In order for audiences to understand their messages, multiple interviewees discussed the length and types of information they needed to convey. P4 mentioned “verbal and visual” cues and P5 also mentioned using graphics, particularly emphasizing the fact that they needed to be chunked (p. 126; p. 142). P2 also mentioned how meteorologists tend to be “numerically”

inclined and have a tendency to include an abundance of information in one post (p. 119). As stated in the checklist, chunking information into disparate points can help alleviate this issue, as well as prioritizing the important information.

Using too much emotion was also a factor interviewees want to avoid in their social media posts. P5 emphasized how meteorologists need to be a “rock” during times of distress, with P2 also noting how too much emotion in urgent contexts could “over-hype” the situation and backfire (p. 144; p. 117). Despite that, P4 noted in his interview the importance of using emotion to some extent in social media posts, as it helps in “building relationships” with viewers (p. 131). Overall, participants agreed that emotion can be useful, but should be avoided in urgent and more serious contexts.

Forecast uncertainty. Winkler (2015) noted in their analysis of Winter Storm Juno the impacts of ineffective approaches to communicating forecast uncertainty. That same irritation was reiterated by several participants. Here is a sample from P3:

I would say that one of the biggest communication barriers is a lot of times, you have various forecasting entities, forecasting slightly different outcomes, or in some cases, drastically different outcomes. So, that creates a lot of confusion in the public, cause people get their weather information from multiple sources. (p. 119)

P2 gave a vivid example of a conversation she had with her mother, who is a non-expert in weather:

My mom texted me and she goes, I kid you not, she texted me and she was like, “Why can’t we buy a better model? What’s with the American model and the

European model and the Canadian model, and why do they all say things different?” So, she was asking cause network TV, they were showing EURO vs. GFS snowfall totals, and she was saying, “Why can’t we buy better models? Because one is saying six inches, and one is saying one.” She interpreted that as we don’t really know what we are talking about, and we’re tossing a coin in the air on whether it is going to be the EURO or the GFS. (p. 107)

Social media also elevates the issues with communicating forecast uncertainty, given that audiences can easily access multiple sources in a short amount of time (Miller & Lammas, 2010).

In approaching this issue, several interviewees gave examples as to what they do in those situations. For instance, P2 avoids labeling specific weather models:

I think our job as a meteorologist is to decide which is better, the EURO or the GFS, or make a blend of the two and create your own snow forecast...when you show both, and show all of these different scenarios based on the different models, I think it confuses people because people don’t understand the difference. They don’t understand how the models work. They don’t understand the difference between them. Like I said, my mom was just totally, like, nobody knows – my mom did not know how much snow she was gonna get because she was totally confused because they just gave her too many options, and I don’t think it’s our job to give the public options and have them pick. It’s our job to tell them what we think is going to happen...I use models but I don’t write “EURO” on top of it, I forecast. (p. 107)

P4 focuses on impacts rather than specific probabilities or amounts:

I think that focusing on more of the impacts rather than the weather itself is sometimes important. So, a lot of times, meteorologists get hung up on, you know, how many inches of snow are we going to get, or how many centimeters of rain are we going to get. People spend so much time making snowfall maps, losing sleep on whether to put 4 to 6 or 3 to 5. But the reality is, I think what people want to know more than exactly how much snow we're going to get is how it's gonna affect me. So, there's sometimes where we don't even post a snowfall map because it's not really important. Like, it's just a little Alberta Clipper system that is going to produce minimal snowfall amount, but if the timing is 4 to 8 am, then an inch of snow can make a big difference. Just due to the timing of the impacts – so doing the impacts scale is an effective way to communicate sometimes. (p. 128)

While there is no set standard in approaching forecast uncertainty, many meteorologists are analyzing their communication strategies and finding ways to overcome this barrier. Given social media's ability to allow for instantaneous responses, meteorologists can gauge their audience's perceptions much easier than they could from simply communicating on-air (Chatfield & Brajawidagda, 2014). However, more research needs to be conducted on communicating forecast uncertainty, so audience responses similar to Winter Storm Juno do not occur again (Winkler, 2015).

Misinformation, credibility, and “arm-chair meteorologists.” As noted by Renn and Levine (1991), trust and source credibility act as prerequisites for individuals to

take action from a message. Several interviewees highlight this in their responses, but P5 details how it has impacted his audiences by the influence of “arm-chair meteorologists”:

... it’s really hard on Facebook now to know who is credible and who isn’t. Even though I’m a meteorologist and I got that verification on my page, I still have – I don’t get a lot of it – but in the winter, I get a lot of, “Well, this guy said this.” And I don’t have any idea who that guy is. Most of them, a lot of times, aren’t even meteorologists. I get a lot of that when it comes to hurricanes and when it comes to winter weather a lot. The posting of snow maps with possible accumulation 7 days out, I compete a lot against that. That separates us the most. An effective part of being a communicator is someone who is more responsible and will take into account that models change, you know, usually more than two or three days out, it’s not going to look that good unless they’re on to something.
(p. 137)

P5 defines “arm-chair meteorologists” as, “people who aren’t meteorologists who are doing it as a hobby and don’t really know everything that they’re talking about. They’re just looking at the models and they’re putting things out there, shares, that kind of thing, don’t have any certification” (p. 138). Their forecasts and Facebook pages can look very similar to that of an actual meteorologist, which can be seen in Figure 4. This makes it difficult for audiences to tell what information is coming from a credible source and given how easily information can be shared on social media, this can lead to widespread misinformation (Lindsay, 2011; Kata, 2010).



Figure 4. Example of a fake forecast.

How can lay stakeholders distinguish between real meteorologists and “arm-chair meteorologists?” P5 mentions posting credentials in his “About” section on his page. Facebook also allows for account verification, putting a blue checkmark beside the names of verified accounts, similar to Twitter’s strategy in combatting misinformation (p. 137; Castillo, Mendoza, & Poblete, 2012). Several meteorologists put “Meteorologist [Their Name]” as their profile heading, and many include a seal of approval in their profile photos from the American Meteorological Society.

Responsible information sharing, as P2 notes in her response, focuses on conveying information that is accurate for the time-frame, saying, “...I’m a responsible

meteorologist, I'm not going to go telling people 5 inches of rain 5 days ahead of time" (p. 117). This also means, as P2 puts, not sharing model data, or weather models in general, without an explanation, which the fake forecast lacks.

Misinformation can also be spread unintentionally by users sharing outdated posts, which several interviewees mentioned as a barrier. Most contributed this to Facebook's algorithm, which, as P2 says, "screws you up" (p. 115). According to Schäferhoff (2018), the algorithm "ranks" posts based more on interaction and relevance than by the time it was posted. So, for example, as P5 mentions in his interview, this could cause a severe weather posts from several days ago to appear at the top of someone's news feed, who may share it thinking the severe weather threat is urgent or imminent.

Several participants gave examples as to how they maneuver around this issue. P5 mentioned deleting posts about severe weather threats after the danger had passed. P2 uses time-stamps in her posts:

So, with the algorithm, three days later, someone could still see that post pop up at the top on Friday. But my hope is that they would catch that it's an old forecast, because it's from Wednesday....you can say [in the post] "today" but make sure somewhere on that post that it says Wednesday [so they can catch it]. (p. 115-116)

Conversely, a few participants have used the algorithm to their advantage. Both P4 and P5 state how they interact with their post specifically to garner more attention on their messages. P4 noticed how photos with a large amount of text tend to be less

relevant, so he avoids using them. P5 will directly “like” and respond on every comment on his posts, saying:

I post something late February about it, “Hey it’s coming, it’s gonna be bad” and if I don’t respond to them, Facebook will, I’ve noticed, not have as many shares, not as much interaction. The more interaction you can get, even if you’re just liking their comments or replying, the more it’s gonna be shared, the more it’s gonna be in their timelines. Facebook rewards that interaction, so I try to – I think that’s the main thing. (p. 139)

In all, social media is an environment where information can be shared quickly, which can bring concerns of credibility as well as problems in misinformation and outdated information, but, as noted earlier, the participants are aware of these issues and have changed their behavior to overcome the problems, but more research on the role of misinformation on weather communication specifically needs to be conducted.

Rapport, audience connection, and sharability. In part of their interview, P3 went into the importance of understanding one’s audience in communicating weather on social media:

I think one of the keys to being an effective communicator in this is having a level of real-world experience in the context of your target audience. So, having that first-hand experience of, you know, if snow is in the forecast, you can relate to how it impacts them, how and, yea, so being able to personally relate to how the weather impacts your audience. (p. 118).

P3 came back to that idea near the end of his interview, saying, “I think consistency is a big thing for forecasters, like some forecasters will just post one thing once a week, or randomly, and they don’t build that relationship” (p. 124).

P5 detailed the opportunity social media presents in being able to build a relationship with the audience, saying:

...it is called social media. You can’t just put a post out there, whether it’s on Twitter or Facebook, or even other outlets, you can’t put a post out there and not interact with your followers...[and I] like and respond to as many as possible, because it is social, and if you are not responding and interacting with your followers, it’s not being social. (p. 139)

Social media allows for building a rapport with an audience through the easiness and flexibility of the medium. Still, most respondents mentioned “sharability” as a challenge, simply because they do not know how to “forecast” what becomes viral. For example, P2 noted in her interview:

I wrote down that the sharability part is the most challenging...I think that getting people to share my posts is the most difficult. I don’t know if that’s where I’m at, because I will say... that the general population here is pretty old, old in that they’re not so social-media savvy, they’re very old parents or old grandparents....[so] it’s hard to tell if the sharability is just because my viewers themselves would be the ones who cared the most about my content and they’re not social media savvy, or if it’s my messaging... (p. 104)

Since sharability as a barrier was a common theme among respondents, having meteorologists approach and think about more ways to connect their information to the audiences in a way that connects on an emotional level and is useful and interesting may need to be more prioritized. Despite that, the participants are actively thinking of this already, even with P2, who described in her interview how photos of severe weather happening, such as a car in a flooded road, instigated more shares and responses than did her images of a radar shot or a watch or warning polygon.

Actionability. Actionability was also stated as a weather communication goal, but usually as a follow up to understandability. For example, P2 mentioned that her audiences needed to understand the message in order to take meaning from the information and, potentially, action:

...the last two days we have had that flooding, so my communication goal, first and foremost, was to get people to understand that three inches of rain in less than 48 hours is a lot, and that, just, you know, we had some ponding on the roads, and stuff, and that, even though it doesn't look like a lot of water, it can still sweep you away, or sweep your car away. So, in that situation, like, safety was my biggest priority, so making sure people take every flood threat seriously. (p. 103)

As stated in Wachinger, Renn, Begg, Kuhlick (2013), a lack of resources, such as money or support systems, can influence an individual to not take action. However, if those factors are not an issue, many times, individuals will not take action due to not knowing what to do in the situation, or not taking the threat seriously (Wachinger, Renn, Begg, Kuhlick, 2013). Understandability, then, acts as a foundation for actionability, for the

audience must understand a message in order to take action (Wachinger, Renn, Begg, Kuhlick, 2013). The goals of actionability should still be met in order to encourage an audience to take action. For example, specifying when to act is important for lay stakeholders to know what to do when they come across the situation. P4 mentioned being aware of this through his own work, saying, “The most likely post for them to take action are definitely during severe weather, where you are saying there’s basically a warning in effect and you need to go do this or go do that” (p. 127).

Credibility also plays a role in actionability as well, since, as P5 notes in his interview, many of his followers take action because they have given him feedback that indicate trust. P5 also details how followers ask him questions during severe weather threats:

I’ll hear back from people that say, “I’ve cancelled my plans since you put that out there. We’re taking shelter now. I’m keeping my phone on to see the updates.” So, that’s encouraging. A lot of people will take action, whether it’s for an event outside of severe weather, where they just need to prepare, get flashlights for a wind event, or if it’s just rain, when they’ll need to cancel plans – they did. That warms my heart. It makes me feel like I’m doing something significant. (p. 142)

In all, multiple factors play into the actionability of a message, which, again, the participants were aware of, or thinking more about, as they were reviewing the thesis products.

Facebook vs. Twitter. While the products were created specifically for Facebook, 3 of the 5 participants also mentioned Twitter as part of their social media use. It's interesting to note the differences the participants mentioned between the two. For example, while P2 used both Facebook and Twitter, she mentioned the more interaction she receives on Facebook:

So that, yea I definitely get way more attraction on Facebook than I do on Twitter. And it's weird, cause I'm more active on Twitter because it lends itself more easily to retweeting and stuff like that. You know, because I have to follow – I follow way more things on Twitter than I do on Facebook, just cause it's, to me, easier and I like it better...[but] my viewers tend to use Facebook more. (p. 105)

She mentioned using Twitter more due to its accessibility and sharability, which is also noted by Hughes, Rowe, Batey, and Lee (2012). Other meteorologists mentioned Twitter as a realm for learning more about meteorology and communication itself, such as P5:

...I use Twitter to learn more meteorology. One of the things is, I graduated in 2000, and can you imagine all the new stuff I've had to go through...So, I've had to learn a lot about that on Twitter, and you also get ideas from other meteorologists. They're really cool. Like, if I see a cool graphic someone posted, I'll be like, "Hey, how did you do that?" (p. 140)

However, as Hughes, Rowe, Batey, and Lee (2012), Twitter is more for the spread of information rather than the interactivity, and research by Du and Gregory (2016) shows the simplicity of becoming part of an "echo chamber" on the social media site, since people tend to follow others with similar views, which, as defined by Colleoni, Rozza,

and Arvidsson (2014) as an environment that “reinforces established perspectives and opinions” (p. 317). That can be noted in P5’s response, where he mostly uses the site “more for education” and to talk to other meteorologists (p. 145). That is similar to P1’s experience, where he uses Twitter to “look at how...really well-trained meteorologists are looking at different storms” (p. 99).

The participants who mostly use Facebook have similar perspectives to Hughes, Rowe, Batey, and Lee (2012) in that they use that to target their specific stakeholders. The social media site allows users to give feedback on posts, which P5 noted as helpful in learning how to understand and relate to the audience. Several meteorologists also mention the use of Facebook Live, which wasn’t discussed as part of the checklist, but allows users to directly stream a video onto their page, as P2, P4, and P5 said in their interviews. Overall, Facebook allows users to directly connect with their followers in a more long-form way than with Twitter, which may be why many of the participants noted Facebook as their most used social media source (Rowe, Batey, & Lee, 2012).

How the Checklist and Instructional Booklet Can Help Weather Communication

Helping meteorologists be more aware of their communication. As P3 said, “I think [the checklist and instructional booklet] is usable, it’s widely applicable, and it’s – people can actually draw from it, if nothing else, to critique what they are doing” (p. 124). For many of the interviewees, the questions prompted a personal reflection of their communication skills. As P2 put:

Ideally, you want your posts to do all of this. You want it to be understandable, you want it to do all of it, but I think that’s the hard part is making it be – making

it do all of it, especially if there is character limitations too...but it makes you think about, “is it working?” That’s what stood out to me while I was reading this, was, “Oh, I’m doing this, I’m doing that!” (p. 117).

Many participants reflected on specific examples and if they were utilizing the strategies. For example, when discussing elucidating explanations, P4 said, “...that’s something I should probably think about more, but I don’t really give counterexamples as to what it’s not” (p. 127). Several pointed out specific steps they would take to implement these strategies into their communications.

However, the research process for this thesis showed that the meteorologists are already actively engaging and reflecting on their social media posts. This response from P5 demonstrates this process where he started implementing a new tactic based on what he noticed in his following:

The chunks of information look better. Something I’ve learned the past couple of years is to really not put too much info on there. You got to really – not dumb it down, but make it more simple, more succinct. You know, having the bullet points, that’s something that seems to make it better, so I definitely agreed with that. Seeing the trigger...something that people are responding to more with me, too. So, that’s something I really incorporated and it’s something that tends to really works. (p. 146)

Organizational communication research shows that a “reflective approach” to one’s communications can be, “problem solving as first beginning with a ‘felt difficulty’ that leads to defining and determining solutions to a problem” (Marques, 2010) As

participants read the goals, they connected the recommendations to problems they had seen in the field and the solutions they came up with on their own (such as in the excerpt from P5). If anything, this checklist and instructional booklet can allow a meteorologist to critique their social media communication strategies and be more aware of how they have and can approach issues in the future.

Overcoming the barriers. Many barriers to communication have been mentioned throughout this thesis, with the goal of this checklist helping to give meteorologists tactics to overcome those issues. Many barriers aligned with the statements from the interviewees, with a few (such as Facebook’s algorithm) that weren’t analyzed with the same consistency as the ones labeled in the literature review. Regardless, the goals themselves can help mitigate several factors within communication challenges.

For example, the barrier of communicating too much information in one post was focused on by P3 and P5. Chunking information, as was a recommendation in memorability, can assist in both breaking apart information and requiring the message creator (the meteorologist) to focus on the most important aspects of the information. In Figure 5, which was used as the “long-term” threat example, the meteorologist chose 4 main points to convey, despite the plethora of information available on tornado safety.



Figure 5. Example of “chunking” information.

Another example is overcoming a lay audience’s misconception of a weather term or event by using a transformative explanation. P3 gave an example of how she confronted an audience’s misconception about the danger of flood waters by bringing a ruler on air. She further described how an audience member reached out to her after she detailed that misconception:

...I got a comment on Facebook from a viewer who said, “Wow, I didn’t realize that it was that little of water that could do it. Last year, I drove through a flooded road and I was nervous about it, but I drove through anyways. I mean, thank God I made it, but now I’ll never do that again.” (p. 108)

Her confronting that misconception allowed that individual to recall that experience and further understand the danger of the hazard, which caused them to decide

to take it more seriously the next time. This echoes findings by Wachinger, Renn, Begg, and Kuhlicke (2013), where the authors write, "...media reports about an expected flood can stimulate individuals to recall the previous experience of a flood event.... It seems to be essential to help people recall the experience of the flood if one wants to motivate them to take protective actions against a new flood" (p.1053). Ideally, audiences should be convinced not to approach a hazard in the first place, but confronting misconceptions with transformative explanations of situations that appear safe (such as driving through flooded waters) can help approach this issue in a way that the audience can better understand the risk.

The challenge of time. P5 noted time as a difficulty in applying the communication goals, saying:

The biggest challenge is, you've got so much model data to look over, and you've got deadlines....there's just so much, and when I was in college, there wasn't this much, but there was still a lot. But now with the internet, you could spend all day, and at some point, you have to make the forecast. Beyond that, you've got to make your special graphics. So, I'm often challenged at time, getting the little short video made or the infographic made with the bullet points, and – because I've gotta know the forecast first, and then I've got to put that out there, and I got to make sure I put it out at a good time, during Facebook peak hours or Twitter peak hours as well. So, the biggest challenge, and I think meteorologists, especially those on TV, will agree... (p. 147-148)

This specific challenge was noted at the beginning of this research, given the importance of making accurate forecasts in a timely manner, as established by Ripberger, Jenkins-Smith, Silva, Carlson, and Henderson (2014). This is why the checklist was created after work by Gawande (2010), who focused on creating a checklist for professionals to use before surgery. Given the high stakes environment, Gawande (2010) needed to create a checklist that could be used efficiently and quickly, and at the end of the work, he writes, "...as a result, from [one] step alone, the checklist saved my patient's life" (p. 191). Not only was the need to prioritize information on a one-page, easy-to-read setup important, but the "routine of the checklist" was just as important (Gawande, 2010, p. 191).

This checklist was created to be used in an efficient manner, but taking the initial time to read and understand it will be the determining factor in its usefulness. However, most of the participants were practicing meteorologists, who took the time to read the products and provide feedback, and as P3 said, it's "usable" and "widely applicable" (p. 124)

CHAPTER SIX

Future Research

Social science research in the field of meteorology is a growing trend, as evidenced by several past conferences of the American Meteorological Society, where weather communication has been at the forefront of discussion (Seitter, 2010). This thesis was a first step in looking at messaging strategies for meteorologists in particular, since research into this aspect of communication had not been done yet.

Going forward for this research specifically, a quantitative analysis needs to be completed to see if these messaging strategies can cause a significant improvement in meteorologists' communications on social media. There should also be another qualitative study completed to incorporate a wider variety of meteorologists, as this study only conducted 5 interviews, with the majority of participants from the private sector. This checklist and instructional booklet needs further review from meteorologists. The final draft of the products shown in this thesis are still a first draft requiring further testing and validation that wasn't achievable in the time allotted for this thesis.

As for the communication barriers, research should also look into overcoming problems with understandability and actionability, since multiple participants listed those two goals as the ones they struggle with the most. For example, understanding how forecast uncertainty is perceived by the general public would be a good start in that

direction. A mental models approach, similar to Bostrom, Morgan, Fischhoff, and Read's (1994) work in understand lay perceptions of climate change, could be effective in taking that first step.

Misinformation on social media has already been labeled an issue within the field of meteorology, as noted in studies such as Carter, Thatcher, and Wright (2014) as well as in Gary (2011). Given how easy it is for non-expert users to create accounts and post weather data as if from a credible source (i.e. "arm-chair meteorologists"), this is an important area that needs further research into preventing that misinformation, or how to better educate users to spot it out on their own.

Limitations

This thesis took a qualitative approach and interviewed 5 meteorologists, which is a limitation due to the very small sample size. The coding technique was also a limitation, as only one researcher (the author) reviewed the information without other perspectives, which could bring issues of generalizability of findings, as is the case with most qualitative research, since, as noted by Rowan et al. (2018), "theory-guided qualitative methods allow generation of further questions, not findings" (p. 24).

Conclusion

If Winter Storm Juno had been approached in a more communication-aware way, would the outcome be different? Would the backlash have been diminished? Probably not but being more aware of communication strategies is important for a field so important to society, as evidenced by the economic impacts and the fact that we choose what to wear everyday based on the forecast. This thesis aimed to create a checklist product that can be

used by meteorologists to improve their communication strategies. After conducting the interviews and analyzing the results, it is clear the meteorologists, especially those beginning their journey into the field, have become more engaged in becoming better communicators. That can be seen in P1's response:

I think you got to really appeal to the younger folks, and they are really open to changing their ways. Not to say to give up – for me, I'm learning, so I want to learn, you know, as much as I can, and I'll keep testing new strategies until I find what I like. (p. 102)

This thesis was a first step in that direction of change.

APPENDICES

APPENDIX A

Screenshot of the First Version Checklist Product

Connecting Weather Messages to Audiences on Social Media

This weather communication checklist, based on science communication research, provides recommendations for specific goals you may have when giving forecasts on social media. These suggestions do not have to be used all at once or together – they are ideas to help you find new ways to connect weather information when communicating directly to your audiences. More information on each goal and examples can be found in the accompanying instructional booklet.

I want my audience to better understand my message.	
Try Using... Explanatory Strategies	
	I defined a confusing weather term by saying what it is and also saying what it is not.
	I gave a real example and a false example and explained why it was false.
	I used an analogy in my message.
	I used visuals within my message.
	I used a story/personal anecdote in my message.
	I confronted a misconception about a weather phenomenon and corrected it.

I want my audience to take action based on my message.	
Does your message have these characteristics?	
	My message is simple.
	I used visuals within my message.
	I specified in my message when my audience should act in a weather event.
	I incorporated subjective norms in my message.
	I reminded my audience/incorporated credibility into my post.

I want my audience to remember my message.	
Does your message have these characteristics?	
	My message is simple.
	I used visuals within my message.
	I embedded a trigger in my message.
	I chunked the information in my message.

I want my audience to share my message.	
Does your message have these characteristics?	
	I framed my message to be useful to my audience.
	I made the information in my message interesting.
	I incorporated emotion within my message.

Created by Jessica Hubbard

Screenshot of the Final Version Checklist Product

Connecting Weather Messages to Audiences on Social Media

Based on extensive science communication research, this checklist provides recommendations for improving the effectiveness of your weather communication. **Not all of these recommendations will be relevant in every communication opportunity, but to the extent possible strive to use all that are relevant to each of your communication opportunities.** For additional information on each recommendation, see the accompanying instructional booklet.

I want my audience to better understand my message.	
Page 2 in Booklet	
	I used simple clear words.
	I defined any weather watch, warning, and/or advisory in my message.
	I defined any potentially confusing terms by explaining what it is and isn't.
	I gave a real example and a false example and explained why it was false.
	I explained a process using analogies, metaphors, and/or graphics.
	I used an appropriate story/personal anecdote in my message.
	I confronted a misconception and corrected it.
	I asked a non-expert to review my message.

I want my audience to take action based on my message.	
Page 3 in Booklet	
	I included simple clear instructions on what action(s) to take.
	I specified <i>when to act</i> in my message.
	I incorporated subjective norms. (e.g., using a graphic of a car turning away from a flood)
	I used a visual representation to reinforce the recommendation.
	I demonstrated why my recommendation(s) are credible. (e.g., use NWS info or logo)

I want my audience to remember my message.	
Page 4 in Booklet	
	My message is simple. (simple = one clear idea, expressed concisely)
	I used a visual representation to reinforce the message.
	I chunked the information into bulleted or main points.
	I embedded a trigger in my message. (e.g., red text for a severe weather post)

I want my audience to share my message.	
Page 5 in Booklet	
	I gave practical guidance in my message.
	I made the information interesting. (e.g., lead with something most people don't know)
	I incorporated emotion within my message that was appropriate for the situation.
	I asked the audience to "Please Share" my urgent weather message.

Created by Jessica Hubbard, BS, MA
jnh76@cornell.edu

Screenshot of the Instructional Booklet Page 1 – First Version

How to Better Connect Weather Information with Your Audiences on Social Media



From aviation, to agriculture, economics, and daily routines, the role of meteorologists can be felt within the life of every individual.

Therefore, it is important that meteorologists communicate forecast information efficiently and effectively.

The accompanying weather communication checklist, based on science communication research, **provides recommendations for specific goals when giving forecasts on social media.** These suggestions do not have to be used all at once or together – they are ideas to help you find new ways to connect weather information when communicating directly to your audiences.

The goals, supported by scientific research, focus on:

Understandability (*Is my message easy to understand?*)

Actionability (*Does my message give clear guidance on what actions to take, and how?*)

Memorability (*Will the audience remember my message?*)

Sharability (*Will my message be shared among my audience?*)

These four goals will be discussed in detail in this instructional booklet, along with strategies to encourage these objectives. Examples of the goals will be shown in three sample Facebook posts within the following weather contexts meteorologists often communicate in:

Urgent weather threats (*i.e., shelter in place*)

Imminent weather threats (*i.e., the weather event is likely to hit*)

Long-term weather threats (*i.e., here's how to prepare for similar weather events*)

It is important to note that these message strategies will be directed towards use on Facebook, since Facebook is available 24/7, is the most popular and used social media site, allows for long-form posts with videos and photos, and allows for users to 'like' and 'comment' on content posted by users.¹ However, these recommendations can also be tailored for other social media websites, including Twitter and Instagram.



Created by Jessica Hubbard

Screenshot of the Instructional Booklet Page 1 – Final Version

How to More Effectively Communicate Important Weather Information to Your Audiences

As a meteorologist, it is important that you communicate as effectively as possible, because sometimes lives depend on it.

This instruction booklet, and the accompanying checklist, provides you with a summary of evidence-based recommendations to improve the effectiveness of your communication.

These suggestions do not have to be used all at once or together – they are ideas to help you find new ways to connect weather information when communicating directly to your audiences.

The goals, supported by scientific research, focus on:

Understandability (Is my message easy to understand?)

Actionability (Does my message give clear guidance on what actions to take, and how?)

Memorability (Will the audience remember my message?)

Sharability (Will my message be shared among my audience?)

Examples of the goals will be shown in three sample Facebook posts using the following weather conditions meteorologists often communicate:

Urgent weather threats (*i.e., shelter in place*)

Short-term weather threats (*i.e., the weather event is likely to hit*)

Long-term weather threats (*i.e., here's how to prepare for similar weather events*)

It is important to note that the examples in this booklet will be directed towards use on Facebook. This is because Facebook is available 24/7, is the most used social media site, allows for long-form posts with videos and photos, and allows for users to 'like' and 'comment' on content posted by users.¹

However, these recommendations can also be useful for posts on other social media websites, including Twitter and Instagram.

Screenshot of the Instructional Booklet Page 2 – First Version

How to Make Your Messages More Understandable

The first goal is **comprehension**, where the receivers of the message understand the content being presented. This is especially important for science topics that may be difficult to explain, and weather hazards tend to be a topic not only difficult in comprehension, but with the potential for many social costs.²

In creating these messages, we must remember to keep them **simple and clear**. Another way to improve message comprehension is to use **explanatory strategies**.³ The strategies include:

- **Elucidating explanations:** *fully defining* a confusing term by saying what it is, what it is not, and giving examples that are true and false (and saying why it is false).

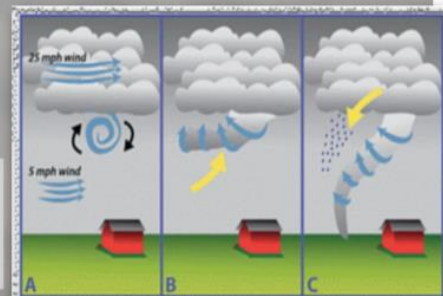
EXAMPLE: "A Nor'easter is a winter storm that is defined by the path it takes, which is along the eastern coast of the U.S. It is different than an Alberta Clipper, which begins near the Canadian Rockies and moves quickly along the northern parts of the U.S. While both are potentially hazardous winter weather systems, they are different due to the path they take, which can influence snowfall amounts."

- **Quasi-scientific explanations:** These explanations help audiences to *visualize* confusing terms and situations. This can be done by having visuals accompany a post, or by using an analogy or narrative.

EXAMPLE: The image to the right shows an explanation describing the process of how a tornado forms, accompanied with a visual.

Source: University Corporation for Academic Research.

- **Transformative explanations:** This type of explanation seeks to *transform an audience's "lay theory"* – or intuitive thoughts – about a topic. Instead of simply pointing out that their intuitions are wrong, we instead *acknowledge why they think that way, and then describe why it could be wrong.*



A tornado can form where winds blow at different speeds causing rotation (A) which can tighten and speed into a funnel cloud if caught in the flow of air moving into the storm (B). Rain and hail can cause the funnel to bend downward (C).

Credit: UCAR

EXAMPLE: "A common misconception is that weather and climate are interchangeable terms when they mean two different things. People may think this way because they have been used similarly within popular media. However, weather is the *day-to-day* events that occur within the atmosphere while climate is the *long-term average* of all those day-to-day weather patterns."

Created by Jessica Hubbard

Screenshot of the Instructional Booklet Page 2 – Final Version

How to Make Your Messages More Understandable

The first goal is **comprehension**, where the receivers of the message understand the content being presented. This is especially important for science topics that may be difficult to understand, and weather hazards can be costly and misunderstood, but with the potential for many social costs.²

In creating these messages, we must remember to keep them **simple**. This means prioritizing information that is **concise** and **most pertinent** to the situation (i.e., explaining tornado safety instead of focusing on the equations that produce it). Another way to improve message comprehension is to use **explanatory strategies**.³ The strategies include:

- **Elucidating explanations:** *fully defining* a confusing term by saying what it means, what it does not, and giving examples that are true and false (and saying why it is false).

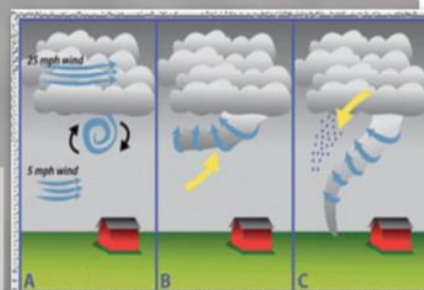
EXAMPLE: "A Nor'easter is a winter storm that is defined by the path it takes, which is along the eastern coast of the U.S. It is different than an Alberta Clipper, which begins near the Canadian Rockies and moves quickly along the northern parts of the U.S. While both are potentially hazardous winter weather systems, they are different due to the path they take, which can influence snowfall amounts."

- **Quasi-scientific explanations:** This type of explanation helps audiences to *visualize* complex structures or processes. This can be a visual accompanying a post, or it can use an analogy or narrative.

EXAMPLE: The image to the right shows an explanation describing the process of how a tornado forms, accompanied with a visual.

Source: University Corporation for Academic Research.

- **Transformative explanations:** This type of explanation seeks to *transform an audience's "lay theory"* – or intuitive thoughts – about a topic. Instead of simply pointing out that their intuitions are wrong, we instead *acknowledge why they think that way, and then describe why the lay view is inadequate.*



A tornado can form where winds blow at different speeds causing rotation (A) which can tighten and speed into a funnel cloud if caught in the flow of air moving into the storm (B). Rain and hail can cause the funnel to bend downward (C).

Credit: UCAR

EXAMPLE: "A common misconception is that water is not 'heavy' enough to drag a car off when it, in fact, can. Here, I have a ruler – only half of this is how much water it takes to drag your car away. It only takes 6 inches of water to cause a car to lose control. That is why it's important to turn around so you don't drown."

Lastly, a good practice is to check your message with a friend or a family member who isn't a meteorologist – if they can understand it, then your audience should be able to as well.

Screenshot of the Instructional Booklet Page 3 – First Version

How to Make Your Messages More Actionable

Another communication goal focuses on **actionability**, which entails how likely an individual will take action based on seeing a message. Motivating audiences to take action during severe weather events is an issue meteorologists face. This is an especially important goal within urgent and imminent weather threats since the overarching goal of weather forecasts is to save lives and minimize hazardous outcomes.⁴

EXAMPLE 1



An example of messages that use actionable guidelines is the successful "Turn Around Don't Drown" campaign by the NWS. The goals are:

#1: Simplicity. Research shows that individuals tend to not take action if they view it as too complex or confusing. **Example 1** is simple in that it lays out a recommendation in just four words.

#2 Specifying when an individual should act when confronting a weather hazard. Messages within this campaign lay out what to do when coming across a flooded roadway. **Example 3** follows an "if-then" formula that gives precise directions: if you come across a flooded roadway, then turn around so you don't drown.

#3: Using subjective norms. Subjective norms are the actions we think others will take (or not take) when in a similar situation. **Example 2** shows this in use.

EXAMPLE 2



EXAMPLE 3



#4: Incorporating visuals. People are more likely to take an action if they can picture themselves in the situation. **Examples 2 & 3** of cars being carried away by flood waters can show the consequence of driving through flooded waters, even if it appears safe.

#5: Reaffirming credibility. All examples have logos, one from government, one from an insurance group, and one from a local broadcast company. Reminding the audience that information from meteorologists are trustworthy can be done by incorporating logos or earned seals, such as the American Meteorological Society's Broadcast Seal of Approval.

Created by Jessica Hubbard

Screenshot of the Instructional Booklet Page 3 – Final Version

How to Make Your Messages More Actionable

Another communication goal focuses on **actionability**, which entails how likely an individual will take action based on seeing a message. Motivating audiences to take action during severe weather events is an issue meteorologists face. This is an especially important goal within urgent and imminent weather threats since the overarching goal of weather forecasts is to save lives and minimize hazardous outcomes.⁴

EXAMPLE 1



An example of messages that use actionable guidelines is the successful "Turn Around Don't Drown" campaign by the NWS. The goals are:

#1: Simplicity. Research shows that individuals tend to not take action if they view the action as too complex or confusing. This also means not including too much information in a single post. **Example 1** is simple in that it lays out a recommendation in just four words.

#2 Specifying when an individual should act when confronting a weather hazard.

Messages within this campaign lay out what to do when coming across a flooded roadway. **Example 2** follows an "if-then" formula that gives precise directions: if you come across a flooded roadway, then turn around so you don't drown.

#3: Using subjective norms. These are the actions we may feel "pressured" to take when we see others, especially individuals we care for or respect, taking the action. Seeing a meteorologist "live-stream" themselves or a viewer turning their car around is an example.



EXAMPLE 2

GRINNELL MUTUAL
INSURANCE SINCE 1908

#4: Incorporating visuals. People are more likely to take an action if they can picture themselves in the situation. **Examples 2** of a car being carried away by flood waters can show the consequence of driving through flooded waters, even if it appears safe.

#5: Reaffirming credibility. All examples have logos, one from two government organizations and one from an insurance group. Reminding the audience that information from meteorologists is trustworthy can be taken by incorporating logos or earned seals, such as the American Meteorological Society's Broadcast Seal of Approval.

Screenshot of the Instructional Booklet Page 4 – First Version

How to Make Your Messages More Memorable

Memorability describes an individual's ability to remember guidelines of a message. This could be important within the context of meteorologists, because of their role in emergency situations, where risks can be high, and information must be accurately disseminated in a timely fashion.

Rebecca Ratner and Jason Riis, both marketing scholars, describe the importance of memorability as a "necessary criterion" for effective science communication, because in order for people to take action, they must first remember what the action is.⁵



EXAMPLE: The image above uses all the memorable guidelines.

It's easy to remember because it is simple.

As with the past message examples, the information is straightforward, which is important for memorable guidelines as, the more complex information is, the harder it is for us to recall it. This message *prioritizes the important information.*

It's easy to remember because it incorporates a visual.

Research shows that we remember things that we can visualize, and images help us do that. This image also has a *visual link* – the information has arrows and color changes to show the transitions between threat levels, which would be harder to remember if it was all grouped in one paragraph or even in three separate images.

It's easy to remember because it "chunks" the information.

This information would be harder to mentally picture if it was written in paragraph or long form. Think of telephone numbers – are they easier to remember as 18009876543 or 1-800-987-6543? The recommendations in this image are easy to remember because they are distinct.

It's easy to remember because it embeds a "trigger."

A cue within the image can help us recall information later. The information is connected to a "trigger" of threat intensity – seeing the green color versus the red indicates different priorities and actions. Just seeing the color in future posts using this image can easily alert the audience to what action they need to take depending on the color of the "current level."

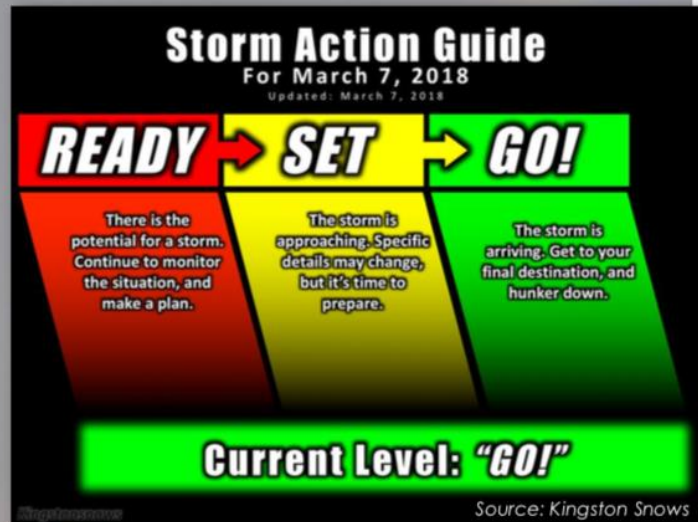
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Screenshot of the Instructional Booklet Page 4 – Final Version

How to Make Your Messages Memorable

Memorability refers to an individual's ability to remember a message. In emergencies, where risks can be high, and information must be accurate, memorability is essential.

Rebecca Ratner and Jason Riis, both marketing scholars, describe the importance of memorability as a "necessary criterion" for effective science communication, because for people to take action, they must first remember what the action is.⁵



EXAMPLE: The image above uses several features to enhance memorability.

It's easy to remember because it is simple.

The information is straightforward. The more complex information is, the harder it is for us to recall it. This message *prioritizes the important information.*

It's easy to remember because it incorporates a visual.

Research shows that we remember things that we can visualize, and images help us do that. This image also has a *visual link* – the information has arrows and color changes to show the transitions between threat levels, which would be harder to remember if it was all grouped in one paragraph or even in three separate images.

It's easy to remember because it "chunks" the information.

This information would be harder to mentally picture if it was written in paragraph or long form. Think of telephone numbers – are they easier to remember as 18009876543 or 1-800-987-6543? The recommendations in this image are easy to remember because they are distinct.

It's easy to remember because it embeds a "trigger."

A cue within the image can help us recall information later. The information is connected to a "trigger" of threat intensity – seeing the green color versus the red indicates different priorities and actions. Just seeing the color in future posts using this image alerts the audience to what action they need to take depending on the color of the "current level."

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4

Screenshot of the Instructional Booklet Page 5 – First Version

How to Make Your Messages More Sharable



A message's sharability is another goal of the checklist product, which focuses on the likelihood that an individual will share the messages with others.⁶ This holds importance, especially for a meteorologist aiming to spread awareness about weather hazards on social media, such as the differences between flood watches and flood warnings.

The image to the left is a Facebook post from NOAA, which was shared over 1,000 times.

Why was it shared so much?

Research from marketing scholars at the University of Pennsylvania found that science messages were most often shared when they were **1.) personally useful for the audience, 2.) interesting, 3.) emotional, and 4.) positive.** While the Facebook post above may not deal with any particular weather threat, **it was still shared by many users because a heart-shaped cloud is interesting and posting it on Valentine's Day had an emotional meaning behind it.** Therefore, we must think about how the audience will connect to the information. How will the audience use my information? How could I frame it to be more personally interesting to my audience? **Those four guidelines are ways we can help motivate our audiences to share our weather information.**

Notice the post to the right about a winter storm uncovering an artifact – it was also widely shared.

In communicating about weather risks, a post like this may not be the most appropriate – but a meteorologist sharing their "safe space" or detailing a list of tips on how to prepare for a tornado can utilize some of these message characteristics. And, given the wide range of networks and reach social media allows us to have, **this is important to understand – so we can work to make our important weather and risk information more sharable.**



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Screenshot of the Instructional Booklet Page 5 – Final Version

How to Make Your Messages Sharable



Sharability focuses on the likelihood that an individual will share messages with others.⁶ This quality holds importance, especially for a meteorologist aiming to spread awareness about weather hazards, such as the differences between flood watches and flood warnings.

The image to the left is a Facebook post from NOAA, which was shared over 1,000 times.

Why was it shared so much?

Research from marketing scholars at the University of Pennsylvania found that science messages were most often shared when they were 1.) personally useful for the audience, 2.) interesting, 3.) emotional, and 4.) positive. While the Facebook post above may not deal with any particular weather threat, it was still shared by many users because a heart-shaped cloud is interesting and posting it on Valentine's Day had an emotional meaning behind it. Therefore, we must think about how the audience will connect to the information.

Notice the post to the right about a tornado siren – it was shared almost 300 times.

This post has an interesting angle because of how the meteorologist made it personally relevant to the audience – have a tornado drill in their area. Also, using the phrase "PLEASE SHARE" can help influence the spread of information, but be sure to not over-use it.

To have our messages be sharable in times of urgent situations, we must remember not to overdo the use of emotion. If this had been during an actual tornado event, it would have had appropriate emotion for not "over-hyping" the event.



Screenshot of the Instructional Booklet Page 6 – First Version

Effective Facebook Posts Using the Guidelines

The last portion of this instructional booklet will illustrate Facebook posts using these guidelines and why you may prioritize certain communication goals over others. **It's important to note that, in all-weather contexts, message comprehension is a priority.**

Urgent threat *(it's happening now)*

When a weather hazard is happening now, we want our audience to **take action** and to **share the information** with family and loved ones.

This Facebook post:

- Is simple and uses a visual
- Frames information as useful by providing guidelines
- Has chunked information so it's easy to read



Imminent threat *(the event is likely to hit)*

In 24-48 hours, you may also prioritize **shareability** and **actionability**. We would want as many people of our audience to know of the incoming threat, so they have enough time to prepare.

This Facebook post:

- Is simple and uses a visual
- Provides useful guidelines
- Incorporates humor/emotion
- Has chunked information so it's easy to read
 - Specifies when to act

Created by Jessica Hubbard

Screenshot of the Instructional Booklet Page 6 – Final Version

Effective Facebook Posts Using the Guidelines

The last portion of this instructional booklet will illustrate Facebook posts using these guidelines and why you may prioritize certain communication goals over others. **It's important to note that, in all-weather contexts, message comprehension is a priority.**

Urgent threat (it's happening now)

When a weather hazard is happening now, we want our audience to **take action** and to **share the information** with family and loved ones.

This Facebook post:

- Is simple and uses a visual
- Defines the warning terms/impacts
- Specifies when to act
- Has chunked information on graphic so it's easy to read
- Frames information as useful by providing guidelines
- Has appropriate emotion for the situation



Short-term threat (the event is likely)

In 24-72 hours, you may also prioritize **shareability** and **actionability**. We would want as many people of our audience to know of the incoming threat, so they have enough time to prepare.

This Facebook post:

- Is simple and uses a visual
- Specifies when to act
- Has chunked information so it's easy to read
- Provides useful guidelines
- Incorporates humor/emotion

Screenshot of the Instructional Booklet Page 7 – First Version

Long-term threat

(preparing for future events)

Similar to the "Turn Around, Don't Drown" campaign, we want to make sure our audience can **remember** and **take action** when they come across the weather event in the future.

This Facebook post:

- Has information chunked in simple statements
- Is easy to visualize
- Embeds a "trigger" on what one should do before a storm
- Specifies when to act
- Gives useful information



La Porte Office of Emergency Management added a new photo.

June 15, 2015 · 🌐

01 BEFORE THE STORM

• ARE YOU SIGNED UP TO GET CALLS FROM THE CITY? - Make sure you are signed up with our notification system, Blackboard Connect, to get phone calls, text messages, and emails from the Office of Emergency Management.

• PREPARE FOR HIGH WINDS AND HEAVY RAINFALL - While we expect this to be a major rain maker for our area, high winds are still a possibility:

- Pick up anything in your yard that could potentially become a projectile
- Park in driveways or on higher ground where/when possible
- Expect power outages and prepare your family

• FOLLOW US ON SOCIAL MEDIA - Make sure you like our pages on Facebook, follow us on Twitter (@laportebythebay & @lpoem), and our website laportetx.gov



So, next time you post weather information on social media, whether it is for an urgent threat or for long-term events, try using the checklist to see if these guidelines can help you reach your specific communication goals.

If you want to learn more about the communication theory and research behind this checklist, here are some further reading options:

¹**The importance of Facebook as a communication tool:** "Social media: a new horizon for forecasting" by James Ferrell in *Weatherwise* (2012); and "A tale of two sites: Twitter vs. Facebook and the personality predictors of social media usage" by David Hughes et al. in *Computers in Human Behavior* (2012)

²**Comprehension in Weather Messages:** "The social burden of weather and climate hazards" by William Riebsame et al. in *Bulletin of the American Meteorological Society* (1986)

³**More detailed information on explanatory strategies:** "Effective explanation of uncertain and complex science" by Kathy Rowan in *Communicating New and Uncertain Science* (1999)

⁴**The importance of actionable messages in meteorology:** "Communicating science-based recommendations with memorable and actionable guidelines" by Rebecca Ratner and Jason Riis in *Proceedings of the National Academy of Sciences* (2014); and "Creation and communication of hurricane risk information" by Julie Demuth et al. in *Bulletin of the American Meteorological Society* (2012)

⁵**Memorable messages and weather communication:** Communicating science-based recommendations with memorable and actionable guidelines" by Rebecca Ratner and Jason Riis in *Proceedings of the National Academy of Sciences* (2014); and "Communication challenges in emergency response" by Balakrishnan Manoj in *Communications of the ACM* (2007)

⁶**Sharable messages:** "The science of sharing and the sharing of science" by Katherine Milkman and Jonah Berger in *Proceedings of the National Academy of Sciences* (2014)

Created by Jessica Hubbard

Screenshot of the Instructional Booklet Page 7 – Final Version


Long-term threat

(preparing for future events)

Similar to the "Turn Around, Don't Drown" campaign, we want to make sure our audience can **remember** and **take action** when they come across the weather event in the future.

This Facebook post:

- Is simple and easy to visualize
- Specifies when to act
- Has information chunked in simple statements
- Embeds a "trigger" on what one should do before a storm
- Gives useful information



Meteorologist Elisa Raffa
April 13 at 6:41pm · @
SAFETY TIPS: Seek shelter inside sturdy building in the event of tornadoes & severe t-storms. When thunder roars, head indoors! #mowx #arwx #kolr10wx

TORNADO *Your Weather Experts*

THINGS TO REMEMBER

- Seek Shelter Inside Sturdy Building
- Get To Lowest Level Or Interior Room
- Stay Away From Windows
- Evacuate Mobile Homes

Lastly, in all your social media posts, keep these tips in mind.

- If you see misinformation/a fake forecast - **repost it and correct it.**
- **Time stamp your posts** – that will help overcome issues with Facebook's algorithm.
- **Build rapport with your audience** – you can't understand their communication needs if you don't interact and understand them.
- **Prioritize info based on the context** – don't focus on defining a Nor'easter during an urgent threat. Focus on defining terms that will be more useful in the moment, such as warnings.

So, next time you post weather information on social media, whether it is for an urgent threat or for long-term events, try using the checklist to see if these guidelines can help you reach your specific communication goals.

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APPENDIX B

Interview Questions

- 1.) What do you see as your main weather communication goals?
- 2.) What do you think separates effective weather communicators from ineffective weather communicators? What are the keys to being an effective communicator in your job, do you think?
- 3.) What is the biggest barrier you see for weather communication in general?
- 4.) How, if at all, do you currently use social media for your job?
- 5.) Describe to me your most shared/popular post (The most recent one you can remember). What do you think explains why this particular post circulated so widely?
- 6.) What do you think could potentially make a social media post about weather hard for an average person to understand?
- 7.) How often, if at all, do you think people take action from your social media posts? What kinds of posts do you find are most likely to lead readers/viewers to take action?
- 8.) What was your overall impression of the product?
- 9.) What worked best in the checklist? What could be improved?
- 10.) Shifting gears to the checklist product – describe to me why you highlighted [reference product] this in green?
- 11.) I see you highlighted portions in red – let’s talk about what led you to mark these portions in red.
- 12.) What would be difficult about using this checklist for social media posts?
- 13.) Do you have any additional comments?

Interview with Participant 1 (P1)

Researcher (R): You have read over the consent form – do you agree to be interviewed?

Participant 1 (P1): Yes.

R: And do you consent to being audio recorded?

P1: Yes

R: Okay, great! So, the first question is what do you see as your main weather communication goals?

P1: Wow, um, I mean, mainly so that people are informed about the weather, I guess. I feel like, uh, for example, on Twitter, I always see theories from friends, like, forecasts for many snowfall events, and I always try to share something that's, like, from the National Weather Service, and me and several others work together to manage our weather group's forecasts that we share on the group's Twitter. Yea, I feel like, I mean, the main reason I communicate weather is that people are informed. That's definitely it.

R: Okay. What do you think separates effective weather communicators from ineffective weather communicators? More specifically, what are the keys to being an effective communicator in your job, or role, do you think?

P1: Wow, that is a hard question. I think, um, effective weather communicators are someone with a media background in meteorology. There's, like, a lot of people on Twitter nowadays that do their own forecasts, and I think that's really weird, sometimes.

R: Just to say, it sounds like you're talking about misinformation, so do you ever correct forecast misinformation, or do you just give your forecast, and say, "this is accurate?"

P1: So, when I do see misinformation – you know what, I don't think I've ever [laughs] – actually, yea, one time, I called someone out for, like, making these weird observations, um, or questioned, like, "oh, did you actually measure that? How did you? What was your methods?" Things like that. Or, like, calling out someone, um, if there's no map, or if I don't understand it, really. Also, sometimes, I have a huge problem with snow maps with the contour lines that overlap with each other.

R: Yes, tell me about that.

P1: It's such a poor way to be, I don't know – I reached out to someone about that before too. But yeah.

R: Okay, let's move on. You kind of already told me about this, but what do you see as the biggest barrier for weather communication in general? You were talking about that contour map, so?

P1: Yea, um, I mean trying to get it across in a way that everyone understands, I think. I mean, of course, it's the biggest barrier, you know. Um, it's just, it needs to come from a well-respected source, and that source needs to be able to communicate in a way that everyone can understand, and then, everyone that retweets that should also, like, respect that too, I think.

R: How, if at all, do you currently use social media for your job or role?

P1: Yea, I use Twitter, like, all the time. It's like my main – it might actually, well, not my main source, but like, I always use it to look at how, like, really well-trained meteorologists are looking at different storms, and things like that. It teaches me things that I wouldn't notice. For example, why is this rain forming? Is there a lifting mechanism? Is it just a convection buildup? Things like that. So, I use Twitter a lot for that. I like to look at the forecasts from all different, like, private corporations, and the public government, of course. Yea, so, yea, I definitely use Twitter. I don't really use Facebook.

R: Um, so, describe to me your most shared or popular post, like, the most recent one you can remember. What do you think explains why it may have been so popular?

P1: That's interesting. Um, so – do you want me to talk about me personally or my group's Twitter page?

R: Either, or.

P1: Okay, so during Hurricane Irma, when it was reaching its peak stage, um, northeast of the Lesser Antilles, that was, like – I mean, basically, the entire hurricane season, by Twitter, was very focused on tropical cyclones, because, you know, I am very interested in that, and so one time, I tweeted about the eyewall of Irma, and how it was, uh, so well developed, and how symmetrical it was, and how that was indicative of a strengthening storm that will strengthen further. And that got the most retweets I've ever gotten.

R: Did you post a photo with that?

P1: I posted a GIF of the, I want to say cloud heights. So, it was basically showing just how symmetrical Irma's eyewall was.

R: Awesome, okay, great. So, what do you think could potentially make a social media post about weather hard for an average person to understand? Like, what kind of qualities could it have that would make it be difficult for someone to interpret?

P1: Um, that's another good question. The first thing that comes to mind is, uh, putting too much information on something. For example, if you're showing some kind of, um, snowfall accumulation map and you have contours showing that, like, "oh, this area's going to get rain, then mixed with snow." Then, you show a different color for snow, then a different color for mixed to snow, then a different color for snow to mix – I think those are pretty iffy.

R: That's interesting. Okay, so how often, if at all, do you think people take action based on your social media posts?

P1: Especially with my group's Twitter page, I think people do look at that and actually take note. I see us being retweeted all the time by my college, and they like our tweets all the time, like our official forecasts. I think it contributes to decisions made by the university, definitely. Even my tweets, like, among my friends, for example, that has some weight, I feel like.

R: Interesting, so do you think it's because of the sourcing of the information that people are, maybe, listening to it more? You said your friends, and then the university shares it. Do you think that sourcing has a role to play, for you in particular?

P1: What you mean by sourcing is, like, where the tweet comes from?

R: Yes.

P1: Oh yea, totally. The audience for my group's Twitter page is going to be way different than the audience for my personal account. I mean, it depends on the situation. I don't know how to say it...I just think with my group's Twitter page, it's like, we are more respected, and we try to make it look very official, easier to deal with.

R: How do you make it look official?

P1: We came out with this special format that we use for certain storms, like winter storms. The last three winter storms we've had, we posted our official forecast, and basically was like, "Oh, at 8am, 12pm, 2pm..." Things like that, every four hours.

R: Do you have the university's logo anywhere on the Twitter page?

P1: Yes. Our group's logo is our profile picture, and also, on the picture that we post with the forecast – that has the logo all over it. I mean, obviously, the audience that sees that is going to react differently than mine, even though I'm still the one tweeting it [laughs].

R: [laughs]. Okay, so I asked you to look at an instructional booklet and a checklist. So, what was your overall impression of it?

P1: Um, let me pull it up. Do you want me to, like, go through and check off certain things?

R: So, yeah. So, I'm going to ask you about the specifics, but for this, your overall impression, or more so, your initial impression when you first saw it, like, about the design or any of the specific examples?

P1: I mean, I like it. I think it's a very good idea. I really like the steps you have set up, I feel like.

R: So, let's go through each of the things. So, I asked you to highlight in green what you liked, or take note of what you liked. So, were there any specific examples or phrasing or anything that you liked? And you just mentioned the steps, so you liked how the steps were laid out?

P1: Yea, yea. On the last page, where it says, "long-term threat" it says all the things that you – yea, I think this example on the last page is very good.

R: So you like the, um, the long-term example? It sounded like you were mentioning the qualities it has? Like, the bullet points?

P1: It just, like, yea, visually looks good. I don't know how to describe that.

R: Were there anything that you noticed that could be improved? Like, in terms of the examples, the wording, or is there anything that comes to your mind that, "oh hey, this should've been in here?"

P1: I don't think so. I mean, I'm only saying that because I feel like, as a young meteorologist in this field, I'm still learning how to communicate. I mean, yea, as a younger meteorologist, I'm open to things and, like, I look at things and I always pick out the good things that I see, and I'm trying to incorporate that into a personal snowfall forecast that I post, or something.

R: Okay, so you were talking about using it. Are there any difficulties, that you would think, that would come across in trying to apply this?

P1: Um, maybe audience response? Like, are you talking about if we apply this, like, the step process, the very specific things?

R: Yea, it could mean this, or, since this is a checklist, would it be hard to maybe, like, look at this every time you're doing a forecast, or do you think, maybe, it's something you look at a little bit, and then you kind of learn how to do it, or maybe just incorporating some of these? For example, under the "How to Make Your Messages More Actionable" there are several recommendations. Would you think it would be hard to implement all of them, or maybe use just some of them, in your opinion?

P1: No, I mean, I like, um, I like these suggestions that are highlighted, especially positivity. I find that whenever I'm talking about something in a more positive way, it's like so much more well-communicated, I feel like. And you can really get down to the science, I feel like, which is good.

R: Okay, um, yea, do you have any additional comments? Or personal instances when you tried to use a communications strategy and it went well or weird?

P1: Yea, so, coming from a pretty conservative area, I – can I talk about climate change?

R: Yea!

P1: Oh, okay. This actually relates to, um, this – whenever I incorporate more emotional, human perspective on climate change into a conversation with someone who doesn't really accept the science behind climate change, it always turns out in a better way. It always gets them a step closer to believing in climate change. When I, like, spit facts at people just – it's not good.

R: Interesting.

P1: So, do you want me to give you a specific example?

R: Oh, you can, or whatever you – actually, I’m going to ask you one more question. You mentioned you are a younger meteorologist who is learning how to communicate, and you don’t seem to have any reservations on applying these communication strategies. Do you, um, do you see meteorologists who are kind of – who you think it would be difficult for? Or is that maybe a reason that influences you to use these, or what are your thoughts on that?

P1: So, you’re asking, like, how do I see this being a problem for other meteorologists?

R: Yea.

P1: Yea, I mean, they would have to change the way they communicate – that’s a pretty big issue.

R: Like, if one of your atmospheric science professors – if I were to hand this to them and be like, “Okay, change everything you’ve ever done!”

P1: I think you got to really appeal to the younger folks, and they are really open to changing their ways. Not to say to give up – for me, I’m learning, so I want to learn, you know, as much as I can, and I’ll keep testing new strategies until I find what I like.

R: Do you think it has anything to do with communication being more of a focus in our field? Like, do you think that has influenced you to be more aware of it, like with your interactions on social media are kind of like, “Oh, I notice that if I do this, it gets to more people.” Or, connects with more people.

P1: I would say that I am so interested in communication as a meteorologist because of the lack of communication I’ve seen between meteorologists and the public. Also, just like, meteorologists are so, like, they stick together, almost, it seems like. There’s not that much –

R: Echo chamber...

P1: Yea! An echo chamber, like when that study was released about how meteorologists communicate mostly with each other [laughs].

R: [laughs] I saw that.

P1: Yea, I always think back to that, and I’m always like, “Honestly, the communication in this field needs to be so much better – we need to be where everyone else is at.” And interacting with all different communities. Yea, you got to make those connections.

R: Okay, awesome! So, those are all the questions I have, so thank you for your time.

Interview with Participant 2 (P2)

Researcher (R): So, I sent you the consent form and you have read over it, so do you consent to being interviewed?

Participant 2 (P2): Yes.

R: And do you consent to being audio recorded?

P2: Yes.

R: Okay, awesome! So, let me start off with the first question - what do you see as your main weather communication goals when you're talking to audiences about weather?

P2: Hmm, that's a tough question, cause I think it depends – I think it depends on the weather hazard.

R: Okay.

P2: Um, like, the last two days we have had that flooding, so my communication goal, first and foremost, was to get people to understand that three inches of rain in less than 48 hours is a lot, and that, just, you know, we had some ponding on the roads, and stuff, and that, even though it doesn't look like a lot of water, it can still sweep you away, or sweep your car away. So, in that situation, like, safety was my biggest priority, so making sure people take every flood threat seriously, and take this one seriously, and understand – I mean, we – I had spent two hours until I was blue in the face saying, "Turn around, don't drown." And our photographer went out after the show to get video, and needless to say, there was a car rolling through water. You know, so how do you drill it inside someone's head, "Turn around, don't drown?" So that – I mean, so for a life hazard situation, of course, the goal of my communication is to get those safety tips out, and to have them communicated well enough for people to know when, how, and where to enact them. Like, a sunny day, um, communication goals would be to be engaging, be interesting, cause I think in the non-life threatening weather, it's still important to get the message out in a clear and understandable, engaging way, because then people will know that you are the person to go to when it is a life threatening situation. They know, "Hey, she was fine the other day, let me see what she's saying about what's going on today" type of thing.

R: That sounds great. Okay, so the next question is what do you think separates effective weather communicators from ineffective weather communicators?

P2: Um, some examples that I've seen of poor weather communication have been trying to – like, I don't like when meteorologists try to scare people. I think scare tactics don't work. I think scare tactics are – it's just poor communication, it makes you come off as, like, bossy and arrogant, and I think that people see right through that. So, I don't think scare tactics work well at all.

R: When do you think people use those?

P2: I've seen it.

R: I mean, why do you think people use them?

P2: I feel like people... I think that some people think that it gets the message across in a way that people would listen. So, like, the last few days, we've had flooding. You know, I kept saying, "Turn around, don't drown" and I would hope that most of the people would listen to me, but I saw pictures and video of a handful of people not, and I don't think it would've worked if I had said, "You are going to die, don't drive through that water." You know? Unless it's a – I mean, we've seen hazards like that where that was true, like a Harvey situation, but this was not Harvey, you know? No one was gonna die, it was just things to take precaution, and I think people see through that, and the more you kind of scare people in the situations that don't really need to be scared, they're not going to listen to you when you do have a Harvey situation, and you do need to tell people, "Get to your roof because your—" you know?

R: Yea.

P2: I think people see through it, and then you wind up crying wolf, and nobody's going to believe you when you need to be believed.

R: So, going along that same theme, what do you think are the biggest barriers you see for weather communication in general?

P2: So, I wrote down that the sharability part is the most challenging.

R: Hmm, interesting.

P2: I think that getting people to share my posts is the most difficult. I don't know if that's where I'm at, because I will say that, in Springfield, MO, my viewing area is of southern Missouri and northwest Arkansas – I will say that the general population here is pretty old, old in that they're not so social-media savvy, they're very old parents or old grandparents. I mean, I get recognized by people – just yesterday, I got recognized by this really old grandpa in the supermarket. So grandpa isn't really Twitter savvy [laughs]. So, it's hard to tell if the sharability is just because my viewers themselves would be the ones who cared the most about my content and they're not social media savvy, or if it's my messaging, but I think getting people to share your stuff as being the most challenging.

R: Yea, and that's actually fascinating. I've wondered if millennials would be more likely to share weather messages, or if they do, or if they don't – that's fascinating. Okay, um, before I get off into a rabbit hole, how, if at all, do you currently use social media for your job?

P2: How?

R: Yes.

P2: Um, so I, even on a sunny day, I will – so I work in broadcasting, you know that. So, I use social media to kind of get the forecast out to my viewers, because in this day and age, I really do believe that half of my viewers watch me on TV, half of my viewers catch up with me on social media, and I don't think that one is out-beating the other.

R: Interesting.

P2: I think they need to work together. So, I think social media is very important to what I do, and I'll use social media on a sunny day to let people know, "Hey, it's gonna be gorgeous outside, it's gonna be nice, here's a planner so you know, going to work or school and coming back, this is what it's gonna be." And I also use it in those life-threatening situations where, you know, yesterday I was sending out updates on the flood watches and warnings as we were getting them in, and pictures and things like that. So, um, that's how I use it for work.

R: So, um, you mostly use Facebook and Twitter, right?

P2: Ah, yes, for professional use, yes.

R: Okay. So, describe to me your most shared or popular post, like, the most recent one you can remember. What do you think explains why that particular post circulated so widely?

P2: This will probably be useless for your research [laughs], but I think it speaks to me being more so broadcast communication. The most – no matter what the weather is happening, no matter what season, and no matter what's going on, the most comments and likes that I get on my posts on Facebook – again, so, I mentioned my viewers being older, so, because they trend older, I get more attraction on Facebook than I do Twitter.

R: Interesting, okay.

P2: So that, yea I definitely get way more attraction on Facebook than I do on Twitter. And it's weird, cause I'm more active on Twitter because it lends itself more easily to retweeting and stuff like that. You know, because I have to follow – I follow way more things on Twitter than I do on Facebook, just cause it's, to me, easier and I like it better. But, any who, that's a different tangent.

R: Yea.

P2: So, my viewers tend to use Facebook more, and no matter the weather, no matter the season, pictures of my personal life, or even my Christmas tree, get more likes, comments, and interaction than any of my weather posts, which is frustrating, but I mean, I get it – people see me as a face on TV and they like to get to know me as a person, see me as relatable, that I have a Christmas tree too, I guess, especially since they know I'm not from the area. "I went to the local blah blah blah, too!" So, like, I get it. For the most part, I get more attraction on personal posts. As far as weather goes, just thinking back the last two days with this flood, uh, on our station page, I got more likes and shares on the visual picture of the flooding, like, of the car running through the flooded road. I got more likes and shares, it was like 20-something shares on the picture of the flooded road, and maybe 5 shares on my actual flood warning.

R: Oh.

P2: Yea, so I do think, and that was one of the points that I wrote down, was that I do think that visual, relatable pictures, um, are more impactful. Meteorologists tend to get excited about polygons and deep colors on the radar and rainfall rates and velocity scopes. Like, we get excited about these things, but to the general public, it literally means nothing. So, for us, where we see

reds and purples, reflectivity on the radar, and we go, “Oh wow, look at that heavy rain” there’s no “oh wow” factor with the public, but if you see that, you know, that creek that came up and is overflowing the street, that has a more “oh wow” factor because it’s relatable to the person. It’s visual. So, I do like pictures more.

R: That’s awesome. Yea, okay, so what do you think could potentially make a social media post about weather hard for an average person to understand?

P2: Um, terminology for sure. I think weather jargon, if used, needs to be spelled out, everything needs to be explained. And then, I’m learning this more as I’m study for my CBM, how some of my mentors who were watching my stuff and said, “Everything needs to be explained.” If you’re gonna try to throw science jargon out there, you can’t do it without explaining it. So, what are you going for, challenges in communication?

R: Um, just, like, characteristics of a social media post that would be hard for an average person to understand. You already mentioned jargon, and you talked about radar examples. So, maybe, do you think that could play a role in it? Or if meteorologists use model images, do you have any opinions or experience with that end? Or seeing other meteorologists using model images in their posts?

P2: I have great examples! [laughs] I have so many things going on in my head at once, I don’t know what to do first. Okay, yea, so jargon is a big thing. So, three points in my head right now...so, with jargon, obviously, a viewer is not going to know what CAPE is.

R: No.

P2: Right, but I think jargon – it stems so far as to what our National Weather Service headlines mean in and of itself.

R: I understand.

P2: So, yesterday and today, we have aerial flood warnings in effect. My news director, people who are from the area, asked me, “What’s an aerial flood warning?” Because now they are confused. We usually get flash flood warnings – “What’s a flash flood warning? What’s an aerial flood warning? What’s a flood advisory?” I think that, in and of itself, is confusing.

R: I’ve never heard of an aerial flood warning.

P2: Right? So, I’ve had to explain to my colleagues that flash flood warnings are more instantaneous. Aerial flood warnings are more widespread and last a little bit longer, like, an hour. I think that alone needs to be explained. You can’t take for granted that the viewers know what that is, cause I don’t think that they do. One of the examples that you had that was one of my critiques, it was a red flag warning, and nowhere in there did it say that red flag was for fire conditions and that the fire conditions meant dry and windy. No, I don’t think people know that. I don’t think people know what red flag means, and I don’t think people – I mean, obviously, there are people that do and people that don’t, but I think that you need to err on the side of caution for the people that don’t.

R: Definitely.

P2: Okay, that was one. The other – I should've written it down. Okay, the models, so the models and radar. So, for the first one with the radar, it was just a week ago or two where we had that moderate risk with all the tornado coverage in the south. A colleague of mine and I had found some viewer comments on social media that – obviously, a correlation coefficient is something that meteorologists want to show during tornado coverage because we can see the debris blow, but when – I was actually in a broadcast meteorologist Facebook page, they were critiquing each other because viewers were commenting, going, “What in God’s name is a correlation coefficient?” You know? So, there were broadcast meteorologists chatting about how to rename that, so it makes sense. Debris signature? Or... whatever, so you have to call it something else because no one knows what that is. So, I think getting caught up in radar sometimes when it – obviously, it’s hard to get a picture of a tornado happening, but if you do, I think that warning speaks bigger truth with that picture of the tornado than it does with a correlation coefficient that nobody knows what that means anyways.

R: Yea, I think I’ve seen that be used in a forecast before.

P2: Yea, and I think my last point is on the confusing part of the communication, where they don’t understand – actually, just last week, my family’s in New York and the northeast has been getting hit with all these Nor’easters, the snow storms. My mom texted me and she goes, I kid you not, she texted me and she was like, “Why can’t we buy a better model? What’s with the American model and the European model and the Canadian model, and why do they all say things different?” So, she was asking cause network TV, they were showing EURO vs. GFS snowfall totals, and she was saying, “Why can’t we buy better models? Because one is saying six inches, and one is saying one.” She interpreted that as we don’t really know what we are talking about, and we’re tossing a coin in the air on whether it is going to be the EURO or the GFS. And my opinion on that is that it does create communication problems. I think our job as a meteorologist is to decide which is better, the EURO or the GFS, or make a blend of the two and create your own snow forecast. You know? And I think, when you show both, and show all of these different scenarios based on the different models, I think it confuses people because people don’t understand the difference. They don’t understand how the models work. They don’t understand the difference between them. Like I said, my mom was just totally, like, nobody knows – my mom did not know how much snow she was gonna get because she was totally confused because they just gave her too many options, and I don’t think it’s our job to give the public options and have them pick. It’s our job to tell them what we think is going to happen. So, I learn a lot from communication just from my mom. My mom comes out with comments like that.

R: So, do you not show models at all when you forecast? You just give them the forecast and you keep your models, like, “that’s what I use to interpret the forecast and make my forecast” but you don’t show that to the public?

P2: Yea, I use models but I don’t write “EURO” on top of it, I forecast.

R: Fascinating.

P2: Right? So this morning I used, you know, I do a future-cast of an RPM with, like, the clouds and the rain, you know, show hour-by-hour rain. I do that every day. I show model data every day, but I don't call it that, I call it the "hour-by-hour forecast." And when I showed my rain forecast, I used my model data, but I just showed the Euro, but I didn't call it the EURO. I called it the rain forecast. You know? Nobody needs to know it's European – I need to know it's the European.

R: You know, I haven't thought about it like that. That is fascinating.

P2: You know, my mom interpreted it as us covering our ass. You're covering your ass to show all sides, and I said to her, too, in those situations – I tried to explain to her, and I explained it, well, you know, like, uncertainty versus certainty, right? We want to see the EURO and the GFS to look the same. When they look different, that's when it becomes hard. She was just like, "Oh, you're just telling us everything it could be, this way, you're not wrong."

R: Yea, I think this goes under the whole bigger conversation about understanding forecast uncertainty and trying to communicate that. Okay, yea, that's great. So, how often, if at all, do you think people take action from your social media posts?

P2: That's tough to gauge. I will say I did severe weather awareness week just two or three weeks ago and it did receive some comments of people, particularly with the flooding – and I wrote this down too – you know, we talked about the pictures of the flooding. I used a ruler on air, and this was mentioned too in the, like, tell people what the misconceptions are and why they are wrong, right?

R: Yea.

P2: The misconception is my truck is huge and it's gonna come through the water no matter what.

R: That's a transformative explanation, yea.

P2: So, yea, I showed a ruler on air and I was like, "How many of you have this in your backpack? The kids take this to school every day. It's a ruler. This much water is going to sweep your car away." To kind of put that misconception to rest.

R: That's brilliant.

P2: Right? Everyone knows how big a ruler is. Everyone has used one at some point in their life. So, I took a ruler on TV and was like, "Half of this is not the whole thing. That's going to sweep you away, it's going to sweep your car away."

R: That's great!

P2: Yea, and I got a comment on Facebook from a viewer who said, "Wow, I didn't realize that it was that little of water that could do it. Last year, I drove through a flooded road and I was nervous about it, but I drove through anyways. I mean, thank God I made it, but now I'll never do that again." So, again, it's hard to gauge if people take action. I think that it's probably skewed because I don't think that anybody's going to come to me and tell me, "I'm not going to take

action.” Someone did yesterday. I swear, I can’t make this up. I said, “Turn around, don’t drown. Check the DOT map for road closers.” And someone commented and said, “Don’t tell me what to do.” I did get a few comments during severe weather awareness week of people saying, “Wow, thanks for this information. You taught me something. I will do this next time.”

R: Oh, wow. So, and this will be the last question before we move on to the actual products. So, what kinds of posts do you find are most likely to lead your viewers to take action? Like, which ones of yours that you posted that you notice that people are more like, “Oh, this information is useful” or, “I’m going to not drive through flooded waters” or something similar to that.

P2: Probably, thinking pretty recently, visual pictures of the flood water and, you know, kind of ruling out those misconceptions, you know, saying all it takes is a ruler’s worth of water for that to happen. I think the list of things to do, like, tornado warning, you want to seek shelter – be very specific. Seek shelter inside of a building, where you got to go, interior room, no windows, blah blah blah – I think all those specifics, visuals, and not necessarily weather visuals, more like real-life visuals, like bulleted steps, bulleted misconceptions – I think those things probably garner the most action.

R: Okay. So, now we are going to transition and talk about the, um, checklist and the instructional booklet. So, my first question is what was your overall impression of the product? And then we will go into the specifics.

P2: Overall, really good, either things that I was already doing or things that I was maybe only doing a little bit, and things that I would do more, like all positive, either doing it already, want to do more of, think it’s a good idea, um, type of tips.

R: Okay, um, so we’re going to start with the, um, so what you think worked best. So, um, this would be the stuff you either highlighted in green or just the stuff you pointed out. What do you think really worked?

P2: Hmm, let’s see. The visuals, for sure. And again, some of those real-life visuals instead of just the radar visuals. The chunked list thing, you know, separating things into, “if A, then B, this is what you do when this happens” and putting those in list form. The explanations, using analogies I love. I used an analogy just yesterday. I explained P-watts by a sponge. You know, we got this soaked sponge in the atmosphere, you know, you wash dishes every day, you soak up the sponge and it’s squeezing out. That’s why we’re – cause we had, it was climate – you would appreciate this, our hour P-watt values were over 1.333 inches – over an inch and a quarter, which for March, for us, is at our climate’s max. That’s the most we typically see this time of year. It was record, we hit record P-watts in February, so it was record, but we were at our climate’s max. You can’t explain to someone what p-watt climate max was [laughs], so I love the analogies. I think people really relate to it. Everybody has used a sponge in their life.

R: Yea, yea.

P2: So, analogies, great. Visuals, great. Pictures, awesome. Um, what else... the chunked list, awesome.

R: Thinking about the checklist itself – actually, let’s go to that first. What are your thoughts on that? Was there anything that you thought need improving for that, in terms of just laying out the recommendations in that format?

P2: For which one, for any of them?

R: Yea, for just – without the context of the instructional booklet, but just, does it seem usable, or is there anything that should be included or taken out?

P2: I will say, as far as checklists go, I made – so, when I did severe awareness week, I made a bunch of safety graphics, and each one I tried to do in a bulleted form, but I have the habit of getting too excited about them, and I would ask my – I like to do a non-weather person check of my graphics sometimes. If I’m unsure about it, I check with someone who is not a meteorologist, because I know I’m seeing with this blinder of science on, well, two-blinders, one, because it made sense to me because I made it, and, you know, I-made-it-blinder, and I-understand-science-better-than-everybody-else-blinder, you know? So, I like to check with my anchors who are not degree meteorologists, who are regular people, and who didn’t make the graphics. The biggest critique they always gave me, even with my listed structure, was that sometimes my list got too chunky. That, even though I had bullets, if each bullet had too many words, or too many lines with it, then it was too much going on and too hard to read. So, I think – I would think it was fine just because I had five bullets, but they would like at it and go, “Oh, you got to get rid of at least two of them.” You know? So, I think you can get carried away with the chunked bulleted information.

R: So, are you saying that, do some of these have too many bullets? Like the “I want my audience to better understand my message” – do you think that’s too many bullets underneath that?

P2: The one with the icons on it I love.

R: Oh, okay, wait – so, I’m talking about the actual checklist, not the instructional booklet.

P2: Oh! [laughs] It was great! There’s nothing wrong with the checklist.

R: Oh, okay cool [laughs].

P2: I was talking about weather graphics. No, the checklist is fine. I was talking about the weather graphics, I thought you were asking me about the –

R: Oh, okay, sorry, I wasn’t clear. I still think that’s interesting to note, having non-weather people review stuff.

P2: Oh yea, all the time! I probably do it a lot [laughs].

R: That’s so useful. I understand the “science tunnel vision.”

P2: I get inside my head all the time.

R: Okay, so let's look at the instructional booklet then, 'cause you said you didn't have any critiques or anything specific about the checklist, so you think that it's pretty straightforward, good. So, in the instructional booklet, we can go over your critiques first, and this can be anything you think could be re-worded, or if you have a better example, or if you think a page should be re-oriented, or if there's anything specific. Feel free to share.

P2: So, I guess what I kind of did hear is, I looked at the checklist and looked at the booklet side by side, and I think – so, what do you want to do? Go section by section?

R: Yea, we can do that. We can start with the first page.

P2: I think this was fine. I think it's really good to kind of, first of all, you have to define the goals, and I think you defined the goals very well. And it's hard to reach all of these goals at once, and I think the goals are going to be different per weather situation. But yea, I think this was A-okay.

R: Thank you. Let's move on to the second page, so how to make your messages more understandable.

P2: So, on the checklist I noted where it says, "I used visuals in my message" that's where I kind of noted, "okay, are they non-weather visuals?" Meaning, is it a picture of flooding, or is it the picture of a flood warning? Is it a polygon or is it a car going through water? I think that matters. I think what the visual is matters. Visuals are great, but if you have a really crappy visual, that's not helping.

R: Okay, that's good, yea.

P2: That's the only thing I noted on the checklist. Oh, with the analogies, I love thinking about – I love analogies. I actually went, so I presented to Girl Scouts two weeks ago, a group of Girl Scouts asked me, they were earning their meteorology badge, and they asked me to go to their class, and they had a bunch of questions. I was the most challenging, and I've done school visits, I've done tours and stuff – it was the most challenging one I had ever done because these girls were asking such smart, inquisitive, detailed questions, but they were only 7, 8, 9 years old. And they were asking me questions like, "How do you get an EF1 versus an EF5? What needs to be different to change the intensity of the tornado? How does hail form? How is hail different from snow?" Very detailed questions that it was hard to explain without using the words CAPE, things like that. So, the way that I got around it, and the way they understood, was by using analogies. For tornado formation, I compared it to baking cookies. You need all these ingredients to bake cookies, you need butter, you need flour, you need chocolate chips. Could you bake a cookie without the chocolate chips? Yes. Is it going to be better if you had the chocolate chips? Yes. So, kind of like, when you get a weak tornado, and you have some sheer, some instability, but neither are impressive, but if you got everything going, then that's when you get the strong tornadoes. So, I used that, I used the sponge for heavy rain and for snow. I made a list of them because I have to think off of my feet, too. So, I think, with the understandability, I just really – I wrote down relatable analogies, like every day analogies.

R: Interesting.

P2: Oh, I also wrote down too, so defining things, yes, and I think defining weather terms, yes, but as I mentioned, also need to define what the weather watches, warnings, and advisories mean.

R: Okay, so you're not only saying the term, but you're saying watches and warnings need to be defined as well, specifically for meteorologists, we should focus on defining terms and defining watches and warnings, like kinda in the same way, or of the same importance.

P2: Yea.

R: Okay, that's interesting.

P2: Yea, because I really, I mean I know the weather service is working on making it less confusing, but I think sometimes it can be confusing. You know, I don't think it's enough to say a tornado watch is in effect, or a tornado warning is in effect. I think you need to say, "A tornado warning is in effect, which means you need to take action and get to your basement" or, "A tornado watch is in effect, which means you need to..." I think they need to be defined, so I would include that in the making things clear and knowing what the actual advisories mean.

R: Okay.

P2: Oh, and then the other thing, so in making things more understandable, and again, this probably doesn't have anything to do with this, it's not really a critique, just more of an addition. So, just specifically thinking about the example of the Nor'easter, of explaining what a Nor'easter is...fabulous, great to explain what a Nor'easter is. But I think, sometimes, you have to prioritize the explanation of the messages. So, like, on the day that there are blizzard warnings in effect, I don't really think it matters what a Nor'easter is anymore. I think, now, we need to explain what a blizzard is and how to stay safe in a blizzard. I think that the science explanations also kind of have their long-term, short-term priorities. Long-term, you're explaining what a Nor'easter is, once you get to short-term, nobody cares about that anymore because we have accidents on the road, because there are blizzard conditions.

R: So, do you think a better example there would be a watch or warning example?

P2: Yea, I don't say that because it is a bad example, it just made me think...

R: Yea, definitely!

P2: Yea, watch, warnings, I think, should be explained like that.

R: I'm going to change it then. Okay, great. Do you have any other comments on that page?

P2: No. The only other thing was I loved the transformative explanations, right? "Acknowledge their intuitions." I wrote that a ruler can take your car away, as far as the water goes, you know? Surprise them with the facts that they think are not true.

R: So, let's move on to actionable. So, how to make your messages more actionable – what are your comments and critiques about this page?

P2: This page, ah, I really don't have a lot. I loved the logos with the credibility, I think that's something that people take for granted. I actually complained to the sales people because they were putting logos on my radar, and I told them, "No, when we have a tornado warning, I need the weather experts at the top, not Honda of the Ozarks"... So, I loved the logos and the credibility, yea, that was pretty much it. The only thing that I jotted down on the checklist was the when part, you know, when to take action. I think that's where the explaining what the warnings and watches and advisories mean, you know, winter storm watch, there are things you could be doing, it doesn't mean sit there and do nothing. These are things you do in a watch, and these are things you do in a warning. So, I think that when is very important, and then you define what the severe thunderstorm warning or watch is or the blizzard warning or watch is. You define what those are by using that when and what to take action.

R: Oh, that's interesting.

P2: Like, winter storm watch means that you are changing plans if you have them, maybe go get some bread and milk if you don't have any. Winter storm warning means you're not going outside, things like that. I think that's kind of how you can work to define them.

R: So, yeah, that's good then. Okay, so memorable, do you have any comments or critiques on that page?

P2: Um, the list, uh, the lists are really good. I love the "ready, set, go" part of that graphic. The only thing, if I was going to be nitpicky, the only thing that I would do is make it a little more bulleted. You know, ready being – do A, B, and C, and bullet it more. My printer at work only prints in black and white, so is the go red or green?

R: The go is green.

P2: The ready is red?

R: Yea.

P2: Okay, so...hmm, that's interesting, because I use the stoplight colors almost every day. I do road commute forecasts, you know.

R: Do you put anything – do you put a stoplight or anything on that image? How do you set up the colors with what you are saying?

P2: So I have two graphics, one that's road hazards, and I just organized it by morning commute, lunchtime commute, dismissal commute, and I give it a red, a yellow, or a green., and I have a word up there to explain why it's red, yellow, or green. So, green means go, A-okay, nothing to worry about. So, I use dry, on a dry sunny day, it's gonna be green. Yesterday, I had red because we had heavy rain that was slowing people down in the morning. So, red for heavy rain, or yellow if it's raining, maybe could slow you down but it's not the end of the world, it's kinda that in-between yellow. I also do that for severe weather. I do severe weather threats with the green stoplight, and I do, you know, tornado, wind, hail, flooding, so people can see which threat is worse.

R: So you use a stoplight picture too with that?

P2: I have the stoplight picture on the traffic graphic just because it's traffic, but I don't put the stoplight on the severe weather graphic.

R: Okay, interesting.

P2: I use it as red is most urgent, or most severe. For the severe weather threats, if I have a red for a tornado that means tornadoes are likely, they'll be widespread, that's the highest risk for tornadoes.

R: I think there's research on this, it's just – I don't know. I was just curious about your opinion on that.

P2: That's interesting, because I think people can perceive the colors as actions, so ready, you're not going to do much because it's widespread, green, you gotta do a lot, so you gotta go – but if you perceive it as the storm, you're not going anywhere if there's a storm, right? So, it's gonna be opposite if you're using it to describe the weather.

R: That is fascinating.

P2: Do you understand what I'm saying? If you see it as the weather, I think you got that red stoplight when you have the storm is arriving and get to your final destination and hunker down. If you're describing the weather, that's a red light, no? It's just how people see it.

R: Interesting. Okay, so are there any other comments or critiques about that memorable page?

P2: The only other thing, and this is just more for your interest and has nothing to really do with the page, I wrote down with the embedded trigger would be those colors, right? The red stoplight – for my radar, you know, you've seen the cones, right? Where I can draw out from the polygon a cone of arrival times, you know what I'm talking about?

R: Are you talking about when you have a tornado that's down? Are you talking about the cone of where it's going?

P2: Yea. In a severe thunderstorm warning, right? We got the storm and the polygon. So, from the storm, I can draw out the cone of where it's going and arrival times, right? My team, my chief and my weekend guy and I, we can change the color of the cone. Some stations opt to have it be the station colors, like blue and yellow. We chose to make it the stoplight, where towards the front of the storm, where people are having it right now, or gonna get it in like a second, it's red, and the farther out you go, it turns yellow, because the threat is a little bit farther away.

R: So, you're going from the threat perception instead of the action perception.

P2: Yea, it's kind of putting it in the cone on our radar.

R: Interesting, I like that. So, let's go to the sharable page, and I know this, for you, you mentioned earlier, is the most challenging part of communication. So, if you have any examples, comments, critiques, feel free to give some feedback.

P2: The only things that I wrote down – so, I say it's challenging not because of your instructions, I think your instructions were great. I think bringing up emotion, bringing up positivity, I think that's why the picture of the car going through the water versus the polygon of the warning – that's why the car in the water got shared more times than my polygon warning is because it's emotional, it's relatable. So, I think the emotions speak volumes to whether or not it is going to get shared. You know, the impact pictures over radar pictures, have them be relatable.

R: Yea.

P2: At the conference, I sat in one of those social media lectures, and one of the broadcast mets said in really urgent situations, like I saw her do it when they had a moderate risk for severe weather in her area, put in caps, "PLEASE SHARE."

R: Ahh, interesting.

P2: Yea, and with the colon, and then say what the message is. You know, tornadoes are likely across Nashville today, do this, this, and this. Here's the forecast. So, maybe the – and she had said it, too, you can explicitly put "please share" – and I think there were some irresponsible meteorologists that can overdo that, right? You don't want to do that, but I think when you have that very urgent situation of a high-risk tornado situation, high risk flood, just being explicit I think helps...and I don't know if it do it for sharability or attention, probably makes it both, but sometimes, especially if the post lends itself to it, I'll start out in caps with no more than two or three words that describes the theme of the post, and then put the post. Sunny and mild colon, today we'll have lots of sunshine with a high of 60 degrees, or, you know what I mean? I do it more on Facebook because Facebook screws you up with the algorithm. I'll do Wednesday in caps colon.

R: That's interesting. I've noticed that.

P2: I've had it happen to me but because, obviously, I keep up with the forecast. The first thing I think is, "Oh, that's old. We had that happen already." Or like, "This has to be old model data."

R: That could be confusing to people.

P2: Not everybody is thinking like me because not everybody is keeping up with the forecast, so I try to avoid that by putting Wednesday in caps sometimes.

R: That's fascinating. And that helps with the algorithm?

P2: I don't think it helps with the algorithm, I just think it might help people catch it, you know? So, with the algorithm, three days later, someone could still see that post pop up at the top on Friday. But my hope is that they would catch that it's an old forecast, because it's from Wednesday. That was one of the biggest tips in that social media part of the conference. Those were the two biggest tips that were in place for social media that I've started to do since I came

back from the conference. It was, like, make sure the words don't – you can say today, but make sure somewhere on that post that it says Wednesday.

R: Okay.

P2: Yea, the algorithm really screws you up.

R: Okay, let's go over the last two pages. This is about the threats. You mentioned you had a critique on something, so we can talk about it.

P2: Yea, the red flag one, it doesn't say anywhere that it's dry air and windy conditions. If I don't know what a red flag warning is – okay, you can say the word critical fire conditions are ongoing, but it says that at the bottom. I have to read three sentences in to see that it says that.

R: So, do you think that every watch and warning post should have the definition, or an explanation of what it means?

P2: In some way, shape, or form. How I probably would have written this is, "Red flag warning in effect. Dry air and windy conditions pose fire danger. Any fires will spread rapidly" is what I usually say. Like, say what the criteria is, what does it mean, and define the hazard. It doesn't really say here that it's dry, that it's windy, or that fires would spread rapidly.

R: That's really good. Do you have any comments on the imminent threat image?

P2: I just love it. I might steal it [laughs]. I love the checklist.

R: Do you have any comments about the long-term threat one?

P2: My initial reaction was that it was a lot of words. You have to read it. I like the tips. One of the other tips that I got from the conference was including links. I know a meteorologist who does it a lot. They always direct you to a link to the radar and direct you to a link to the forecast. And I thought about it, because this one directs you to where to find them on social media, and the website, so like directing people to more information, I think that's pretty important, and maybe we don't do that enough. I probably don't do that enough. I rarely post links...and long-term, so leading up to the flooding we had just the last two days, was pretty well advertised. We had the heavy rain setting up by – I mean, this a Monday, Tuesday event, but by Wednesday of last week, we're really honing in on it. And I posted a couple of long-term threats, and the way that I would do that is, if it's a long-term forecast, and obviously I can't do a specific forecast with rainfall totals, but what I would do is show the pattern, show it being stormy, and show – I love the rainfall chances bars, because it's visual. And I circled Monday and Tuesday with a 90 or 100 percent rain chance and circled it with concern for heavy rain. So, I think there's a way to make urgent weather long-term. Because, I mean, heavy rain isn't an urgent threat, but there's a way to – I mean, I was posting stuff about it Wednesday and Thursday with details that it was going to be heavy rain, but without throwing out rainfall totals that I would be irresponsible for me to do at that time.

R: Did you give any tips on how they could prepare?

P2: It was more so – so, I actually did. What I did was, I said something to the fact of, “Heavy rain most likely Monday and Tuesday. If you live in the Woolwine areas near rivers or creeks, we’re looking at something that will make you susceptible to flooding, so stay up-to-date with the latest forecast. And that’s how I address on air too because I’m a responsible meteorologist, I’m not going to go telling people 5 inches of rain 5 days ahead of time. So, that was my way of talking about it without being too over-hyped or too irresponsible with my information. Just being like, “Hey, we’re confident in heavy rain, more details to come. Stay up to date, especially if you know that where you live always floods.”

R: Interesting. Okay, so we’ve went over the instructional booklet. My last question is what would be difficult about using this checklist for social media posts?

P2: Ideally, you want your posts to do all of this. You want it to be understandable, you want it to do all of it, but I think that’s the hard part is making it be – making it do all of it, especially if there is character limitations too...but it makes you think about, “is it working?” That’s what stood out to me while I was reading this, was, “Oh, I’m doing this, I’m doing that!” And again, I think it also really matters who your audience is, which they stressed a lot – all the social media things I sat in on the conference. That was, like, literally the point in every social media topic was know your audience. Know if you’re talking to moms or grandpas or men or women. Like, I know my audience uses Facebook more than they use Twitter. I don’t really act differently because of it. Maybe I should, I don’t know. But I know my audience tends to answer me more on Facebook.

R: Great, this was such a good conversation! Do you have any additional comments?

P2: I think you did a fabulous job. You did a really nice job with putting examples that were different in weather, different in how much science they use. I think a lot of the steps were thought provoking. Like, “Oh, do I do that? I don’t know if I do that.” And some of them were like, “Okay, good, I do this. I’m doing the right thing.” I think you did a very wonderful job with this.

R: Thank you so much!

Interview with Participant 3 (P3)

Researcher (R): So, I sent you the consent form and you have read over it, correct?

Participant 3 (P3): I did read the consent form.

R: So you agree to be interviewed for my study?

P3: I do, I agree.

R: And you agree to being audio recorded?

P3: I agree to be recorded for this interview.

R: Great! So, let's start with the first question, what do you see as your main weather communication goals?

P3: I would say that my main weather communication goal is to convey the forecast in a way that is relevant to people's daily lives. Basically, you know, it's one thing to make a forecast, but it's only worth something if people can get something out of it as it relates to them.

R: Okay. So, we are going to go on to the next question, what do you think separates effective weather communicators from ineffective weather communicators? What do you think are the main differences?

P3: I would say that one of the major differences is that definitely knowing your target population. I mean, I am a firm believer that it's two very separate things to A make a weather forecast, and B have that weather forecast be utilized by the public or whoever your target audience is. So, really that's the determination between effectiveness, for me.

R: Okay, so what are the keys to being an effective communicator in your job, do you think?

P3: I think one of the keys to being an effective communicator in this is having a level of real-world experience in the context of your target audience. So, having that first-hand experience of, you know, if snow is in the forecast, you can relate to how it impacts them, how and, yea, so being able to personally relate to how the weather impacts your audience. Also, being able to clearly communicate it so people can understand what you're saying is a big key of it.

R: So what, in your perception, do you mean by being understood? What is that measure?

P3: I would say that a measure of being understood is that people can adequately prepare in advance of a weather event. That doesn't necessarily mean that it's going to be all hunky-dory for them, but the fact that they take the appropriate preparation steps and have a foundation of what to expect.

R: What is the biggest barrier you see for weather communication in general?

P3: I would say that one of the biggest communication barriers is a lot of times, you have various forecasting entities, forecasting slightly different outcomes, or in some cases, drastically different outcomes. So, that creates a lot of confusion in the public, 'cause people get their weather information from multiple sources. Also, I think another big barrier is that people aren't – the public isn't always up to date on the latest forecasts, so they may be looking at a forecast, it can be someone else's, it could even be your own forecast, but that you posted two days ago that is now totally irrelevant and they haven't gotten the updated forecast, especially with social media, because social media lingers. So, it's not that – when they go to share a forecast, it may not be for nefarious purposes, or for spreading fake news, but to just spreading outdated forecasts. Other barriers are, you know, explaining complex situations, where you have something like a Nor'easter or a hurricane, where small deviations in the forecast can have significant impacts. Classic example with that is Irma just this past fall, where everyone was like, "It's going to Miami, it's going to Miami!" It shifted a little bit, delayed the turn, or whatever, and then everybody's like, "Oh! That was a bust." It's like, "No, you just dodged a bullet."

R: Great example. How, if at all, do you currently use social media for your weather forecasting or job?

P3: So, I currently use two forms of social media. I have my forecast website, which is a primary source, but I also do have a Facebook because it allows me to interact with more people. For me, personally, what I will do is I will post a more thorough forecast on my website that allows me to go into a little more depth and explain the scenario a little bit more, and then I will provide a link on the Facebook with a basic summary that gets the main points across.

R: Okay, so describe to me your most shared or popular post, this can be that most recent one you can remember. What do you think explains why this particular post circulated or shared so widely?

P3: One of my more widely shared posts was – so, this year, we unveiled a new weather graphic that communicates basically when to act based on the forecast, and I think this was the third time we had used it this season for a potentially significant storm, and we upgraded from, basically, are you ready – to, I don't know how to explain it concisely. Just a nice concise weather graphic.

R: That's okay, we'll come back to it. What do you think could potentially make a social media post about weather hard for an average person to understand?

P3: Oh, there are a lot of things that can make it hard to understand. As forecasters, I believe that many forecasters are numerically inclined. They are data driven, so I feel that it's easy to put too much numerical data information on a forecast graphic. I feel that it's easy to use too much text to describe a scenario. You want to be thorough, but if you write an essay, who is going to read it, especially on social media? I think that one of the issues that forecasters face is that they don't get enough – not all forecasters get enough public input in their graphics. So, it looks great to them, but they don't have other people commenting, and I personally believe that can be a negative feedback loop. Like, if you don't have people interacting with your graphics to tell you that, "Hey, these are great!" Or, "no, they are not." They are just going to keep sharing the same ones, and if they're not great, then people still aren't going to be interacting with them.

R: Fascinating. Okay, so next question, how often, if at all, do you think people take action because of your social media posts? In other words, what kinds of posts do you find are most likely to lead readers or viewers to take action?

P3: Um, I definitely think that the graphical posts, like posts with images that convey that either something has changed or that the forecast has become more confident, are most likely to trigger some sort of action by the user.

R: Interesting.

P3: Yea, basically, those are two triggers I've noticed the most, like when the confidence increases drastically, or if there's a significant change.

R: Okay, cool. So, we'll move on to the next question. So, we're at the product, so now, we'll transition to the checklist and instructional booklet. I know you sent me comments on that, so I'm going to ask you about those. First, we'll start with the checklist...looking at the checklist itself, what was your overall impression of the product?...You mention you like the color coding?

P3: Mhm. Yep, I do like the color coding. It helps to associate the various categories...I actually used your checklist, and thought they were all easy, like understandable. I thought the wording was okay. There was some overlap, like, "Is my message simple? Is my message simple?" That's fine. I don't think that's a problem.

R: Yea, some of them overlap. But okay, good. So, we're going to move on to the instructional booklet. So, we're just going to go page by page, comment by comment. Let's start with the first page. What were the main things you noticed?

P3: Just rewording...So, my first impression when I read it through the first time was that, um, the accompanying weather communication checklist based on science communication provides...now that I'm reading it again, it's not that bad. My first impression of it was that it was a bit of a mouthful, just because that whole paragraph is two sentences.

R: Okay, yea.

P3: So, um, basically, my recommendation was to break it down into three sentences. Basically, first off, just saying what the recommendation checklist is. So, here, you have the comments spliced in where you say, "Based on science accompanying communication research" I would put that into a separate sentence. This way, the description of the checklist is one focused sentence, especially since you are introducing new information.

R: Okay, so do you believe I need to take out "scientific research?" You said it was a bit redundant and text-heavy.

P3: That was my initial impression, that the first page was text-heavy.

R: Okay. Do you have any further comments on the first page? Anything with images or any recommendations or examples you could think of to replace?

P3: It's a good page, um, obviously, you're introducing new information. My initial impression, when I first saw it, was that this is very text-heavy. I didn't realize it was going to be this much. So, it was – but it's information you have to put on there. And it's not stuff you can directly necessarily tie to any particular image. So, I mean, like, it really depends on who you're going to have reading this, and if you're gonna have forecasters reading it, then that's something they'll have to deal with...the information is on point.

R: Okay, so, let's see...we're on the understandable page. So, what were the main things you noticed in terms of the examples? We'll start there.

P3: I think the examples you used were relevant. So, for like the elucidating, you took the Nor'easter, you said what it is, what it isn't, and you used an actual piece that someone could directly relate to, like, as a forecaster. With the quasi-scientific one, the image says it all, you know. And then, the transformative, yea, I mean, I think you used very relevant examples, and I like them. I didn't have any problems with this page, as far as that goes...I think that you actually did pick a good variety of things, like you have the Nor'easters, which are the northeast, and then your second example is tornado stuff, which is more Midwestern. So, like, it feels like it has a general applicability. Obviously, they're general examples – no one's gonna have, not everyone is going to have the specific thing.

R: Yea, so you like having the multiple different types of examples?

P3: Yea, it's like, it's not stuff we just find in the desert southwest.

R: Okay, cool. So, we'll move on to the actionable page. Let's see – so, let's talk about this. So, you talked about simplicity as being ambiguous. Can you tell me more about that critique?

P3: It was mainly a wording thing, I think. When you say "it" so, "research shows that individuals tend to not take action if they view it as too complex or confusing. I thought it was ambiguous because I wasn't sure if you were talking about "it" being the action that they're supposed to take, or "it" being the graphic or the message you're putting out there.

R: It means the message. Okay, yea, no, thank you for telling me that.

P3: Yea, so I would change "it" to if they view the message as too complex or confusing.

R: Okay, um, can you describe to me this comment – it's the comment right above "using subjective norms." You say, "as soon as you said, 'don't drown,' my attention actually went from example one to example three back to number one.' Was that confusing, me using example three for number two? Should I incorporate example one and number three? Or just one or three?"

P3: I think you could do it with just example three. The "if, then" thing made sense, but as soon as you got to "don't drown" I associate "don't drown" more with example 1 opposed to the little bit in example three. I would say that, for your "if, then" example in number three, I would maybe look at, "if you can't see the road, then turn around" as your example text in it, because that's what popped out to me more than the "Turn around, don't drown" at the top.

R: Okay. You also think the third image has too much text?

P3: Yes.

R: Interesting. Are there any other comments for the actual page that we haven't talked about that you would like to bring up?

P3: No, I think it is effective, it's obviously more text-heavy than the previous page, but it works, and the style you used to deduce it works. With example three being more text-heavy, I figured you wanted it for the news outlet feel. I did link you to another one that you could consider using. There's actually two in there that you could consider using. The second one is probably better, but it's not perfect, but you know....I figured that's what you were looking for.

R: That's great! Yes, thank you. So, we're going to move on to the memorable page. Let me look over these highlights...so, you're confused as to why I highlighted the bottom text versus the top text?

P3: No, I think that works. Yea, it does work, and that's what I was saying. That part – I've seen that kind of style in magazines before, where they just do part of the page. But no, I think that worked, and it makes the information that you have up top – it gets your point across and it's nice and concise. I really liked the part where you actually threw in the scientific support behind it, about the Rebecca and Jason thing.

R: Oh yea, that's from an actual research article. You liked that?

P3: I really did like that, like this page and the next page really have that magazine kind of feel to them, where you could almost flip through it and just read it casually. I really like these two pages.

R: Okay, you didn't say that about the actionable page, though. So, do you think that one is a little too busy?

P3: The actionable page, it just has more text on it, basically. So, that's the only drawback for me.

R: Okay. Are there any other comments on the memorable page? Like, do you think it relates to the visual well, or vice versa?

P3: This page actually worked well for me. I liked the layout. I felt that your headings over the "easy to remember" part, they are big and they stand out, so it makes it easy to focus on and not get lost in the text.

R: Okay, so we're going to go to the sharable page. So, this one, you only have two highlights.

P3: I do only have two.

R: Tell me about your perception of the "safe space" vernacular that you pointed out.

P3: So, basically, I know exactly what you are talking about by that, but my question is will other people know what you are referring to in that? That seems like a point of inquiry somebody might have. Like, “what exactly is that?”

R: Interesting, I could see that if someone who wasn't a meteorologist read this, and how that term may have a politicized tone.

P3: That's actually where I went. Obviously, I knew it wasn't that, but I kind of went into, like, LGBT stuff, like mentally in the back of my head. And then, I thought that your first graphic was great, it's spot on. It's from the National Weather Service. Your second one is from the Weather Channel, so, I mean, it's relevant. The only suggestion/critique I would've had with it was – if you could find a viral safe space one, I think it would be a little more appropriate than the second one.

R: Okay, great! We're going to move on, then, to the threats pages, so the last two. You have two things highlighted here...so you would change “imminent threat” from...you would add “before the event?”

P3: Yea, I wouldn't change the numbers, I would change the way you word it. Like, instead of 24 to 48 hours, to 24 to 48 hours before the event.

R: Okay. And I should shift my bullet points?

P3: [laughs] I mean, it's not that, it was just funny.

R: Okay. Do you have any issues with the images used?

P3: No, I think they were relevant issues. I think you did a good job with picking an urgent one, like the red flag warning that's in effect now versus the one that's a little bit in advance, where you have time to actually go shopping.

R: I love how your last comment is, “I love all but the first page.”

P3: [laughs] I mean, the first page really isn't that bad, I think it's just the first thing you see, it needs to have that “wow factor” like on the other pages.

R: Okay, and you like the additional resources? Do you think they are hard to read?

P3: I think the formatting of them is fine, the size is fine. If people really wanted to, they could go look it up, but probably, most people aren't going to, you know? Just like credits at the end of the movie sort of thing.

R: Okay, so we went through all the pages. I just have two more questions for you. So, in your perception, what would be difficult about using this checklist for social media posts?

P3: The hardest part about doing that... I mean, I really don't see an issue with them using it, you know? Besides the fact that, you know, it takes an extra 5 minutes or so to go through and see, “Oh, hey, do I have this? Or this?” It's like what you said on the first page, you don't have to

incorporate all the things, you can incorporate a little bit or a couple from each category. And when I was going over your pages, it didn't take me long at all. I just went through and was like, "Okay, is it simple? Does it have visuals?"

R: Should I highlight more that they don't have to use all of them?

P3: I think you could highlight that more, 'cause I know on the first page that you did mention it, but – or maybe even, like, even putting it on the checklist itself, you know? I would put it on the checklist itself. You don't have to have all these things. Maybe one or two from each thing.

R: I like that.

P3: The only thing I would maybe modify with the layout of the checklist is, now that I'm looking at it – so, you have different number of checks in each category, each of the four categories. I might consider taking out, like, say, taking out the visuals from the first box just to make the number in each category more equal, you know what I mean? 'Cause you have six there, five, four, and then three.

R: What is your reasoning for that?

P3: I'd say my reasoning for it is mainly just because, when you look at the checklist, it's not intimidating, so if you didn't do anything, it would be totally fine. Just the idea of – same common thread that I've had so far, like a bunch of text at the beginning is kind of, not intimidating, but, you know, it's more to process, you know?

R: Okay.

P3: If you were to leave it in, though, it would be totally fine. It's not going to hinder anybody. It's like, what, six words? I think it's more about the visualization of seeing equal sized boxes.

R: That makes sense. Do you have any additional comments about the checklist or examples you want to share, or any weather communication experience, or just anything additional?

P3: I think what you've done here is awesome. I think it's usable, it's widely applicable, and it's – people can actually draw from it, if nothing else, to critique what they are doing. As far as my experience, I think consistency is a big thing for forecasters, like some forecasters will just post one thing once a week, or randomly, and they don't build that relationship.

R: So, you're saying that their relationship to the audience is very important for their messages?

P3: Yea, it's something that, you can't just post it and expect people to just jump on top of it. You got to maintain something.

R: Hmm...consistency, interesting. Well, thank you so much for your time!

P3: Absolutely!

Interview with Participant 4 (P4)

Researcher (R): So, I sent you the consent form – do you agree to be interviewed for this project

Participant 4 (P4): Yes

R: And you agree to being audio recorded?

P4: Yes I do.

R: Great, thank you! We're going to start with the first question, and then we'll get into looking at the product, but first, I'm going to start off with a general question. What do you see as your main weather communication goals?

P4: My main weather communication goal is to make the information easy to understand and useful for the viewers to incorporate in their life, either to be safer or be more informed.

R: Okay, great. What do you think separates effective weather communicators from ineffective weather communicators?

P4: Um, I would say effective weather communicators are able to translate the scientific information in a way that's easy to understand and are able to break down the technical terminology and the ambiguity with the weather terms and make it something that everyone can understand.

R: Great. So, what are the keys to being an effective weather communicator in your job, do you think?

P4: The keys to being an effective weather communicator is, I guess, figuring out how to incorporate verbal and visual cues that people can understand.

R: Verbal and visual cues...can you give me an example of maybe what you're thinking?

P4: Yea, for sure! For example, if you create a weather graphic for Facebook, or TV, or Twitter, the graphic should be easy to understand, and should be processed as a stand-alone. But, I guess, if you want to explain it in further detail, use your voice on TV or the text in the post.

R: Okay, awesome! How, if at all, do you currently use social media for your job?

P4: I use social media, A during severe weather to, you know, spread storm reports and warnings and watches that might affect viewers. I also use it in benign situations to sort of build relationships with viewers. And then, during nuisance weather, so, for instance, today, it's raining, but it's not really flooding or anything too severe. So, I guess, during nuisance weather, it's important just to give people a heads up if they have plans that might be difficult depending on the weather.

R: Okay, great. That's interesting. What is the biggest barrier, do you think, in terms of weather communication in general?

P4: The biggest barrier is that, as a meteorologist, you have the science background, and you know all the mechanisms and all the terms and the equations, but the viewers don't know those things. So, it's sort of bridging the barrier between the science and the viewer is difficult sometimes.

R: Bridging the barrier...okay. So, describe to me your most shared or popular post, or the most recent one you can remember. What do you think explains why this particular post circulated so widely?

P4: That's a tough one. I mean, if we're talking about our station page, the most popular things we probably have is Facebook Live during tornado warnings.

R: Interesting.

P4: If you're talking about individual posts, or does Facebook Live count?

R: Like, an individual Facebook post you have posted on your meteorologist page. Facebook Live is also interesting as well, though.

P4: Gotcha. Some of my most popular posts I've noticed have been basically medium-range sort of outlooks, basically saying – so, we're in late March right now, so saying, "Oh, first two weeks of April are going to be super warm and nice. Are you excited?" Or, posting, like, a Climate Prediction Center map saying that, "Oh, it's gonna be nice and warm for the next couple weeks." I think people like that sort of long-range outlooks.

R: Hmm. Is there a lot of interaction in your posts?

P4: Yea, absolutely. It's not just a one-way communication street. It's gotta be sort of a conversation. So, the more questions you can ask of your viewers and getting them engaged, I feel like, in the future, they're gonna be more engaged on your page, because they'll see it not just as you sharing information, but they'll also see it as a way for them to ask questions and express their opinions.

R: Yea, definitely. So, what do you think could potentially make a social media post about weather hard for an average person to understand?

P4: If there's no explanation of the terms, for instance. I know this one particular meteorologist in our viewing area who draws occluded fronts on a surface map and they don't explain them.

R: Oh no!

P4: Yea, and I don't want to explain that to viewers. So, I guess if you leave a term undefined, that can sort of leave the viewer confused. And sometimes, if you're trying to convey too much information all at once, like if the graphic is too busy, and there is not really a focal point, then too much information can be a bad thing too.

R: Yea, good. So, how often, if at all, do you think people take action from your social media posts?

P4: I mean, probably at least on a weekly basis. It may not be action in terms of going to your tornado safe space, but it could be action in terms of planning an Easter egg hunt on Sunday or just bringing their umbrella in the car or what they wear. So, I hope at least on a weekly basis.

R: What kinds of posts do you find are most likely to lead viewers or readers to take action?

P4: The most likely post for them to take action are definitely during severe weather, where you are saying there's basically a warning in effect and you need to go do this or go do that. So, obviously, during tornado warnings, those posts get shared a ton because they want to spread the word.

R: Okay, great! So, we're gonna move on to the checklist, so I just want to ask first what was your overall impression of the product?

P4: Yea, I made a few notes on some of the bullet points, but I think that, generally speaking, breaking it down into those different categories, like the understandability, actionability, memorability, and sharability, I think all of those are really important for an effective post, and when you combine all of those together, I think that makes the best post.

R: Okay, great. Yea, so we're just gonna go – we'll just do page by page, and we'll start off with the checklist. Do you have any comments about that? How it looks? Anything that could be improved? Or any thought you may have?

P4: Um, I think it's interesting – so, the first bullet point, you said it's helpful to explain a weather term in not only what it is but also what it isn't, and that's something that I probably don't do as often as I should, but I can think of an example. Like, when you're trying to differentiate weather and climate, you might want to differentiate them by saying that, you know, climate is not a short-term thing, climate is not what happens on a day-to-day basis, it's not the weather right now. It's basically more of a long-term average of all the weather. So, that's something I should probably think about more, but I don't really give counterexamples as to what it's not.

R: So, you thought that was interesting? Like, “Oh, I didn't know I could do that.”

P4: Yea, yea. It's something that I might try to incorporate into the future.

R: That's fascinating. Awesome, is there anything else?

P4: So, for the second section, the subjective norms, those are kind of things that are almost sort of tradition by now, because you hear the same saying go around, like, “When thunder roars, go indoors.” Or, “Turn around, don't drown.” So, those are definitely message I have found that I can use a lot on air. Like, during pretty much any flooding event, we use the “turn around, don't drown” thing, so I think those are good. They make it more memorable because they rhyme, or they have a nice sound to them. But they are not things that I have created myself. I have just borrowed them from other common places.

R: Interesting, yea. Okay, that's interesting. So, from your experience, being on-air, is there anything you do that wasn't included in this checklist that, maybe, you think is effective?

P4: Hmm...I'm trying to think of any particular graphics or...I think that focusing on more of the impacts rather than the weather itself is sometimes important. So, a lot of times, meteorologists get hung up on, you know, how many inches of snow are we going to get, or how many centimeters of rain are we going to get. People spend so much time making snowfall maps, losing sleep on whether to put 4 to 6 or 3 to 5. But the reality is, I think what people want to know more than exactly how much snow we're going to get is how it's gonna affect me. So, there's sometimes where we don't even post a snowfall map because it's not really important. Like, it's just a little Alberta Clipper system that is going to produce minimal snowfall amount, but if the timing is 4 to 8am, then an inch of snow can make a big difference. Just due to the timing of the impacts – so doing the impacts scale is an effective way to communicate sometimes. We also do that with severe weather. Like, rather than using the slight, moderate, and enhanced scale, those are all kind of synonyms. What we basically say is greatest severe risk, least severe risk, greater severe risk, lower severe risk. Basically, just making it all relative, so who as the greatest severe risk, who has the lowest.

R: That's fascinating – so, you're using a non-probability tactic to talk about forecasts? That's interesting.

P4: Yea, cause when you make a snowfall map and it's totally wrong, the viewers are not happy about it, because they love snow, especially around here [laughs]. When you make it an impacts map, nobody really gets mad at you, and then they only really thank you, because you're giving them a heads up about the weather that could affect them. That's where the nuisance weather really comes in. Like an Alberta Clipper at 4 to 8am isn't really a big winter storm, it's not the blizzard of '78, but it's still a nuisance event where it's going to slow down your morning commute. So, I think that impacts for nuisance weather is a really important thing to convey.

R: Yea, and like you said, you're kinda not toying with their trust as much, it's more of a focus on the impacts rather than the specific amount of snow that falls. That is really interesting. Okay, so let's start with the first page on the instructional booklet. We'll just go page by page and just talk about anything that you noticed or liked or think should be improved. Do you have any comments or critiques about the introductory page?

P4: Yea, definitely. So, I do like how you differentiated between the different kinds of weather events, like urgent, imminent, and long-term. And that's something we totally focus on because, you know, even though there's so much uncertainty in a 7-day forecast, even forecasting something a week out would be more of a long-term thing, but, you know, if there's like a slight risk for two days in advance, that's more of a medium range, and if there's a tornado watch like right now, that's urgent, obviously. The only thing is, I don't know if imminent is the right word for the medium range weather threat. The other thing about the long-term weather threats that I kinda want to relate to something many TV stations do, is -- this is becoming more popular in the broadcast industry -- is to brand a particular day in your 7-day forecast or 10-day forecast as an alert day basically. Those sorts of days are kind of just "heads up" days where, 4 or 5 days out, you see whether it could be impactful – you're setting that day apart from the rest of the forecast,

and basically telling the viewer that, “Hey, you’re going to want to stay weather aware that day.” So, I think it’s good to alert people to those long-term weather threats. But otherwise, I like it.

R: A weather alert day? That’s fascinating. Okay, awesome. Let’s move on to the second page, then. So, how to make your messages more understandable – what are your comments on this page?

P4: Okay, let’s see...I definitely define terms that need defining because some people just don’t know, like some people don’t – like the terms “funnel cloud” and “wall cloud” – they seem like common sense to us, but a lot of people just don’t know what they are. I think it’s important to define terms, I do agree with you on there. Um, oh yea, the quasi-scientific explanations – that’s kind of what – I actually did one of those last week. Sometimes, you can’t get overly complicated with it, and it’s better just to draw a schematic diagram with it. So, one thing I posted was that a lot of people were asking me why it has been so windy lately. So, I wanted to sort of convey the fact that, well, since in the Midwest we’re smack dab between strong high pressures and low-pressure systems, we get sort of the intermediate flow were those are converging. So, I basically just drew a two-dimensional diagram with basically, like, a big L and a big H hovering over the ground. And obviously, it’s not a two-dimensional system, the atmosphere is four-dimensional, cause there’s time, too. But, it’s more of like a schematic diagram. It’s obviously not totally realistic, but it can still help get the message across.

R: Okay, cool, yea. Do you have any comments about the transformative explanation?

P4: So that’s pretty much when they have some sort of pre-conceived idea about something?

R: Yea.

P4: Um...sorry, I can’t think of anything off the top of my head.

R: Oh no, if you don’t have any issues with it –

P4: Yea, it makes sense. I’m just trying to think of an example where I used a transformative explanation.

R: Oh no, that’s fine. You don’t have to give me examples for all of them. I just wanted to point that out in case –

P4: Actually, one little wording that I did like in this is, “Instead, we acknowledge why they think that way.” That’s really important because, whenever you’re trying to change someone’s opinion on anything, you’ve got to sort of meet them in the middle and identify, “Hey, I see where you’re coming from, I get it.” ...Like with climate change, a few people fight me on that, but I don’t call them dumb though [laughs]. ...I’m considering posting in the future basically a transformative explanation telling people why long-term climate models can be trusted, because one common misconception is, “Well, if you can’t forecast the weather weekly, how can you forecast the surface temperatures a hundred years from now?”

R: Oh yea.

P4: So, um, so one thing I wanted to do is basically say, “Well, yea, that makes sense on the surface because, you know, if meteorologists who forecast for 7-day are doing the climate models, obviously then why would they be right?” But, I wanted to sort of transform their understanding then and say, “Well, it’s like flipping a coin, basically. When you forecast the weather, it’s just one coin-flip. When you forecast the climate, you just got to basically forecast for a thousand coin-flips. I’m pretty sure out of those 1,000 coin-flips, 500 will be heads.”

R: Yea, that’s an interesting way to put it. Now we’re going to move on to the how to make your messages more actionable page, so the third page. Do you have any comments about any of these, or critiques, or something better?

P4: Well, the examples you used are pretty good. I’ve always liked the “Turn around, don’t drown” from NOAA.

R: Yea, I definitely wanted to highlight that because it has a lot of the characteristics and it’s so universally known.

P4: It is! Yea, because of the visual and the verbal cues. That TV graphic with the, “is there a sinkhole here?” That’s kind of – is that all the graphic or did you modify that at all?

R: No, that was how it was.

P4: ...Yea, it’s almost too busy. There’s too much text on there. I think the visual in the background is very powerful, but really, all they need to do is just circle that dark area of water and, you know, they can probably explain it on-air. If you’re posting this on social media, then maybe the words are fine, but if it’s an on-air graphic, you don’t want that many words on there.

R: Okay. Cool, yea, so if you don’t have any other comments on that page, we can go on to the more memorable page. So, yea, do you have anything you highlighted in green or that you liked for this page?

P4: Definitely, memorability is important because if they don’t remember, then everything else fails. If they can’t remember your message, then they can’t take action because they won’t know what to take action on. Let’s see...so, I’m looking at the storm action guide graphic. I do like the red, yellow, and green colors. The only problem I see is red almost has two different meanings. On one hand, if you look at the stop sign, it’s like stop and ready, but if, at the same time, red is also, if you think of it in terms of severe weather, urgent, take action – green obviously means take action and go, but at the same time, it can mean you are good to go and you don’t have anything to worry about. So, red and green can both mean both things, which is really confusing.

R: Yea, no, I can see that. It’s all about the audience’s perception. It just depends on how people see it. I would see it from a traffic light perspective –

P4: Yea, I would too!

R: Yea, so maybe if it was an actual traffic light, maybe...

P4: I have found traffic lights to be effective to visually communicate with viewers. We do that a lot during winter weather. We'll do, basically, localized forecasts for different parts of our viewing area if the weather is different. Or, we'll do like a red, yellow, green traffic light and basically identify whether it's gonna be really bad, be careful yellow light, or green light good to go.

R: Yea.

P4: That's why I usually think green means okay, no weather hazards...I'm thinking of the SPC graphics and green is the least chance. Green is when thunderstorms are marginal, like it goes yellow, orange, pink, red.

R: Yea, that's fascinating. Okay, are there any other critiques of the page you may have?

P4: I mean, I do like how you underlined the important bullet points "it's simple" and "it incorporates a visual." That kind of does make it visually stand out as the important communication guidelines to remember.

R: Yea. Great! We'll move on then to the sharable page. Yea, let's start off with anything you particularly liked about this page.

P4: I remember the heart-shaped cloud when they posted it. Was that last year?

R: No, it was 2016 actually. It was shared a lot, so that's why I used it.

P4: Yea. Yea, I mean I guess -- this would probably be -- the emotional connection would probably be applicable for benign weather, just kind of communicating with your viewers in building relationships. But generally speaking, I feel like emotion is not something you want if there's actually imminent weather that you need to just be very objective about.

R: Okay.

P4: Yea, I don't know who told me this, it might have been my first news director here, but they said that, in order for viewers to trust you during severe weather, they have to trust you during benign weather. If they don't trust you when it's sunny and 70 out, then they're not going to trust you when there's a tornado warning. So, doing some of those fun, personable, goofy posts when there's no active weather is a good way to build rapport. Once you have that rapport, people trust you. Like, obviously, my personal page is not the most serious page in the world, but the thing is, the viewers trust me enough that, if there was a tornado on the ground -- when I do post serious stuff, they take it seriously. So, yea, you can't be all fun and games, but you can't be all serious either. I found that more meteorologists than not are all serious, and they don't really build that relationship.

R: That's interesting, because in a way, meteorologists are scientists, so maybe it might play into, oh you see them as scientists, and if you do, there's a distance, but maybe to your viewers, you seem more, like, part of the community.

P4: Yea, yea that's true, but at the same time, you don't want to throw out your credibility.

R: Exactly. It's like a fine line to walk.

P4: It is. It is, yea.

R: Okay. So, yea, are there any other critiques?

P4: Actually, the post you included from the Weather Channel kind of brings up another point to me. You notice the caption is only one quick sentence. It says, "it was discovered after the powerful Nor'easter." I generally think that the less text you can use, the better. At least, in terms of text in the post, or in the graphic too. If the visual can tell the story, then that's the best. If you think about it, when people are scrolling down Twitter or Facebook, you know, just quickly on their laptop or phone, and they don't really have time to read all that text. So, for the NOAA post, I guess the picture of the heart is what draws my attention, but with the Weather Channel post, the picture draws my attention, and then there's just one quick sentence, and I can read that very clearly. But the NOAA post – most people who saw that heart probably just looked at the heart and didn't actually read about the GOES-13.

R: Fascinating.

P4: And then, you also had a...well, I guess the chunking we already went over, but that reminds me that if you do have a paragraph or a longer body of text, just dividing it up into different sections is probably a good way to break down the information.

R: Yea I agree with that...okay, yea, are there any other comments you have for that page?

P4: Um...I don't think so.

R: Okay cool, then we'll move on to the last part, talking about the threat levels. So, the first page talks about urgent threats and imminent threats, and you already told me about your comment about the imminent term. So, are there any other – is there anything you notice on this page?

P4: Well, for the first urgent threat example, it looks like the National Weather Service is trying to define a term, which we talked about a little bit at the first page, which is good, because even, like, a red flag warning is something I probably need to define to me, because I don't see those in Indiana. But, yea, I don't know, that graphic is a little bit too textual and not visual enough for me, but that's the National Weather Service for you. The imminent threat graphic is hilarious, and I think those checkmarks are a great way to do it. Emojis are also – like, it's kind of sad, but we live in the 21st century where people communicate with emojis and not words...we've done checklists like that before, and it's definitely sort of an easy visual cue, like a checkmark, yes, green, or an x, with red, it's no.

R: Yea, I definitely agree.

P4: Yea, I think it's the only other – yea, it looks like you defined imminent as 24 to 48 hours. Yea, I don't think imminent is the right word then for that time range.

R: Interesting...okay, let's look at the long-term threat page, the last page. So, do you have any critiques on this page?

P4: I'm glad you bolded the words "remember" and "take action" because, especially if it's a long-term threat, people don't remember long-term things, because they have a short-term memory [laughs]. So, if you're gonna do a Climate Prediction Center outlook that's two weeks, people need to be able to remember that. One thing the viewers like with long-term threats is that you follow-through. There are some stations in town that will issue a forecast two weeks out and they won't follow up on it, so people just kind of think that they're not tracking the weather anymore. But, if there's a weather event that we're expecting a week out, we're going to do an update every single day, whether that's a live update or a graphic or whatever it is, just to kind of keep – even if there isn't new information, just telling people, "Hey, there is no new information, but here's still an update." It'll help refresh their memory that you're expecting some sort of weather. And that's kind of why the alert days are good too, because if every single day they see that part of the 7-day in red as an alert day, then they might be more inclined to remember that there's a long-term weather threat.

R: Yea. Do you have any comments on the visual that I used?

P4: The "before the storm" one?

R: Yes.

P4: I mean, it is definitely chunked. I guess I liked how they used all-caps to headline individual sections. The photos at the bottom aren't really too eye-catching. I know they are kind of relevant, but it doesn't really draw my attention. My attention is drawn to the top where it says "01 Before the Storm" with that white line, because that's the biggest text on the thing.

R: Yea.

P4: You wanna know another little social media secret? When you share photos that have a lot of text embedded in the photo, like in this one, Facebook tends to group that as spam.

R: Interesting...

P4: For instance, I don't know if you're familiar with promoting posts, paying money to boost the post?

R: Yea, I am.

P4: I don't do that anymore, but I did at one point. Boosting a post that is a photo with a lot of text in it doesn't render many results. It doesn't get to many people to see the post because Facebook sort of categorizes it as, "Hey, this might now be good information or might not be good." But, when you boost a post on Facebook that is just a picture with the text all in the body and not in the actual photo itself, I feel like that is more advertiser friendly on Facebook. So, this photo right here, honestly, might not reach that many people if Facebook's algorithm thinks it's spam.

R: Interesting. I would have never known that. So, are there any other critiques or comments in general for the instructional booklet that you want to bring up now? Or just anything that we didn't go over specifically?

P4: I don't have anything right now. I definitely like how you, on the very first page, broke down the different categories, which are your goals, like understandability, etcetera, and then made each of those its own segment. I do really think those are good ways to describe what makes a good social media post. I guess the actionability one might not be as important if it's a long-term weather event, but they are all important at some point in some way for communication...and if you can check off all those recommendations instead of one, your message is going to be better.

R: Yea, exactly. I just have two more questions and then we'll be good to go. So, what would be difficult about using this checklist for social media posts?

P4: Well, I think the term sharability is difficult for a lot of people because sharability almost implies that you know how people are going to react ahead of time. So, you're not only forecasting the weather, you're forecasting people's reactions to your posts about the weather [laughs]. Sometimes, you find out sharability after the fact, and then learn from either your mistakes or successes in the past. But, a lot of meteorologists probably don't really know what necessarily is going to be sharable, and actually, I have another interesting comment to make. One sort of way that we're going to try to get feedback is we're gonna post – we're gonna ask viewers to fill out a survey about our weather forecasts, basically, and ask them a variety of questions about our communication. So, for instance, “do you like using percentage values in the 7-day? Do you like using the color key for severe weather outlooks? Do you like using those words slight, moderate, enhanced?” Stuff like that. That's going to hopefully give us insight into what's understandable and memorable, and honestly, all of them, really. And that's something that most meteorologists don't do because they're basing it off of what they're thinking in their head, and as scientists, they probably don't know what's going to meet those four goals. I've never really heard of that many stations doing surveys about their weather communication. But, that's something we're going to be doing soon. I wish we had done it already in the past, so I could tell you about it.

R: No, that's really cool. You can see what people really like and see if any of those characteristics can re-affirm the successes of these ideas.

P4: Yea, I guess the only way to find out is to just ask.

R: [laughs] Exactly. Do you have any additional comments?

P4: Not really. I do kind of want to reiterate the fact that you need to communicate the weather no matter what the weather is. In order to be a successful broadcast meteorologist or a communicator in general, people have to follow you for information no matter what the weather is. So, that can mean, even during the summer, it's like sunny every single day for a week, you've got to find out what the important weather information is to convey. And a lot of times, the information people want is the next change in the weather. So, if it's a stretch of seven days in a row that are sunny, then you should focus more on the long-term, the less imminent threats. Maybe focus on a long-term temperature outlook, or something. But if there's a storm coming today, then obviously, that needs to take front-seat. That's kind of something I faced last weekend when I was doing some of

my forecast, because we got four rounds of rain this week, so honestly, it's so hard to forecast for the long-term in that sort of situation, almost exclusively focus on the first one that's going to happen, and then once that happens, we start doing the next one.

R: Yea! Well, thank you for your time!

P4: No problem!

Interview with Participant 5 (P5)

Researcher (R): So, I sent you the consent form, and you have reviewed it, so do you consent to being interviewed for this study?

Participant 5 (P5): Yes

R: And you consent to being audio recorded for this as well?

P5: Yes.

R: Yes, okay, great! So, I'm going to start with the first question. What do you see as your main weather communication goals?

P5: First goal is certainty to alert on social media as best as I can, because Facebook has algorithms that sometimes keep warnings out longer, but my first goal is to get the warnings out as soon as possible. And I pay \$30 a month out of pocket to subscribe to ReadyWarn, that's a service that instantly, or if something's going on and I can't get to a computer, it'll post a central message like of a tornado warning, or whatever warning, like a winter storm warning, will pop up on my Twitter and my main Facebook page. So, that's priority one. I'd say the second most is very forecast driven. What are we going to be getting over the next two or three days? Mainly big events, if there's any snow, is it a big snow? I want my followers to know that. And it's really kind of a competition thing at that point. You know, you want to them to know it for their safety, but – I don't do a lot of television anymore, mainly online – so, I'm kinda competing online with the other meteorologists in town in terms of saying, "I've seen this on the models, I think you need to watch it over the next couple of days." There's a little bit of that involved too, but, of course, it's a safety thing as well.

R: Okay. And what did you say the name of that site was?

P5: ReadyWarn, it's called ReadyWarn.

R: ReadyWarn? Okay.

P5: And you'll see on the posts, like there will be – I think another local station does it as well, and some other stations use it. I think it's great. I used to personally, when I was first getting popular on Facebook, on my main page, I'd stay up all night if we'd have a severe weather event. I would manually copy the warnings and image from my radar that I use here. So, but I still do that, it's a secondary thing because automated posts created on ReadyWarn, you can create a tag or intro, and it'll say, "From me, severe thunderstorm warning for so-and-so county, I'm going to have more updates." And after I see that warning come out, if I'm already on it, I'll go ahead and do, as a secondary follow-up, a copy-and-paste of the National Weather Service text, so that I'm giving them – they're now doing the bullet points and a lot of the things that you have in your chart, your booklet there, as far as chunking information. So, I do that as a secondary thing. I usually attach a current radar image from when the warning is issued that shows the polygon and shows the radar and what needs to be seen there. That tends to get more reaction, and a lot of times, the ReadyWarn is just simple text that are coming out there, and it'll at least alert them to know. And you know, a day or two before, I usually try to put out a SPC, severe thunderstorm

outlook, or create some kind of graphic like you mentioned, sometimes little videos, highlight the bullet points and what to expect. Simple things, like the difference between a watch and a warning. Things like that. That's how I do it usually.

R: Okay, so what do you think separates effective weather communicators from ineffective weather communicators?

P5: Okay, are we talking about, too, the "arm-chair meteorologists" that have their pages that get shared now?

R: Yea, whatever comes to your mind as someone, a meteorologist –

P5: Yea, that's the first thing that comes to my mind, is the credibility, and it's really hard on Facebook now to know who is credible and who isn't. Even though I'm a meteorologist and I got that verification on my page, I still have – I don't get a lot of it – but in the winter, I get a lot of, "Well, this guy said this." And I don't have any idea who that guy is. Most of them, a lot of times, aren't even meteorologists. I get a lot of that when it comes to hurricanes and when it comes to winter weather a lot. The posting of snow maps with possible accumulation 7 days out, I compete a lot against that. That separates us the most. An effective part of being a communicator is someone who is more responsible and will take into account that models change, you know, usually more than two or three days out, it's not going to look that good unless they're on to something. I do try to include a little bit of what the "arm-chair meteorologists" do in that I think, sometimes, the professional, and I mean about your affiliates, they're held to a higher standard too, they are a little bit conservative – even the National Weather Service sometimes when there's a winter weather or a severe weather event that looks like it's gonna verify in a few days – usually, you don't see them talk about it until right when it's coming. I've been in television before. I know that we try to be very aggressive in our approach because we take it very seriously. Our meaning behind that was, "Don't overdo it." But if it's like a, you know, now we got the storm supercell parameters, and different things to look at, significant tornado parameters, and when I see something coming up, I'll let people know about it. I'll give an example. Appomattox, the tornado that happened, I think it was 2016. The models were all – the NAM – were all over it. Even the high-resolution NAM, the storm, the parameters I was telling you about, which was off the charts for the area. And, even the situation, where we had that wedge in the place and on the outside of the wedge, we get that rotation a lot, you get that enhanced vorticity. I kind of noted that and showed the storm and the tornado parameter, I think a few days before. I got a lot of bad reaction from that. I got a lot of people that shared it, and I had a lot of folks who were – it wasn't a lot, it was a few – who said, "Who is this guy?" Because it was being shared outside the area that I covered. "This isn't going to verify, it's not going to happen." The other outlets didn't seem to say, "Well, the chance of tornadoes is there. It's low, but it's not zero." And I have a problem with that because you have to take into account the climatology of the area. When you do get tornadoes, there are certain set-ups. I think that, yea, if you're looking at something in Oklahoma, then the chance is near zero. Here, we usually get something, at least tornado warnings issued, at something like that. So, I had an issue with that, but I've noticed the National Weather Service has stepped it up since then. But, you know, there was an EF3 in Appomattox, and I wasn't, I'll be honest, I looked at the models before, and I was putting out things all day, letting people know right up until the event. There were 3 and 4 events that I kind of had issue with and, even for snowfall, it seems that, sometimes it's scary, it's a very

conservative approach here. And sometimes, the “arm-chair meteorologists” end up being more right, unfortunately, even though they’re not certified.

R: So, can I clarify – what do you mean by “arm-chair meteorologists?” Are you talking about people who don’t have--?

P5: People who aren’t meteorologists who are doing it as a hobby and don’t really know everything that they’re talking about. They’re just looking at the models and they’re putting things out there, shares, that kind of thing, don’t have any certification.

R: Oh, okay. So, they’re – okay, I didn’t know that was an issue, actually.

P5: Yea, it’s an issue with a lot of the broadcast meteorologists. They have trouble with that because we all get – one of the “arm-chair” folks will put out something, you know, “Major snow on the way. One foot plus state-wide.” And it’s six or seven days out, and I’ll get – and I’ve talked to other broadcast meteorologists – we’ll get messages from people, from out followers, saying, “Hey, what do you think of this? Is it verified?” You know, they’ll ask me if it’s legit or not, but it’s still very inconvenient, because you want to say, “Well, I haven’t said anything about it, so, I don’t think it’s legit, you know, otherwise, I would post about it.” But there’s an issue that all of the major meteorologists in the area face, and we’ve talked about it, where they will do that. So, the followers get confused, they don’t know if it’s verifiable, and it’s frustrating because you want them to say, “Listen, if it’s not on my page, you don’t worry about it.” And so, I post, you know, and it’s just frustrating on that end, too.

R: Wow. I didn’t know that was such an issue.

P5: Yea, it’s just more confusion about it. And yea, there’s misinformation, sure. They’ll say, “It’s gonna snow 12 inches” and I’ll say, “Well, I didn’t call for that.” Just a random guy that [laughs] shared that one model. And it throws people into a panic...or, it’ll be from a year ago. I try to put timestamps on my posts when there’s something like that. But even, you know, Facebook puts the timestamp on everything, too, but they’ll still share even if it’s years past.

R: Fascinating, and you mentioned algorithms –

P5: Yea, it’s really hard to communicate it.

R: Okay, let’s move on to the next question. What are the keys to being an effective communicator in your job, do you think?

P5: In terms of social media, the keys are, you’ve got to be on every event. You’ve got to...you’ve got to really be there for them. You can’t just not cover something. The other big issue is – the other big issue that, well, the other big thing that, and it’s an effective one, is if you post something, and some of the comments start coming in – questions. Some of them are really not that bright [laughs], they don’t read everything in your post. So, we’ll get to that maybe later, but the thing I want to bring up is...it is called social media. You can’t just put a post out there, whether it’s on Twitter or Facebook, or even other outlets, you can’t put a post out there and not interact with your followers. Some of the things I try to do, I try to read all the comments, and at the very least, I’ll like what they say so they know I read it. If I’m doing a Facebook Live video, I

try to read a few of them live on the air and try to go back as soon as that video is over, and like and respond to as many as possible, because it is social, and if you are not responding and interacting with your followers, it's not being social. The other thing is, I know Facebook, and I feel like Twitter does this some too...the more, so let's say I'm talking about a big wind event coming up, like the March 2nd event. I post something late February about it, "Hey it's coming, it's gonna be bad" and if I don't respond to them, Facebook will, I've noticed, not have as many shares, not as much interaction. The more interaction you can get, even if you're just liking their comments or replying, the more it's gonna be shared, the more it's gonna be in their timelines. Facebook rewards that interaction, so I try to – I think that's the main thing.

R: Wow, that's really interesting.

P5: Yea, it's huge, and I'll tell you what, on my personal page, the way I try to beat some of the competition, and I don't want to give the impression that we're not concerned about safety, but there is competition in broadcasting, and social media, for all of us, really. But I try to go through my feed and I see the posts about, "Hey, I'm hearing about snow. I'm hearing about this" and I've got a lot of followers and a lot of people in my feed, so I like what they say just so – because that's the other algorithm -- if I'm liking people into the weather, they're gonna see my posts more. So, I try to do that, too.

R: What is the biggest barrier you see for weather communication in general? And this can be on social media.

P5: Yes. The biggest barrier is the, and I don't want to throw people out here, but the laziness of the followers sometimes.

R: Okay.

P5: To clarify, you're only hearing the comments -- the people that are commenting are those in that one sector that really doesn't understand that much – the people that understand aren't going to ask that much, obviously. But, you know, I can...just the other day, I said, "After some clouds, it's gonna be warmer today, and warmer this week on Thursday." And I posted my 7-day forecast and it had the big sun icon up with the temperatures. You assume that people can read a 7-day forecast graphic. The first comment was, "When is it going to warm up?" And that drives me crazy. Even the automated posts, like we we're talking about the weather warnings, it'll say, you know, something clear and simple, "Severe Thunderstorm Warning for Roanoke City until 3:45. Take cover, more info to come." All the comments usually are, there will be a lot of "thank yous," but there will also be just, 50 percent of that will be, "What about Bedford? Martinsville? What about Bassett? What about Lynchburg?" That's just...Facebook just isn't there in terms of getting that message across that, there are a few other posts that will tell you about Lynchburg, because they are only seeing that one. So, I guess it's just the fact that they – you gotta create those graphics you were talking about and get them prepared – but a lot of them just don't read it. They just wanna comment and skip the graphic, skip what you said, and they just want to talk to you directly. That's just an endless battle right there, so that would be the biggest thing.

R: That's fascinating.

P5: Yea, and Facebook also, you can, I think, time-out posts, or something, after some time, but I – a few people will, like, I had a lady yesterday that liked a snow post I had. And, again, I timestamped it, but she still liked it because it apparently was still on her feed, and that was from a week ago. So, that’s a Thursday, and Facebook will still show it.

R: Interesting. So, how, if at all, do you currently use social media for your job?

P5: I use it to about do everything. I use it to put out my forecasts. I’m also kind of in charge of – we have a very small website, we are a small local station. If I’ve got a news story, I’ll do a little news story sometimes, if there’s breaking news I come across, or if there’s breaking weather, I will, I’ll do Facebook Live when there’s big weather. And then, a lot of times, I’ll do a condensed Facebook Live and record it and air it on our stations. So, I’m not doing it in front of the wall like you see the big stations do it. I’m doing it more like somebody that’s analyzing it.

R: Do you use any other social media?

P5: I use Twitter. I’ve gotten into Instagram some, not for information just as much as observation there because I’m trying to figure out since Instagram is just pictures. I don’t use Snapchat for weather, but I’ve heard of meteorologists that are doing that. A lot of the stations will do that. Twitter is kind of getting fun, because I have a different audience. I’ve noticed on Twitter, especially with hurricanes, something that affecting the whole country, I get a lot of followers that respond, interaction from people all over the world. I had a lot of people in Florida, and Georgia, and all across the area talking to me. That’s really encouraging, and the Twitter folks tend to, and I think it’s because Twitter is so condensed, Twitter folks tend to understand my posts more. I don’t get that kind of reaction on Facebook, with people asking silly questions when the content is right there [laughs]. So, with the Twitter folks, it seems to be a different population.

R: Yea, it seems that meteorologists use Twitter to talk to each other as well.

P5: Yea! We’re talking to ourselves, that’s exactly right. That’s frustrating to me, but it’s also neat because I use Twitter to learn more meteorology. One of the things is, I graduated in 2000, and can you imagine all the new stuff I’ve had to go through. We only had the – the AETA had just come out, and out to about 48 hours, maybe. It was just going out to 60 when I graduated. We had the ABN, which is technically the GFS, and that went out to 72 hours...all the oscillations we use in the winter now, the NAO, and all that stuff. we didn’t learn about that in college. So, I’ve had to learn a lot about that on Twitter, and you also get ideas from other meteorologists. They’re really cool. Like, if I see a cool graphic someone posted, I’ll be like, “Hey, how did you do that?” I don’t have a broadcast computer like they do, with the WSI system.

R: Yea, it’s expensive [laughs].

P5: Yea, you have to make your own stuff. So, I use PowerPoint for my graphics. And I use Gibson Ridge products, which, you know, that includes GR Earth, which is just a mapping program, satellite, radar, all that stuff, visualizations. It also has WSV-3, which is almost like a TV weather box. It shows 3-D stuff, warnings, all that good stuff. So, you get around it, but anyway, I just use it every way I can. I pay for AlisonHouse plugins, place files, lightning data, all that stuff, RadarScope, I use that. I try to use as much as possible.

R: Okay, so describe to me your most shared or popular post, the was so popular?

P5: Okay, when Facebook changed its algorithm, I've noticed that my – I've got two pages. I've got a personal page that I used to put a bunch of weather on, I still put some on there. It's just because I created my account so early, before the real Pages came out -- personal Pages. I've got a "Meteorologist" Page, and I usually didn't do much with that, but I noticed with the new algorithm, it rewards that more. In saying that, I posted when we had that, not the last one, but snowfall accumulation for the 13th, the event before the last event. I put a snowfall map up and it was a tricky forecast...that one had, let me see...I think it had well over 100,000 people it had reached. I was used to seeing 20,000, 16,000, but that one went semi-viral for me. I think it was one of my more popular ones, but the snowfall maps, not usually the second or third ones, because you update them as you get more information, but the first snowfall map will get the most. And I think it's just because people think that it's gonna snow, you know, they want snow, sometimes, people don't, but they get excited for it, and if they don't want it, they want to know what its gonna do.

R: Do you think it has to do with the climatology, since people don't see snow much there? Since, if we were in the Northeast, you know, they get snow all the time.

P5: Oh yea, definitely. You know, you go down to Alabama, or even in North Carolina...but yea, it depends on the accumulation, the type of snow. And also, that Appomattox tornado post – what I did is I posted, "Significant tornado parameters" about three days out. And I also put my own graphic up, just a simple graphic, what to expect, the times, and the impacts, what to do. Several posts like that got a lot of shares. I'm looking for a post now – I'm almost to it, where it's almost a crazy amount of interaction. It actually surprised me...it was actually insane. I was a little nervous, because, as a forecaster, you put something out, especially about a snowfall, and you're like, "Okay...is this going to verify?" Because you never know. You don't want people to say, "He's not worth listening to." Okay, here it is. There we go. This was put out 2pm Wednesday, March 7th. And the headline is, "Significant snowfall into Monday." I explained the computer models. I've got kind of a, like you said, segmented information, within the graphic itself. Monday AM to Sunday AM, forecast subject to change. 179,941 – about 180,000 people saw that. 1,776 shares, so it was crazy. That was probably the biggest. And an added thing to that – when that happens, you start to get people from outside your area...when that happens, I'll start getting questions and comments because people are sharing like crazy. And so you have to be mindful – there are no more boundaries, like there was on television with viewing areas. In social media, you are competing against everybody, because there are people on Twitter, and on Facebook, that are forecasting – real meteorologists, that are putting things out for outside the area, too. So, really, you know, if I wanted to -- I'm actually thinking about creating a page for significant weather across the country by the summer.

R: Interesting. So, the next question is what do you think could potentially make a social media post about weather hard for an average person to understand?

P5: Definitely, I would say, getting a little too technical. I find it on Twitter. I try to talk, like you say, to the realm of meteorologists, at the same, because I'm appreciating meteorology, but a lot of folks just don't understand over like a 5th or 6th grade level. It's frustrating for other meteorologists to have to dumb it down like that, but the same point, you have to make it easier

for folks to understand. And so...getting a little too technical when you don't realize you're being technical or being more scientific. Even the weather service stuff, they are doing a good job at segmenting things. They put out a packet of information...and it'll say, "Main impacts, Highlands, Foothills" and it's actually a really simple graphic. It goes back to what I'm saying. I posted some of that stuff. I get a lot of comments, "What are we in? Are we in the Foothills?" So, if you're not specific on the geography, they still don't know. I'm from a small county, you know, a bunch of simple folks. They're farmer, they work in factories. Now, I'm not saying they're dumb, they just don't know that type of stuff. I can even post a county that, you know, shows the Weather Service when they've highlighted the thing, here's the impacts. I put the track on there, the times...they'll still say, "Well, where am I at?" They will screenshot the map and say, "Can you send this back to me and show me where I'm at?" So, yea, it's just...geography is frustrating. You gotta think like them. You can't think scientific. You gotta think – you know, a scientific person might say, you know, "Ensembles are forecasting snow. It can go either way." You got to really dumb it down. "It may snow here, from this time to this time, by the hour." You got to put the timing in for them. They really don't like it when you leave out the timing. I've noticed that. That's changed over the last ten years. I used to be able to go on television, and even...I did weather on MySpace for a little while, but you can be simple there, you know, "Scattered showers this afternoon" and they liked that. Now, they don't take that. They say, "Well...what about my area? What time? What time should we be prepared for this?" Scattered showers and storms, it's really hard to do that. So, you know, just details, but you got to detail it in a way they can understand it.

R: I agree.

P5: Yea, and when I forecast the weather, I give them a headline at the top, coming up, that says, "It might snow in early April." And I put that out today, in all caps. And then, underneath, there's a little bit more explanation. That's the challenge. And that goes with another thing – you can't bury the lead. Meteorologists will do this sometimes on social media, "We got a low pressure coming up, and a cold front coming down, and this is happening. The blocking still continues. It's forcing the jet stream south." Then, at the very end they'll say, "It might snow in early April, April 5th or 6th." That needs to be at the top, and in a way that they can understand it. You know, say, "Winter's not going away, it'll be hanging around for a little bit, even so for some." And then, underneath it, you chunk your information, like you were talking about.

R: That's brilliant. So, how often, if at all, do you think people take action from your social media posts?

P5: A lot of people still do, yea. Despite the ones that don't understand quite as much, I'll hear back from people that say, "I've cancelled my plans since you put that out there. We're taking shelter now. I'm keeping my phone on to see the updates." So, that's encouraging. A lot of people will take action, whether it's for an event outside of severe weather, where they just need to prepare, get flashlights for a wind event, or if it's just rain, when they'll need to cancel plans – they did. That warms my heart. It makes me feel like I'm doing something significant. With severe events, like tornados warnings, that sometimes panics people, but it also, you know, prepares them ahead of time to take action for that. I usually try to say, "Listen, there's a chance of severe weather, there's a chance of rotating storms, large hail" all that stuff. I've got a program that does a 30-second video of slides for them to watch. They like that better than just typing it.

As you were saying, it's kind of sharable. And that'll get shared. But as you get closer, I'll say, "We're getting closer to the event" with warnings like, "Right now" kind of thing.

R: What kinds of posts do you find are most likely to lead readers or viewers to take action?

P5: I find the "take action" ones, obviously, the warnings. And again, the way I do it...I think, when you warn them up, you know, "You need to take action." Or just the warnings. The ReadyWarn's tend to – it's a simple text...the Weather Service has these great things they'll post on Twitter now that, you know, "Severe Thunderstorm Warning" the polygon that shows the hospitals affected. A very simple graphic. It's great, because I'll screen-capture that and post it with the text below. The image itself has all the information, and I say that because, when I was in – I'm sure it's the same thing in television, it's a severe thunderstorm and you want something that's sharable...if you're going to create a graphic on that, you need to have that ready to go, and the time to do that. These automated posts from the Weather Service that include the graphic – and it showed the locations – are really the ones that tell them to take action, because you can get those out faster than you can making your own graphics, sometimes. And I would say Facebook Live during severe weather is also effective, because it's on the fly, you know. I don't keep the video because people will go re-watch it and think, 2 days later, "What's happening?" Or wait until the storms pass, because they get confused sometimes. But yea, the short, simple graphics from the NWS is what I use a lot of times. When I show a radar image with an attachment on it, if I can get somebody to send me a picture of the storm, I'll say, "This is heading your way." It also helps to have that image overlay the radar, and say, "This is what's happening." Also, if I can use one more thing here, if I see that severe weather is coming that's like a past event that has brought us bad weather, you said an analogy, I'll use that and compare it to other events – compare and contrasting. "This happened here, similar events have happened. Not saying it's going to happen, but..."

R: It's like statistical forecasting.

P5: Yea. Like MOS.

R: Yea, that's what I was thinking! MOS and FOUS [laughs]. Okay, so now we are going to move on to looking at the products, and again, if you come up with any examples you have used, you can bring them up then as well. We'll look at the checklist itself and go over each page of the instructional booklet. I have what you sent me, and you highlighted two things on the checklist in red. I want to ask you about those first. I'm quite interested in why you highlighted those. "I incorporated subjective norms in my message." Why did you highlight that in red?

P5: Well, I was a little confused about subjective norms and what that meant. But also, you know, sometimes it's hard, again, to get the followers to realize what you're trying to say, and again, it kind of – in my experience, I haven't done a lot of that probably, so I also wrote that down for that reason. That's something I need to work on.

R: Okay...the idea is, if everyone else is doing it – not like peer pressure – but then, you'll do it too. An idea that comes to mind is, "Oh, if everyone in my neighborhood is recycling and I'm the one who isn't" you'll be more likely to recycle than if you weren't in a neighborhood who didn't recycle.

P5: I gotcha. So, showing exemplary examples of what to do. Yea, and again, that's a great idea, and that's something that I should probably work on, to be honest with you. The thing that comes to mind is, before social media, was this one meteorologist during Hurricane Andrew, he saved thousands of lives because he was live on, I think it was one of the channels down in Miami, he was live with wall-to-wall hurricane coverage, but they went into their shelter behind the studio on live television. He told people in advance, "Get ready." It was crazy, but it was a simple thing – it wasn't fancy, no graphics, no nothing. It was just them going live with their crew, evacuating the studio, getting up from the set. They had a hand-held camera that followed them behind the set into the shelter room, and he did the rest of the broadcast from there. He heard back – he did interviews on this – but he heard back from countless viewers saying, "When we say you do that, that's when we got in our safe spot." Because they saw the meteorologist doing it.

R: Okay, and the other one you highlighted in red, "using emotion." I definitely want to hear your thoughts on that.

P5: Yea, sure. The only thing I said on that...I didn't want – that sometimes comes across as being a bit too not conservative, it's a bit up there when it comes to, "Hey, do this." And, especially during severe weather...you gotta stay calm. You still have to be kind of a rock. So, if you're showing too much emotion, you can easily get the viewers in a panic. And that's what I have, but, at the same time, the energy...I've got compliments on it, and this goes with when I first did weather, I started in '94, when I was in high school doing it at the local station, and then I started on television in '98. I always put emotion as far as being excited about the weather changing, the weather's awesome, "These hurricanes are actually transferring extra heat energy to the Poles, and vice versa, the cold comes down..." Simple things like that, you can put in a little more emotion... "here's what's going on, here's an info-graphic." People clamor to that. They love it. So, that type of emotion is good. It gets people involved. When severe weather comes, you got to – you're always fighting this urge to panic and get people involved. You've got to put a little bit of that in there, but not too much...even when you look at news anchors who do this, consultants always told is to have "anchor perspective." You know, the shooting at Virginia Tech, that's horrible...that tends to be more conversational, but the news has gotten different now. You know, one of the things is you don't get up in a suit anymore and sit behind a desk. A lot of people who are just communicating things are showing their emotion, just doing a simple Facebook Live. It makes you more real. You're not wearing the fake makeup. You're not in a suit and tie, and so that is subtle emotion, in my opinion. That tends to relate more to your audience.

R: Yea...okay, do you have any other comments? Because the rest you highlighted in green. So, if there's anything you want to point out specifically, or any other general comments.

P5: Well, I love giving examples, like a real example of why something's going to happen. I love doing analog forecasting here. That comes from experience. If you've lived here a while, you know the area, so you can do that. Say, "Listen, the models are doing this, but in my experience, back in '94, this brought us a lot of freezing rain, an ice storm." You know it may not happen, but to add that personal touch to it that you've been through it, you forecasted it – I'll even be honest and say, "Listen, back in 2004, there was a similar setup and it was a bust." You know, that kind of thing, like, "Here's my forecast for 4 inches, but I'm just saying, that may bust because we're not getting the moisture from the Gulf with this one." That seems to be something that tells viewers that this guy's credible, and he knows his stuff more. So, that works for me more. Analogies too – a simple analogy, if I can think of anything, how tornadoes form, something like

an ice skater pulling their arms together...that type of thing. Anything I can think of, and it's always live – it comes to me, and I'll put it in there [laughs].

R: Okay. Great, I really liked your examples. So, we went over that...let's look at the instructional booklet specifically, and what we're going to do is look over each page and, if there's anything you really liked or something you want to critique, we're just going to talk about that. So, we'll start with the very first page, the intro page. Did you highlight anything in red on that page? Or pointed out anything you thought, "Oh hey, this is confusing." Or could be improved?

P5: Um, just the overall...everything was great. On the instruction booklet, the understandability – I just, I have a really hard time getting through, even when I dumb stuff down to some of my followers. They just either don't understand or they didn't read the post or didn't read the graphic. That's just a challenge to me. Ideally, it's perfect [laughs]. In the real world, a lot of people just don't know or take the time to read...but if you're doing that versus writing a long text paragraph and not explaining things, you know, like putting out a forecast discussion online, people are not going to understand that. So, yea, you definitely have to do something...And I've noticed on my Facebook, it's more of a personal following, almost like a cult following [laughs]. On Twitter, it's more for education, so you just have to know your audience...but you have to watch it, a lot of folks will say, "Well, that's not what it's called" and you don't want to be mean to them, if they are complaining about it, you just need to be as nice as possible. They follow you, and you hope they understand more, too. And the other thing is, the folks that are commenting and asking questions, and you know, I've got about 20 or 30 thousand followers combined, I believe, and I might hear from 5 or 6 that are confused, but, you know, there might be a couple thousand that are perfectly fine, but just did not respond to liking or whatever, because they don't need to. They read it, they understood it. So, I try to remember, like, "This guy is getting on my nerves because he doesn't know what I'm talking about when I've dumbed it down" but the other 3,000 did, they just didn't respond. So, it's just the ones that are interacting, sometimes, that can throw off your perception of how effective your post is. So, you need to keep in mind that people are reading it and understanding it. I'll hear from people in public that say, "Hey, I read your post, I understood it, yep. You nailed the forecast; the dry air came in like you said." And I'll think, "Well, I didn't see a comment about that. It was more shared than I thought."

R: Okay. So, if there's nothing else for the first page, let's move on to the second one. So, this page is about making messages more understandable. I know you have thoughts about that, but is there anything on this page that you underlined or read or you wanna critique, or just point out?

P5: Um, not really. I liked it. I'm going to work on doing more of it, because sometimes, again, a challenge is time. You want to get something out there, but – I have the software to create the cool graphic, or a simple one. That would be the only thing...just a matter of time.

R: Is there any particular thing on here you connected with or that you liked?

P5: Um, the understanding what something is and isn't...that comes up a lot. A lot of people – I have an example where a shelf cloud was seen in Lynchburg and people thought it was a tornado. I took the picture, and the original was shared like crazy, and I included the downdraft and blue arrows and I kind of just drew over it and said, "Not a tornado, a shelf cloud." And shared that and it got a lot of shares.

R: Yea, and it could be a transformative explanation as well because you're confronting a misconception. You got two birds with one stone. That's a good example.

P5: Yea, and around here, it's hard because we're not really in a tornado alley situation. Our tornadoes, even the real ones that are verified, are probably not as easy to spot sometimes when they happen less.

R: Okay, cool. So, we're going to move on to the actionable page. So, overall, do you have any critiques for this page or anything that was confusing, or you would want to change, or any other examples?

P5: I just saw things I needed to work on [laughs]. I like examples 2 and 3, you know, just showing examples in an overlay. I do it with the clouds but I never thought to do it with the flooding stuff and the other things...doing more of that.

R: Okay, yea. Then we'll move on to the memorable page, so that's page 4. Is there anything you want to point out or talk about for this page?

P5: The chunks of information look better. Something I've learned the past couple of years is to really not put too much info on there. You got to really – not dumb it down, but make it more simple, more succinct. You know, having the bullet points, that's something that seems to make it better, so I definitely agreed with that. Seeing the trigger...something that people are responding to more with me, too. So, that's something I really incorporated and it's something that tends to really works.

R: Okay, cool, that's good. Then we'll move on to the sharable one then, so page 5. Do you have any comments on the examples or the guidelines, or even the page and how it looks? Do you have any critiques?

P5: Not really. I think, you know, obviously, you want something that's interesting, but you don't want to go over-the-top though, and be one of those people that – obviously, you want things shared, and if it's good, it's good – but I think, sometimes, it can get a little out-of-hand. Like, if I post something that's cool, like that heart cloud, and that gets shared a lot, and later – it just goes back to algorithms, and later when there's actually severe weather...you have to just apply those funny, the cool, the kinda fluffy information there and know that, if there's bad weather coming later, you might not want to post that because, even though it's current, your severe weather posts are going to need more interaction. When I post something that's, "Hey, check out this cool cloud earlier today, it's a hole-punch cloud, this is how it formed, this is what it's not" and then later on, there's severe thunderstorms, I'll notice that there's not as much interaction because my cloud is getting all the shares. The ones that I actually need to get the shares aren't because I've already posted something. So, on severe weather days, you have to account for that.

R: Oh, wow. That's fascinating.

P5: And you know, I try to do now, when there's bad weather coming, or there's stuff that's coming, when I know my ReadyWarn is going to be going off like crazy so I know there's going to be a lot of posts, I try to keep my, "get ready" and the sharable posts to maybe one or two a day

max, and not to do too many posts because that actually hurts. That's something I learned from probably 2008 to 2012. I learned to hold back from it, but, you know, if it – it goes back to being more succinct, and not burying the lead and have what you need to be sharable in there too...I try to get those out the day before. I try to be like, "Hey, something's coming tomorrow. Be ready." And some meteorologists will say, "Just please share" you know.

R: Okay, yea, yea. Okay, so we're gonna move on, then, if there's nothing else on that page, to the two threat pages, about the threat levels. So...yea, the first page, the urgent threats and imminent threat examples – do you have any critiques, or anything you highlighted in red on this page?

P5: No, that was very much a green page for me.

R: Is there anything you particularly liked?

P5: I like what the Weather Service did with the "take action" there at the bottom. I think that gets folks to do that. They are gonna share that for sure. I also like what that station did with the emojis or whatever, the bullet points. Yea, I love it. I did that...I was actually inspired by one station to do, in the snowfall we had last, the last one, to put the accumulation on there, but not just put the accumulation out full, but I condensed it a little bit and, off to the side, I had about four bullet points, "Power outages possible, you know, you're going to see this happening. The roads may be slick between these times. It's going to be heavy, wet snow. It may knock down trees and power lines." It got a lot of shares because it was, you know, at the very top, it said, "What to expect tonight." It was very direct, it's gonna happen. We're in the middle of it, here we go. The 12 hours are gonna be bad for us. So, that was something I had success with.

R: Okay. So, if there's no other comments on this page, let's move on to the last one. Did you underline anything in red or have thoughts or critiques about this page?

P5: Not really. Some of the emergency management, and even posts by the NWS, can be a little lengthy, but I don't know if there's any way around that because you have to put out the information. Again, I keep referring back to the folks who just don't bother to read, even when it's simple. But, other than that, I didn't have anything on that page.

R: Okay, is there anything you particularly liked or noticed?

P5: Again, I like the trigger part when it happens. It's a long-term threat, but yea, I'll say a lot of times, "The severe weather threat is here, there's a potential for storms and tornadoes." If we are under a tornado watch – and I'll remind them what a watch and warning is, that I need you to be ready. I'll say, "Go ahead and plan ahead" in kind of a bullet point format. So, you know, okay, a watch is issued, here's what to look for next. You'll look for a warning next, that's when you need to take action, but you need to have everything ready.

R: And that's specifying when to act, too. Very specific, great...I just have two more questions. In your opinion, what would be difficult in using this checklist for social media posts?

P5: The biggest challenge is, you've got so much model data to look over, and you've got deadlines. I've got things that I have to get on the air, things I have to get on the website. I've got

to look at the EURO now – there’s just so much, and when I was in college, there wasn’t this much, but there was still a lot. But now with the internet, you could spend all day, and at some point, you have to make the forecast. Beyond that, you’ve got to make your special graphics. So, I’m often challenged at time, getting the little short video made or the infographic made with the bullet points, and – because I’ve gotta know the forecast first, and then I’ve got to put that out there, and I got to make sure I put it out at a good time, during Facebook peak hours or Twitter peak hours as well. So, the biggest challenge, and I think meteorologists, especially those on TV, will agree...they’re coming in earlier now to forecast because they have to do so much on social media, which you didn’t have to do 10 years ago. So, the biggest thing is time limits on, for the follower’s part, because you have to create those images. A lot of things you can have templates for, like safety, what to do, what a winter storm watch is, but you also want to be specific to that event, so you’re seen as accurate, so you want the viewers to know it’s really going to happen too. So, there’s a time thing involved in that. It works best if you have a team involved, but I’m on my own, so, I kinda fight that sometimes, just getting info out. A lot of times, if I know something’s probably going to happen, I’ll go ahead and start something like that and not post it yet but have it ready to post when the time comes...sometimes, I find myself posting bullet points about the snow coming up, and I’ll look and the snow is three hours ahead of schedule. It’s already snowing. So, let me go ahead and post this and see their reaction [laughs]. But, you know, you always fight that, fight whether or not you are going to get that out on time.

R: Do you have any additional comments?

P5: I used to work in TV, and if it had not been for social media, I don’t know if my brand would continue. So, I’m very, very thankful for the internet. I can remember, being on MySpace, going, “You know, if there’s only a way I could post something so that everyone could just see it.” And then Facebook came along, and that has really kept me one of the sources for weather information. So, I’m extremely thankful, even though there’s a lot of controversy surrounding Facebook right now [laughs], that my following has been able to continue. You know, a lot of people know me now – I’ll be in the store or something – and they say, “I know you from Facebook, thanks for the updates on the storm!” They remember me from social media, which is crazy. So, I’ll say, there’s been the bad sides with people not understanding what you’re talking about and ask dumb questions, but at the same time, it’s been great for maintaining what I like to do, what I love to do. And so, without it, I would be lost. So, in terms of having my purpose in life, it’s been great.

R: Okay, great! Thank you so much!

REFERENCES

- Anfara Jr, V. A., Brown, K. M., & Mangione, T. L. (2002). Qualitative analysis on stage: Making the research process more public. *Educational Researcher*, 31(7), 28-38. <https://doi.org/10.3102/0013189X031007028>
- Aven, T., & Renn, O. (2009). On risk defined as an event where the outcome is uncertain. *Journal of risk research*, 12(1), 1-11. <https://doi.org/10.1080/13669870802488883>
- Bell, H. M., and Tobin, G. A. (2007). Efficient and effective? The 100-year flood in the communication and perception of flood risk. *Environmental Hazards*, 7(4), 302-311. <https://doi.org/10.1016/j.envhaz.2007.08.004>
- Bell, P. et al. (2009). *Learning science in informal environments: People, places and pursuits*. Washington, DC: National Academy of Science.
- Besley, J. C., and Nisbet, M. (2013). How scientists view the public, the media and the political process. *Public Understanding of Science*, 22(6), 644-659. <https://doi.org/10.1177/0963662511418743>
- Bessi, A., Coletto, M., Davidescu, G. A., Scala, A., Caldarelli, G., and Quattrociocchi, W. (2015). Science vs conspiracy: Collective narratives in the age of misinformation. *PloS One*, 10(2), 1-17. <https://doi.org/10.1371/journal.pone.0118093>
- Bier, V. M. (2001). On the state of the art: risk communication to the public. *Reliability Engineering and System Safety*, 71(2), 139-150. [https://doi.org/10.1016/S0951-8320\(00\)00090-9](https://doi.org/10.1016/S0951-8320(00)00090-9)
- Bird, D., Ling, M., and Haynes, K. (2012). Flooding Facebook-the use of social media during the Queensland and Victorian floods. *Australian Journal of Emergency Management, The*, 27(1), 27. Retrieved from <https://search.informit.com.au/documentSummary;dn=046814266005608;res=IELAPA>

- Bostrom, A., Morgan, M. G., Fischhoff, B., and Read, D. (1994). What do people know about global climate change? 1. Mental models. *Risk Analysis*, 14(6), 959–970. <https://doi.org/10.1111/j.1539-6924.1994.tb00065.x>
- Bruns, A. (2008). The active audience: Transforming journalism from gatekeeping to gatewatching. In C. Paterson and D. Domingo (Eds.), *Making online news: The ethnography of new media production* (pp. 171-184). New York, NY: Peter Lang.
- Burningham, K., Fielding, J., and Thrush, D. (2008). ‘It’ll never happen to me’: understanding public awareness of local flood risk. *Disasters*, 32(2), 216-238. <https://doi.org/10.1111/j.1467-7717.2007.01036.x>
- Burns, T. W., O'Connor, D. J., and Stocklmayer, S. M. (2003). Science communication: a contemporary definition. *Public Understanding of Science*, 12(2), 183-202. <https://doi.org/10.1177/09636625030122004>
- Carter, L., Thatcher, J. B., and Wright, R. (2014, January). Social media and emergency management: Exploring state and local tweets. In *2014 47th Hawaii International Conference on System Sciences* (pp. 1968-1977). Waikoloa, HI: IEEE.
- Casey, M. (2015, January 27). Blizzard 2015: How did the forecasts get it so wrong? *CBS News*. Retrieved from <https://www.cbsnews.com/news/blizzard-2015-how-did-the-forecasts-get-it-so-wrong/>
- Castillo, C., Mendoza, M., & Poblete, B. (2013). Predicting information credibility in time-sensitive social media. *Internet Research*, 23(5), 560-588. <https://doi.org/10.1108/IntR-05-2012-0095>
- Chatfield, A. T., and Brajawidagda, U. (2014, January). Crowdsourcing hazardous weather reports from citizens via twittersphere under the short warning lead times of EF5 intensity tornado conditions. In *2014 47th Hawaii International Conference on System Sciences* (pp. 1968-1977). Waikoloa, HI: IEEE.
- Clarke, C. E., Niederdeppe, J., and Lundell, H. C. (2012). Narratives and images used by public communication campaigns addressing social determinants of health and health disparities. *International Journal of Environmental Research and Public Health*, 9(12), 4254-4277. <http://dx.doi.org/10.3390/ijerph9124254>
- Colleoni, E., Rozza, A., & Arvidsson, A. (2014). Echo chamber or public sphere? Predicting political orientation and measuring political homophily in Twitter using big data. *Journal of Communication*, 64(2), 317-332. <https://doi.org/10.1111/jcom.12084>

- Comfort, L. K. (2007). Crisis management in hindsight: Cognition, communication, coordination, and control. *Public Administration Review*, 67(s1), 189-197. <https://doi.org/10.1111/j.1540-6210.2007.00827.x>
- Demuth, J. L., Morrow, B. H., and Lazo, J. K. (2009). Weather forecast uncertainty information: An exploratory study with broadcast meteorologists. *Bulletin of the American Meteorological Society*, 90(11), 1614. <http://dx.doi.org/10.1175/2009BAMS2787.1>
- Demuth, J. L., Morss, R. E., Morrow, B. H., and Lazo, J. K. (2012). Creation and communication of hurricane risk information. *Bulletin of the American Meteorological Society*, 93(8), 1133-1145. <https://doi.org/10.1175/BAMS-D-11-00150.1>
- Dillard, J. P., Shen, L., and Vail, R. G. (2007). Does perceived message effectiveness cause persuasion or vice versa? 17 consistent answers. *Human Communication Research*, 33(4), 467-488. <https://doi.org/10.1111/j.1468-2958.2007.00308.x>
- Doherty, K. L., and Webler, T. N. (2016). Social norms and efficacy beliefs drive the Alarmed segment's public-sphere climate actions. *Nature Climate Change*, 6(2), 879-884. <https://doi.org/10.1038/nclimate3025>
- Du, S., & Gregory, S. (2016, November). The echo chamber effect in Twitter: Does community polarization increase? In H. Cherifi, S. Gaito, W. Quattrociocchi, & A. Sala (Eds.), *International workshop on complex networks and their applications* (pp. 373-378). Berlin, DE: Springer.
- Dudo, A., and Besley, J. C. (2016). Scientists' prioritization of communication objectives for public engagement. *PloS One*, 11(2), 1-18. <https://doi.org/10.1371/journal.pone.0148867>
- Edwards, J. (2008, November 17). JandJ triggers mommy war with Motrin 'anti-baby sling' ad. *CBS News*. Retrieved from <https://www.cbsnews.com/news/j038j-triggers-mommy-war-with-motrin-anti-baby-sling-ad/>
- Eisenman, D. P., Cordasco, K. M., Asch, S., Golden, J. F., and Glik, D. (2007). Disaster planning and risk communication with vulnerable communities: lessons from Hurricane Katrina. *American Journal of Public Health*, 97(Supplement_1), S109-S115. <https://dx.doi.org/10.2105%2FAJPH.2005.084335>
- Ferrell, J. (2012). Social media: a new horizon for forecasting. *Weatherwise*, 65(4), 12-17. <https://dx.doi.org/10.1080/00431672.2012.689584>

- Finch, K. C., Snook, K. R., Duke, C. H., Fu, K. W., Tse, Z. T. H., Adhikari, A., and Fung, I. C. H. (2016). Public health implications of social media use during natural disasters, environmental disasters, and other environmental concerns. *Natural Hazards*, 83(1), 729-760. <https://doi.org/10.1007/s11069-016-2327-8>
- Fischhoff, B. (2013). The sciences of science communication. *Proceedings of the National Academy of Sciences*, 110(Supplement 3), 14033-14039. <https://doi.org/10.1073/pnas.1213273110>
- Flegenheimer, M. (2015, January 27). Leaders in New York and New Jersey defend shutdown for a blizzard that wasn't. *New York Times*. Retrieved from <https://www.nytimes.com/2015/01/28/nyregion/new-york-blizzard.html>
- Gao, H., Barbier, G., and Goolsby, R. (2011). Harnessing the crowdsourcing power of social media for disaster relief. *IEEE Intelligent Systems*, 26(3), 10-14. <https://doi.org/10.1109/MIS.2011.52>
- Gary, J. (2011, May 31). Alabama tornados: Twitter, Facebook, other social media make a big mark in disaster response, relief. *AI.com*. Retrieved from http://blog.ai.com/spotnews/2011/05/alabama_tornadoes_twitter_face.html
- Gawande, A. (2010). *The checklist manifesto: How to get things right*. New York, NY: Metropolitan Books.
- Heath, C., and Heath, D. (2007). *Made to stick: Why some ideas survive and others die*. New York, NY: Random House.
- Henson, R. (2000). Billion-dollar twister: The Oklahoma City tornado on May 3, 1999, set a record for destructiveness. *Scientific American*, 11(1), 32-39. Retrieved from <https://www.scribd.com/document/211591373/weather>
- Hermida, A., Fletcher, F., Korell, D., and Logan, D. (2012). Share, like, recommend: Decoding the social media news consumer. *Journalism Studies*, 13(5-6), 815-824. <https://doi.org/10.1080/1461670X.2012.664430>
- Ho, A., McGrath, C., and Mattheos, N. (2017). Social media patient testimonials in implant dentistry: information or misinformation? *Clinical Oral Implants Research*, 28(7), 791-800. <https://doi.org/10.1111/clr.12883>
- Hughes, D. J., Rowe, M., Batey, M., and Lee, A. (2012). A tale of two sites: Twitter vs. Facebook and the personality predictors of social media usage. *Computers in Human Behavior*, 28(2), 561-569. <https://doi.org/10.1016/j.chb.2011.11.001>

- Hyvärinen, O., and Saltikoff, E. (2010). Social media as a source of meteorological observations. *Monthly Weather Review*, 138(8), 3175-3184.
<https://doi.org/10.1175/2010MWR3270.1>
- Imran, M., Castillo, C., Diaz, F., and Vieweg, S. (2015). Processing social media messages in mass emergency: A survey. *ACM Computing Surveys (CSUR)*, 47(4), 67. <https://doi.org/10.1145/2771588>
- Janković, V. (2015). Working with weather: atmospheric resources, climate variability and the rise of industrial meteorology, 1950–2010. *History of Meteorology*, 7, 98-111. Retrieved from <http://meteohistory.org/wp-content/uploads/2015/09/08-Vladimir-Jankovic-Working-with-Weather.pdf>
- Kaplan, A. M., and Haenlein, M. (2010). Users of the world, unite! The challenges and opportunities of Social Media. *Business horizons*, 53(1), 59-68.
<https://doi.org/10.1016/j.bushor.2009.09.003>
- Kata, A. (2010). A postmodern Pandora's box: anti-vaccination misinformation on the Internet. *Vaccine*, 28(7), 1709-1716.
<https://doi.org/10.1016/j.vaccine.2009.12.022>
- Keim, M. E., and Noji, E. (2011). Emergent use of social media: a new age of opportunity for disaster resilience. *American Journal of Disaster Medicine*, 6(1), 47-54. Retrieved from <http://europepmc.org/abstract/med/21466029>
- Leiserowitz, A., Maibach, E., and Roser-Renouf, C. (2009). Climate change in the American mind: Americans' climate change beliefs, attitudes, policy preferences, and actions. *SSRN*. 1-56. <http://dx.doi.org/10.2139/ssrn.2667029>
- Lindell, M. K., and Perry, R. W. (2012). The protective action decision model: theoretical modifications and additional evidence. *Risk Analysis*, 32(4), 616-632.
<https://doi.org/10.1111/j.1539-6924.2011.01647.x>
- Lindsay, B. R. (2010). Social media and disasters: Current uses, future options, and policy considerations. *Journal of Current Issues in Media & Telecommunications*, 2(4), 287-297. Retrieved from
<http://search.ebscohost.com/login.aspx?direct=true&profile=ehost&scope=site&authtype=crawler&jrnl=19353588&AN=79919807&h=xYfpitfm07FNJCHdk7aEqwIRxoFNE%2B0wqI4P8PFXIaIQSaREH49Z2NLtdPi2jmqDDtRrlg7D%2FfyW1ZE0oYHnjQ%3D%3D&crl=c>

- Loman, N. L., and Mayer, R. E. (1983). Signaling techniques that increase the understandability of expository prose. *Journal of Educational Psychology*, 75(3), 402. <http://dx.doi.org/10.1037/0022-0663.75.3.402>
- Maibach, E. (2016, February). Increasing public awareness and facilitating behavior change: Two guiding heuristics. *AGU Fall Meeting Abstracts*. Retrieved from <http://adsabs.harvard.edu/abs/2016AGUFMED31D..02M>
- Maibach, E. W., and Parrott, R. (1995). *Designing health messages: Approaches from communication theory and public health practice*. Thousand Oaks, CA: Sage.
- Manoj, B. S., and Baker, A. H. (2007). Communication challenges in emergency response. *Communications of the ACM*, 50(3), 51-53. <https://doi.org/10.1145/1226736.1226765>
- Marques, J. F. (2010). Enhancing the quality of organizational communication: A presentation of reflection-based criteria. *Journal of Communication Management*, 14(1), 47-58. <https://doi.org/10.1108/13632541011017807>
- Mileti, D. S., and O'Brien, P. W. (1992). Warnings during disaster: Normalizing communicated risk. *Social Problems*, 39(1), 40-57. <https://doi.org/10.2307/3096912>
- Mileti, D. S., & Peek, L. (2000). The social psychology of public response to warnings of a nuclear power plant accident. *Journal of Hazardous Materials*, 75(2-3), 181-194. [https://doi.org/10.1016/S0304-3894\(00\)00179-5](https://doi.org/10.1016/S0304-3894(00)00179-5)
- Milkman, K. L., and Berger, J. (2014). The science of sharing and the sharing of science. *Proceedings of the National Academy of Sciences*, 111(Supplement 4), 13642-13649. <https://doi.org/10.1073/pnas.1317511111>
- Miller, S. (2001). Public understanding of science at the crossroads. *Public Understanding of Science*, 10(1), 115-120. <https://doi.org/10.3109%2Fa036859>
- Miller, R., and Lammas, N. (2010). Social media and its implications for viral marketing. *Asia Pacific Public Relations Journal*, 11(1), 1-9. Retrieved from <http://www.seokursu.com.tr/social-media-and-its-implications-for-viral-marketing.pdf>
- Mitchell, A., Kiley, J., Gottfried, J., and Guskin, E. (2013). The role of news on Facebook: Common yet incidental. *Pew Journalism Project*, 1-24. Retrieved from http://www.journalism.org/files/2013/10/facebook_news_10-24-2013.pdf
- Munger, K., Egan, P., Nagler, J., Ronen, J., and Tucker, J. A. (2017). Political knowledge and misinformation in the era of social media: Evidence from the 2015 UK

- election. *NYU*, 1-63. Retrieved from <https://pdfs.semanticscholar.org/3fb5/81a1cc6d440fec0052593236d9f605b58441.pdf>
- Nelkin, D. (1987). *Selling science: How the press covers science and technology*. New York, NY: W.H. Freeman.
- NOAA. *Weather forecast uncertainty*. National Weather Service Louisville. Retrieved from <http://www.crh.noaa.gov/Image/lmk/pdf/WeatherForecastUncertainty.pdf>
- Parmesan, C., and Yohe, G. (2003). A globally coherent fingerprint of climate change impacts across natural systems. *Nature*, 421(6918), 37. <https://doi.org/10.1038/nature01286>
- Perrin, A. (2015). *Social media usage*. Retrieved from http://assets.pewresearch.org/wp-content/uploads/sites/14/2015/10/PI_2015-10-08_Social-Networking-Usage-2005-2015_FINAL.pdf
- Peters, R. G., Covello, V. T., and McCallum, D. B. (1997). The determinants of trust and credibility in environmental risk communication: An empirical study. *Risk Analysis*, 17(1), 43-54. <https://doi.org/10.1111/j.1539-6924.1997.tb00842.x>
- Pew Research Center (2017, February 5). *Social media fact sheet*. Retrieved from <http://www.pewinternet.org/fact-sheet/social-media/>
- Priest, S. H., Bonfadelli, H., and Rusanen, M. (2003). The “trust gap” hypothesis: Predicting support for biotechnology across national cultures as a function of trust in actors. *Risk Analysis*, 23(4), 751-766. <https://doi.org/10.1111/1539-6924.00353>
- Ratner, R. K., and Riis, J. (2014). Communicating science-based recommendations with memorable and actionable guidelines. *Proceedings of the National Academy of Sciences*, 111(Supplement 4), 13634-13641. <https://doi.org/10.1073/pnas.1320649111>
- Renn, O., and Levine, D. (1991). Credibility and trust in risk communication. In R.E. Kasperson & J.M. Stallen (Eds.), *Communicating risks to the public: International perspectives* (pp. 175-218). Dordrecht, NL: Springer.
- Riebsame, W. E., Price, M., Diaz, H. F., and Moses, T. (1986). The social burden of weather and climate hazards. *Bulletin of the American Meteorological Society*, 67(11), 1378-1388. [https://doi.org/10.1175/1520-0477\(1986\)067%3C1378:TSBOWA%3E2.0.CO;2](https://doi.org/10.1175/1520-0477(1986)067%3C1378:TSBOWA%3E2.0.CO;2)

- Rimer, B. K., and Kreuter, M. W. (2006). Advancing tailored health communication: A persuasion and message effects perspective. *Journal of Communication*, 56(s1), S184-S201. <https://doi.org/10.1111/j.1460-2466.2006.00289.x>
- Ripberger, J. T., Jenkins-Smith, H. C., Silva, C. L., Carlson, D. E., and Henderson, M. (2014). Social media and severe weather: Do tweets provide a valid indicator of public attention to severe weather risk communication? *Weather, Climate, and Society*, 6(4), 520-530. <https://doi.org/10.1175/WCAS-D-13-00028.1>
- Rowan, K. E. (1988). A contemporary theory of explanatory writing. *Written Communication*, 5(1), 23-56. <https://doi.org/10.1177%2F0741088388005001002>
- Rowan, K. E., Botan, C. H., Kreps, G. L., Samoilenko, S., and Farnsworth, K. (2009). Risk communication education for local emergency managers: Using the CAUSE model for research, education, and outreach. In R.L. Heath & O.H. Dan (Eds.), *Handbook of risk and crisis communication* (pp. 168-191). New York, NY: Routledge.
- Rowan, K. E., Kotcher, J., Walsh-Thomas, J., Baldwin, P., Trowbridge, J., Thaker, J. T., Witte, J., Klinger, B. A., Cohen, L., Tresch, C., & Maibach, E. W. (2018). Best practices of “innovator” TV meteorologists who act as climate change educators. In D. O’Hair (Ed.), *Risk and health communication in an evolving media environment*. London, UK: Routledge.
- Schäferhoff (2018). The Facebook algorithm change 2018: What it means for your marketing. *Torque*. Retrieved from <https://torquemag.io/2018/03/facebook-algorithm-change-2018/>
- Seitter, K. (2010): Recongnizing the importance of communication. *Bulliten of the American Meteorological Society*, 91(6), 797–803. <https://doi.org/10.1175/1520-0477-91.6.797>
- Silver, N. (2012, September 7). The weatherman is not a moron. *The New York Times*. Retrieved from <https://www.nytimes.com/2012/09/09/magazine/the-weatherman-is-not-a-moron.html>
- Spence, A., Poortinga, W., and Pidgeon, N. (2012). The psychological distance of climate change. *Risk Analysis*, 32(6), 957-972. <https://doi.org/10.1111/j.1539-6924.2011.01695.x>
- Sturgis, P., and Allum, N. (2004). Science in society: re-evaluating the deficit model of public attitudes. *Public Understanding of Science*, 13(1), 55-74. <https://doi.org/10.1177%2F0963662504042690>

- Sutter, D. (2013). Broadcast meteorology and the supply of weather forecasts: an exploration. *Journal of Economics and Finance*, 37(3), 463-477.
<http://dx.doi.org/10.1007%2Fs12197-011-9186-7>
- Sutton, J. N., Palen, L., and Shklovski, I. (2008). Backchannels on the front lines: Emergency uses of social media in the 2007 Southern California Wildfires (pp. 624-632). *Proceedings of the 5th International ISCRAM Conference*, 1-9.
Retrieved from
<http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.156.9517&rep=rep1&type=pdf>
- van der Linden, S., Maibach, E., and Leiserowitz, A. (2015). Improving public engagement with climate change: Five “best practice” insights from psychological science. *Perspectives on Psychological Science*, 10(6), 758-763.
<https://doi.org/10.1177%2F1745691615598516>
- Van Eperen, L., and Marincola, F. M. (2011). How scientists use social media to communicate their research. *Journal of Translational Medicine*, 9(1), 199.
<https://doi.org/10.1186/1479-5876-9-199>
- Wachinger, G., Renn, O., Begg, C., and Kuhlicke, C. (2013). The risk perception paradox—implications for governance and communication of natural hazards. *Risk Analysis*, 33(6), 1049-1065. <https://doi.org/10.1111/j.1539-6924.2012.01942.x>
- Westerman, D., Spence, P. R., and Van Der Heide, B. (2014). Social media as information source: Recency of updates and credibility of information. *Journal of Computer-Mediated Communication*, 19(2), 171-183.
<http://dx.doi.org/10.1111%2Fjcc4.12041>
- Wilson, K. (2008). Television weathercasters as potentially prominent science communicators. *Public Understanding of Science*, 17(1), 73-87.
<https://doi.org/10.1177%2F0963662506065557>
- Winkler, R. L. (2015). The importance of communicating uncertainties in forecasts: Overestimating the risks from winter storm juno. *Risk Analysis*, 35(3), 349-353.
<https://doi.org/10.1111/risa.12398>

BIOGRAPHY

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