TORNADO WARNING MESSAGING EFFECTIVENESS IN OKLAHOMA: HOW DOES THE PUBLIC PERCEIVE ITS RISK?

By

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Abstract:

This study analyzes tornado risk perception and information channel preferences to receive tornado warning notifications and to receive additional information about ongoing tornado warnings. The relationship between age and use of Facebook and Twitter as a severe weather information source is examined. Through an online survey distributed to Oklahoma residents, 117 responses were received and analyzed.

In this study, responses are also used to understand what specific information people consider important to receive during a tornado warning. Also, the study will look at specific information or phrasing which will trigger protective action, without delay, when a person is in a tornado warning. This study will examine these parts of the tornado warning process, using the framework of Lindell and Perry's Protective Action Decision Model. Results can be used to help eliminate delays in protective action decisions caused by ambiguity in tornado warning messaging.

Finally, factors which help develop and grow a trust relationship between viewers and television meteorologists (still a critical information channel for tornado warnings) will be analyzed. What attributes, credentials, delivery styles and content of television meteorologists and their presentation will help build viewer trust. Finally, content recommendations are presented for television meteorologists during tornado warnings, to build trust, to provide relevant information, and to prompt viewers to take protective action when needed.

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CHAPTER I

INTRODUCTION

Natural disasters in the United States are taking an ever-increasing economic toll in property damage, and in some cases, cause significant numbers of deaths and injuries. More specifically, the two most violent natural hazards which regularly threaten the United States are tornadoes and hurricanes. This research project will examine particular cues which survey respondents in Oklahoma look for before taking protective action during tornado warnings. Information channels used to receive severe weather warnings and updates will be examined, and specific message phrasing and content will be tested for capacity to encourage protective action decisions. Television meteorologists play a vital role in prompting members of the public to take protective action, and this paper will help understand how to the style and content of meteorologists' messaging may increase protective action by viewers.

1.1 Severe Weather Statistics

Even though official National Weather Service weather alerts for tornadoes have been issued since 1952 (Coleman, Knupp, Spann, Elliott, & Peters, 2011, p. 570) , and official alerts for hurricanes since 1935 (Sheets, 1990, p. 195), some storms are still causing alarming death tolls. The average annual tornado death toll in the United States has dropped by decade, from 142 in the decade from 1950 to 1959 to 56 from 2000-2010 (Brooks, 2013). This corresponds well to the timeline of the organized effort by the National Weather Service to provide warnings for tornadoes (Coleman et al., 2011, p. 570).

The tornado death toll data from 2011 to 2018, however, shows a significant average annual death toll jump, back to 107, the highest (by decade) since the 1950s (National Weather Service, 2018). This is due, in large part, to the 553 tornado deaths occurring in 2011, the highest yearly death toll since 1925, and the highest in the modern era of the National Weather Service (Appendix B-Figure 4) (Brooks, 2013).

1.2 Tornadoes in Outbreaks

A disproportionate number of tornado deaths occur during tornado outbreaks. While there is still no established definition for a tornado outbreak, the meteorological community generally accepts an outbreak definition as more than five tornadoes during the life-cycle of a single thunderstorm-causing weather system (Joseph G. Galway, 1977, p. 477). Since most notable, large-scale tornado outbreaks contain several long-track, violent tornadoes (EF4-EF5), the risk to the public is higher, due to the high-end magnitude of these tornadoes. In fact, 80% of United States tornado fatalities from 1875-2003 occurred during tornado outbreaks (Schneider, Brooks, & Schaefer, 2004, p. 5.4).

In general, tornado warnings during tornado outbreaks out-perform overall tornado warnings, due to the more significant and easily forecast favorable tornado formation parameters, and more readily apparent signatures on Doppler radar. In fact, Bruick and Karstens show, during tornado outbreaks from 2007 to 2016, the probability of detection for tornadoes is 90%, far above the average tornado probability of detection of 58% (2017, p. 19).

1.3 Research Objectives

I'll examine several aspects of the tornado warning process, how that process fits into the framework of Lindell and Perry's Protective Action Decision Model, and how the behavioral response predicted by the PADM can be used to improve messaging of tornado warnings. During tornado warnings, public reliance on local television is high, from receiving initial warnings, to seeking additional information after a warning is issued (Hammer & Schmidlin, 2002, p. 578). The PADM integrates the study of how people respond to environmental cues and warnings with theories on persuasion, decision-making, and protective action, in order to adjust and modify risk communication. Collected data will be examined with the primary objective of eliminating delays in protective action decision-making. One of the key points of delay in the PADM takes place when seemingly ambiguous information causes repeated cycles of information gathering, delaying protective action decisions. I'll examine data on public trust in television meteorologists and how messaging from television meteorologists can play an important role in motivating the public to take protective action during tornado warnings.

When results are completed, I will provide a framework of effective content for television broadcasts of tornado warnings that will improve and hasten protective action decision making by the public. These results will help tornado warning effectiveness by allowing the public to spend fewer cycles in the information-seeking portion of the PADM. This will be accomplished by reducing the perceived need of viewers to clear up ambiguity, by presenting information viewers consider important, and information that will more directly prompt protective action decisions without undue delay.

In Chapter II, I present past scholarship as a base to develop hypotheses. Initial background on information channel use by the public to receive tornado warnings, and the significance local television meteorologists have played in past tornado events is shown. A more detailed look at the Protective Action Decision Model is presented. Focus is on how the PADM framework can be used to adjust and modify tornado warning messaging. More specifically, what content needs to be broadcast by local tv meteorologists to more effectively skip delays from perceived ambiguous information, and prompt protective action decisions. Additionally, Social media's role and how it applies to the PADM is a relatively new point of study. I present recent literature showing that social media easily fits into the PADM in several spots: social influence, persuasion, direct risk communication, reception of warnings and information. A detailed presentation of prior literature shows not only the preference for television meteorologists as an information channel during severe weather, but how a trust relationship a viewer has with a local tv meteorologist can develop and grow. This trust relationship may prove important as a social influence in the PADM to allow messaging to carry more influence, and be perceived with less ambiguity, thereby accelerating a protective action decision. The difficulty of the nocturnal tornado hazard is also addressed. I show literature further defining the continuing vulnerability sleeping residents face by comparing fatality rates of daytime and nighttime tornadoes. Since the problem of receiving warnings while asleep has similarities with difficulties hearing impaired people have with "normal" information channels during severe weather, literature is presented showing what methods are used by this segment of the population to receive tornado warnings.

The methodology of the study, and survey structure details are presented in Chapter III. Residents of Oklahoma were surveyed using a survey developed and hosted by Qualtrics, with distribution of the survey through Amazon's mTurk workforce. I discuss why mTurk was used for survey distribution, and the advantages and disadvantages of the platform. Demographics of the respondents are presented. Data showing strengths and relationships between variables is shown, and a brief discussion of the appropriateness of using Kendall's tau-b correlation to test those relationships is presented. The survey question groups are shown: General tornado watch/warning knowledge, social media use, tornado warning information channel and notification, relationship with local television meteorologist, personal experience with severe weather, and basic demographic information.

Chapter IV discusses answers from the survey, presented in order of the survey question groups. Relationships between demographic groups and survey questions are presented. Responses to questions are examined for relationships to answers from the key question in the survey: “When a tornado warning is issued for MY LOCATION, my first thought is.” Potentially predictive factors are searched for, with the goal of increasing the response of, “I must take protective action.” To more specifically address the research question of how can messaging of television meteorologists be adjusted and modified to reduce ambiguity and accelerate protective action, answers from the question array, “I would (never / rarely / sometimes / often / always) take protective action WITHOUT DELAY during a tornado warning if a TV meteorologist I’m watching says or does the following:” is presented. There are several relationships between variables that were significant at $p < 0.01$, and these relationships are noted and discussed. Differences in answer frequency of information channel use to receive initial tornado warnings while awake and asleep are noted. Interestingly tornado siren use rates as one the most highly used information channels for notification of tornado warning while awake and asleep.

Chapter V shows why this study’s findings are important in risk messaging theory for messaging during severe weather, and in practice for television meteorologists to help tailor content of their tornado warning messaging to limit delays in protective action decision making. I present priorities for television meteorologists to consider during tornado warning coverage. Additionally, the communication gap between a forecast for severe weather days in advance, and the public not being aware of a tornado risk until immediately before a tornado impact is discussed. This gap between forecasting and public perception of risk will be discussed, and options to address this failure point of risk awareness are presented. Chapter V summarizes the findings of this research, and shows the reliance on local television weather and outdoor warning sirens as information channels. The chapter also discusses the limitations of this survey, and opportunities for future research, mainly expanding on the scale from Oklahoma only to other severe weather prone regions, and to have more research concentration on exactly how social media platforms are used as information channels.

CHAPTER II

REVIEW OF LITERATURE

This review of published scholarship begins by examining several studies conducted after significant tornado events in the United States. These studies, conducted from 1997 to 2016, concentrated on how affected people received tornado warnings and made protective action decisions. The second section summarizes Lindell and Perry's Protective Action Decision Model. The emphasis of the summary centers on the critical aspects of the PADM related to tornado warning messaging and perception, and how they may affect protective action decisions when tornadoes threaten. The next section presents literature on the growth of social media (Facebook and Twitter) and its use during crisis communication events (three campus shootings). A study in the aftermath of a tornado outbreak in central Oklahoma in May 2013 examines the use of Twitter and how the content of Twitter messages changed during the timeline of the event.

2.1 Receiving Warnings and Protective Action

In a survey of homeowners whose homes were destroyed by the 3 May 1999 F5 tornado in Moore, OK, it was found that 89% of survey respondents received the tornado warning from local television broadcasts (Hammer & Schmidlin, 2002, p. 578). The messaging in those broadcasts was apparently so effective that 100% of the respondents reported taking protective action when alerted to the danger (Hammer & Schmidlin, 2002, p. 579). However, some of the protective actions taken may merit closer examination in future research. Nearly 47% of those surveyed reported leaving their homes and driving out of the tornado's path (Hammer & Schmidlin, 2002, p. 579). This behavior, while effective in this instance, has the potential to result in great personal danger if traffic or insufficient time to escape the tornado result in these ad hoc evacuees being trapped in their automobiles during a tornado. An analysis of the tornado-caused traumatic deaths (not including indirect deaths, such as cardiac failure) from a 1979 F4 tornado in Wichita Falls, TX, clearly shows the danger of being in an automobile during a tornado. It was found 26 of the 43 direct tornado deaths occurred in vehicles (Glass et al., 1980, p. 736).

Some differences in taking protective action and primary method of receiving tornado warnings exist in three other post-tornado surveys. For example, Liu, Quenemoen and Malilay found 73% of residents near a 1994 tornado path in Calhoun County, AL received their initial tornado warning via local television (1996, p. 88). In contrast to the Moore, OK study however, only 56% in one of their survey groups and 31% in a second survey group reported taking protective action after receiving the initial tornado warning (Liu et al., 1996, p. 588).

Following a tornado outbreak in Kansas, Missouri and Tennessee in 2004, a post-storm survey showed 70% of respondents received a warning from local television. This number was a lower than the previously mentioned surveys, but it was reduced by several respondents in an area hit by an overnight tornado. Many of those affected by the overnight tornado had already reported going to bed for the night, with the television off, represented by around 11% of the respondents reporting no advance warning of a tornado (Paul, Brock, Csiki, & Emerson, 2003). Nearly 90% of those surveyed reported taking immediate protective action, but 10% reported going outside to visually determine the tornado threat before taking protective action (Paul et al., 2003).

After a 1997 tornado outbreak in Arkansas, 146 residents of the two counties with the highest level of damage were surveyed. Seventy-six percent (76%) of respondents reported receiving the initial tornado warning through local television broadcasts (Balluz, Schieve, Holmes, Kiezak, & Malilay, 2000, p. 74). In comparison to the studies presented above, this survey reported a comparatively low number of people taking protective action, only 46% reported taking protective action. This is closer to the results of the Liu et al. study in Alabama, but far below the rate of taking protective action reported in Moore by Hammer and Schmidlin and in the Kansas, Missouri and Tennessee study by Paul, Brock, Csiki and Emerson.

A more recent study (2016) of students at the University of Nebraska showed the trend of relying on local television broadcasts for tornado warning information, both initially and for further details is still valid. Data showed 91% of respondents reported using television as a warning source. In an indication of the proliferation of mobile device use since the four previous surveys, 16% reported primary use of mobile apps or text, and 21% using internet sources as the primary warning receiving method (Jauernic & Van Den Broeke, 2016, p. 336). The same survey showed 13% of respondents reported ignoring or failing to receive the last tornado warning in their area, while the same number (13%) reported seeking to confirm the threat visually (Jauernic & Van Den Broeke, 2016, p. 340).

In general, these studies show the weak point in the current tornado warning system: the perception that personal risk from a tornado isn't high enough to take action. Despite generally adequate warnings, mostly from local television, many people are still not self-assessing their personal risk as high enough to take protective action. The survey results show alerts are also being communicated and received efficiently by the public, given the high number of respondents that report receiving the warnings. However, these surveys show (with the notable exception of Moore in 1999 and 2013) significant numbers of people often do not choose to take protective action.

Nocturnal tornadoes present a major issue in the tornado warning process and the effort to reduce tornado fatalities. In an analysis of killer tornadoes in the United States between 1950 and 2005, Ashley, Krmenec and Schwantes investigated 48,165 tornadoes, and found only 27.3% were nocturnal, but 39.3% of tornado fatalities took place at night (2008, p. 798). From 1960 to 2005, by decade, the percentage of nighttime tornadoes has actually decreased from 28.4% in the 1960s to 25.7% from 2000-2005. Conversely, the percent of nocturnal tornado fatalities has increased from 32.4% in the 1960s to 63.0% from 2000-2005 (2008, p. 800). In a 2018 study, certain cognitive factors, prior experience, and an increased regional tornado risk were shown to influence decisions to take proactive steps to receive nighttime tornado warnings (Mason, Ellis, Winchester, & Schexnayder, 2018, p. 568). A survey in the aftermath of the 4 May 2003 Jackson, TN tornado showed the same trend. In a post-storm survey of survivors, 14 reported not being aware of a tornado warning, because they were asleep (Paul et al., 2003, p. 12).

I will analysis the information channels used by respondents, both while awake and asleep, to receive initial notification of a tornado warning for their location, and what information channels used to receive additional information during a tornado warning. Additionally, I will examine the types of information respondents consider important to have during a tornado warning for their location, and what information they hear from a local television meteorologist which will prompt protective action.

RQ1: What information channel are people most likely to use to receive initial notification of a tornado warning while awake?

RQ2: What information channel are people most likely to use to receive initial notification of a tornado warning while asleep?

RQ3: What information channel are people most likely to use to receive additional information during a tornado warning?

RQ4: What information do people consider most essential to know during a tornado warning?

RQ5: What information or phrases, used by a television meteorologist, will most effectively prompt people to take protective action without delay during a tornado warning?

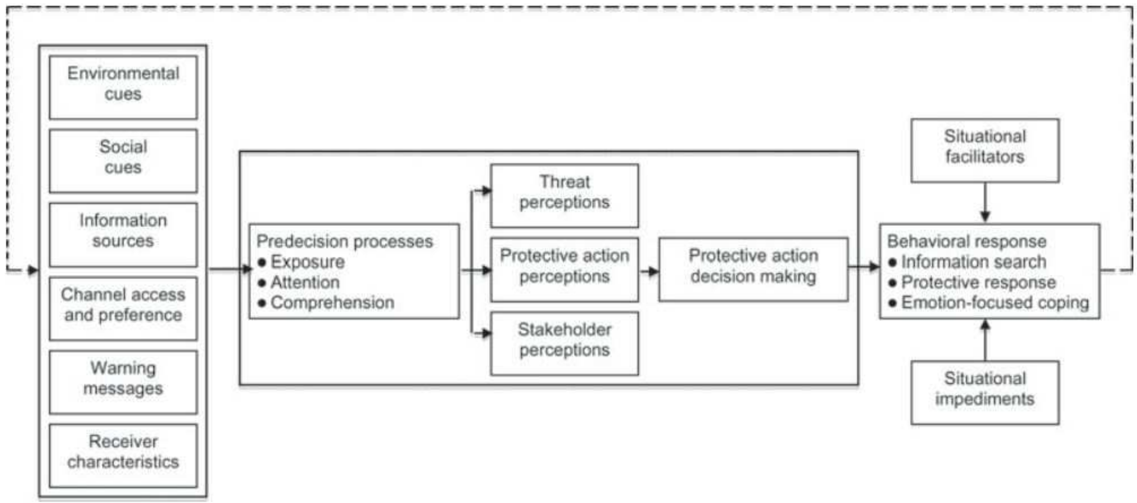
2.2 The Protective Action Decision Model

Several efforts have been made to model protective action decision-making by the public. Among the most widely accepted is the Protective Action Decision Model (PADM) developed by Michael Lindell and Ronald Perry. Since its initial development in 1992, Lindell and Perry have continued to develop the PADM (2012, p. 616).

The PADM (Figure 2.1) explains the processes and factors most people use to evaluate the need to take protective action in the face of an environmental hazard or disaster. The model describes how people use cues from their environment, the social structure around them and characteristics not only of the warning but their personal situation to aid in their decision-making processes. The model also describes the process when those cues are perceived to be delivering incomplete or ambiguous information: often the person will go into a mode of searching for more information before moving forward with taking protective action (Lindell & Perry, 2012, p. 617).

Figure 2.1

Information Flow in The Protective Action Decision Model



(Lindell & Perry, 2012, p. 617)

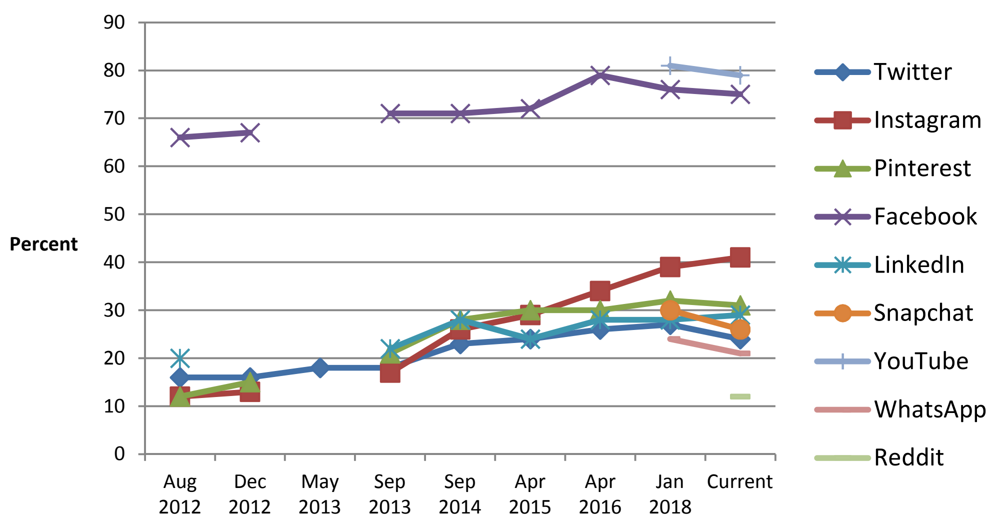
Lindell and Perry specifically point out that an excess in ambiguity can cause a person to spend more and more time in a repetitive process of information seeking and processing, instead of making a decision to prepare for a natural hazard. This cycle runs the risk of repeating itself until hazard onset, when it is too late to initiate protective action (Lindell & Perry, 2012, p. 618). Mileti and Sorensen discussed a similar decision-making process in public response to hazards or disasters (1990). The stages described are similar in structure to Lindell and Perry. Both involve a sequence of mental events or stages that people use and work through, in order to evaluate and assess their own personal risk to the hazard outlined in a warning. This individual evaluation and the resultant confirmation of personal risk is necessary for a person to initiate protective action (Mileti & Sorensen, 1990, p. 5.12). In agreement with Lindell and Perry, they also stress that confusion can be generated by ambiguity or non-clarity of messaging, and those factors can lead to poor decisions or a critical delay in taking protective action while seeking threat clarity (Mileti & Sorensen, 1990, p. 2.8).

2.3 Social Media

Use of social media platforms showed steady growth between 2009 and 2012, but since 2016, only Instagram is showing an increase in use. According to 2019 research from the Pew Research Center, Facebook and YouTube are the most popular online platforms (Figure 2.2), with usage of Facebook, Pinterest, LinkedIn and Twitter largely unchanged since 2016 (Perrin & Anderson, 2019a, p. 4). General social media use shows a sharp drop regular use in the 65+ age category (Figure 2.3), with Facebook being the most popular in among that age group (2019b).

Figure 2.2

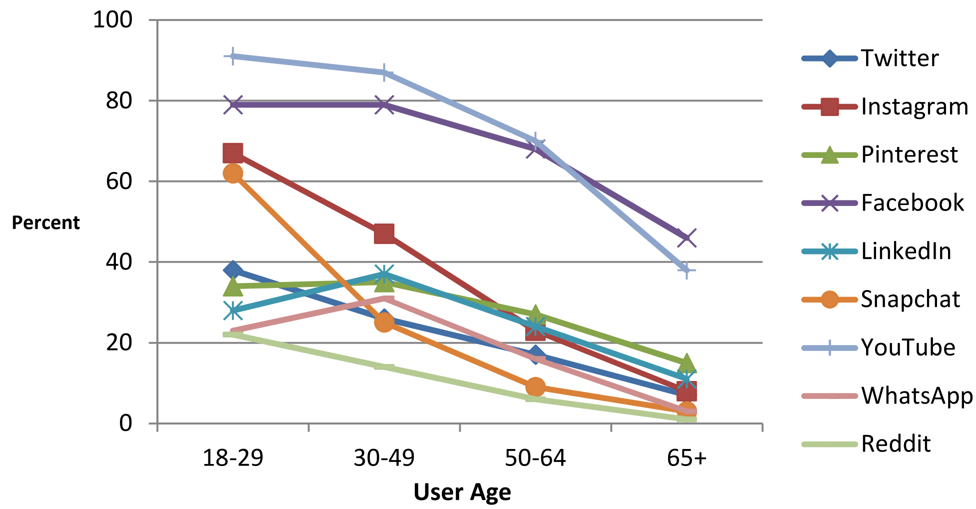
Social Media/Online Platform Use



(*Perrin & Anderson, 2019, p. 4-5*)

Figure 2.3

Social Media/Online Platform Use by Age



(Perrin & Anderson, 2019b)

During severe weather, using Facebook for current information is problematic, due to its complex and unpredictable newsfeed chronology, days old information may bubble to the top of a user's newsfeed (Eachus & Keim, 2019, p. 599). The more chronological order of Twitter is more intuitive for timely severe weather information (though Twitter has implemented a Facebook-style feed for older, but popular tweets that may obscure the most recent tweets). While Instagram has overtaken Twitter in general use, its use as an information channel for severe weather information has only been studied sparingly.

Four of the initial five surveys mentioned in Section 2.1 were conducted prior to 2005. Explosive growth of social media is now playing a role in delivery of tornado warnings, as shown by Jauernic and Van Den Broeke. From 2010 to 2018, growth in Twitter, for example, has been nearly six-fold, from a 2010 number of 10,000,000 monthly users to 60,000,000 by 2018 ("Twitter Q3 2018 Metrics, page 1," 2018).

Since the use of social media and microblogging tools like Twitter, is a relatively new phenomenon by disaster management standards, there is a relative paucity of studies regarding its use during tornado warnings. There are, however, a few studies regarding the use of microblogging and Twitter in other emergencies, and patterns of Twitter use during emergencies likely shares many characteristics with Twitter use during tornado warnings.

Thomas Heverin and Lisl Zach, in 2012, studied the use of Twitter during three campus shooting events. Each incident they studied shared common phases: within the "critical period" of a shooting, information and information seeking was the primary content related to each shooting, transitioning to more opinion content, then back to information content (Heverin & Zach, 2012, p. 34). The authors presented a preliminary five step model to describe the use of Twitter during emergencies: Information sharing, opinion sharing, event hashtag contribution to contribute to understanding by self and others, "talking cure" contribution to the event hashtag for connection with others, and contribution to the event hashtag to foster and build a sense of social structure and community (Heverin & Zach, 2012, p. 45).

After the EF-5 killer tornado in Moore, OK on 20 May 2013, Blanford, Bernhardt and Savelyev (2014, p. 320) analyzed 86,100 geo-located tweets from May 19-21 in Oklahoma. Analysis was performed on the tornado-relevant tweets to determine content trends. Tweets the day before (also a day with additional tornadoes in Central Oklahoma) and prior to the tornado on the day of the Moore tornado were largely focused on the upcoming threat. During the tornado itself, response and shelter steps were the focus, including tornado sirens and visual reports. After the tornado, tweets shifted into discussion of the damage that had occurred (Blanford et al., 2014, p. 320). This study did not break down the tweets into specific categories as Heverin and Zach, but the general trend, from information seeking to information sharing, then sharing opinions before a surge of damage reports and recovery information (Blanford et al., 2014, p. 322).

I will examine the use of Facebook and Twitter, both before and during severe weather events to test the following hypotheses about age and the use of Facebook and Twitter to gather weather information before and during severe weather.

RH1: While seeking weather information before severe weather, younger people are more likely to use Facebook than older people

RH2: While seeking weather information before severe weather, younger people are more likely to use Twitter than older people

RH3: While seeking weather information during severe weather, younger people are more likely to use Facebook than older people

RH4: While seeking weather information during severe weather, younger people are more likely to use Facebook than older people

2.4 Local Television Meteorologists and Trust

Most studies, including those cited above, clearly show the importance of local television as a delivery mechanism for tornado warnings. Television personalities have long formed a connection with viewers. Horton and Wohl (1956, p. 215) called this "seeming face-to-face" connection parasocial interaction (PSI). It is logical that local television meteorologists also form a PSI connection with their viewers. Since meteorologists are not reading from a script, Kathleen Sherman-Morris suggests their PSI connection could be even more intimate than that of script-reading news anchors (2005, p. 202). In Sherman-Morris's study of Memphis-area television viewers, she found a significant amount of PSI between local weathercasters and their viewers, in fact, the majority of respondents reported trusting their weathercaster during severe weather, and they would be likely to take protective action if the weathercaster advised it (2005, p. 208). The three variables found to most highly influence a positive decision to take shelter were PSI, trust and the perceived skill of the weathercaster. Breaking that down even more, results showed, at least to some extent, PSI also increased the level of trust in a weathercaster, which results in more likelihood of a person taking shelter when that action is recommended by the weathercaster (Sherman-Morris, 2005, p. 209).

In a 2012 study of television viewers in Missouri, results from the qualitative research portion of a mixed-methods study showed how trust is gained (Ebner, 2013, p. 19). Respondents reported trusting television meteorologist who were local, reliable, delivered factual information, visuals and had a caring manner. Past experience with their area's severe weather was also reported as an important factor from which trust is gained. This study also examined the reasons why a viewer expressed a lack of trust in a television meteorologist when that meteorologist was providing severe weather information, but only 24% reported complaints about hype or exaggeration of severe weather coverage or impact potential (Ebner, 2013, p. 48). It is clear this trust relationship between a viewer and a local television meteorologist is a critical factor in making protective action decisions without unnecessary delay.

In a study of National Weather Service tornado warning false-alarm rates, it was found that frequent false alarms and missed events caused the public to perceive their local National Weather Service office as inaccurate, and that perception of inaccuracy reduced the public's trust in the agency (Ripberger et al., 2015, p. 54). The study data also supported the conclusion that persons perceiving their local National Weather Service office as inaccurate, are less likely to take protective action during a tornado warning (Ripberger et al., 2015, p. 56).

With trust shown to be a significant factor in the credibility of and information source, and therefore, prompting a faster progression through the PADM, I will measure what factors viewers say help build trust in a local television meteorologist.

RQ6: What are the most likely reasons viewers use to determine the level of trust they have in a particular television meteorologist?

2.5 Research Significance

This study focuses on specifically on factors affecting response to tornado warnings in Oklahoma, and can serve as a framework for a more expansive study in other tornado-prone parts of the country. This research will provide unique and valuable information by analyzing the role different information channels play in the tornado warning process in Oklahoma, with particular attention on the use of relatively new tools like social media and smart phone apps. This analysis will also show whether specific types of information will reduce ambiguity and accelerate protective action decisions when used by a television meteorologist.

A framework of guidance will be developed for television meteorologists to use during tornado warning coverage. This guidance will help focus content decisions and priorities, with the focus on factors which will reduce time spent in the information-seeking phase of the Protective Action Decision Model. By reducing the perceived ambiguity of information for a viewer, it is hoped less time will be spend looking for additional information before viewer makes a protective action decision.

CHAPTER III

METHODOLOGY

A survey was developed to evaluate a wide range of severe weather information from respondents. Responses from the survey were used to gain insight into protective action decisions. The survey examined several key items: what information respondents are seeking during tornado warnings in order to take protective action, what messaging platform is used to receive that information, and what effect does having a trusted television meteorologist have on protective action decision making. Survey procedures were approved by the Institutional Review Board at Oklahoma State University.

3.1 Survey

The survey was hosted and administered by Qualtrics, and the link to the survey was distributed to Oklahoma residents via Amazon Mechanical Turk (mTurk) from August 1 to August 10, 2020. Respondents were paid 2.00 USD for completion of the survey, and given a 30 minute time window in which to complete the survey. There were 117 valid responses to the survey. The quantitative survey had 57 multiple choice questions: 38 nominal, 15 ordinal, 3 interval-ratio and 2 open-ended. Six groups of questions examined basic severe weather knowledge, information channels used to receive tornado warnings, level of trust of television meteorologists, prior experience with tornadoes, specific phrasing viewers look for to trigger protective action, and basic demographic information. The questions are presented exactly as they appeared in the survey in Appendix A.

Demographic data on age (years) was collected, as a scale variable (not age range) to serve as the independent variable on social media use for seeking weather information. Using Likert-scale questions (1=Never, 2=Rarely, 3=Sometimes, 4=Frequently, 5=Very Often), ordinal data was collected on the frequency of Facebook and Twitter use for weather information, both before and during storms. The social media use rate served as dependent variable for analysis of the research hypotheses. In a specific attempt to understand nighttime tornado risk perception, identical questions were presented asking about preferred information channels to receive tornado warnings, one set for when the respondent is awake, one when the respondent is asleep. This analysis is presented, and differences between methods to receive initial tornado warning notification while awake and while asleep are presented. It is important to note, significantly more demographic data was collected, but due to the small sample size (n=117), reliable analysis was not feasible.

3.2 Amazon Mechanical Turk

Amazon Mechanical Turk is an online marketplace which allows people (called "requesters") to pay other people (called "workers") for completing tasks like this survey. Workers on mTurk exist world-wide, but requesters can use filters to narrow down the worker field. In this survey, using the optional geographic filters to limit workers by state, I limited the worker field to residents of Oklahoma.

Paolacci, Chandler, and Ipeirotis analyzed the demographics of mTurk workers in the United States in 2010, and found those demographics skewed female, slightly younger and slightly more educated than the United States population as a whole. Interestingly, despite the self-reported higher education, they report lower income than the United States population (2010,

p. 412). This may be explained by individuals self-selecting into the mTurk worker pool based on financial incentives (Shank, 2016, p. 50). Even though only 13.4% of workers report mTurk as a primary source of income, 61.4% of U.S. based workers report additional money was an important motivation to participate (Paolacci et al., 2010, p. 412).

There are advantages to using mTurk as a distribution method for a survey. It is often far less expensive than using traditional survey distribution methods, making it an attractive option when cost is a concern. Survey datasets can also be generated quickly (Cheung, Burns, Sinclair, & Sliter, 2016, p. 359). It is easy: researchers don't need physical labs or time-consuming mailing and response processes. The logistics of large group studies are significantly less daunting (Paolacci & Chandler, 2014, p. 187).

There are disadvantages as well. Mechanical Turk workers are not a representative sample, and there is potential for worker pool composition to vary widely from task to task. Data quality is also difficult to measure, since most false responses require the same response effort as true responses. Attention-check questions in the survey assume workers are devoting the same level of attention throughout each survey, and have a high measurement error (Paolacci & Chandler, 2014, p. 186). Overall, Paolacci and Chandler found data quality can be increased by expressing tasks with meaning for the work. It is important to note, since mTurk workers are not a random sample, generalizing conclusions is not advised.

3.3 Demographics of Respondents

Survey responses were gathered from 131 participants in August, 2020. After examination of the dataset for out-of-state replies and respondent failure to answer the attention-check questions correctly, 117 valid responses were analyzed. An analysis of the demographic data is listed on Table 3.1. An analysis of the community respondents reported as where they lived, or as the closest is shown in Table 3.2, more than half the respondents (61/117) did not answer this question.   Note that total number of answers on each question may be less than 117 due to some respondents failing to answers certain questions. Comparison to United States Census Bureau data was difficult due to categorical differences in all of the data except sex. In the survey, the sex of the respondents was remarkably similar to the Census Bureau data, 58 (49.6%) male, 59 (50.4%) female, compared to 49.5% male, 50.5% female reported by the U.S. Census Bureau (U.S. Census Bureau, 2019).

Table 3.1:

Demographics of respondents (n=117)

Variable		n	%
Sex	Male	58	49.6
	Female	59	50.4
Age	21-29	26	22.2
	30-39	43	36.8
	40-49	26	22.2
	50-59	15	12.8
	60-69	7	6.0
Marital Status	Married	68	58.1
	Single	33	28.2
	Divorced	11	9.4
	Separated	1	0.9
	Widowed	4	3.4
Ethic Group	Hispanic or Latino	5	1.3
	White (non-Hispanic or Latino)	91	77.8
	Black or African American (non-Hispanic or Latino)	8	6.8
	Asian (non-Hispanic or Latino)	3	2.6
	Native American or Alaska Native (non-Hispanic or Latino	8	6.8
	Other (please specify)	2	1.7
Residence	Apartment	31	26.5
	Mobile Home	12	10.3
	Site-Built Home	72	61.5
	Condominium	1	0.9
	Other (please specify)	1	0.9
Housing Situation	Homeowner	54	46.2
	Renter	49	41.9
	Living with others, NOT paying rent or mortgage	11	9.4
	Living with others, assisting with rent or mortgage	2	1.7
	Other (please specify)	1	0.9
Education	Less than a High School Diploma	1	0.9
	High School Diploma/GED	13	11.1
	Some College	24	20.5
	Associate's. Degree	13	11.1
	Bachelor's Degree	47	40.2
	Master's Degree	16	13.7
	Doctorate	3	2.6
Household Income	LT $30,000	28	23.9
	$30,000-$54,999	38	32.5
	$55,000-$79,999	27	23.1
	$80,000-$104,999	11	9.4
	$105,000-$130,000	7	6.0
	GT $130,000	6	5.1

Table 3.2

Population of respondents' communities (n=56)

Population	n	%
0-499	2	1.7
500-999	3	2.6
1,000-4,999	8	6.8
5,000-9,999	9	7.7
10,000-49.999	17	14.5
50,000-99,999	3	2.6
100,000 +	14	12.0

3.4 Methods

The associations and correlations of four hypotheses will be measured using Spearman's Rho with age considered the independent variable, and reported social media use the dependent variable. Spearman's rho is a measure of association for ordinal-level variables or for a scale variable and an ordinal-level variable (Healey, 2019, p. 330). The rate of Facebook use before severe weather (RH1) or during severe weather (RH3) to gather weather information will be tested. Likewise, the rate of Twitter use before severe weather (RH2) or during severe weather (RH4), to gather weather information will be tested for statistically significant correlations.

I will use Repeated-Measures Analysis of Variables (ANOVA) to test for statistically significant differences between the means on information channel preferences while awake (RQ1), while asleep (RQ2), and during an ongoing tornado warning (RQ3). Using the same test, I will test the differences between the means of importance of the responses rating the importance of particular types of information to have during a tornado warning (RQ4). Repeated-Measures ANOVA will also be used to test for statistically significant differences in the means in responses rating the effectiveness of information or phrasing from a television meteorologist during a tornado warning which would prompt a protective action decision without delay (RQ5).

CHAPTER IV

ANALYSIS

IBM SPSS Statistics software was used to analyze the dataset, perform statistical analysis as described in section 3.4, build correlations, and produce statistical relationship data between variables. Despite the small sample size (n=117 for most questions), sufficient data was present to draw relationships to test the hypotheses and answer the research questions.

4.1 Information Channels: Use and Content

In this section, respondents were asked to rate how often they might use various methods to receive tornado warning information. Since a troubling number of tornado fatalities have historically occurred at night, information channels used while respondents are awake, and while they are asleep were investigated. The responses to the first research question (*What information channel are people most likely to use to receive initial notification of a tornado warning while awake?*) are addressed and an analysis is ordered and presented in Table 4.1. Outdoor warning sirens (M=3.50; SD=1.199) and Local TV broadcasts (M=3.26; SD=1.322) were the top two information channels. These were followed by six digital or mobile device information channels: local TV station weather app (M=2.97; SD=1.469), smartphone WEA alert (M=2.96; SD=1.440), text message from friend or family (M=2.95; SD=1.329), text message from automated warning service (M=2.84; SD=1.402), NWS website (M=2.76; SD=1.297), and local TV station website

(M=2.71; SD=1.314). Despite the growing use of social media in general, both Facebook (M=2.45; SD=1.424) and Twitter placed in the bottom five information channels.

Table 4.1

Respondent's preferred information channel use while awake (n=109)

Information Channel	Mean	S.D.
Outdoor warning siren	3.50	1.199
Local TV broadcast	3.26	1.322
Local TV station weather app	2.97	1.469
Smartphone WEA alert	2.96	1.440
Text message from friend or family	2.95	1.329
Automated text message service	2.84	1.402
NWS website	2.76	1.297
Local TV station website	2.71	1.314
Local radio	2.61	1.333
Weather Channel app	2.61	1.478
Facebook	2.45	1.424
Phone call from friend or family	2.43	1.308
Twitter	2.07	1.425
NOAA/All Hazards radio	2.06	1.321
Automated phone call service	1.75	1.263

Wilks' Lambda = .325, $F_{(14,95)}$=14.111, p<.01

Analyzing data related to the second research question (*What information channel are people most likely to use to receive initial notification of a tornado warning while asleep?)* is ordered and presented in Table 4.2. Again, outdoor warning sirens (M=3.50; SD=1.412) was the highest ranked information channel, followed by smartphone WEA alerts (M=3.14; SD=1.567). The importance of social capital and family connection shows in the next two responses: phone call from friends or family (M=2.56; SD=1.480) and text message from friend or family (M=2.54; SD=1.419). Following notification from an automated text messaging service (M=2.52; SD=1.467), and local TV station weather app (M=2.12; SD=1.469), NOAA/All Hazards radio (M=2.08; SD=1.460) edged out the last two information channels with alarm capability: Weather Channel app (M=1.99; SD=1.316) and notification from an automated phone call service (m=1.97; SD=1.389). Facebook (M=1.75; SD=1.278) and Twitter (M=1.75; SD=1.316) finished last.

Table 4.2

Respondents' preferred information channel use while asleep (n=102)

Information Channel	Mean	S.D.
Outdoor warning siren	3.50	1.412
Smartphone WEA alert	3.14	1.567
Phone call from friend or family	2.56	1.480
Text message from friend or family	2.54	1.419
Automated text message service	2.52	1.467
Local TV station weather app	2.12	1.469
NOAA/All Hazards radio	2.08	1.460
Weather Channel app	1.99	1.316
Automated phone call service	1.97	1.389
Local TV station website	1.94	1.392
Local TV broadcast	1.91	1.259
NWS website	1.91	1.306
Local radio	1.83	1.243
Facebook	1.75	1.278
Twitter	1.75	1.316

Wilks' Lambda = .326, $F_{(14,88)}$=12.977, p<.01

The third research question (*What information channel are people most likely to use to receive additional information during a tornado warning?*) is analyzed, ordered and presented in Table 4.3. Respondents report local TV broadcast (M=3.56; SD=1.296) as the most often used method to receive additional information during an active tornado warning. Despite outdoor warning sirens being only an on/off notification signal, they were noted (M=3.28; SD=1.466) as the second-most-used method to gain additional information during a tornado warning. The digital space of local TV had the next two most used information channels: Local TV station website (M=2.95; SD=1.295), followed by Local TV station app (M=2.93: SD=1.379). Text message from friend or family (M=2.74; SD=1.451) was next, then Smartphone WEA alert (M=2.71; SD=1.474), followed by NWS website (M=2.60; SD=1.265), then phone call from friend or family (M=2.55; SD=1.372). Again, Facebook (M=2.27; SD=1.414) and Twitter (M=2.00; SD=1.453) made up two of the bottom four.

Table 4.3

Respondents' preferred information channel use during a tornado warning (n=110)

Information Channel	Mean	S.D.
Local TV broadcast	3.56	1.296
Outdoor warning siren	3.28	1.466
Local TV station website	2.95	1.295
Local TV station weather app	2.93	1.379
Text message from friend or family	2.74	1.451
Smartphone WEA alert	2.71	1.474
NWS website	2.60	1.265
Phone call from friend or family	2.55	1.372
Local radio	2.51	1.319
Automated text message service	2.49	1.513
Weather Channel app	2.49	1.438
Facebook	2.27	1.414
NOAA/All Hazards radio	2.03	1.310
Automated phone call service	2.02	1.414
Twitter	2.00	1.453

Wilks' Lambda = .451, $F_{(14,96)}$=8.354, p<.01

Responses to research question four (*What information do people consider most essential to know during a tornado warning?*) are ordered and presented in Table 4.4. This is the pivot in research questions toward messaging content instead of information channel used to receive this content. It is logical to assume, as respondents receive information they consider important, they will spend less time in repeating information seeking and progress toward making a protective action decision. The top three responses all revolved around knowing a time of arrival for the storm or tornado at the respondent's location. A tornado path forecast graphic showing my town or city with a specific arrival time (commonly called a stormtrack) (M=4.12; SD=0.965) and how long before the storm reaches my location (M=4.12; SD=0.854) were closely followed by specific arrival time of storm to your location (M=4.09; SD=0.924). Next in order: magnitude of the threat (M=3.96;SD=1.004), radar map for my area, showing major streets and highways (M=3.75; SD=0.990), statewide radar map (M=3.50; SD 1.194), safety instructions for my situation (M=3.29; SD=1.280) and description of the damage this tornado has already caused (M=3.15; SD=1.205). Interestingly, the bottom two information types were live storm chaser reports of the tornado (M=3.14; SD=1.161) and live picture or video of the tornado (M=2.64; SD=1.217). Explanation of the placement of the last two is conjecture: perhaps, Oklahoma residents rate tornado video lower just from seeing it so much? Or perhaps, with no specific geographic information, only imagery of a tornado, viewer still want more information about the location and path of the storm.

Table 4.4

Respondents' importance of information to receive during a tornado warning (n=110)

Information	Mean	S.D.
A tornado path forecast graphic showing my town or city with a specific arrival time	4.12	0.965
How long before the storm reaches my location	4.12	0.854
Specific Arrival time of storm to your location	4.09	0.924
Magnitude of the threat	3.96	1.004
Radar map for my area, showing major streets and highways	3.75	0.990
Statewide radar map	3.50	1.194
Safety instructions for my situation	3.29	1.280
Description of damage this tornado has already caused	3.15	1.205
Live storm chaser reports of the tornado	3.14	1.161
Live picture or video of the tornado	2.64	1.217
Picture or vide of damage this tornado has already caused	2.64	1.260

Wilks' Lambda = .441, $F_{(10,100)}$=12.701, p<.01

A goal of this work is to improve the rate in which people receiving tornado warnings will make protective action decisions. One specific way to do that is addressed with research question five (*What information or phrases, used by a television meteorologist, will most effectively prompt people to take protective action without delay during a tornado warning?*). By directly ranking survey answers when respondents are asked what information or phrasing they need to prompt protective action without delay, we can provide guidance for warning messaging and content to move toward this goal.

Responses are analyzed, ordered and presented in Table 4.5. It is important to note, the means in this group have a small range, indicating that arguably all of this information is considered important to a prompt decision to take protective action. Specifically, there is tight grouping in the top three responses started with says “a large tornado is on the ground” (M=3.86; SD=1.139) closely followed by shows a tornado path forecast with a specific tornado arrival time for my town or city or nearby landmark (M=3.83, SD=1.042) and says “a tornado is confirmed” (M=3.83; SD=1.094). Says “tornado emergency” (M=3.76; SD=1.174) is next, followed by says a nearby highway or intersection is in the path of the tornado (M=3.73; SD=1.079), then says “a tornado is on the ground” (M=3.72; SD=1.159). Two more items in the category of local landmark-related content was next: says my town name is in a tornado warning (M=3.66l; SD=1.169), then says a nearby school is in the path of the tornado (M=3.64; SD=1.125). Second-to-last on the ranking was says my county name is in a tornado warning (M=3.23; SD=1.134). Shows a live picture of video of a tornado (M=3.10; SD=1.202) is last in the ranking. This reinforces the data used to address RQ4 and shows live pictures or video of a tornado are the least important type of information or phrasing a person uses to prompt protective action without delay.

Table 4.5

Respondents' rating of information or phrases from a television meteorologist during a tornado warning which would prompt protective action without delay (n=115)

Information	Mean	S.D.
Says "a large tornado is on the ground"	3.86	1.139
Shows a tornado path forecast with a specific tornado arrival time for my town or city or nearby landmark	3.83	1.042
Says "a tornado is confirmed"	3.83	1.094
Says "tornado emergency"	3.76	1.174
Says a nearby highway or intersection is in the path of the tornado	3.73	1.079
Says "a tornado is on the ground"	3.72	1.159
Says my town name is in a tornado warning	3.66	1.169
Says a nearby school is in the path of a tornado	3.64	1.125
Says my county name is in a tornado warning	3.23	1.134
Shows a live picture or video of a tornado	3.10	1.202

Wilks' Lambda = .574, $F_{(10,105)}$=7.783, p<.01

4.2 Social Media

Social media, as shown in section 2.4, is used more often by younger people. The research hypotheses were tested to see if that is a trend that is valid while using Facebook and Twitter to seek information about severe weather in Oklahoma.

RH1: While seeking weather information before severe weather, younger people are more likely to use Facebook than older people

RH2: While seeking weather information before severe weather, younger people are more likely to use Twitter than older people

RH3: While seeking weather information during severe weather, younger people are more likely to use Facebook than older people

RH4: While seeking weather information during severe weather, younger people are more likely to use Facebook than older people

A Spearman's correlation was run to assess the relationship between age and use of Facebook both before and during severe weather and to assess the relationship between age and use of Twitter before and during severe weather, and the data is presented in Table 4.6. No statistically significant correlation is shown between age and Facebook use before (r_s *= .073, p = .432)* and during storms (r_s = .000, p = .999), and no statistically significant correlation is shown between age and Twitter use before
(r_s = -.050, p = .593) and during storms (r_s = -.013, p = .887).

Table 4.6

Correlations between age and use of Facebook and Twitter to receive severe weather information, both before and during severe weather

Variable	*N*	*Correlation Coefficient*	p-value (*Sig.)*
Before Storms			
Facebook	117	.073	.432
Twitter	116	-.050	.593
During Storms			
Facebook	117	.000	.999
Twitter	115	-.013	.887

Since the relationships between age and use of both Twitter and Facebook before and during severe storms are not statistically significant, we cannot accept any of the research hypotheses. This result almost certainly is a result of using mTurk to distribute the survey. Mechanical Turk workers are assumed to be more computer-savvy and presumably more likely to use all aspects of the online experience, including social media.

4.3 Trust in a Television Meteorologist

As shown in section 2.5, trust plays an important role in the relationship between a viewer and a television meteorologist, especially during severe weather. Survey results were analyzed for factors to help build that trust, and addressed in research question six (*What are the most likely reasons viewers use to determine the level of trust they have in a particular television meteorologist?*). Responses were analyzed, ordered and are presented in Table 4.7. Delivering relevant information (M=4.25; SD=0.860) was the most important factor. The second-highest-rated factor is stays calm during severe weather (M=4.06; SD=0.943), followed closely by has knowledge of local weather patterns (M=4.05; SD=0.985). Knows local towns/landmarks ranked highly as well (M=3.92; SD=1.049), then has college degree in meteorology (M=3.89; SD=1.076). These are followed by two more emotional connections: does not hype or exaggerate (M=3.82; SD=1.027) and seems to care about my community (M=3.72; SD=1.156). Has certification from a professional organization (M=3.67; SD=1.157) was ahead of has been on TV here for many years (M=3.22; SD=1.173). Interestingly again, the social media use ranks at the bottom of the trust factors list: posts often on social media (M=2.60; SD=1.374) was followed by the final trust factor, responds to me on social media (M=2.19; SD=1.362).

Table 4.7

Respondents' You (n=114)

Factor	Mean	S.D.
Delivers relevant information	4.25	0.860
Stays calm during severe weather	4.06	0.943
Has knowledge of local weather patterns	4.05	0.985
Knows local towns/landmarks	3.92	1.049
Has a college degree in meteorology	3.89	1.076
Does not hype or exaggerate	3.82	1.027
Seems to care about my community	3.72	1.156
Has certification from a professional organization	3.67	1.157
Has been on TV here for many years	3.22	1.173
Seems to care about my well-being	3.15	1.257
Posts often on social media	2.60	1.374
Responds to ME on social media	2.19	1.362

Wilks' Lambda = .385, $F_{(10,135)}$=14.959, p<.01

CHAPTER V

CONCLUSION

On 3 March 2019, a quiet Sunday afternoon in rural Lee County, Alabama, was shattered by an EF4 tornado. Twenty-three people were killed and nearly 100 injured. The severe weather event was forecast days in advance, and well-warned immediately prior. NOAA's Storm Prediction Center mentioned the region's severe weather risk four days before the tornado in its Day 4 to 8 severe weather outlook, and subsequently fine-tuned and amplified that risk in subsequent outlooks (NOAA National Weather Service, 2019). On the day of the tornado, NOAA's Storm Prediction Center issued a tornado watch more than three hours before the tornado which included the phrase, "A few tornadoes likely with a couple intense tornadoes possible." The tornado warning was issued by the Birmingham, AL office of the National Weather Service, with eight minutes lead time for westernmost portion of Lee County, and 20 minutes lead time for the eastern portion of the county. Previous tornado warnings had covered areas west of Lee County (Leslie, Ladue, Mayeux, & Bryant, 2020, p. 4).

How does a well forecast and well warned tornado still cause such a high death toll? Interviews with 38 survivors at 27 destroyed homes after the tornado show 88% of the interviewed survivors received a warning before the tornado, but 85% waited to see or hear the tornado (and two respondents waited until they FELT the tornado) before taking their main sheltering action (Leslie et al., 2020, p. 5). Importantly, only 33% of respondents reported knowing about the chance of tornadoes prior to the immediate warning (2020, p. 5).

Despite the forecast for severe weather and possible tornadoes days in advance, most of these survivors were not aware of the severe weather threat until immediately beforehand. The majority waited to make protective action decisions until only last-second sheltering options were left. In this case, and presumably generally, effective severe weather forecasts aren't getting from forecasters to the public in advance of severe weather events. Additionally, when severe weather is imminent, protective action decisions are either not received, or not acted on until the actual tornado is sighted or heard. This communication and perception disconnect causes severe weather forecasting and warnings to be less effective, and results in a higher death toll.

5.1 Options

Local media, both broadcast and streaming, perform well, and are the messaging platforms most often used by the public to monitor severe weather. Local media can communicate comprehensive and wide-ranging information about a threat, potential impact, and protective action recommendations. However, local media requires an active choice by the public to select and monitor for information. As streaming video services like Netflix grow in popularity, severe weather information won't be transmitted through the platform to the public. While weather warnings on IP-based streaming systems present technological difficulties, they could be overcome with either hardware or configuration modifications. YouTubeTV already has some users verify their location with a GPS-enabled smart phone every six months.

Passive messaging platforms work well too. WEA smartphone alerts, alerts from smartphone weather apps, and automatic text messaging systems all require little or no active participation by the user. Smartphone use continues to climb, with 86% of United States adults reporting owning a smartphone in 2018 (Taylor & Silver, 2019, p. 43). Even with smartphone saturation, there are still failure modes in smartphone alerts, for example: telecom network failure, power issues at cell towers, and depleted batteries on user's phones.

The ideal solution for communicating immediate tornado warning information requires no active participation by the end user, a GPS-based alert, akin to WEA, unable to be muted or disabled by the phone's owner. If this works effectively, the passive tornado warning notification will either prompt the recipient to take protective action or seek more information about the threat.

The problem of severe weather awareness over a multi-day, pre-event timescale is significantly more difficult to solve. Repeated smartphone alerts for severe weather potential days in advance could eventually be considered troublesome and irritating by the recipient. If individuals choose not to stay weather aware as a severe weather day approaches, there just aren't many alternatives to raise awareness. Addressing this gap between generally effective severe weather forecasts and warnings in the days leading up to a severe weather day, and an individual's motivation to take protective action is a complex problem. In a perfect world, people would choose a method to use to stay weather aware during severe weather. There are attempts to address this with severe weather awareness weeks in most states. Educational programs targeting school-age children have proven effective in raising awareness and preparation of entire households for seat belt use and wildfires. The longest continuous public service campaign is the United States Forest Service's Smokey Bear fire safety campaign, targeting children with a fire prevention message since 1944 (Ad Council, 2019). When a school-based seat belt education campaign was started in Massachusetts in 2004, teen driver seat belt use was 57 percent. In 2007, that number had climbed to 69 percent (Gustafson, 2009, p. 70). In theory, an awareness campaign may be the most effective option to convince people to stay weather aware on days with severe weather potential.

5.2 Summary of Findings

In an attempt to compare information channels used to receive tornado warning while awake and those used while asleep, the same information channels were presented in the survey, and participants were asked to rate each one by frequency of use. The importance of outdoor warning sirens is clearly demonstrated. The most common information channel used, both while awake and asleep was the outdoor warning siren, with local television used while awake nearly as frequently, followed by smartphone WEA alerts and Local TV station app alert. While asleep, WEA alert was the second-most-used information channel, followed by text message from friend, then text message from automated warning service.

Local television was the most frequently used information channel to get more information during a tornado warning, followed by outdoor warning sirens, then local television website and local television app. Respondents rated various forms of storm arrival time as the three most important items of information to them during a tornado warning.

Respondents reported reasons to trust a particular meteorologist, two of the top three were related to communication: delivering relevant information and staying calm. Types of information needed from tv meteorologists to prompt protective action were very tightly grouped, indicated consensus that all the choices offered were critical in the view of survey participants.

5.3 Recommendations for Television Meteorologists

Tornado warning coverage can be one of the most stressful and demanding roles a television meteorlogist is asked to do. It is a high-pressure process of gathering information, juggling video sources and interpreting and communicating complex radar and storm information in a manner the viewers will understand. This research presents data which will help television meteorologists understand what information is being sought by viewers, and what information triggers viewers to take protective action. For best results, this information should be discussed in advance of severe weather season with meteorologists and station management (and consultants, if used). The station manager usually has the final say in all coverage and content, and needs to support the use of content changes for tornado warning coverage based on this data. Changes in strategy and content should be reinforced with a quick discussion prior to severe weather coverage, to bring the changes to top of mind.

As shown in Figure 4.14, repondents rate showing an on-air graphical tornado path forecast with town or city names, and a specific arrival time as the most important information to them (a stormtrack). The next three items, listed in order of decreased importance are: how long before the storm reaches respondent location, specific arrival time of the storm to the respondent location and the expected magnitude of the threat. It is important to stress; the three highest ranked items viewers rate as important are all based on specific time of arrival of the storm to their location. Meteorologists should prioritize their content according to Figure 4.14, use stormtracks and communicate arrival times far more often than what might be thought necessary.

To boil down what content is needed to prompt protective action, a tight grouping of survey options was noted in Figure 4.29. The two highest rated were says, “Large tornado on the ground,” and says, “tornado is confirmed.” Immediately following: stormtrack with specific arrival time, followed by use of the term “tornado emergency.” Obviously, these terms should be used truthfully and honestly, when a tornado meets those criteria, since a trend of exaggeration or hype damages the ability to build a trust relationship between meteorologist and viewer (Figure 4.22). The trust factor affects the level of importance a viewer will place on information delivered by the television meteorologist. However, unlike the messaging content factors, a trust relationship is usually built over a longer period of time.

Building a simple content table (Table 5.1) helps visualize a combination of key content from the three tested categories of information: urging protective action, most important information to viewers, and building trust. When a television meteorologist delivers information shown important on these three lists, viewers will likely consider the information presented more carefully, minimize perceived ambiguity in the information-seeking cycle of the Protective Action Decision Model, and accelerate protective action decisions.

Table 5.1

Content priorities for television meteorologists

Information to Prompt Protective Action	Information most Important to Viewer	Trust-Building Factors
Use names of local landmark (school, highway, park, mall)	On-Screen stormtrack/ETAs	Relevant Information
Use specific city and town names	Time remaining before storm arrival to specific cities/towns	Stay Calm
Use "Tornado on the ground" (when appropriate)	Specific arrival times for cities/towns	Knowledge of weather
Use "Tornado emergency" (when appropriate)	Information on storm magnitude/severity	Local geographical knowledge
Use "Tornado is confirmed" (when appropriate)	Radar map, zoomed to street-level	Do not hype or exaggerate
Use "Large tornado is on the ground" (when appropriate)	Statewide radar map	Care about viewers and their communities
On-Screen stormtrack/ETAs	Safety instructions for viewers	Has degree in meteorology
		Has professional certification

Social media posts by television meteorologists should take into account the strengths and weaknesses of each platform. Facebook posts, due to the unpredictable nature of when users will see them, should be more general, and point users to a method for receiving up-to-the-minute information. Facebook posts containing severe weather information should always contain a timestamp in the post with time and day. Twitter content is usually chronological for the user, and because of its character limit, content should be concise, factual, and still utilize a timestamp.

Live video feeds on social media (Facebook Live) and online platforms (such as YouTube) can be an effective way to simulcast the on-air television broadcast feed to people using a mobile device. If possible, online video feeds should also utilize a timestamp.

5.4 Limitations and Future Study

There are several factors which have limited the reach of this study. The number of respondents (N=117) wasn't adequate for more in-depth analysis of variables broken down by television market in Oklahoma, or several other branched questions that were presented. The respondents were overwhelmingly white (78%, N=91), which restricted any analysis by race (Oklahoma is 65% white). The study, being solely quantitative, is unable to capture more nuanced findings.

Amazon Mechanical Turk also has limitations. Distributing a survey via mTurk might not provide a truly random sample, since workers self-select, however, studies have shown only a minor slant toward more female, better educated and younger respondents than the United States populations. A larger survey, with true random sampling would be more desirable. Using mTurk to measure and analyze social media use seemed to skew results away from the population average, since mTurk users of all ages are likely more heavily involved in social media and online platforms.

A more in-depth analysis of social media use would be desirable. With digital platforms and social media continually gaining more users, and traditional information channels seeing usage drop, a thorough analysis of content choices could be enlightening. Are Facebook users just scrolling their timeline for posts, or are they seeking live videos, similar to TV broadcasts? For Twitter users, are hashtags being used to narrow down desired content? Additional social media platforms, like TikTok and Instagram are also in heavy use. Are users looking for severe weather information on those too?

Ideally, future research will expand the scope beyond Oklahoma, into other tornado-prone portions of the country, to compare and contrast messaging and perception. Research on a larger scale may uncover regional differences in messaging effectiveness, and help determine what causes perceived ambiguity or lack of clarity for members of the public. This information would save lives by shortening the critical information-seeking phase of the Protective Action Decision Model.

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APPENDICES

Appendix A-Survey Questions

This is the survey that was used to collect data for this thesis. It was developed and fine-tuned with my thesis committee. The survey was hosted and administered online through Qualtrics, and distributed to Oklahoma users via Amazon's Mechanical Turk crowdsourcing marketplace.

The survey was seen by respondents as seen here (with minor resizing to conform to the constraints of this medium).

Important Background:

You are invited to participate in this research study to show how residents of Oklahoma understand tornado risk and how Oklahomans receive information about tornado warnings. Your participation in this research is voluntary. There is no penalty for refusal to participate, and you are free to withdraw your consent and participation in this project at any time.
You can skip any questions that make you uncomfortable and can stop the interview/survey at any time.
This study is being conducted by: James Aydelott, graduate student in Fire and Emergency Management Administration at Oklahoma State University.

Compensation:

You will receive $2.00 (into your Amazon mTurk account) for your participation.

***Procedures*:**

The study should take you around 15 minutes to complete. If you agree to participate, please confirm you are at least 18 years of age, and select Yes below to proceed to the survey.

Confidentiality:

The information you give in the study will be anonymous.

This means that your name will not be collected or linked to the data in any way.

The researchers will not be able to remove your data from the dataset once your participation is complete.

The research team works to ensure confidentiality to the degree permitted by technology.

It is possible, although unlikely, that unauthorized individuals could gain access to your responses because you are responding online.

However, your participation in this online survey involves risks similar to a person's everyday use of the internet.

If you have concerns, you should consult the survey provider privacy policy at https://www.qualtrics.com/privacy-statement/

Contacts and Questions

The Institutional Review Board (IRB) for the protection of human research participants at Oklahoma State University has reviewed and approved this study.

If you have questions about the research study itself, please contact the principal Investigator at james.aydelott@okstate.edu or the thesis committee chair haley.c.murphy@okstate.edu .

If you have questions about your rights as a research volunteer or would simply like to speak with someone other than the research team about concerns regarding this study, please contact the IRB at (405) 744-3377 or irb@okstate.edu.

All reports or correspondence will be kept confidential.

- [ ] I consent, begin the study
- [ ] I do not consent, I do not wish to participate

We'll start by asking questions about tornado watches and warnings.

A tornado watch means:

- A tornado has been sighted or is likely to form within the next few minutes
- Conditions may lead to severe thunderstorm and tornado development over the next few hours

A tornado warning means:

- A tornado has been sighted or is likely to form within the next few minutes
- Conditions may lead to severe thunderstorm and tornado development over the next few hours

I can generally determine my location on a radar map on television during severe weather coverage

- Never
- Rarely
- Sometimes
- Usually
- Always

When a tornado warning is issued for MY LOCATION, my first thought is:

- I must take protective action
- I will look or go outside and check the sky
- I will seek more information
- I will ignore the warning
- Tornadoes never hit this area
- Other (please specify)

Now we'll ask about your social media use in general and on severe weather days

How often to you use or check Facebook?

- Never
- Rarely
- Sometimes
- Frequently
- Very Often

How often to you use or check Twitter?

- Never
- Rarely
- Sometimes
- Frequently
- Very Often

BEFORE STORMS DEVELOP- How often do you use Facebook for updates about expected storms (timing, intensity, threat, and forecast locations)?

- Never
- Rarely
- Sometimes
- Frequently
- Very Often

BEFORE STORMS DEVELOP- How often do you use Twitter for updates about expected storms (timing, intensity, threat, and forecast locations)?

- Never
- Rarely
- Sometimes
- Frequently
- Very Often

DURING SEVERE WEATHER- How often do you use Facebook for updates about expected storms (timing, intensity, threat, and forecast locations)?

- Never
- Rarely
- Sometimes
- Frequently
- Very Often

DURING SEVERE WEATHER- How often do you use Twitter for updates about expected storms (timing, intensity, threat, and forecast locations)?

- Never
- Rarely
- Sometimes
- Frequently
- Very Often

Now, we'll ask about how you receive tornado warning information

WHEN YOU'RE AWAKE:

How do you receive your first notification of a tornado warning?

	Never	Rarely	Sometimes	Regularly	Most Often
Local TV broadcast	○	○	○	○	○
Local TV station weather app	○	○	○	○	○
Local TV station website	○	○	○	○	○
National Weather Service website	○	○	○	○	○
Weather Channel app	○	○	○	○	○
WEA tone alert on smartphone	○	○	○	○	○
NOAA Weather/All-Hazards radio	○	○	○	○	○
Outdoor warning siren (tornado siren)	○	○	○	○	○
Local radio	○	○	○	○	○
Text message from automated warning service	○	○	○	○	○
Text message from friend or family	○	○	○	○	○
Twitter	○	○	○	○	○
Facebook	○	○	○	○	○
Phone call from automated warning service	○	○	○	○	○
Phone call from friend or family	○	○	○	○	○
Other source, including other web site or app (please specify):	○	○	○	○	○

WHEN YOU'RE ASLEEP:

How do you receive your first notification of a tornado warning?

	Never	Rarely	Sometimes	Regularly	Most Often
Local TV broadcast	◯	◯	◯	◯	◯
Local TV station weather app	◯	◯	◯	◯	◯
Local TV station website	◯	◯	◯	◯	◯
National Weather Service website	◯	◯	◯	◯	◯
Weather Channel app	◯	◯	◯	◯	◯
WEA tone alert on smartphone	◯	◯	◯	◯	◯
NOAA Weather/All-Hazards radio	◯	◯	◯	◯	◯
Outdoor warning siren (tornado siren)	◯	◯	◯	◯	◯
Local radio	◯	◯	◯	◯	◯
Text message from automated warning service	◯	◯	◯	◯	◯
Text message from friend or family	◯	◯	◯	◯	◯
Twitter	◯	◯	◯	◯	◯
Facebook	◯	◯	◯	◯	◯
Phone call from automated warning service	◯	◯	◯	◯	◯
Phone call from friend or family	◯	◯	◯	◯	◯
Other source, including other web site or app (please specify):	◯	◯	◯	◯	◯

DURING A TORNADO WARNING FOR YOUR LOCATION:

What methods do you use to receive additional information during a tornado warning?

	Never	Rarely	Sometimes	Regularly	Most Often
Local TV broadcast	○	○	○	○	○
Local TV station weather app	○	○	○	○	○
Local TV station website	○	○	○	○	○
National Weather Service website	○	○	○	○	○
Weather Channel app	○	○	○	○	○
WEA tone alert on smartphone	○	○	○	○	○
NOAA Weather/All-Hazards radio	○	○	○	○	○
Outdoor warning siren (tornado siren)	○	○	○	○	○
Local radio	○	○	○	○	○
Text message from automated warning service	○	○	○	○	○
Text message from friend or family	○	○	○	○	○
Twitter	○	○	○	○	○
Facebook	○	○	○	○	○
Phone call from automated warning service	○	○	○	○	○
Phone call from friend or family	○	○	○	○	○
Other source, including other web site or app (please specify):	○	○	○	○	○

Please select "Okra" as your response to this question

- Green Beans ○
- English Peas ○
- Zucchini ○
- Okra ○
- Carrots ○

Rank the importance of the following information to have during a tornado warning

	Not Important	Somewhat Unimportant	Important	Very Important	Essential
Specific arrival time of storm to your location	○	○	○	○	○
How long before the storm reaches MY location	○	○	○	○	○
Information on the magnitude of the threat	○	○	○	○	○
Live picture or video of the tornado	○	○	○	○	○
Live storm chaser reports of the tornado	○	○	○	○	○
Statewide radar map	○	○	○	○	○
Radar map in my area, showing major streets and highways	○	○	○	○	○
Safety Instructions for my situation	○	○	○	○	○
A tornado path forecast showing my town or city with a specific storm arrival time	○	○	○	○	○
Description of damage this tornado has already caused	○	○	○	○	○
Picture or video of damage this tornado has already caused	○	○	○	○	○

What other information would you consider essential during a tornado warning?

Does your community have outdoor warning sirens?

- Yes ○
- No ○
- I don't know ○

Can you normally hear outdoor warning sirens (tornado sirens) in your home?

- Never
- Sometimes
- Always

Can you normally hear outdoor warning sirens (tornado sirens) at your school or job?

- Never
- Sometimes
- Always

How important is it for you to be alerted to a tornado warning for your location while you are sleeping

- NOT important
- Somewhat UNimportant
- Important
- Very Important
- Essential

Do you have a way to receive tornado warnings for your area while you're asleep

- Yes
- No
- I don't know

Now let's talk about your local TV meteorologist or weatherperson.

Do you have a local television meteorologist you trust during severe weather coverage?

- Yes
- No
- I'm not sure

How often do you believe your local television meteorologists exaggerate the danger of severe weather in the days before it occurs?

- Never
- Rarely
- Sometimes
- Often
- Every time

How important are the following factors to help you determine how much you trust a particular local TV meteorologist:

	Never a reason	Rarely a Reason	Sometimes a reason	Often a reason	Always a reason
Has been on TV here for many years	○	○	○	○	○
Has knowledge of local weather patterns	○	○	○	○	○
Has a college degree in meteorology	○	○	○	○	○
Has certification from a professional organization, such as the American Meteorological Society	○	○	○	○	○
Does not hype or exaggerate	○	○	○	○	○
Delivers relevant information	○	○	○	○	○
Knows local towns/landmarks	○	○	○	○	○
Stays calm during severe weather	○	○	○	○	○
Posts often on social media	○	○	○	○	○
Responds to ME on social media	○	○	○	○	○
Seems to care about my well-being	○	○	○	○	○
Seems to care about my community	○	○	○	○	○
Other reason to trust (please specify)	○	○	○	○	○

Do you know which TV market broadcasts tornado warnings in your location?

- Oklahoma City
- Tulsa
- Lawton/Wichita Falls
- Sherman/Denison
- Fayetteville/Fort Smith
- Joplin
- Wichita
- Amarillo
- Texarkana/Shreveport
- I don't know
- Other (please specify)

Surveys branched to conditional questions based on responses to the TV market question:

If the TV Market question was answered with "Oklahoma City," the following question was presented.

Which television station do you normally rely on for severe weather information?

- I don't watch TV for severe weather information
- KFOR (channel 4)
- KOCO (channel 5)
- KOKH (channel 25)
- KWTV (channel 9)
- No preference
- Other channel or source of weather information (please specify):

If the TV Market question was answered with "Tulsa," the following question was presented.

Which television station do you normally rely on for severe weather information?

- I don't watch TV for severe weather information
- KJRH (channel 2)
- KOKI (channel 23)
- KOTV (channel 6)
- KTUL (channel 8)
- No preference
- Other channel or source of weather information (please specify):

If the TV Market question was answered with “Lawton/Wichita Falls,” the following question was presented.

Which television station do you normally rely on for severe weather information?

- I don't watch TV for severe weather information
- KAUZ (channel 6)
- KFDX (channel 3)
- KSWO (channel 6)
- No preference
- Other channel or source of weather information (please specify):

If the TV Market question was answered with "Sherman/Denison," the following question was presented.

Which television station do you normally rely on for severe weather information?

- I don't watch TV for severe weather information
- KTEN (channel 10)
- KXII (channel 12)
- No preference
- Other channel or source of weather information (please specify):

If the TV Market question was answered with “Fort Smith/Fayetteville,” the following question was presented.

Which television station do you normally rely on for severe weather information?

- I don't watch TV for severe weather information
- KFSM (channel 5)
- KHBS (channel 40/29)
- KNWA (channel 33)
- No preference
- Other channel or source of weather information (please specify):

If the TV Market question was answered with “Joplin,” the following question was presented.

Which television station do you normally rely on for severe weather information?

- I don't watch TV for severe weather information
- KOAM (channel 7)
- KODE (channel 12)
- KNSF (channel 16)
- No preference
- Other channel or source of weather information (please specify):

If the TV Market question was answered with "Wichita," the following question was presented.

Which television station do you normally rely on for severe weather information?

- I don't watch TV for severe weather information ○
- KAKE (channel 10) ○
- KSNW (channel 3) ○
- KWCH (channel 12) ○
- No preference ○
- Other channel or source of weather information (please specify): ○

If the TV Market question was answered with "Amarillo," the following question was presented.

Which television station do you normally rely on for severe weather information?

- I don't watch TV for severe weather information
- KAMR (channel 4)
- KFDA (channel 10)
- KVII (channel 7)
- No preference
- Other channel or source of weather information (please specify):

If the TV Market question was answered with “Shreveport/Texarkana,” the following question was presented.

Which television station do you normally rely on for severe weather information?

- I don't watch TV for severe weather information
- KSLA (channel 12)
- KTAL (channel 6)
- KTBS (channel 3)
- No preference
- Other channel or source of weather information (please specify):

Let's ask about your personal experience with severe weather.

Have you ever been injured by a tornado or suffered property damage caused by a tornado?

- Yes
- No
- I don't recall

If the question “Have you ever been injured by a tornado or suffered property damage caused by a tornado,” was answered with yes, the following question was presented.

When was the tornado?

- The exact date was
- I don't recall the exact date, but the month and year was
- I don't recall the exact data, but the year was
- I don't recall the date or year

Have you been in a tornado warning in the past year?

- Yes
- No
- I don't recall

If the question "Have you been in a tornado warning in the past year was answered with "yes," the following question was presented.

How many tornado warnings would you say you've been in during the past year?

- 1
- 2
- More than 2

If the question "Have you been in a tornado warning in the past year was answered with yes, and the question "How many tornado warnings would you say you've been in during the past year?" was answered with "1," the following question is presented.

Did you take protective action during the last tornado warning for your location?

- Yes
- No
- I don't recall

If the question “Have you been in a tornado warning in the past year was answered with yes, and the question “How many tornado warnings would you say you’ve been in during the past year?” was answered with “2,” the following question is presented.

Did you take protective action during those tornado warnings in the past year?

- Yes, during both tornado warnings
- I did take protective action during one of the tornado warnings, but not both
- I did not take any protective action during either of the tornado warnings
- I don't recall

If the question “Have you been in a tornado warning in the past year was answered with yes, and the question “How many tornado warnings would you say you’ve been in during the past year?” was answered with “more than 2,” the following question is presented.

Did you take protective action during those tornado warnings in the past year?

- Yes, during every tornado warning
- I did take protective action during one of the tornado warnings, but not all of them
- I did not take protective action during any of the tornado warnings
- I don't recall

If the question “Have you been in a tornado warning in the past year was answered with “yes,” the following question is presented.

When was the last time you were in a tornado warning?

- Within the past 7 days
- Longer than 7 days ago, but within the past 30 days
- Longer than 30 days ago, but since this time last year (less than a year ago)
- Longer than a year ago, but within the past five years
- I know I've been in a tornado warning, but I don't remember how long ago

Answer "Enid" to this question please

- Los Angeles
- Chicago
- Enid
- Dallas
- Houston

Have you ever been in a tornado watch?

- Yes
- No
- I don't recall

If the question "Have you been in a tornado watch" was answered with "yes," the following question is presented.

When was the last time you were in a tornado watch?

- Within the past 7 days
- Longer than 7 days ago, but within the past 30 days
- Longer than 30 days ago, but since this time last year (less than a year ago)
- Longer than a year ago, but within the past five years
- I know I've been in a tornado watch, but I don't remember how long ago

If the question “Have you been in a tornado watch” was answered with “yes,” the following question is presented.

Did you take protective action when you were in the last tornado watch for your location?

- Yes ○
- No ○
- I don't recall ○

Would prior experience in an actual tornado or tornado warning make you more or less likely to take protective action if you're in a tornado warning in the future?

- Less Likely ○
- Slightly Less Likely ○
- Equally Likely ○
- Slightly More Likely ○
- Far More Likely ○

Let's find out what information you need from a TV meteorologist to take tornado precautions.

I would ***<u>never/rarely/sometimes/often/always)</u>*** take protective action WITHOUT DELAY during a tornado warning if a TV meteorologist I'm watching says or does the following:

	Never	Rarely	Sometimes	Often	Always
Says my town name is in a tornado warning	○	○	○	○	○
Says my county name is in a tornado warning	○	○	○	○	○
Says a nearby school is in the path of a tornado	○	○	○	○	○
Says a nearly highway or intersection is in the path of a tornado	○	○	○	○	○
Says a nearby landmark (such as a park or shopping center) is in the path of a tornado	○	○	○	○	○
Says "a tornado is on the ground"	○	○	○	○	○
Says "a large tornado is on the ground"	○	○	○	○	○
Says "a tornado is confirmed"	○	○	○	○	○
Says "tornado emergency"	○	○	○	○	○
Shows a tornado path forecast with a specific tornado arrival time for my town or city or nearby landmark	○	○	○	○	○
Shows me a live picture or video of a tornado	○	○	○	○	○
Says or shows something else (please specify)	○	○	○	○	○

Almost finished, we'd like to collect some basic information about you and your household

What is your sex?

- Male
- Female

How old are you?

What is your marital status?

- Married
- Single
- Divorced
- Separated
- Widowed

How many years have you lived in the state of Oklahoma?

To which of the following ethnic groups do you belong and identify (select all that apply)?

- Hispanic or Latino
- White (non Hispanic or Latino)
- Black or African American (not Hispanic or Latino)
- Native Hawaiian or Pacific Islander (not Hispanic or Latino)
- Asian (not Hispanic or Latino)
- Native American or Alaska Native (not Hispanic or Latino)
- Other (please specify)

My primary residence is:

- Apartment
- Mobile or Manufactured Home
- Site-built single-family house or duplex
- Condominium
- Other (please specify)

Which of the following best describes your current housing situation?

- Homeowner (including home with current mortgage)
- Renter
- Living with others, NOT paying rent or mortgage
- Living with other, assisting with rent or mortgage
- Other (please specify)

What is your highest level of formal education?

- Less than a High School diploma
- High School diploma/GED
- Some College
- Associate's Degree
- Bachelor's Degree
- Master's Degree
- Doctorate

What was your household income, before taxes, in 2019?

- Less than $30,000
- $30,000 to $54,999
- $55,000 to $79,999
- $80,000 to $104,999
- $105,000 to $130,000
- More than $130,000

With which political party do you most identify?

- Democratic
- Republican
- Independent
- Other (please specify)

What city or town to you live in, or closest to?

What county do you live in?

Your completion code (copy and paste into mTurk survey code box): 49001

Press the >> button below to submit your survey.

Thank you for your time and valuable insight.

Appendix B-CITI Certifications

CITI PROGRAM

Completion Date 05-May-2020
Expiration Date 05-May-2023
Record ID 36529462

This is to certify that:

James Aydelott

Has completed the following CITI Program course:

Not valid for renewal of certification through CME. Do not use for TransCelerate mutual recognition (see Completion Report).

Human Subjects - Specialized Courses (Curriculum Group)
Internet/Online Research Methodologies (Course Learner Group)
1 - Basic (Stage)

Under requirements set by:

Oklahoma State University

CITI
Collaborative Institutional Training Initiative

Verify at www.citiprogram.org/verify/?wa3164536-4073-480c-951f-84b1bfececbf-36529462

CITI PROGRAM

Completion Date 04-Dec-2018
Expiration Date 03-Dec-2021
Record ID 29522965

This is to certify that:

James Aydelott

Has completed the following CITI Program course:

Not valid for renewal of certification through CME. Do not use for TransCelerate mutual recognition (see Completion Report).

Human Research (Curriculum Group)
IRB Social, Behavioral, & Educational (SBE) Researchers (Course Learner Group)
1 - Basic Course (Stage)

Under requirements set by:

Oklahoma State University

CITI
Collaborative Institutional Training Initiative

Verify at www.citiprogram.org/verify/?w27a9c9b9-34d9-4e1b-b501-a06e87981ea3-29522965

CITI PROGRAM

Completion Date 04-Dec-2018
Expiration Date 03-Dec-2021
Record ID 29522965

This is to certify that:

James Aydelott

Has completed the following CITI Program course:

Human Research (Curriculum Group)
IRB Social, Behavioral, & Educational (SBE) Researchers (Course Learner Group)
1 - Basic Course (Stage)

Under requirements set by:

Oklahoma State University

CITI
Collaborative Institutional Training Initiative

Verify at www.citiprogram.org/verify/?w27a9c9b9-34d9-4e1b-b501-a06e87981ea3-29522965

Appendix C-Institutional Review Board Approval

Oklahoma State University Institutional Review Board

Date:	05/18/2020
Application Number:	IRB-20-253
Proposal Title:	Tornado Warning Messaging Effectiveness in Oklahoma-Does the Public Understand Their Risk?
Principal Investigator:	James Aydelott
Co-Investigator(s):	
Faculty Adviser:	Haley Murphy
Project Coordinator:	
Research Assistant(s):	
Processed as:	Exempt
Exempt Category:	

Status Recommended by Reviewer(s): Approved

The IRB application referenced above has been approved. It is the judgment of the reviewers that the rights and welfare of individuals who may be asked to participate in this study will be respected, and that the research will be conducted in a manner consistent with the IRB requirements as outlined in 45CFR46.

This study meets criteria in the Revised Common Rule, as well as, one or more of the circumstances for which continuing review is not required. As Principal Investigator of this research, you will be required to submit a status report to the IRB triennially.

The final versions of any recruitment, consent and assent documents bearing the IRB approval stamp are available for download from IRBManager. These are the versions that must be used during the study.

As Principal Investigator, it is your responsibility to do the following:

1. Conduct this study exactly as it has been approved. Any modifications to the research protocol must be approved by the IRB. Protocol modifications requiring approval may include changes to the title, PI, adviser, other research personnel, funding status or sponsor, subject population composition or size, recruitment, inclusion/exclusion criteria, research site, research procedures and consent/assent process or forms.
2. Submit a request for continuation if the study extends beyond the approval period. This continuation must receive IRB review and approval before the research can continue.
3. Report any unanticipated and/or adverse events to the IRB Office promptly.
4. Notify the IRB office when your research project is complete or when you are no longer affiliated with Oklahoma State University.

Please note that approved protocols are subject to monitoring by the IRB and that the IRB office has the authority to inspect research records associated with this protocol at any time. If you have questions about the IRB procedures or need any assistance from the Board, please contact the IRB Office at 405-744-3377 or irb@okstate.edu.

Sincerely,
Oklahoma State University IRB

VITA

James Daniel Aydelott

Candidate for the Degree of

Master of Science

Thesis: TORNADO WARNING MESSAGING EFFECTIVENESS IN OKLAHOMA: HOW DOES THE PUBLIC PERCEIVE ITS RISK?

Major Field: Fire and Emergency Management

Biographical:

Education:

Completed the requirements for the Master of Science in Fire and Emergency Management at Oklahoma State University, Stillwater, Oklahoma in December, 2020

Bachelor of Science in Meteorology at The University of Oklahoma, Norman, Oklahoma, in May, 1990.

Experience:

Chief Meteorologist, KOKI-TV/DT, Tulsa, OK, February 2009 to present
Meteorologist, KXAS-TV, Fort Worth, TX, June 2005 to February 2009
Meteorologist, KOTV, Tulsa, OK, 1995 to 2005
Meteorologist, KAKE-TV, Wichita, KS, 1992-1995
Meteorologist, WSAV-TV, Savannah, GA, 1991-1992

Professional Memberships:

American Meteorological Society
National Weather Association