# A SOCIAL PERSPECTIVE OF WARN ON FORECAST: IDEAL TORNADO WARNING LEAD TIME AND THE GENERAL PUBLIC'S PERCEPTIONS OF WEATHER RISKS

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**ABSTRACT:**

In this study, 136 National Weather Center visitors were surveyed to assess their understanding and perception of weather risks. The majority of the respondents performed well overall. They seemed to be familiar with tornado seasons, however, they were not aware of the relative number of fatalities caused by several weather phenomenon each year in the United States. This study also aimed to pinpoint the ideal tornado warning lead-time for the general public, which was found to be 33.5 minutes. This justifies the fact that a longer lead-time of 1-2 hours, of which the possible future tornado prediction paradigm called warn on forecast could provide, would not be necessary for the general public. In fact, when asked what they would do if given a one-hour lead-time, respondents reported that taking shelter was a lesser priority than if given a 15-minute lead-time, and fleeing the area became a popular alternative. The majority also reported the situation would feel less life threatening if given a one-hour lead-time. Responses were analyzed according to several difference parameters, including age, region of residency, and educational level, however no significant conclusions can be drawn when evaluating how these variables can change the public's perceptions of weather risks or their preferred ideal lead-time. Thus, the results of this study are informative to future studies, which evaluate the true impact of warn on forecast on the public, since the social perspective of a longer lead-time is often overlooked and under-researched.

## 1. INTRODUCTION

Determining how the public perceives severe weather events is an essential aspect in maximizing tornado safety. A tornado warning is not effective if the public does not respond to it by taking the appropriate action. Many factors could play a significant role in molding how an individual responds to a tornado warning. Some of these factors include level of education, sex, ethnicity, age, prior tornado experience, and number of children (Riad, 1999; Balluz, 2000; and Sorensen, 2000). An individual's response to weather warnings is controlled in part by how dangerous they perceive an event to be. For example, someone who believes an event to be of little risk to them personally might take less immediate action compared to someone who feels an event to be life threatening. According to Breakwell (2007), "risk refers to the likelihood of some specific negative event as a result of an exposure to a hazard." Previous research conducted in Hong Kong on weather warnings showed that most individuals were not prepared for severe weather events and were not aware of warning signs when a warning was issued in their town. In fact, only 31% of the respondents stated that they would take precautions at the issuance of a weather event warning, and while the majority of respondents claimed they were aware of weather signals, most only had a basic understanding of what they actually meant (Wong, 2002). Clearly, the participants in this study either did not feel like

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severe weather events posed that much of a personal risk, or they simply accepted the risk and chose not to act.

Tornado prediction capabilities have advanced significantly over the past few decades. For example, in 1978 there was a 22% probability of tornado detection with a 3-minute tornado warning lead-time. Twenty years later, in 1998 there was a 65% probability of tornado detection with a 13-minute lead-time (Golden, 2000). Currently, tornadoes are warned based upon a "warn on detection" method, meaning tornadoes are warned based upon observed (not predicted) weather information (Erickson and Brooks 2006). However, the National Weather Service (NWS) is currently considering adding "warn on forecast," which would extend tornado warning times to as much as one to two hours based upon weather prediction data. This new method of early tornado prediction is possible by using convection-resolving models, which assimilate Doppler radar data into mesoscale numerical models that operate at the convective scale of resolution in time and space. This allows for a more reliable means of providing improved predictions of thunderstorms and their associated severe weather to the public. The National Oceanic and Atmospheric Administration (NOAA) expects this new technology to be available by the year 2020 (Stensrud et al 2009). Although the science behind this new technology of early tornado forecasting is underway and rapidly advancing, the social science perspective of understanding for a longer lead-time has made much less progress. Meteorologists and social scientists do not have a clear understanding of how the general public will respond to an increased tornado lead-time.

In general terms, the public thinks they know more about weather risks than they actually do (Wong, 2002). Thus it's important for meteorologists and forecasters to know exactly how much the general public knows so they can issue warnings in the most effective and appropriate manner. Knowing the ideal lead-time also will help NWS forecasters issue weather warnings at the most appropriate time. One particular study found that the ideal tornado warning lead-time was no more than 30 minutes. However, this study focused solely on administrators of schools and elderly homes, and did not attain any new information regarding the *general public*. Another study was an empirical investigation of tornado casualties that showed that a lead-time of about 15 minutes was the optimal warning time, resulting in fewer fatalities compared to a lead-time of more than 15 minutes (Simmons, 2008). Thus, the limited research done on tornado warning lead-times questions whether such an extended lead-time would be necessarily advantageous for the general public. In fact, a longer lead-time may create new problems. (Ewald, 2002 and Doswell, 1999).

This study investigates the amount of time that the general public feels is the most ideal tornado warning lead-time. It also assesses how accurately the public perceives weather risks, particularly *tornado* weather risks. In essence, this study will evaluate the benefits and limitations of the possible future paradigm, warn on forecast, by seeing if the target lead-time of one to two hours is necessary for the public to seek shelter.

## 2. METHODOLOGY

### *2.1 Survey Instrument*

The survey used for this research project was 34 questions long and comprised of two parts, each addressing a separate research question: 1.) How accurate are the general public's perceptions of weather risks? 2.) What is the ideal tornado warning lead-time for the general public? Both parts were categorized into several specific subsections. In the first part, the public's knowledge of general weather risks was tested by asking them to choose the correct response for fatality rates of five severe weather events (hurricanes, flooding, heat, tornadoes, & thunderstorms). The focus then shifted to assess the public's knowledge of tornado risks. From there, respondents answered true/false questions pertaining to common tornado myths.

The second part of the survey looked at tornado warning lead-times. Respondents were asked to write down the number of minutes they felt is appropriate for a tornado warning to be issued for three different situations: the absolute minimum time required to get to shelter, the time needed to get necessary belongings *and* get to shelter, and lastly, the *desired* tornado warning lead-time. The survey ended with a question asking the public if there can actually be *too much* lead-time. The demographic component of the survey included such questions as number of children, their prior tornado experience, and if they had a designated tornado shelter. See *Appendix A* for a complete list of demographics included & the relative distribution.

### *2.2 Survey Population & Distribution Methods*

The survey was administered to visitors touring the National Weather Center in Norman, Oklahoma. It was taken by 136 people at the start of their tour of the building. Tours usually lasted about an hour and were given one time per day, three to five times a week. The average tour group size was 15. Minors (those under age 18) were not allowed to take the survey.

This population sample included a broader demographic than in other studies (Ewald, 2002). The participants represented all age groups over 18 years with a wide range of education levels and residing in 19 different states. They came from many different professional backgrounds, and were not a part of a specific institution as in previous research (Ewald, 2002). One main limitation of this study is that the results may be biased given that the survey was taken by people who may have some interest or knowledge of weather since they are taking a tour of the National Weather Center. Sampling other groups would need to be done in order to determine if having an interest or prior knowledge of weather actually skews these results.

### *2.3 Data Analysis and Quality Control*

Simple descriptive statistics were used to analyze the data. Linear regressions, confidence intervals, and common statistical techniques such as averages and medians were applied in order to analyze the data.

Though every survey was attempted, a handful of them were incomplete. The sample size therefore changed from question to question, depending on which questions were skipped. The free response questions addressing the public's actions and behaviors when given a 15-minute verse 1-hour lead-time were the questions left blank the most often (~16% of sample did not respond).

Another set of questions may have been misinterpreted by some participants. When asked what the minimum tornado warning lead-time to take shelter, or the minimum lead-time to gather any necessary belongs and take shelter, approximately 17% of the sample reported a higher lead-time on the former question than the latter. Therefore, for the results for this section to be entirely accurate, these several questions may need to be reworded to become clearer and then repeated with another sample population.

## 3. RESULTS

### *3.1 Demographics*

The survey was completed by 136 visitors to the National Weather Center. The demographic section of the survey included several components: sex, age, ethnicity, state of residence, highest education level, number of children, and prior tornado experience. It also asked each respondent if they had an action plan if a tornado were to strike, as well as if they had a designated tornado shelter (see *Appendix A* for a complete distribution of the demographics). It is important to note that of the 89 people who stated that they have a tornado action plan, only 79 of them said that they have a designated tornado shelter, meaning that ten people did not include having a secure shelter as part of their tornado action plan (Fig. 1).

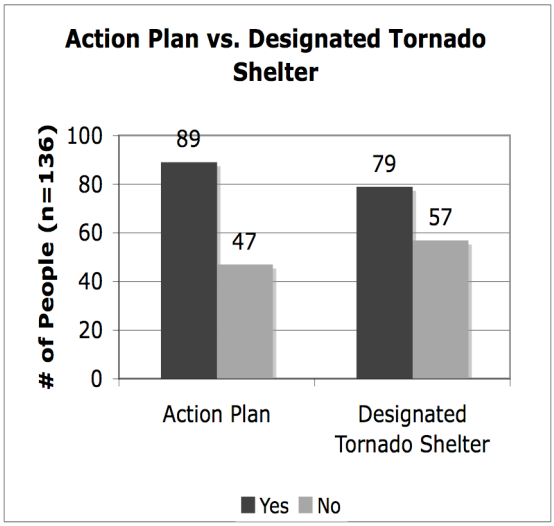


*Figure 1: Number of respondents who answered Yes/No to having a tornado action plan and a designated tornado shelter.*

### *3.2 General Weather Risk Perceptions*

The first section of the survey focused on the public's perceptions of fatality rates for five different severe weather categories: tornadoes, lightning, flooding, heat, and hurricanes. Each respondent was asked to choose the correct response for the average annual U.S. fatality rate caused by each of the five events (Fig. 2-Fig. 6**)**. The accuracy of the public's responses was based upon fatality and hazard information provided by the NWS. The true weather fatality values are according to a 10-year average from 1998 to

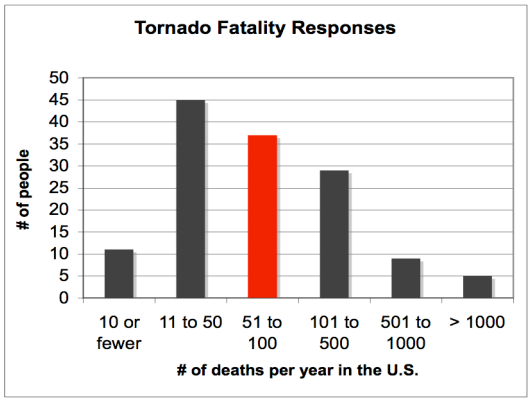


*Figure 2: Distribution of the number of people who chose each range of fatalities caused each year in the U.S. by tornadoes.*

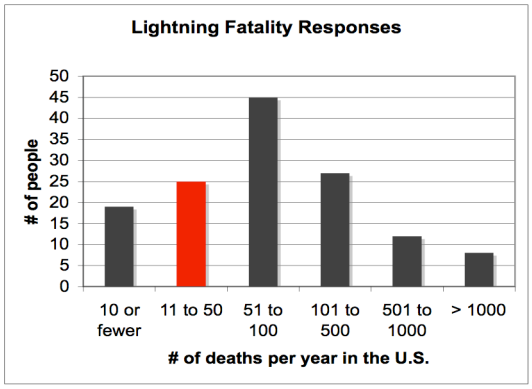


*Figure 3: Distribution of the number of people who chose each range of fatalities caused each year in the U.S. by lightning.*

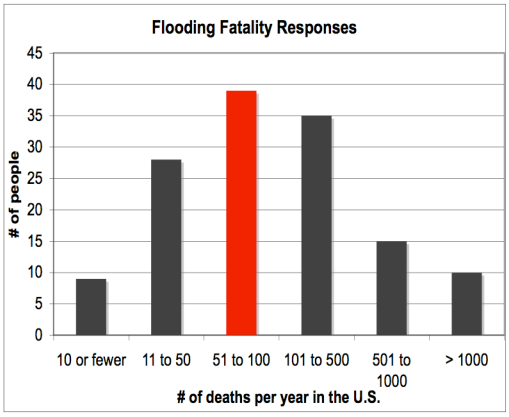


*Figure 4: Distribution of the number of people who chose each range of fatalities caused each year in the U.S by flooding.*

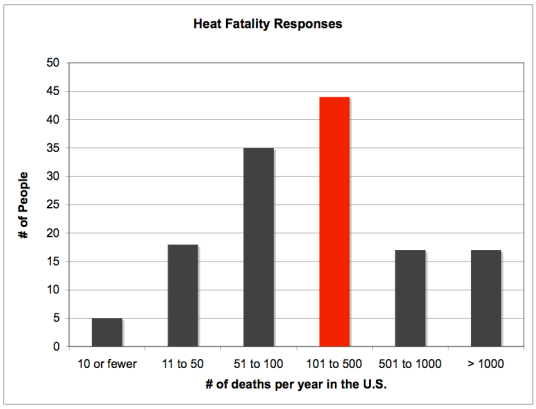


*Figure 5: Distribution of the number of people who chose each range of fatalities caused each year in the U.S by heat.*

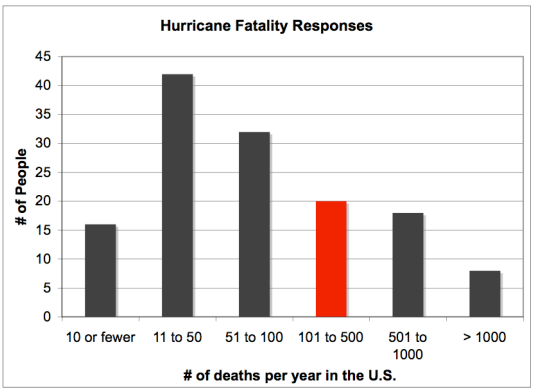


*Figure 6: Distribution of the number of people who chose each range of fatalities caused each year in the U.S by hurricanes.*

2007 (NWS website). The public perceived hurricanes as being the least fatal, even though hurricanes report the second most fatalities each year after heat waves with a 10-year average of 117 deaths in the U.S. (Fig. 6). Approximately 66% of the respondents estimated the fatalities to be under 100 each year. The public perceived tornadoes, heat, and flooding accurately overall, with correct 10-year average fatality rates of 62, 170, and 74, respectively (Fig. 2, Fig. 4, & Fig. 5**)**. On the other end of the spectrum, the public overestimated the number of deaths caused by lightning each year in the U.S. (Fig. 3). In fact, nearly 68% of respondents overestimated the total number of lightning fatalities, while the true fatality rate is on average only 44 per year (20.5% of respondents chose this range).

The fatality responses were further analyzed by ranking how the public perceived the relative danger of each weather category, with 1 being the category perceived as most fatal and 5 as least fatal. The rankings according to each age group are listed in Table 1, and the rankings

according to educational level are listed in Table 2. The age group, 18-25, ranked the weather events most accurately relative to the other age groups. Those older than 26, on average ranked hurricanes as being the weather event the least deadly, when in actuality, they rank second most fatal after heat. Something to keep in mind is that if their rankings were based off of average fatality rates for each category for a period of more than 10 years, then possibly the older groups may have ranked them more accurately, given recent events such as Hurricane Katrina highly skewing the average 10-year hurricane fatality rate. When looking at the breakdown for education levels, it's clear once again that hurricanes were considerably underestimated across all educational categories. All age and educational categories reported heat as being one of the deadliest weather events, which is correct. The responses for tornadoes, lightning, and flooding, on the other hand, ranged across all possible values from 1 to 5.

*Table 1: Table of ranking of perceived fatalities (with 1 being viewed as most fatal) for five different severe weather events according to the different age groups.*

| | 18-25 | 26-35 | 36-45 | 46-55 | 56-65 | 65+ | Accurate Ranking |
|---|---|---|---|---|---|---|---|
| **Tornadoes** | 5 | 3 | 4 | 3 | 1 | 4 | 4 |
| **Lightning** | 4 | 4 | 2 | 4 | 4 | 2 | 5 |
| **Flooding** | 3 | 2 | 3 | 2 | 3 | 1 | 3 |
| **Heat** | 2 | 1 | 1 | 1 | 2 | 3 | 1 |
| **Hurricanes** | 1 | 5 | 5 | 5 | 5 | 5 | 2 |

*Table 2: Table of ranking of perceived fatalities (with 1 being viewed as most fatal) for five different severe weather events according to highest level of education.*

| | High School Graduate | Bachelors Degree | Masters Degree | Doctorate | Other | Accurate Ranking |
|---|---|---|---|---|---|---|
| **Tornadoes** | 5 | 4 | 4 | 3 | 3 | 4 |
| **Lightning** | 3 | 3 | 2 | 5 | 2 | 5 |
| **Flooding** | 1 | 2 | 3 | 1 | 4 | 3 |
| **Heat** | 2 | 1 | 1 | 2 | 1 | 1 |
| **Hurricanes** | 4 | 5 | 5 | 4 | 5 | 2 |

### *3.3 Tornado Knowledge and Risk Perceptions*

Participants were asked three questions pertaining to tornadoes. The first question asked them where they would take shelter in the case of a tornado, assuming that they were at home when the warning was issued. About 98% of respondents stated that they would take shelter in either a tornado shelter/basement or in an interior room of their house (Fig. 7).

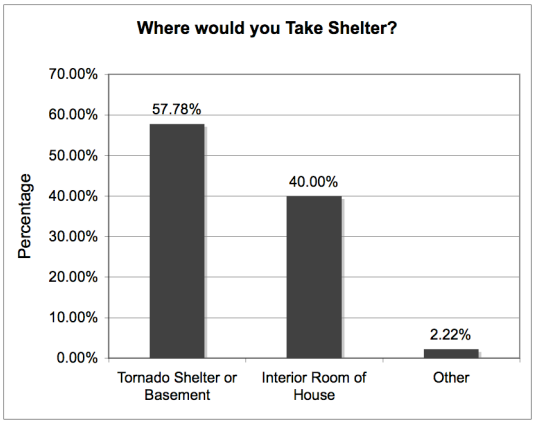


*Figure 7: Percentages of respondents taking shelter in various locations.*

They were then asked what they think is the average number of tornadoes that hit the U.S. each year (Table 3). Those from the Midwest reported the closest average response to the correct response (1000-1500 tornadoes, depending on the year), while the Northeast was the furthest from the actual value.

*Table 3: Average responses according to region of stated number of tornadoes that hit the U.S. each year*

| Northeast (n=5) | West (n=27) | Southwest (n=67) | Southeast (n=11) | Midwest (n=24) |
|---|---|---|---|---|
| 420 | 611.1 | 635.51 | 718.18 | 929.16 |

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The next question tested the public's knowledge of tornado seasons. They were asked to circle up to three months during which they felt tornadoes are most likely to occur *where they live*. The probabilities of their responses (calculated according to region) were compared to the actual probability that a tornado would occur during each month in each region (Fig. 8) (Brooks, 2003), and both were graphed on the same axis in order to assess how accurately the publics' responses were to the correct answer (Fig. 9, Fig. 10, Fig. 11, Fig. 12, & Fig. 13).

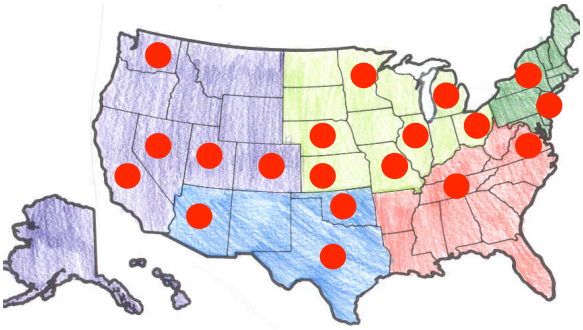

*Figure 8: This map illustrates the five regions used for this study: Northeast, Southeast, Midwest, Southwest, & West. The dots depict the 19 states represented by the survey population.*

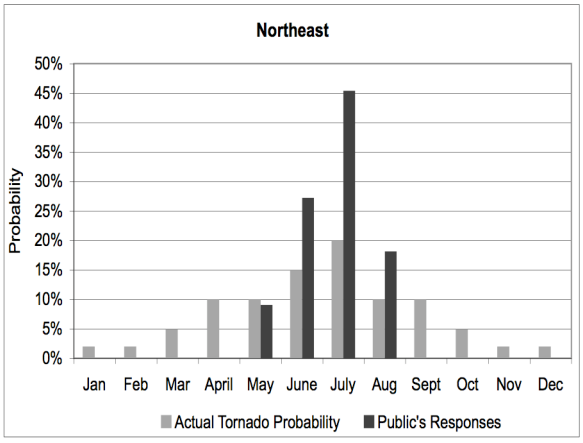


*Figure 9: The actual tornado probabilities (maximum probabilities) for each month in the Northeast compared with the public's responses.*

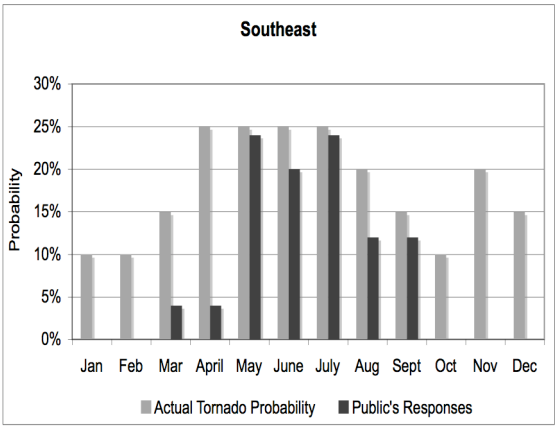


*Figure 10: The actual tornado probabilities (maximum probability) for each month in the Southeast compared with the public's responses.*

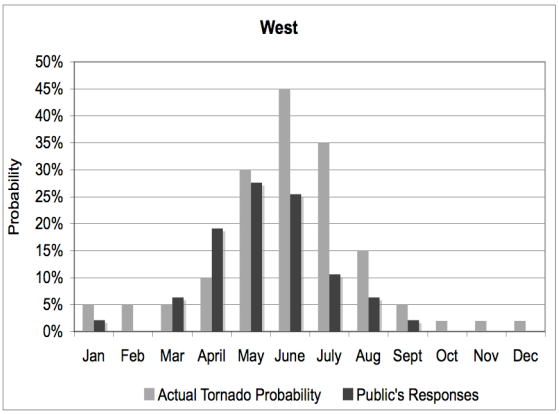


*Figure 11: The actual tornado probabilities (maximum probability) for each month in the West compared with the public's responses.*

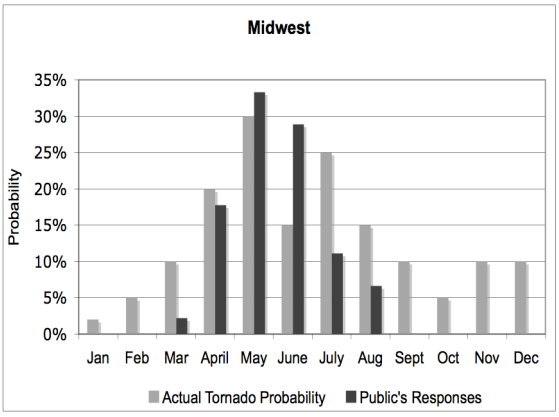


*Figure 12: The actual tornado probabilities (maximum probability) for each month in the Midwest compared with the public's responses.*

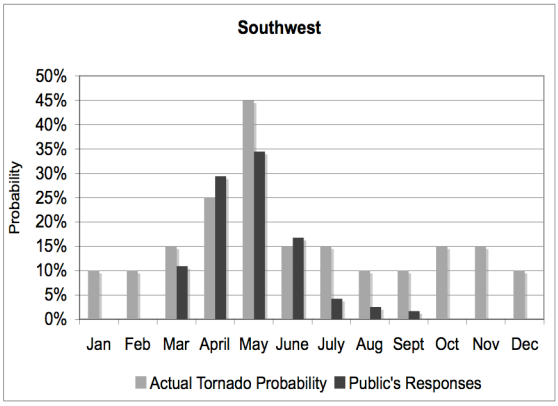


*Figure 13: The actual tornado probabilities (maximum probability) for each month in the Southwest compared with the public's responses.*

The maximum probabilities were used for each month when figuring out the probability that a tornado would occur in each region. In general, the Northeast and Southwest had more accurate responses overall, with the sample population choosing the three months during which the highest probability of a tornado actually occurred for each region. However, in general all five regions performed relatively well.

### *3.4 Common Tornado Myths*

The survey included nine true/false questions pertaining to common tornado myths (see *Appendix B* for a complete list of the questions). The average correct response for all respondents was 77.7%, or approximately seven out of the nine questions correct. Only 8% of respondents got all nine questions correct. The lowest score was from one participant who received two out of the nine correct. The average percentage of participants that answered correctly for each myth varied greatly, from 42% to 99% (Fig. 14). The myth that received the lowest number of correct responses (with only 42% correct) was the myth that the Southwest corner of the basement is the best part of the basement in which to take shelter. Nearly 60% stated that this was true. On the other hand, there were three myths that nearly everyone answered correctly (approximately 98%): that tornadoes never strike twice, that tornadoes cannot cross water, and that cities are safe from tornadoes. Approximately 70-75% of respondents answered the remaining myth questions correctly.

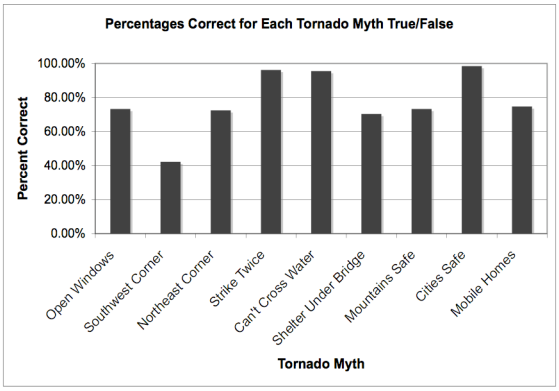


*Figure 14: Percentages correct for each true/false tornado myth. They range from 42.22% to 98.52%.*

Two variables were used to compare percentages correct of different groups. First, age differences (18-25 year olds vs. 65+ year olds) were analyzed in order to see if a generational gap affects the average percent correct. According to Figure 15 below, there is no significant difference between the two age groups overall. However, the older group did better than the younger group on several of the myths. The main exception is for the last myth, which stated that mobile homes are more likely to be hit by a tornado. Only 46% of the older group got this true/false question correct, while over 30% more of the younger group got it correct. Although this could be due to the generational gap, it does not explain how the older group scored higher than the younger group on several of the other myths. Also, by using some simple descriptive statistics such as confidence intervals, the differences found according to age are not statistically significant due to the small sample size. Further research with a larger sample size would be required to determine statistical significance of differences in age and tornado perception.

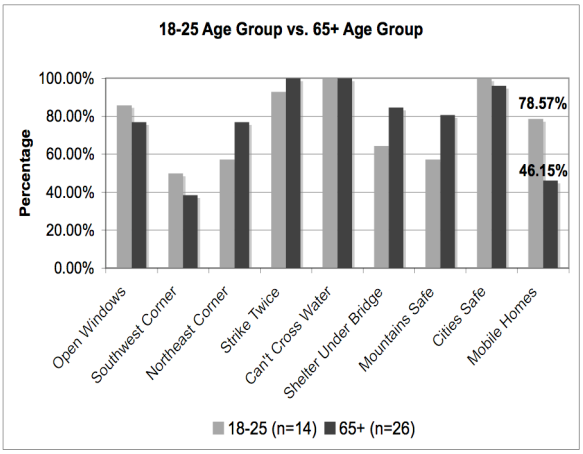


*Figure 15: Percentages correct for the true/false tornado myth questions for both the 18-25 and 65+ age groups.*

The percent correct according to educational level was also evaluated. According to Fig. 16 below, there is no main difference between the groups that are only high school graduates and those with higher education. The high school

graduates scored slightly higher on average for a number of the myths, but overall, no significant conclusions can be drawn without a larger sample size.

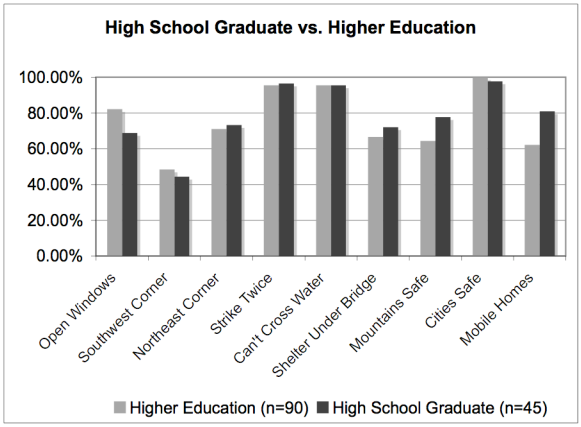


*Figure 16: Percentages correct for the true/false tornado myth questions according to education level.*

### *3.5 Tornado Warning Lead Times*

Tornado warning lead-times are the main focus of the second part of the survey. This section helps answer the second research question of this study: What is the ideal tornado warning lead-time for the general public? The public was asked to write down the number of minutes that they feel is appropriate for three different situations:

1.) the minimum time needed to just take shelter

2.) the minimum time needed to gather any necessary belongings AND take shelter, and

3.) the *ideal* tornado warning lead-time

The average number of minutes for the 136 responses was 8.75, 13.87, and 33.5 minutes, respectively.

The differences in minutes stated for each of the situations varied by region and by age. According to Fig. 17, all five regions stated a similar average amount of time (in minutes) needed to take shelter, and to gather belongs and take shelter. However, the *ideal lead-time* fluctuated depending on the region. On average, those from the Northeast preferred a desired lead-time of 63.75 minutes, which was 42.79 minutes more than the average desired lead-time for those in the Midwest, which was the region where respondents stated the lowest ideal lead-time. The other regions had lead-times in between those two extremes. Thus, it's clear that location is key when it comes to assessing the publics desired warning time.

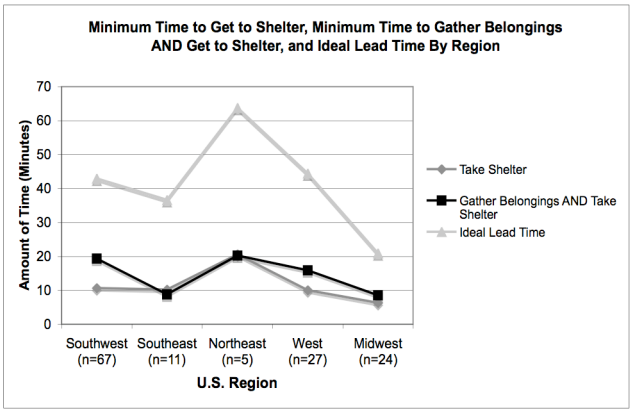


*Figure 17: Minimum time needed to get shelter, gather belongs AND get shelter, and desired tornado warning lead-time according to region.*

Age also plays an important determinant in warning lead times. Overall, for all three situations, the amount of time stated by the public *decreased* with age. Fig. 18 illustrates a decrease in amount of time (in minutes) needed to take shelter, gather belongings and take shelter, and desired lead-time, as age increases. This is especially true for the ideal lead-time, with a difference of nearly 22 minutes between the youngest and oldest age groups (Fig. 19**)**.

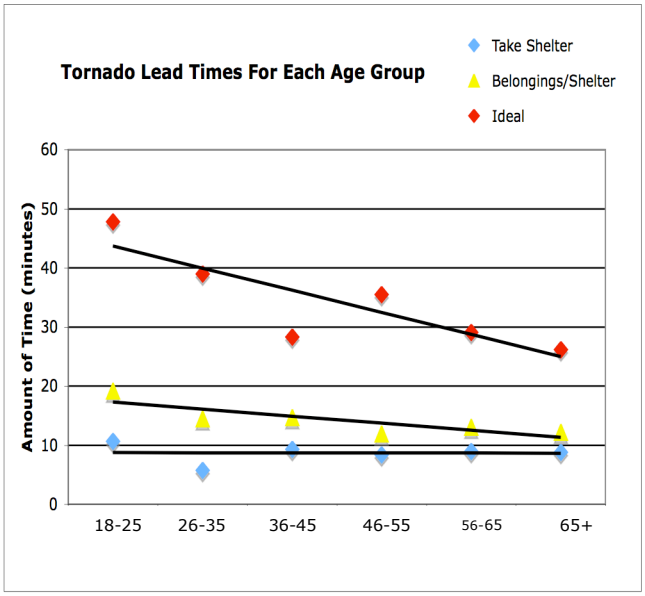


*Figure 18: Amount of time (in minutes) stated by the public (according to age group) to take shelter, gather belongings and take shelter, and desired ideal lead-time.*

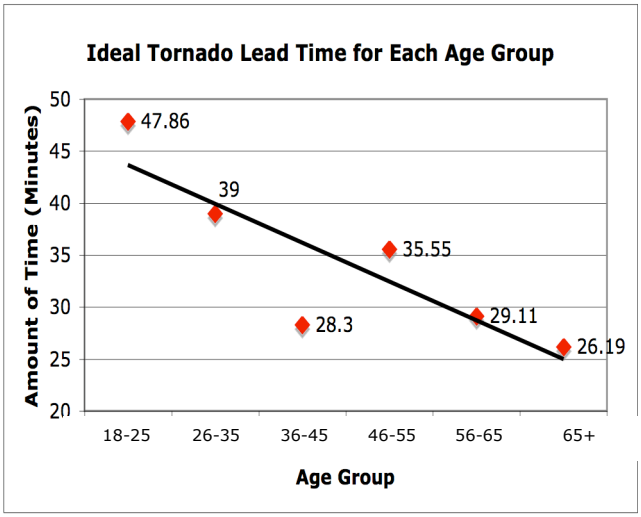


*Figure 19: Amount of time (in minutes) stated by the public (according to age group) for the ideal tornado lead-time.*

The fact that the ideal lead-time was lower for the eldest group is opposite from what was concluded in previous studies (Ewald, 2002). The ideal lead-time preferences were also compared according to sex, prior tornado experience, and having a designated shelter and action plan. However, no differences were found and thus no conclusions can be made regarding warning time preferences for these variables.

### *3.6 Free Response Questions*

The survey participants were asked two free response questions pertaining to how they would act/behave given both a 15-minute warning lead-time and a one-hour warning lead-time. Their responses were divided into seven main categories, along with the percentage of participants who stated that category in their response (Table 4). Often, a respondent stated more than one action, and therefore, the sum of percentages for each column total more than 100%. It is important to note how the percentages change from the 15-minute lead-time to the 1-hour lead-time. If given a one-hour lead time, approximately four times more people would flee, three times more people would gather/secure belongings, four times more people would obtain further information regarding the storm, and a third *less* people would take shelter.

*Table 4: The percentage of respondents who said each of the seven categories for both the 15-minute and 1-hour lead-time.*

| Category | 15-Minute Lead Time | 1-Hour Lead Time |
|---|---|---|
| Seek Shelter | 73.5% | 52.9% |
| Call Family/Friends | 5% | 8% |
| Gather/Secure Belongings | 3.6% | 11.7% |
| Gather Family | 8.8% | 3.6% |
| Get More Info (Radio, TV) | 11% | 43.4% |
| Flee | 6.6% | 24.26% |

A typical response for the 15-minute free response question was: pack belongings and then take shelter. A typical response for the one-hour free response question was: pack belongings, gather family, listen to the radio/watch TV, and then take shelter. There were several very interesting statements, some of which included: questioning the possibility of a one-hour lead-time, waiting to take action until the storm was really close, using Twitter, going about business as if normal day, and opening the windows.

A follow-up question to the free response questions asked the public if they felt like a longer tornado warning lead-time would make the situation any more or less life threatening. 48% of the respondents stated that a one-hour lead-time would make the situation *less* life threatening, while 43% reported no change, and 9% stated it would make the situation more life threatening (Fig. 20).

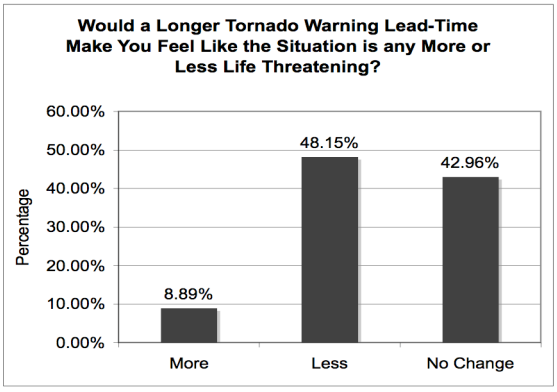


*Figure 20: Percentage of respondents who feel like a longer tornado warning lead-time would make the situation more/less/or no different when it comes to life value.*

### *3.7 Too Much Lead-Time*

The survey participants were asked whether or not they feel that there can be *too much* lead-time. Fig. 21 below demonstrates that 54% stated there cannot be too much lead-time, while the remaining 46% felt like there can be too much lead-time. Of the 46%, nearly 25% of them reported 60 and 120 minutes as being too much warning time.

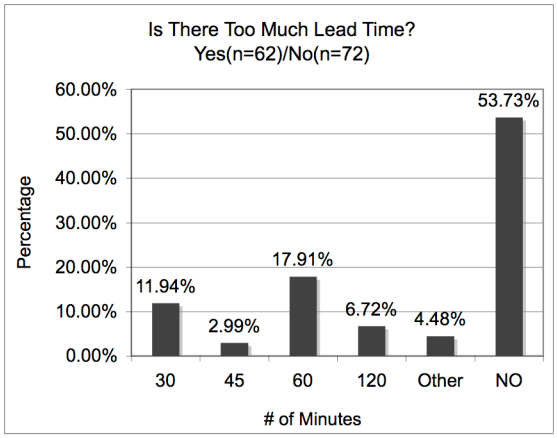


*Figure 20: Percentages of respondents who felt like there can/cannot be too much warning time. Of the 46.27% who felt that there could be too much lead-time, the number of minutes they felt is too much is given along with the corresponding percentages.*

## 4. CONCLUSIONS

This study was composed of two research questions. First, it assessed the accuracy of the public's perceptions of weather risks. This study showed that overall, the public had a relatively accurate perception of general weather risks. The public knew for the most part the appropriate value for annual fatality rates for most general weather categories. However, as a whole, the respondents underestimated the hurricane risk, while overestimating the risk from lightning. Neither age nor educational level played a vital determinant in general weather event knowledge, with the exception that the age group, 18-25, perceived the danger of the events in the most correct fashion. When it came to tornado knowledge specifically, the public correctly perceived the fatality risks associated with tornadoes, however, they underestimated the overall number of tornadoes per year. The public overall had a basic understanding of the months during which most tornadoes occur, with the Northeast and Southwest estimating closest to the actual number of events. The public performed well on the tornado true/false questions, with an average of 77.77% correct, or 7 out of 9 true/false questions correct. The only variable that showed even a slight difference in responses was age, where the oldest group performed better overall compared to the youngest group, except on the myth regarding mobile homes being more likely to be struck by a tornado.

The second research question aimed to pinpoint the ideal tornado warning lead-time for the *general public*. When asked about the minimum time to gather belongings and take shelter, the average response was about 13.8 minutes. This estimate is significant given that it is comparable to the current lead-time today. The *ideal* lead-time was found to be 33.5 minutes. This indicates that the general public *may* not need the one to two hours that warn on forecast could provide. In fact, when asked if there can be too much lead-time, 46% of the respondents stated yes, 28% of whom said that one to two hours is too much. Thus, not only does the public not desire a lead-time of more than an hour, but Simmons and Sutter (2008) also showed that a longer lead-time does not improve fatality statistics. Therefore, a longer lead-time would not be of the best interest to the general public, for reasons that could only be found by looking at this topic more in-depth in a future study.

It is also important to note that the responses from the free response questions showed that less people would gather their family and seek shelter when given a one-hour lead-time compared to a 15-minute lead-time. It would take further research to figure out if this would actually be more dangerous than taking immediate shelter. More people also stated that they would flee/drive away from the area if given more time, which, according to Hammer (2001) and Golden (2000), might be a safer response than staying at home given a longer lead-time. Similarly, 48% of the respondents stated that they would feel like the situation is less life threatening if given a one-hour lead-time compared to a 15-minute lead-time. Once again, it would take further research to figure out if there is a correlation between people taking fewer precautions since they feel the situation is less life threatening, and fatality rates.

In conclusion, this study showed that the possible future tornado warning lead-time of 1-2 hours that warn on forecast would provide is not necessary for the general public, and may actually be more inconvenient and hazardous. The social perspective of warn on forecast is a key and evolving research area that will better define the very specific and critical needs posed by individual users.

## 5. ACKNOWLEDGEMENTS

I would like to thank my mentor team, Rachel Butterworth, Kim Klockow, Dr. Jerry Brotzge, and Somer Erickson, for all of their support. I would also like to thank Dr. Harold Brooks for providing the necessary weather event fatality and tornado frequency information, as well as for all of the guidance he has provided. Lastly, I would like to thank the National Science Foundation for providing the funding under Grant No. ATM-0648566 to make this project possible.

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**APPENDIX A: Demographic Information**

. a. Sex (n=136)

| Female | Male |
|---|---|
| 51% | 49% |

b. Age (n=136)

| | |
|---|---|
| 18-25 | 10.29% |
| 26-35 | 11.03% |
| 36-45 | 23.53% |
| 46-55 | 22.06% |
| 56-65 | 13.24% |
| 65+ | 19.85% |

c. Ethnicity (n=135)

| | |
|---|---|
| Caucasian | 91.85% |
| Asian | 3.70% |
| Native American | 1.48% |
| Pacific Islander | 1.48% |
| African American | 1.48% |
| Hispanic/Latino | 0.00% |

d. Region of Residence (n=134)

| | |
|---|---|
| Northeast | 3.73% |
| Southeast | 8.21% |
| Midwest | 20.15% |
| Southwest | 50.00% |
| West | 17.91% |

e. Highest Education Level (n=136)

| | |
|---|---|
| High School Graduate | 33.82% |
| Bachelors Degree | 29.41% |
| Masters Degree | 25.74% |
| Doctorate | 2.21% |
| Other | 8.82% |

f. Number of Kids (n=135)

| | |
|---|---|
| 0 | 19.26% |
| 1 | 23.70% |
| 2 | 33.33% |
| 3 | 9.63% |
| 4 | 7.41% |
| 5 | 3.70% |
| 6 | 2.96% |

g. Prior Tornado Experience (n=135)

| | |
|---|---|
| Was in a One | 19.26% |
| Witnessed One | 32.59% |
| Family/Friends Experienced One | 12.59% |
| No Prior Experience | 35.56% |

h. Action Plan (n=136) and Designated Tornado Shelter (n=136)

| | Action Plan | Designated Tornado Shelter |
|---|---|---|
| Yes | 65.44% | 58.09% |
| No | 34.56% | 41.91% |

**APPENDIX B: True/False Tornado Myth Questions**

1.) If a tornado is coming towards your house, you should open the windows.

2.) The Southwest corner of a basement is the safest location during passage of a tornado.

3.) The Northeast corner of a basement is the safest location during passage of a tornado.

4.) Tornadoes, like lightning, never strike the same place twice.

5.) Tornadoes can cross water.

6.) If you're driving, you should take shelter under a bridge during a tornado.

7.) Areas near mountains are safe from tornadoes.

8.) Areas near populated cities are safe from tornadoes.

9.) Mobile home parks are more likely to be hit by a tornado.