

EXPERIENCES OF SMITHVILLE, MISSISSIPPI RESIDENTS WITH THE 27 APRIL 2011 TORNADO

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Abstract

Interviews were conducted with residents of Smithville, Mississippi, following a deadly EF-5 tornado that occurred 27 April 2011. The primary purpose of the interviews was to examine participants' use of information in confirming the warnings. Individuals who were at home searched for more different types of information, and individuals in cars looked for or received the fewest types of information. Several participants who received a number of confirmatory cues or messages still chose not to seek shelter. The majority of respondents did respond appropriately, including some who took action to protect their pets. Some comments made by the participants suggested they stopped paying attention to the warnings or did not take them seriously at the time. Related to information use, participants were also asked a series of questions about a hypothetical warning polygon and the amount of spatial variability they inferred from the graphic. The results suggest respondents may infer a certain amount of spatial uncertainty in tornado warning polygons.

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1. Introduction

During the month of April 2011, Mississippi faced several rounds of severe weather. Five severe weather episodes over 10 non-consecutive days brought tornadoes, severe winds and hail throughout the state. The worst event occurred from 25-27 April, concluding with two EF-5 tornadoes, one in northeast Mississippi and one in east-central Mississippi. The EF-5 tornado that occurred in Monroe County in northeast Mississippi during the afternoon of 27 April killed 16 people in the town of Smithville, almost 2 percent of the population (Fig. 1). The fact that this event occurred during a very busy month in terms of the number of warned events led to public speculation that a high number of fatalities occurred in this and other tornadic storms on the same date partially due to complacency on the part of an overwarned population. This study sought to determine whether individuals living in the Smithville community found the warning sirens unnecessary at the time and if this resulted in a lack of response. We were also interested in what steps respondents took to confirm the warning.

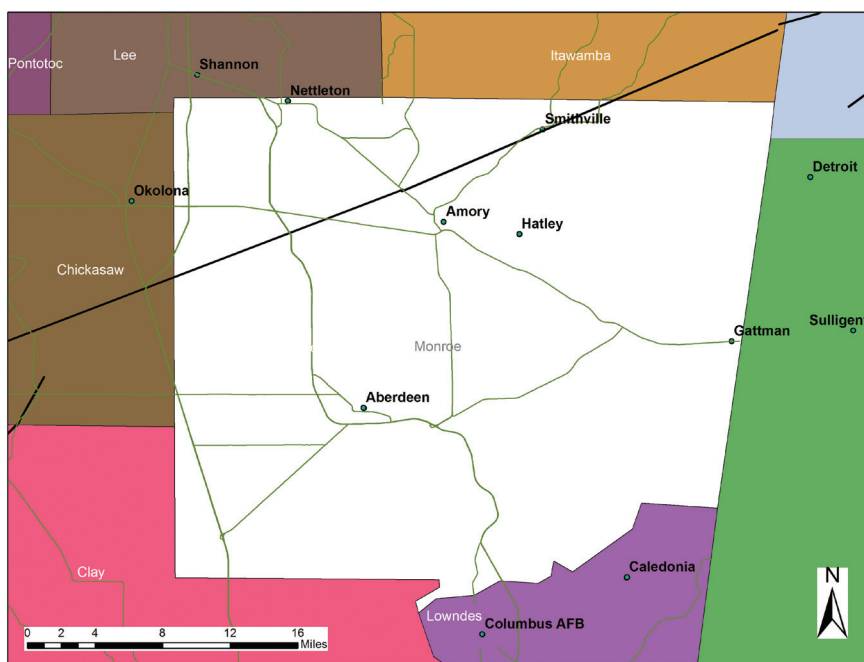


Fig. 1. Path (solid black line) of EF-5 tornado that caused 16 fatalities in Smithville, Monroe County, MS.

2. Background

Only about one out of every four tornado warnings is associated with a verified tornado—the highest false alarm rate among all weather hazards (Barnes et al. 2007). Intense television coverage of tornado warnings has been linked to a “numbing” effect on tornado response and the sense among respondents that they were not in immediate

danger (Schmidlin and King 1997). This effect does not always occur, however (Legates and Biddle 1999). Paul et al. (2003) indicated respondents were hesitant to respond to warnings because they are so common, but most people surveyed complied with the warning anyway. This is consistent with literature on other hazards that does not show evidence of a “cry wolf” effect (e.g., Dow and Cutter 1998). However, there may be an effect on confirmatory information-seeking behavior. Dow and Cutter (1998) found that respondents may perceive a decrease in the credibility of government officials and seek alternative sources to confirm the warning and its impact on them personally.

The current study examines this confirmatory information-seeking. People tend to seek other information before responding to a warning (Mileti and Darlington 1997). There are a number of influences on individual’s decision-making including environmental cues, and the actions of one’s peers (Lindell and Perry 2004). The local television weathercaster may also impact response (Sherman-Morris 2005). Besides the influence of the weathercaster him- or herself, it is not clear what role different types of information play in the response to severe weather coverage. The Smithville tornado took place during the day, so it was also not clear whether to expect a large role for television. Typically, local television is a primary source of warning information (Chaney and Weaver 2010; Schmidlin et al. 2009; Sherman-Morris 2005; Hammer and Schmidlin 2002; Paul et al. 2003; Legates and Biddle 1999). Sirens are also cited as a primary or confirmatory warning device (Paul et al. 2003; Balluz et al. 2000; Legates and Biddle 1999) and may be more important during the daytime when individuals are away from their televisions (Comstock and Mallonee 2005).

Another type of confirmatory behavior is the attempt to confirm the tornado visually. Some percentage of respondents in tornado surveys usually report doing this either before, or instead of, taking shelter, although the percentage has varied from as little as 10% (Paul et al. 2003) to as high as 54% (Tiefenbacher et al. 2002). While the rate of fatalities from tornadoes occurring outdoors is small (Ashley 2007), research has shown the risk of death and injury is higher when one is outdoors than if one is inside a permanently anchored house (Daley et al. 2005). Even though it appears from this one study that many of the people killed or injured may have been outdoors for other reasons than looking for the tornado (Daley et al. 2005),

it is still not recommended, especially in the Southeast where tornado visibility is reduced (Ashley 2007).

We also examine the actions taken upon receiving the warning information. While it is common for people to pursue additional confirmatory information upon hearing a warning, most do eventually attempt to take shelter. In other work, approximately three quarters or more of the people surveyed have reported taking shelter during a tornado (Chaney and Weaver 2010; Paul et al. 2003; Comstock and Mallonee 2005; Hammer and Schmidlin 2002; Sherman-Morris 2010), although lower percentages have been observed (e.g., Mitchem 2003; Schmidlin et al. 2009). Living in a mobile home (Schmidlin et al. 2009) and having less than a high school education (Liu et al. 1996; Balluz et al. 2000; Blanchard-Boehm and Cook 2004; Chaney and Weaver 2010) have been linked with lower levels of shelter-taking.

Finally, we examine the potential role location within a warning may play in determining one's risk perception of the tornado. Risk perception has been a strong predictor of response to multiple hazards (e.g., Baker 1991; Dow and Cutter 1998; Kalkstein and Sheridan 2007). In a study on response to a tornado, the vast majority (95%) of mobile home residents who perceived they were in personal danger fled to a safer location—a greater response than among those who did not perceive as high a danger (Chaney and Weaver 2010). Schmidlin et al. (2009) also found a relationship between believing one was located in the path of a tornado and taking shelter. We did not measure respondents' perception of risk from the actual tornado that occurred. Rather, we were interested in whether a participant's judgment of the likelihood of tornado occurring varied spatially across a sample warning polygon shown to them. Past research has shown that individuals' understanding of their location within a warned area is not always accurate (NWS 2009; Arlikatti 2006). Individuals watching televised severe weather coverage have had trouble interpreting map scale, inferring the future path of the tornado, and recognizing locations on the map (Klockow 2011). Nagele and Trainor (2012) determined that respondents located within a warning polygon were more likely to take shelter and that larger polygons may lead to less shelter taking. In the case of hurricane warning polygons (such as the Cone of Uncertainty, the common name given to the graphical product issued by the National Hurricane Center to show the probable track of a tropical cyclone), people interpreted the track near the center of the forecast as more likely, possibly underestimating the likelihood of the rest of the cone (Broad et al. 2007). It is unclear whether this is the result of the forecast track being drawn in for the user, or if the same level of spatial uncertainty would be interpreted from the graphic without the center line.

The current level of uncertainty the public interprets from tornado warning graphics is unknown.

3. Data

To examine the use of information during the tornado and its influence on response, interviews were conducted by the authors over three weeks during the summer of 2011 with residents of northern Monroe County, Mississippi, primarily from Smithville, the town that had been devastated by the EF-5 tornado on April 27. Primary attention was focused on their experiences immediately before the tornado hit, and especially confirmatory information seeking. They were also asked whether they believed previous warnings and severe weather coverage were necessary. Twenty-nine people were interviewed. The average age was 54.7 with a minimum age of 19 and a maximum 79. The majority was female 15/27 (56%) and 12/27 (44%) were male. The average age and percentage of females in the sample were both higher than the Smithville population, although there is a female majority. Two respondents were not identified with race or sex. All respondents whose race was recorded were White, which could be expected because the population of Smithville is approximately 96% White. Most had graduated from high school. The education level of the sample distribution is similar to the population with the exception of the high and low ends. Only 10% of the sample had only some high school education, while this is true of 32% of the population. Similarly, less than 2% had an advanced degree in the population, while this was true of 10% of the sample. The other categories are within 5 percentage points.

a. Receiving and confirming the warning

Smithville received four warnings during this event, including the prior overnight period and earlier on the same day as the EF-5 tornado. Nearly all, 28 out of 29, reported receiving a tornado warning. The most common way for people to have first been warned about the EF-5 tornado was by the siren (12/29), followed by multiple ways (9/29) (Fig. 2). Of the nine who could not distinguish which source was their first, five said siren and local TV together. Only three cited local TV as the primary source of the warning, but 15 reported watching local television to see if they would be personally affected by the tornado. The tornado occurred at approximately 15:45 Central Daylight Time. Because the tornado occurred during the daytime while many people are at work, it was not expected that television would be the primary source. More individuals reported being at home (18 out of 29) than the researchers expected.

Respondents were then asked whether they did

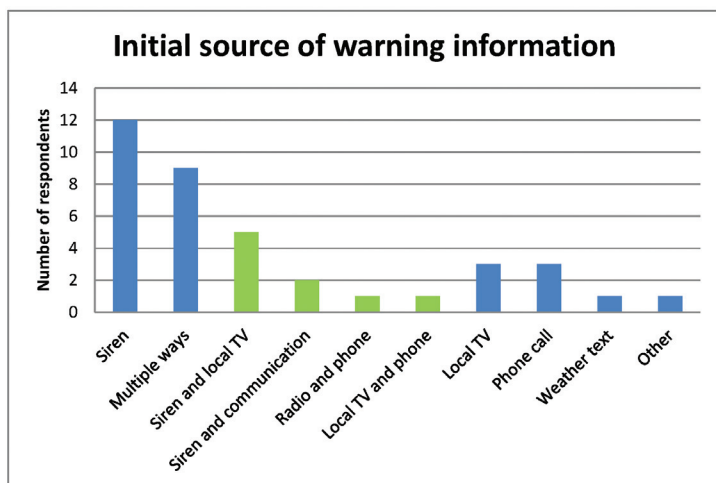


Fig. 2. Respondents' initial sources of warning information. Green bars indicate the respondent listed more than one initial warning source.

anything to find out if they would be personally affected. About half, 15 out of 29, watched local TV coverage. All but one watched the same local station. No one went online to read or post any information from social media. Eighteen respondents were 50 or older, and the storm was moving 65 miles per hour, suggesting there could be a lack of participation in social media or a lack of time to share information in this format. At least three individuals did report using their phone for information such as radar.

Participants were also asked what information they looked for before deciding what to do after receiving the warning (Fig. 3). Location information was mentioned most frequently. Respondents who were at home reported looking for many more different types of information about the tornado before taking shelter. Information they reported seeking included whether they were in the warning area, whether they would be affected, if a tornado had been spotted, where it was located, what time it was expected, whether it had produced damage,

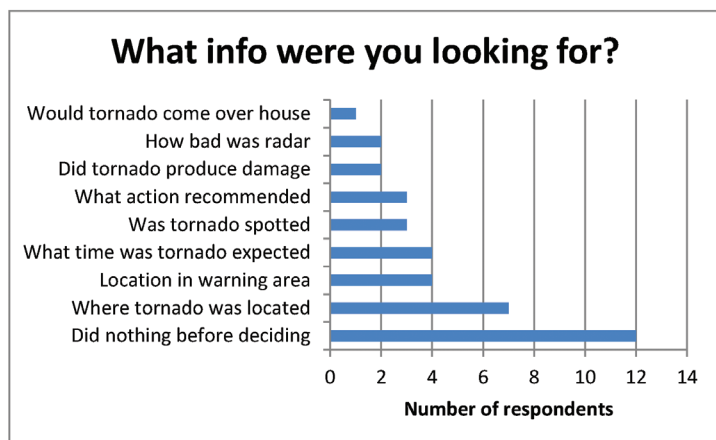


Fig. 3. Specific information participants sought to confirm the warning threat.

what actions to take, and what the radar looked like. Two respondents who were at work were still able to watch local television for additional information, and one person checked weather information on her phone. While they were not asked if they could have used additional information about the storm, respondents who were driving appeared to have the greatest lack of information. One person admitted she did not know "how bad it was." Unfortunately, this sample is too small to draw any generalizable conclusions about the type of information that leads to a person taking shelter.

b. Responding to the warning

Most respondents, 22 out of 29, reported putting themselves in a safer place after finding out about the storm. Seven did not. Of the 18 people who were at home when the tornado hit, 16 took shelter. Of those who were not at home, one was at a restaurant, five were at work and five were driving. Only two out of the five who were driving took shelter. The person at the restaurant and three out of the five who were at work took shelter. Respondents cited a hallway most frequently (8/22) as their "safe place," followed by a bathroom. One resident of a mobile home stated that the bathroom was his safe place, even though being in a mobile home has been shown to be more dangerous than a permanent home or a vehicle during a tornado (Schmidlin et al. 2002; Schmidlin et al. 2009; Daley et al. 2005).

About half of the respondents who took shelter also took some action to ensure the safety of their pets. Six respondents took a pet with them to their safer location, while 6 reported doing nothing. Others left pets inside or left them in another safe location (it was not clear where this was). One respondent described letting a cat outside because it wanted to go out; that cat crawled under the house and was not harmed. One of the most interesting stories shared about a pet during the tornado was about a family dog that had been acting "strange" all day. This dog had never gone into the storm shelter with the family in the past, but kept walking toward the shelter and laying down on it. The dog followed the family into the storm shelter when they went into it. The average age of people who did nothing with their pet was 43, while the average age of people who did anything to make their pet safer was 62. That this age difference is almost significant ($p = .057$) with only 16 responses suggests age may have played a role in what respondents did with their pets.

Because the sample size is small and the interview allowed for information to be collected that was not part of the interview questionnaire, the responses of those seven who took no protective action can be examined in greater detail.

"Harry," a 75-year-old white male with some college

education and living a brick house, watched the storm from his deck. He did not know severe weather was coming. He heard the siren, and a few minutes later his power went off. He went outside to see what was going on. He and his wife could tell the storm was away from his house and they watched it. He said the storm was very loud; "it sounded like a bunch of trains," and he had never heard anything like it before. "You could feel the storm," he and his wife said, pointing to and stroking their legs. This respondent claimed he did not know severe weather was possible, but watches local news at least once per day and gets a weather forecast multiple times per day.

"Dave" was a 40-year-old white male, a college graduate living in a brick house. Dave was south of the tornado near Amory, which was in the warned area (see Fig. 1 for location). He was at work, and after hearing the warning on local TV and via siren, tuned in to see where the tornado was located and when it was expected.

"Helen" a 79-year-old white female, high school graduate in a brick house, did nothing. She first heard the warning on local TV, and had it confirmed through at least one family member and environmental cues, but did not take shelter. Once she found out about the tornado, she said it "happened before she knew it." Prior warning cues included her sister telling her that she was going to go take shelter in a church basement and a "roar" Helen thought was thunder. Another family member called to tell her that his house was gone and Smithville was destroyed, but this probably happened after the danger had passed. She reported hearing a siren at other times during the day and thought it was unnecessary "at the time" but said she did not hear the sirens at all times. She did recall seeing other tornado warnings on television in the hour or so before the tornado.

"Amanda", a 31-year-old white female, a college graduate living in a brick house, was driving when her mother called her to take cover. She was listening to the radio to see if it was a test. She did not do anything to put herself in a safer place, but it is not clear why. She was aware of severe weather because she had spent a portion of the day at work sheltering due to warnings.

"Alex" (no age or sex recorded, college graduate) said he/she was not in the path of the storm. This respondent was traveling, but it is not clear whether he or she was in the warned area.

"Mary", a 62-year-old white female with some college education, was living in a brick house. Mary was driving between towns located south and southeast of the track in Fig. 1, but did not know how bad things were and continued to drive. She said people thought the storm was coming toward Amory. She first heard the warning from her employer and attempted to find out where the tornado was located before deciding what to do. She did

not hear a siren before the tornado and did not go to a safer place because she did not know "the magnitude" or "how bad" things were.

"Chris" (no age or sex recorded) was at work and went home. This person, who lived in a brick house and graduated college, reported hearing the warning via siren, and said the tornado was "very loud." When asked why he/she did not go to a safer place, this person said he/she was not in Smithville. The work location was in the warned area, however. This respondent admitted with a tinge of guilt, "We did not pray...we were not scared." This underscores the fact that the person did not feel affected by the tornado at the time. Chris's report of the siren and the loudness of the tornado indicate he/she was likely in or near the path.

All of the individuals who did not take shelter knew about the tornado before it occurred. They received a mixture of confirmatory information from phone calls from relatives to a physical response that the weather was bad. Only one of these individuals may have been outside of the warned area (it is not clear where he was). There were different reasons why they did not feel at risk. Harry was watching the storm and believed it was moving away from him. Dave was at work and tuned into television to see the location of the tornado and when it was expected. For whatever reason, the television coverage did not cause Dave to feel the risk was great enough where he was located, about 3-4 miles south of the actual track, to require action. (The tornado did not pass through Amory, where he was located at the time.) Mary was driving away from the track, and may have been given enough information to make the correct decision. The path she described hearing about would have placed her very close to the tornado, however. Even though she was not in the path, from her description, it sounded like she thought she was. The others who did not take shelter did not seek any specific information about the tornado, and Helen reported that she thought the siren was unnecessary "at the time." Age did not play a role in whether respondents did or did not seek safer shelter. Having less than a high school education has been linked with lower levels of shelter taking during tornadoes. However, most of the respondents who did not seek safer shelter in this sample had at least some college education.

c. The warning process: problems and suggestions

To delve deeper into the belief that the siren was unnecessary, respondents were asked if they had heard a siren at any time on April 27, if they heard a siren at any time other than for the storm that produced the tornado, and if they recalled seeing television coverage of other warnings during the hour before the tornado hit. If they did, they were also asked whether they thought the siren

was necessary and/or the television coverage too much. Most people reported hearing a siren (24 out of 29) and 14 saw television coverage of other warnings in the hour before the tornado. Six out of 21 believed at least one of the times the siren was sounded was unnecessary, and 6 more were not sure. One person added “too many sirens” but did not state whether he believed any were unnecessary (and the interviewer did not probe the response). No one believed that every time was necessary. A few people made comments such as “not anymore,” or “I did at the time.” This provides some evidence, albeit weak, that for many people, the siren is unnecessary unless there is a confirmed tornado. Whether or not they personally received damage did not matter in whether they believed the sirens were unnecessary. One person who said he believed the sirens were unnecessary said that they went off so many times in the previous three to four days that “I got numb,” and did not take them seriously.

Regarding the television coverage, only one person thought it was too much. This respondent explained that she “got immune [to the severe weather coverage]” and that because of all the reports going off in the previous two days, “lots of us didn’t pay attention.” Eleven respondents stated it was just right. Tuning in to a local television station is a choice, while hearing the siren is not, so this may explain why more people believed the sirens were unnecessary than who believed there was too much television coverage. Television also provides a richer source of information than sirens, which at most indicate that a warning has been issued. One person said “absolutely” there were some unnecessary sirens, but the severe weather coverage on television was “excellent.”

Respondents offered suggestions to improve the warning process. One respondent said that sirens could be improved. He added the request for the siren to let him know “is it right here or will it be later?” Others suggested better siren coverage or louder sirens. Many felt the current method was adequate, and some offered suggestions for text messaging or phone applications. The majority of respondents older than 50 suggested improvements to sirens (six out of eight suggestions), while 5 out of 8 suggestions made by people 50 and younger included text messaging or phone applications. From the small number of interviews that were conducted with people who were on the road at the time of the tornado, it appears that this group is an audience that could use additional warning information. There was no consensus, however, on what form this information should take. Ways to provide additional information to drivers must balance the amount of attention the warning information requires with the level of attention already needed to drive the vehicle safely, because the risk of death from an automobile accident is already higher than all

natural disasters combined (<http://www.disastercenter.com/traffic/>).

d. Spatial perception of risk in a tornado warning polygon

Most respondents in this study received a tornado warning prior to the EF5 tornado that hit Smithville. Many also reported looking for location information about the tornado. It was the most commonly searched-for piece of information. This suggests that they did not assume every location in the warned area is equally likely to be affected by the tornado. That people did not believe every siren was equally likely to indicate a tornado touchdown also indicates some level of uncertainty understood in the warnings. Emergency managers have also acknowledged that just because they are included in the warning area does not necessarily mean one is in an imminent threat; the warnings are uncertain with respect to “when, where or if a tornado will hit” (League et al. 2010). While some emergency managers in the League et al. study did not sound sirens for every location in the warning polygon, others report sounding sirens countywide any time a warning polygon enters the county (Brown 2012). This raises the question of how warnings are interpreted and whether there is a level of uncertainty inferred by those who use them.

To begin to explore the public’s interpretation of warning polygons, the authors concluded the survey interviews with a hypothetical scenario. Participants were shown a hypothetical warning polygon for portions of Monroe County (Fig. 4, without grid overlaid). Participants who reported either seeing a warning displayed graphically on the 27th, or who were not sure whether they had seen one, were additionally asked, “Is there anywhere in this warned area where you believe a tornado would be MORE likely to occur?” Participants were asked to draw this area on the map. Ten of the fifteen people who were asked about the hypothetical warning polygon drew some area with the pen. Two additional people drew short lines with their finger but would not take the pen, and 3 people said the whole area would be at risk. One person who said the whole area was at risk described correctly how the likelihood varied within the polygon. The sum of the areas designated as more likely can be seen in Fig. 4. Pink and red show the most frequent areas selected. This area is close to the center of the map. Interestingly, it is not shifted closer to where the probable tornado would be located at the time the warning was issued. Also, it appears to be offset slightly north of northeast, which may also show the participants’ thought process that the path should be one that would impact the study area.

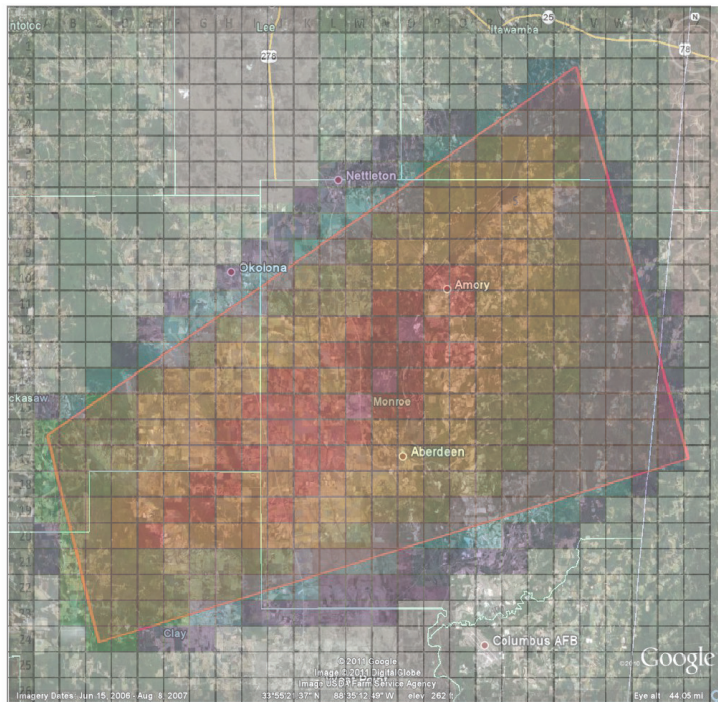


Fig. 4. Hypothetical warning polygon with grid showing areas respondents perceived were of higher risk. Red colors in the center of the diagram indicate the threat area designated by the most respondents.

4. Conclusions

The Smithville Mississippi, EF-5 tornado occurred in a rural portion of northeast Mississippi. The majority of those surveyed received warning of the tornado by the town's siren system. However, those interviewed indicated a strong need for confirmatory information. This is similar to the findings of NWS Service Assessment of the Joplin, Missouri, Tornado, where "the majority of surveyed Joplin residents did not take protective action until receiving and processing credible confirmation of the threat and its magnitude from a non-routine trigger" (NWS 2011). These non-routine triggers included hearing about or seeing the tornado on radio or television, and the observation of the tornado by moving oneself outdoors. Smithville residents commented that to make sirens more effective, "They should only be sounded for real tornadoes", and they "need different siren sounds, one for when there is a tornado and one for when they [implying the National Weather Service] think there is a tornado". Again, this is similar to the Joplin findings that "familiarity with severe weather and the perceived frequency of siren activation not only reflect normalization of threat and/or desensitization to sirens and warnings, but they also establish that initial siren activation has lost a degree of credibility for many residents." In the absence of being able to see the tornado on TV, many Smithville residents

relied on the local broadcast meteorologist for safety clues. One resident said she was swayed into seeking shelter because "the tone of the weatherman's voice was different, you knew, he knew, this was bad".

The interviews also raised questions about why individuals come to determine that they are not at risk after observing the conditions outside—especially the individuals who feel, see and hear a tornado and still do not seek shelter. Future work should also examine more quantitatively how each kind of information about the tornado is used, and what impact different parts of severe weather coverage has on response. The increase in mobile technology makes it possible to reach individuals who are not at home, including those in automobiles. In the future, a larger sample of respondents who were driving during a tornado would help create better ways to warn this group.

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