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Examining a "Near-Miss" Experience: Awareness, Behavior, and Post-Disaster Response Among Residents on the Periphery of a Tornado-Damage Path

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INTRODUCTION

On the evening of Monday, June 18, 2001, a tornado struck the extreme northwestern Wisconsin Village of Siren, without any warning from the town's siren. This community of about 1000 people approximately 65 miles northeast of St. Paul, Minnesota sustained a direct hit from the storm through the center of town. The path of the F-3 tornado, which began five miles west of town, was approximately 25 miles long and up to one-half of a mile wide (Figure 1). Newspapers and other media across the country reported three deaths and 16 injuries resulted from the storm. Approximately 200 of the village's 400 homes and 40 of its businesses were damaged or destroyed.

This post-disaster study one week after the storm helps to understand the nature of local warnings and responses on the periphery of a tornado damage path, as well as the effect a proximate disaster has on pledges to improve preparation, awareness, and mitigation. Capturing and working with such information from the local residents yielded an important opportunity for the enhancement of awareness and mitigation.

RESEARCH PROBLEMS

Tornadoes often devastate both property and lives (Marshall, 1993; Grazulis, 1993). While some researchers have concentrated on the physical nature of the tornado event (e.g. Fujita, 1970; Bluestein, 1999), others have considered the social aspects of tornado hazards and disasters (e.g., Kessler and White, 1981; Burton et al., 1993; Mulilis and Duval, 1997; Paul, 1998; Balluz et al., 2000). Tornado-victim research has concentrated on those people most directly affected by the tornado, i.e. those in the main path of the storm (Schmidlin and King, 1996). However, more investigation is warranted into the awareness, behavior, and long-term response of those involved in "close-call" or "near-miss" situations with tornadoes. "Close calls" or "near misses" are defined as peoples' experiences on the periphery of a tornado damage path. Although people and property on the periphery are usually safer than within the path itself, their relationship to the path is purely a chance condition. These areas still possess important moments for mitigation decisions carried-out by the physically unscathed (and less-scathed) residents, and it is probably important to understand this "near-miss" experience.

Factors such as knowledge and perception of the location, timing and magnitude of events, attitudes about effectiveness and meaning of warnings, and feelings of survivor-guilt may generate pledges to undertake higher vigilance, increased responsiveness to warnings, and safer behavior. Indeed, personal awareness of tornado risk may be raised, and commitment to future mitigation practices in light of a recent disaster may appear strong. Such mitigation efforts may include technological (acquisition of a weather radio for instance), infrastructural (installation of either tornado safe rooms or storm clips to roofs) or behavioral (heeding warnings, sheltering, or evacuation) efforts.

RESEARCH DESIGN

A week after the event, the principal investigator and three research assistants traveled to the tornado disaster zone where an F-3 tornado had caused significant damage, injuries, and loss of life in a path that cut through and near the small town of Siren, Wisconsin. The path of the tornado was surveyed by ground and air and was mapped and recorded with conventional and digital cameras and video. The research team sought out residents near the edge of the path of destruction who had experienced the storm but did not bear its full brunt and were therefore still present and occupying their homes. Information regarding monitoring of the developing extreme event, preparedness, pre- and post-disaster response activities, perceptions of the event and of risk from future events, and plans for future mitigation were assessed through informal interviews using a standardized set of questions developed prior to the event (Table 1). In addition to collecting information about location and household characteristics, the research team gathered data regarding warnings, response, and possible future mitigation and responses. This study provides a baseline for later longitudinal studies of time's impact on efforts at mitigation planning and action.

THE GEOMETRY OF IMPACT, THE PERIPHERY OF THE DAMAGE PATH, AND SURVEY POPULATION

The Village of Siren stretches north and south of east-west trending 2-lane state highway 70 at its intersection with state highway 35. The downtown area of Siren is just north of this intersection and has recently expanded northward along highway 35 with businesses oriented toward tourism (primarily hunters and anglers). The path of the tornado paralleled highway 70 and was nearest that highway as the storm progressed through the business district (Figure 2), thus many businesses were devastated and a 6-block residential area to the east of downtown was leveled. Little residential development could be found to the north of the damage path where the town gave way to lakes and forestland. The only sizeable and remaining subdivision of residential development suitable for study was a 15-square block area to the southeast of the 70-35 intersection and a 9-square block area to the southwest of this intersection. These were the homes where the survey was administered for this study. Other homes untouched by the storm were scattered to the northeast and east of the town and were not surveyed. The study-area may have experienced gusty winds, downbursts, lightning, and hail, but experienced only minor damages.

The Village of Siren is a small community in Burnett County, Wisconsin. The population of 988 is ethnically homogenous (98% White and 2% American Indian). The population is stable, economically lower middle class, and is composed of a significant number of elderly and retired residents. In 1989, the average annual household income was approximately $15,500. The average age of the Village population in 2000 was 41.9 and 30% of the population was 62 years of age or older. While 60% of the 413 occupied housing units were occupied by homeowners, the balance was occupied by renters. In the Town of Siren, a more rural political unit based upon the 36-square-mile township surrounding the Village, housing occupancy, though higher during the summer months due to the influx of vacationers, is actually below 50%. A larger percentage of the housing in the Town of Siren is rental housing than is the case for the Village (U.S. Census Bureau, 2001).

The team interviewed residents in 31 households. Though surveys of many other homes was attempted, many were unoccupied during our visit. Often, residents were volunteering at the local recovery center and were not available for interview. The sample of the population surveyed represents 10% of the approximately 300 occupied residences that survived the storm in the Village and the township in the immediate vicinity of the central place.

RESULTS

The survey responses were primarily from households that had only one or two adults in permanent residence (Table 2). Seven respondents were the only resident adults in the household while 18 lived with one other adult. Four had two other adults living in the house (for a total of 3) and one household had four resident adults. At the time of the storm, in early evening, most adults were at home, but in three cases, no one was home. In 27 cases, at least one adult was at home.

More than half of the respondents (16 of 31) did not have children living in the house, which is consistent with the Village's proportion of households with children (approximately 47%). Fewer households had children at home during the storm as well (19 of 31). Other "children" in the home often elicit special attention during severe thunderstorms and the chaos of damaging weather events: only 12 of the 31 households had no pets, requiring nearly two-thirds of respondents to care for pets during their moves for protection during the tornado.

Almost three-quarters of respondents, 72%, were home during the evening storm, and although at least one person knew nothing of the devastation until the next day, more than half, 62%, were aware within just a few minutes that a tornado had generated damage in town. Similarly, almost two-thirds of those interviewed on the edge of the damage path, 63%, believed that their home had been hit or damaged by the tornado. The most common reasons given to explain their beliefs included the noise and wind associated with the storm; falling trees; and the sound of hail hitting windows, roofs of houses, and sheds.

Warnings

Although the source and type of warning varied, more than half of respondents, 53%, said they had received a warning (Table 3). Approximately one-third of the individuals, 35%, received a severe thunderstorm warning indicating an imminent and potentially dangerous thunderstorm. Another 35% gained a heightened sense of awareness through the issuance of the tornado watch, indicating the potential for the development of tornadoes. Lastly, a little more than a quarter of respondents, 27%, received a warning of an actual tornado developing or of a funnel cloud on the ground.

One third of those interviewed received their warning from television (Minneapolis-based broadcast networks), with an equal percentage receiving their warning over the telephone. Thirteen percent received their warning through word of mouth, and the same number obtained a visual warning by looking at the sky. With respect to amount of warning time, 18% said that they had less than one minute of warning time. On the other hand, nearly a half of the respondents, 45%, had 1 to 10 minutes of warning. Nine percent had 11 to 15 minutes, while nearly one quarter, 23%, had 16 to 30 minutes of warning. One individual reported having more than 30 minutes of warning time.

Forty-one percent strongly agreed and 36% generally agreed that their warning had given them enough time to seek safe shelter. Nine percent and 14% disagreed and strongly disagreed, respectively, and felt the warning did not give them enough time to seek safety. The most common complaint was that the tornado hit quickly. Also, because the town's emergency siren was inoperable due to a lightning strike the previous month and there was an interruption of the town's electricity 20 minutes prior to the tornado, some never heard the National Weather Service's tornado warning.

Sixty-five percent of study respondents were relatively pleased with the applicability of the warning to their personal circumstances. Twenty-six percent strongly agreed and 39% generally agreed that the tornado warning was adequate for their location, while only 22% and 13% disagreed and strongly disagreed, respectively. But, when participants were asked if they believed that the "overall" tornado warning was adequate, two-thirds were displeased with the warning.

Response

Eighty-one percent of respondents stated that they had a preset plan of action in the event of a tornado (Table 4). Once again, more than 4 out of 5, 83%, of those interviewed claimed that their action plan involved going to their basements. The remaining plans were to move to a closet, the lowest room, a bathroom, and a crawl space. Fifty-seven percent followed their action plan, however, those that did not were either not at home, sheltered in an alternative location, watched the storm from their porch, or were entirely unaware of the storm.

Sixty percent sought out or gathered family members before moving to a safe place. More than three-quarters, 76%, felt safe in their actions to evade the tornado or reduce its impact, which, as mentioned earlier, largely involved going to the basement. However, 38% moved to an interior room, bathroom, or a closet for safety, and one person moved to a bathtub for protection. No one moved to a motor vehicle for safety; left a car, truck, or motor home; or moved to a low-lying depression or ditch. Three-quarters of respondents appropriately never opened their windows before the

tornado. Twenty-one percent closed their windows; only one person intentionally opened them.

More than half of the respondents, or 54%, attempted to visually verify the tornado threat before taking action. Of those that watched for the tornado, almost two thirds, 62%, looked at the sky for the storm for 1 to 5 minutes. Twenty-three percent of those watching looked briefly (for less than a minute). One person watched for 16 to 30 minutes, while another looked out for more than half an hour. Three-quarters of those interviewed did not see the tornado. But of those that said they did see a tornado, approximately one-half, 45%, watched the tornado for less than a minute, and another third watched it for 1 to 5 minutes. Nobody that we talked to, however, photographed or videotaped the tornado.

Fifty-four percent believed that the chance of experiencing another tornado at their given location was less than 10%. Eleven percent thought that there was a 10 to 25% chance that a tornado would be experienced again at their location. An additional 18% believed that there was a 25 to 50% chance of a recurring tornado. Lastly, 7% felt that there was a 50 to 75% chance, while 11% (greater than 75% chance) expected another tornado at their location. Surprisingly, several people voiced the belief that they lived in a mini-tornado-alley that encompassed the region northeast of the Minneapolis-St. Paul metropolitan area.

Future Response and Mitigation

More than half of respondents, 55%, said that they would respond differently in the future. The most frequently cited actions that people would undertake to prepare for future threats included the acquisition of a NOAA weather radio and reliance on it and television for weather information and warnings. Another common response was that some residents would seek shelter in the lowest level of the home in the future. Other responses included flight from the tornado path, reliance on commercial radio for weather updates, the commitment of more time spent looking for or at the tornado, and conversely, spending less time looking at the tornado. When asked if there were any outstanding lessons, the responses were thoughtful and varied (Table 5).

DISCUSSION

An important aspect of this "near-miss" experience includes approximately a quarter of respondents, 26%, that had positive beliefs in the adequacy of their personal warning, given that the tornado did not directly affect their precise location, but experienced feelings that the overall tornado warning was unsatisfactory, possibly given that nearby places sustained a direct hit from the storm. Once again, there appeared to be an emphasis and implied dependency on being able to hear a working siren.

Interestingly, NOAA weather radio reception in and around Siren is fairly weak, thus virtually no one received a warning via NOAA weather radio. Since the electricity went off 20 minutes before the tornado hit, most people knew only of a tornado watch issued much earlier or of a severe thunderstorm warning issued on television within the hour prior to the storm. Television sets ultimately proved ineffective in disseminating an actual tornado warning. Even when receiving phone calls from friends and relatives or hearing of a tornado warning over a fire/police scanner, many waited for a confirmation from the town's siren, which, as mentioned earlier, was inoperable.

A majority of people attempted to visually verify the storm before taking shelter in a basement. The National Weather Service does not recommend such behavior, and many regretted doing this, stating that they realized it was a "stupid" response that they would refrain from in the future. In fact, some did not take shelter until they noticed trees starting to go down. However, the Siren tornado was most likely shrouded and obscured by curtains of rain and would not have been visually apparent to most people outside the storm.

Some people on the south side of town near the edge of the damage path viewed the rotating thunderstorm with a low cloud base and a rain-wrapped tornado that was largely blocked by trees. Witnesses said that enough moisture and/or debris existed in the air such that they could "see" the wind. Given the long summer day, improvements in film emulsions, and enhanced video cameras of today, most people would have had little if any problem recording the

images of the tornado on film or video, had they actually seen it. This is especially true given the ample amount of time that some residents spent on their front porches looking at the sky for a funnel cloud.

CONCLUDING COMMENTS

Through this study, the research team garnered a greater understanding of the less-studied victims involved in a "close-call" with a tornado: a sudden onset, spatially variable event. We identified common attitudes, beliefs, and behaviors jointly referred to here as reflecting a "near-miss" experience of a regional nature in Siren, WI. The examination of individual perception of timing, magnitude, adequacy, and meaning of storm warnings as they relate to the desire for future mitigation augment the present status of disaster theory. This study provides a baseline for future longitudinal study that will help clarify the connection, weaknesses, and conflicts between expressed and revealed mitigation activities. The information gathered can inform risk and emergency managers so that they may induce and reinforce more effective mitigation measures undertaken by the public.

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