

Evacuation Decision-Making during Hurricane Matthew: An Assessment of the Effects of Social Connections

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ABSTRACT

This study conducted in Florida examines the relationship between an individual's social connections and their decision to evacuate during a hurricane warning. Using Hurricane Matthew in 2016 as a case study, a survey was conducted on two groups (those who evacuated and those who did not), assessing one's social connections considering three dimensions: dependability, density, and diversity. These factors, in addition to socioeconomic variables (e.g., age, race, education), were used to better define a picture for what influences evacuation decision-making. To avoid memory decay, the surveys were completed at the time of the evacuation for those who evacuated and immediately after the passage of Matthew for those who did not evacuate. It was concluded, through statistical analyses, that the perceived dependability of a person's social connections (i.e., their perceived access to resources and support) played a significant role in the decision to evacuate or not, with non-evacuees having more dependable relationships and having a tightknit community they can rely on during a storm event. On the other hand, the density and diversity of peoples' social connections did not significantly impact the decision to evacuate. This study has important implications for adding to the knowledge base on community-based sustainable disaster preparedness and resilience.

1. Introduction

The impact of major hurricanes striking the United States has redirected attention to examining the influence of social support and social connections in prompting individuals and families to evacuate when a storm warning is issued (Dash and Gladwin 2007; Gladwin et al. 2001; Haines et al. 2002; Whitehead et al. 2000). The devastating impact particularly of Hurricane Katrina on the city of New Orleans and surrounding Gulf Coast (Schmidlin 2006) heightened the need to understand the way social connections function, particularly for vulnerable populations who have become socially and economically marginalized (Cutter et al. 2003; Moore et al. 2004; Real 2007). As a result, understanding the influence of social connectedness and social support

on evacuation behavior remains a relevant component for disaster mitigation and preparedness planning.

Vulnerability research encompasses geophysical processes as well as social and economic factors (Cutter and Finch 2008; Tobin and Montz 1997; Wisner et al. 2004). Wisner et al. (2004, p. 11) define vulnerability as "the characteristics of a person or group and their situation that influence their capacity to anticipate, cope with, resist and recover from the impact of a natural hazard." This conceptualization of vulnerability shifts attention to the role social connections and supports play in buffering people, processes, and places when confronted with exposure to a natural hazard. Much of this thinking is incorporated into the well-known Pressure and Release model (PAR) developed by Wisner et al. (2004), which identifies various social and geophysical pressures believed to heighten the level of vulnerability for individuals and communities, thereby contributing to a disaster.

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While literature on the function of social connectedness within a context of natural disasters continues to emerge, there is empirical evidence on the utility of social ties in buffering pathogenic stressors (Caplan 1974; Sarason and Sarason 1985). Specifically, the work of Cohen and Wills (1985) notes that social supports act to “buffer” or protect persons from harmful influences of stressful life events. They discuss both structural and functional measures of social integration and note that while the former assesses the existence of relationships, it falls short of measuring “the functions actually provided by those relationships” (Cohen and Wills 1985, p. 314). They further note low correlations reported in other studies (e.g., Barrera 1981; Cohen et al. 1982) between the number of social connections and functional support since “adequate functional support may be derived from one very good relationship, but not be available to those with multiple superficial relationships” (Cohen and Wills 1985, p. 315). Cohen et al. (1985) recommend further study of the functional domain of social support, particularly tangible resources that an individual can depend on in coping with an impending stressor and the utility of social supports within other contexts. Our conceptual framework considers the role social support and social connectedness have on peoples’ evacuation decision-making. We argue that supportive functional social connections may buffer people from the deleterious impact of a hurricane.

Lakey and Cohen (2000) suggest social supports buffer a stressor to the extent that the type of support adequately meets the demand of the stressor. Therefore, it is important to examine the diversity of one’s social connections and the function or dependability of the support available. Miller (2007) acknowledges the important role of diverse formal and informal social connections in sharing information and establishing trust during evacuations stemming from Hurricanes Katrina and Rita. Both the number of contacts and the range of contacts across different social roles aided in the evacuation process.

The density or closeness of social connections and ties with individuals who share similar social and economic characteristics has been shown to provide increased sources of support during a natural hazard (Haines et al. 2002; Haines and Hurlbert 1992). Social isolation stemming from a lack of connectedness with social supports was found to contribute to one’s vulnerability, as suggested by the demographic profile of those who did not evacuate during Hurricane Katrina (Brinkley 2006). Likewise, social connections deemed to be weaker or less dense, but provide greater network diversity, suggest increased access to resources that are harder to obtain (Granovetter 1973; Unger and Powell 1980).

How social connections are utilized to influence hazard evacuation behavior remains a critical component for the development of disaster resilience models as part of mitigation and preparedness planning (Buckle 2006; Dynes 2002). Dynes (2002, p. 18) asserts that “social networks provide the channels whereby individuals develop a perception of risk and can be motivated to take some type of preventative action.” While social supports are intuitively thought to play a pivotal role in disaster preparedness and decision-making (Mathbor 2007), a paucity of studies on the topic provides mixed results with regard to hazard evacuations (Dynes 2002; Riad and Norris 1998). Therefore, it remains uncertain just how informal supports and social connections are used to arrive at a decision to leave or stay and whether the process varies in relation to certain social and economic characteristics of individuals and their communities (Moore et al. 2004).

Figure 1 depicts the conceptual framework guiding this study. Characteristics such as ethnicity, gender, age, income, and education often shape the number and types of social connections formed among people. Here, social connections are operationalized according to three dimensions: density, diversity, and dependability. Each is assessed from high to low using two validated instruments. Social connection density refers to the number and the closeness of social relationships. Social connection diversity measures the variety of social relationships (e.g., within and outside the family). Social connection dependability assesses the perceived functional nature of the social relationship to determine any tangible type of support or resource available. Solid arrows in the figure illustrate our deconstruction of social connectedness into the three dimensions, which in turn are suggested to influence evacuation behavior. Dashed arrows indicate the possible outcomes resulting from evacuation decision-making, that is, to evacuate or not evacuate (nonevacuation in our study includes those who sheltered in place or went to a local shelter).

We examine the following hypotheses related to the density, diversity, and dependability of social connections with regards to evacuation status during Hurricane Matthew in October 2016. People who evacuated (evacuees) compared to those who did not (non-evacuees) will have a significantly larger number of social supports (more dense), significantly closer supports (more dense), significantly varied supports (more diverse), and significantly more functional supports (dependable). In addition, we posit that there is a positive correlation between social class and dependability of social connections.

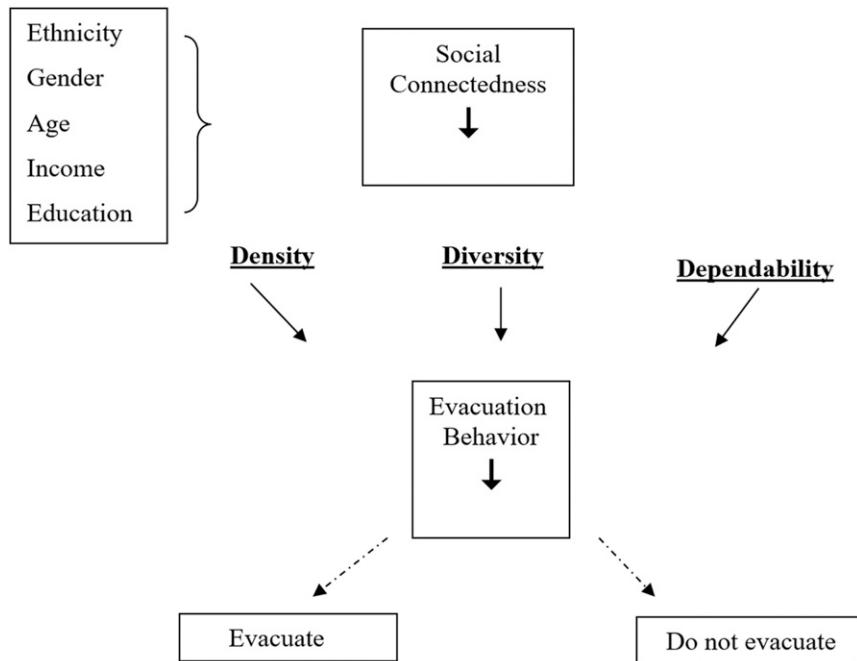


FIG. 1. Conceptual framework.

2. Methodology

a. Study area

Because of Florida's long peninsula, there are limited choices in evacuation routes, thus increasing vulnerability for the coastal population (Cutter et al. 2007). Dow and Cutter (2002) note considerable traffic pressure during an evacuation with choke points forming on highways where cars can be jammed for hours. This study surveyed evacuees at a westbound rest stop on Interstate 4 in Polk County, Florida, on 5 and 6 October. Surveys of non-evacuees were conducted at a Home Depot in the city of Titusville on 8 October and a Walmart Neighborhood Market in Port Orange on 9 October (Figs. 2, 3). On 2 October, the Florida east coast was on the western edge of the 4–5-day forecasted track cone of uncertainty. On 3 October, the majority of the eastern side of the state of Florida was in the cone of uncertainty for the 4–5-day forecasted track. On 4 October, Brevard County, which includes our study sites where we interviewed non-evacuees, was under a hurricane watch. On 5 October, Brevard County was in the 1–3-day cone of uncertainty. On 5 and 6 October, Brevard County had a mandatory evacuation order for barrier islands, Merritt Island, low-lying flood prone areas, and mobile or manufactured homes. Governor Rick Scott urged other coastal residents potentially in harm's way not to wait to leave. On 7 October, as the storm skimmed Florida, Brevard County was the portion of Florida closest to

Matthew's Center (Stewart 2017). On this date, a tropical storm warning was issued for the Volusia/Brevard County line to the Flagler/Volusia County Line.

b. Survey

A 15-min survey instrument containing 62 items was used to collect sociodemographic data along with information on previous and current hurricane evacuation experiences; factors influencing evacuation decision-making; and the density, diversity, and dependability of social connections. The latter three dimensions were measured using two valid questionnaires related to research on social ties and networks.

1) BERKMAN–SYME SOCIAL NETWORK INDEX

The Berkman–Syme social network index (B-SSNI; Berkman and Syme 1979) measures the diversity and density of an individual's social connections. We used the B-SSNI to assess the type, size, closeness, and frequency of contacts in a respondent's current social network. This 11-item instrument is a composite measure of several types of social connections: sociability (number and frequency of contacts with close relatives and close friends), church group membership, and membership in other community organizations.

2) INTERPERSONAL SUPPORT EVALUATION LIST

The interpersonal support evaluation list (ISEL; Cohen and Hoberman 1983; Cohen et al. 1985) measures



FIG. 2. Location of our surveys.

the functional component of social support. [Cohen and Syme \(1985\)](#) refer to social supports as those resources that can be offered by other individuals to provide aid or assistance. We use the ISEL to assess the perceived dependability (or functionality) of an individual's social networks. The 40-item general population version of the ISEL is divided into four subscales. For the purpose of our study, the tangible subscale was used, incorporating 10 items to assess a specific form of support the respondent believes can be obtained from his/her social support network (e.g., if I needed a ride to the airport very early in the morning, I would have a hard time finding someone to take me). Each item is rated on a four-point Likert scale with anchors ranging from "definitely true" to "definitely false." [Cohen et al. \(1985\)](#) report the ISEL

to have excellent internal consistency and good test-retest reliability.

c. Data collection procedures

An important limitation to evacuation behavior studies is the potential for "memory decay" when asked to recall past actions and factors that influenced decisions ([Stallings 2002](#)). [Baker \(1979, 1995\)](#) and [Lindell et al. \(2005\)](#) note that in addition to the inability of people to articulate their prior decisions, it is also likely that people's ideas and perceptions also changed over time. [Brewer \(2000\)](#) notes it is particularly difficult when people try to recall their social networks. Since memories change with the passage of time, the timing of research of people in relation to their hurricane experiences and evacuation decisions is critical. In this



FIG. 3. Photo of team member and survey participant.

study, we overcome this problem by collecting data for an expected landfalling hurricane immediately as evacuation commenced. The Interstate-4 rest stop location allowed us to capture evacuees as they came from the east coast of Florida inland. Senkbeil et al. (2010) and Brommer and Senkbeil (2010) also adopted this real-time approach for their evacuation study of Hurricane Gustav. In addition, data were collected on the non-evacuees immediately after the storm passed. This methodology of collecting real-time or near-real-time data will likely provide more accurate results than previous studies since people are more likely to remember the intricacies of their decisions, allowing us to gain useful insight. Convenience sampling was used here because of the real-time conditions under which data were gathered. Norris (2006) has noted the prevalent use of this method in her analysis of 225 disaster studies. Only one person from a family or group was surveyed.

d. Data analysis techniques

All data were coded and cleaned and then analyzed using the Statistical Package for the Social Sciences (SPSS), version 23. Statistical analyses focused on two-tailed independent samples Student's *t* tests for the difference in means to examine evacuation status on each

measure (e.g., density, diversity, dependability) and Mann–Whitney *U* tests to compare sources of information participants relied on to inform their evacuation status and the degree to which they relied on them. A Spearman's correlation was conducted in order to determine the correlation between dependability of social connections and social class (as measured by several demographic data collected such as income and education). These different tests were used due to the varying types of data collected from the survey, some being continuous, some categorical, and others ordinal.

3. Results

a. Sample size and characteristics

Our sample size was $N = 132$. Those surveyed included 15 early evacuees on 5 October, 47 later evacuees on 6 October, 17 Titusville non-evacuees on 8 October, and 53 Daytona non-evacuees on 9 October. The groups were combined to create 62 evacuation surveys and 70 non-evacuation surveys. It was noted that evacuees often came from locations outside of areas that were under a voluntary or mandatory evacuation order. Likewise some non-evacuees were found to live in areas that were ordered to evacuate. The rejection rate was 65% for people not willing to complete the survey, possibly because of the rush evacuating from the storm or repairing damage poststorm. Analyses of the sample revealed the category of each demographic variable, which people self-identified with the most, that is, 78.8% of people were between 18 and 64 years of age, 51.5% were female, 67.4% were white, 47.7% completed a college degree, and 23.5% made \$80,000 or higher. Note that for some of these demographic variables, there were several categories the participant could choose from; for instance, they had the option to self-identify with eight different incomes ranges and four different levels of education.

b. Evacuees versus non-evacuees

It should be noted that with the non-evacuee group, no one reported going to a shelter. We used a two-tailed independent samples Student's *t* test for the difference between the mean responses of evacuees and non-evacuees (Table 1). The B-SSNI looked at density in regards to how many people are found in their networks and how close they are, along with network diversity. When considering the two dimensions of density and diversity, results showed no significant differences between evacuees and non-evacuees. However, a significant result was found with the social connection dimension of dependability using the ISEL index, comparing evacuees to non-evacuees: $t(125) = -2.089$ and $p = 0.039$. When comparing the mean score for

TABLE 1. Hypotheses, variables, tests, and results. Note the Student's t test refers to a two-tailed independent sample Student's t test for difference in means. Values in bold represent significant results found with the social connection dimension of dependability using the ISEL index. Note that those who go to a shelter or those who shelter in place are referred to in this paper as non-evacuees. In this study, there were no participants who responded that they went to a shelter.

Hypothesis	Variables	Tests	Results
People who evacuate out of their county will have a significantly larger number of social connections than those who evacuate to a shelter or those who shelter in place (H_1).	Measures of network size from B-SSNI	Student's t test	$t(115) = 1.477, p = 0.142$
People who evacuate out of their county will have significantly more dense social connections (i.e., closer ties) than those who evacuate to a shelter or those who shelter in place (H_2).	B-SSNI density index	Student's t test	$t(118) = 0.227, p = 0.821$
People who evacuate out of their county will have significantly more diverse social connections (i.e., varied types) than those who evacuate to a shelter or those who shelter in place (H_3).	B-SSNI diversity index	Student's t test	$t(118) = -0.186, p = 0.853$
People who evacuate out of their county will have significantly more dependable social connections (i.e., functional support) than those who evacuate to a shelter or those who shelter in place (H_4).	ISEL index	Student's t test	$t(125) = -2.089, p = \mathbf{0.039}$
There is a positive correlation between social class and dependability of social connections (i.e., functional support; H_5).	Income and education level; ISEL index	Spearman's rho	Income: $r_s = 0.249, p = \mathbf{0.011}$ Education: $r_s = 0.186, p = \mathbf{0.041}$

dependability between the two groups (evacuees and non-evacuees), evacuees show a lower mean score (22.24) compared to non-evacuees (24.74), suggesting that those who evacuated perceived their networks to be less dependable. We might infer that non-evacuees felt they could rely on their networks for support allowing them to hunker down, feeling secure with the people around them. The Mann–Whitney U test, which looked at evacuees and non-evacuees and if they relied on family far away (50 miles or more) for information that influenced their decision to evacuate or not showed a significant relationship again pointing to this conclusion ($U = 1612.5, p = 0.023$).

Finally, we examined the correlation between dependability and social class based on income. The Spearman's rho indicated a weak to moderate positive significant relationship ($r_s = 0.249, p = 0.011$). Likewise, examining the correlation between dependability and social class based on education, the Spearman's rho showed a weak, positive significant relationship ($r_s = 0.186, p = 0.041$). Other demographic variables, such as ethnicity, were considered in our analyses, but only income and education showed significant relationships.

4. Conclusions

The decision to evacuate from a hurricane is characterized by a multitude of social- and storm-specific

variables that together relate to the seriousness of the threat and combine to influence risk perception and decision-making differently for each individual or household. Many evacuation behavior studies have examined meteorological variables related to the decision-making process (Zhang et al. 2007; Senkbeil et al. 2010; Brommer and Senkbeil 2010; Stein et al. 2010). This study considers the social influences on hurricane evacuation behavior, which has emerged as a strong influence from recent storms such as Hurricane Katrina. The development of sustainable community-based disaster preparedness will benefit from approaches that consider the influence of real-time decision-making regarding the role of social support and connectedness on evacuation decision-making. This research showed that the dependability dimension of social connections has a significant effect on the decision to evacuate, with those who have more perceived functional support tending to not evacuate, as they feel comfortable and receive support with their local communities. Because of the results from the Spearman's rho, areas of socioeconomic weak spots (as determined in this study by education and income) may have trouble in an emergency situation because of the importance of functional support as determined by the dependability dimension. Further studies considering social connections related to future hurricane evacuations are needed to verify this result. Hazard managers may be able to integrate this new

knowledge into more targeted disaster education campaigns. Likewise, local disaster service organizations may better understand the role social support and connectedness play in linking individuals to preparedness and recovery services as a way to promote community resiliency.

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