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## Efficacy and authority of the message sender during emergency evacuations: a mixed methods study

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### ABSTRACT

To understand why coastal residents do not always evacuate before storms, a pair of studies analyzed evacuation decision-making among residents of Long Beach, NY and surrounding municipalities on Long Island, NY via a mixed methodology approach. First, residents who lived in Long Beach, NY during ‘Superstorm’ (hurricane turned post-tropical cyclone) Sandy in October 2012 were interviewed about their evacuation decision. Second, 34 pre-storm messages were developed and administered to residents of the same area: faced with a hypothetical oncoming hurricane, respondents indicated after each message whether they would evacuate. In the interviews, residents spoke more about friends and family than traditional authority figures; survey results, however, imply that residents are more likely to evacuate given messages from traditional authority figures. This can be resolved with the Elaboration Likelihood Model of persuasion, which suggests that motivation and emotional state influence information processing. Implications for actual emergency message formation are discussed.

### ARTICLE HISTORY

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### KEYWORDS

Evacuation communication;  
coastal storm; Superstorm  
Sandy; authority

This purpose of this study is to consider whether and how the source and content of messaging influence evacuation behavior prior to a major storm event and to make recommendations for enhancing the effectiveness of messaging strategies by local governments and emergency management teams. The study employs a mixed methodology approach, using retrospective accounts of actual behavior gathered during post-Superstorm Sandy interviews and prospective surveys about a hypothetical storm situation. Subjects for the interviews and surveys, respectively, were residents of the barrier island coastal community of Long Beach, New York. Prior research on source credibility and French and Raven’s (1959) concept of interpersonal power, as well as Petty and Cacioppo’s Elaboration Likelihood Model (ELM) (1986), provide a theoretical framework for considering the receiver’s psychological state and social relations between sender and receiver as factors that influence whether and how messages are received and acted upon.

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## Literature overview

There is a small window of time during which residents in the path of an oncoming storm must decide whether to evacuate to a more secure location. Despite adjustments to the storm warning system, including the ongoing development and deployment of recommendations from the Hurricane Forecast Improvement Program (<http://www.hfip.org/>), there still appears to be a large gap between the desired reaction to coastal evacuation warnings and actual resident behavior. According to city officials, approximately two-thirds of Long Beach, NY residents did not heed the order to evacuate before the landfall of hurricane/post-tropical cyclone Sandy in October 2012, despite clear warnings from the City Manager and others to do so. In contrast, at the peak point of evacuation after the storm, an estimated 90% of people left the city due to infrastructure and housing damage (Jack Schnirman (City Manager) and Gordon Tepper (Director of Communications), personal communication). Ultimately, 'Superstorm' Sandy killed 147 people, although no casualties were reported in Long Beach, and caused at least 50 billion dollars in damages when it made landfall on 29 October 2012 (National Climatic Data Center/National Oceanic and Atmospheric Administration, n.d.; National Hurricane Center/National Weather Service [NHC/NWS], 2013).

Following previous studies on hurricane evacuation behavior, the current study recruited a population heavily affected by this recent storm, located in Long Beach, NY. The nine-mile-long barrier island that includes the City of Long Beach varies in width from 1500 to 4000 feet. Bounded on all sides by water, the terrain is low-lying and flat, with elevations generally less than 10 feet above National Geodetic Vertical Datum. The island is subject to flooding during storms and unusual high tides (Coastal Planning and Engineering, Inc., 2009). Despite the known flooding risk, residents of Long Beach largely ignored evacuation warnings before the 2012 storm, including the remarkably successful forecasts of the storm track and predicted impacts (Cohn, 2012; Gall, Franklin, Marks, Rappaport, & Toepfer, 2013; NHC/NWS, 2012, 2013; Samenow, 2012). Examining the gaps in communication that may have contributed to failure to evacuate is an important step towards mitigating the loss of life during future storms. To identify the types of information residents are using and the relative importance of that information and corresponding sources, the current pair of studies used a mixed methodology approach through personal interviews and storm messaging questionnaires.

## *Psychological factors impacting the decision process*

During the days leading up to a storm, residents are receiving information from a variety of sources, including official weather services, government representatives, family, and neighbors, either directly or by way of television, radio, or social media. Some of the information from these various sources may be contradictory, perhaps due to competing goals of various actors in the emergency warning system such as emergency managers and media outlets (Anthony, Cowdon-Hodgson, O'Hair, Heath, & Eosco, 2014; Veil, 2012). These competing messages may only serve to confuse residents in their decision-making process regarding evacuation. It is clear that risk perception is not

simply a formulaic problem that will resolve itself when residents are given the correct scientific information in a timely manner. Instead, there are several layers of internal biases, defense mechanisms, and beliefs that need to be addressed during the dissemination of storm information.

Current hurricane warning systems emphasize information regarding storm track, wind speed, and flooding potential. However, strict guidelines about the scientific classification of storms as ‘hurricanes’ limited the use of the term in reference to a devastating storm approaching the northeastern coastline in late October 2012. Authorities were left with the cumbersome title of ‘Post-Tropical Cyclone Sandy,’ which may not have adequately conveyed the severity of the oncoming storm (Lubick, 2013; Meyer, Baker, Broad, Czajkowski, & Orlove, 2014). Without the specific label of ‘Hurricane Sandy,’ residents may not have understood the physical size and strength of the storm. Indeed, the first recommendation of an internal study by the U.S. Department of Commerce on future National Weather Service storm warnings addresses this problem (U.S. Department of Commerce, 2013).

In addition to technical labeling requirements, emergency management officials are often engaged in an uphill battle against the prior beliefs of the residents they wish to evacuate. Although the weather community may be systematically skipping the more personal component of risk communication (Lazo, 2012), the perception of risk may rely more on attitudes and specific fears rather than calculations of probability and magnitude (Sjöberg, 2000; Slovic, 2000; Westerman, Spence, & Lachlan, 2012). One example of this is the role of prior experience with extreme weather and the associated storm warnings. If the same language is used to describe several different levels of risk, residents may become immune to how dangerous any given storm may be (the ‘cry wolf effect’; Dow & Cutter, 1998; Whitehead et al., 2000). For example, prior research found lower risk perception and concern given a hypothetical oncoming hurricane among Florida residents who had previously experienced a hurricane (Meyer, Broad, Orlove, & Petrovic, 2013). In the case of ‘Superstorm’ Sandy, experience with the less drastic Hurricane Irene just a year prior may have altered some residents’ perceptions of the veracity of storm information (NHC/NWS, 2012, July 17). Experiencing ‘near miss’ events, such as Hurricane Irene, often leads to failure in taking protective measures in the future (Dillon, Tinsley, & Cronin, 2011).

Furthermore, in attempts to relay scientific information to the lay public, misinformation is often harder to correct than ignorance (Lewandowsky, Ecker, Seifert, Schwarz, & Cook, 2012). Once a person latches onto a particular piece of information, it is difficult to change his/her opinion based on further evidence or retractions of the initial information. This is particularly important as later storm warning messages may contain important updated data regarding evacuation options, road closures, power failures, and other emergency situations. Although there is a need to repeat emergency messaging throughout the time leading up to the storm, residents may become overwhelmed by the constant barrage and start to ignore later messages (Morrow, 2009) – a concept noted in interviews of local media members in a hurricane-prone area of southern Florida (Demuth, Morss, Morrow, & Lazo, 2012). This suggests that storm communication guidelines should consider the rate and quantity of repeated messaging throughout the days leading up to a storm.

### **Communication factors affecting the decision process**

Although understanding risk and prior exposure to extreme weather disasters may play a large role in the decision to evacuate, it is also important to remember that residents incorporate information from a variety of other, non-authoritative sources (Burnside, Miller, & Rivera, 2007). A study of people affected by Hurricane Katrina found that the influence of social relations (both friends and family) was more important during evacuation decisions than prior experiences of extreme weather events and duration of residency (Adeola, 2009). Similarly, interviews of evacuees from Galveston during Hurricane Ike indicated that influence from friends and family is approximately equal to the influence of authorities (Morss & Hayden, 2010). A study of college students' communications during crises indicated that 'participants were more likely to seek additional information about crises through other forms of media when they heard about crises through a third party' (Austin, Liu, & Jin, 2012, p. 203). Huang, Lindell, and Prater (2016) summarize in their review the many factors that significantly influence evacuation decision-making, including social cues such as other people's behavior. Their findings highlight the importance of informal networks that residents may reference while making evacuation decisions – and a need to determine the credibility of those informal sources.

There is an assumption in the psychological literature that 'authority' (e.g. related to the government) automatically means 'credibility' (e.g. trustworthiness), but this is not necessarily the case in the communication literature. Information seekers may incorporate sources outside the established power structure (i.e. 'authorities') that they believe to be similarly or more trustworthy (i.e. 'credible'). Austin et al. (2012) use the Social-Mediated Crisis Communication model to explore information seeking through social and traditional media, finding that informal communication on social media is as important for information seekers as communication from official sources. Separately, Anthony, Sellnow, and Millner (2013) refine a 'Message Convergence Framework' that was originally proposed by Perelman and Olbrechts-Tyteca (1969) to model the information-seeking process when audiences have access to competing sources and recommendations in the midst of a crisis. They found that source credibility is an important factor for deciding whether information pertaining to a crisis is believable; in particular, audiences paid more attention to established government entities than organizations whose profits were at stake. This finding suggests that the 'cry wolf effect' may result not only from the repeated use of messaging (Dow & Cutter, 1998; Whitehead et al., 2000), but also from the perception that messaging is influenced by the corporate interests of the source (Veil, 2012). For example, media outlets that rely on ratings may be perceived as unnecessarily 'hyping' upcoming weather events to gain more viewers. This perception may lead some viewers to disregard information despite the presence of appropriate meteorologists and other credible sources during the broadcast.

In general, a high-credibility source is more persuasive than a low-credibility source in gaining behavioral compliance; however, Pornpitakpan (2004) found that variables that can interact with source credibility may 'dramatically affect the superiority of a high-credibility source such that a low-credibility source turns out to be more influential' (p. 267). This paradoxical finding may be clarified by taking the issue of social power into account. French and Raven (1959) propose five different bases of power that account for different types of social influence. These five bases include: *reward power*, based on the perceived

ability of another to mediate rewards; *coercive power*, based on the perceived ability of another to mete out punishments; *legitimate power*, based on the perception that another has the legitimate right to prescribe behavior; *referent power*, based on interpersonal identification; and *expert power*, based on the perception that another holds special knowledge or expertise. In the case of storm evacuation warnings, the shift from a high-credibility to a low-credibility source (from a television meteorologist to a neighbor, for example) may be a matter of a shifting locus of influence from expert power to referent power on the basis of social identification.

In addition to the social relations between sources and recipients, studies of responses to disaster messaging have also attempted to account for psychological state as a factor (Rodríguez, Donner, & Trainor, 2017). A frequently cited model is Petty and Cacioppo's ELM (1986). The ELM explains different ways of processing persuasive cues, the conditions under which processing occurs, and the results. According to the model, there are two paths to persuasion: the central path and the peripheral path. An individual who has sufficient motivation and ability to engage with an issue will process messages along the central path that involves cognitive effort, such as weighing evidence and seeking out corroborating sources. An individual who lacks motivation to engage will instead process messages along the peripheral path, which usually involves variable attention to shorthand cues, such as slogans, appealing visual images, and estimations of the credibility of the source. The attitude shifts that result from peripheral processing tend to be fleeting and consequently less predictive of actual behavior than those that result from central processing. If the purpose of studying pre-storm messaging is to be predictive of human behavior during an actual weather event, it is important to consider whether or not processing of those messages is happening under similar conditions.

### ***Justification of mixed methods approach***

Under the ELM (Petty & Cacioppo, 1986), it is important to consider how motivation and processing ability impact the absorption and influence of incoming information from a variety of sources. The current paper studied evacuation decisions through a mixed methodology approach, using both retrospective and prospective measurements of hurricane evacuation behavior. Retrospective accounts of actual evacuation behavior may highlight how decisions occur in situations with highly emotional and time-sensitive components, while prospective surveys can assess how decision-making may occur under less motivated conditions. Our unique approach also builds on the frameworks of information seeking envisioned by Austin et al. (2012) and Anthony et al. (2013) by investigating the role of government authorities, local sources, and the media during the evacuation decision process. A comparison of the results of these studies both adds to the crisis communication literature in general and provides commentary on the consistency of results between the two methods, which should be considered when developing future studies.

First, we collected interviews from residents of Long Beach, NY within two years of landfall of 'Superstorm' Sandy. These personal accounts were then analyzed to identify key components of pre-storm evacuation decisions, both regarding traditional authorities and the role of friends, family, and neighbors. This represents a departure from previous studies' utilization of multiple-choice surveys, typically administered by phone. The open-ended interview methodology was selected for its potential to highlight aspects of the

evacuation decision process that may not be captured by close-ended survey instruments. In considering post-storm questioning of evacuation behavior, it is crucial to consider the potential for demand characteristics among respondents. When answering questionnaires or direct interview questions with limited pre-specified response choices, participants may feel social pressure to indicate 'smart' or 'rational' decision-making, even if that differs from what really happened. Although the use of questionnaires may be an easy way to find an overview of risk perception, one-on-one interviews are the best way to identify specific issues related to language and content, particularly when those interviews are constructed to avoid leading the subject into mentioning or discussing certain facts or reactions over others (Fischhoff, Bostrom, & Quadrel, 1993). By asking participants to narrate their experiences during the storm in response to agnostic questions, the resulting information is a more accurate personal description of the events surrounding the storm. By then analyzing the patterns of words used by Long Beach residents to describe their decision process regarding whether to evacuate before the storm, we can begin to identify what phrases and terms have the most salience and influence over that decision process.

In a separate second study, we then tested the perceived efficacy of specific messages based on the same themes coded for in the interviews. The messages were distributed across sources, including appeals from federal, state-level, and local government authorities, alternate local authorities (e.g. police, fire department, utility companies), weather authorities and information, and man-on-the-street style personal anecdotes to mimic informal community sources. These messages were developed to represent the types of sources previously indicated as likely to influence evacuation decisions, both in the initial interviews collected here and in previous literature (Adeola, 2009; Huang et al., 2016; Morss & Hayden, 2010).

Morss et al. (2016) cite 'limited previous related work on hurricane risk messaging' (p. 396), a deficit that our study aims to address. Our mixed methodology approach allowed us to consider both retrospective and prospective evacuation decision processes within a single affected community. The goal was to highlight the ability to replicate and extend earlier findings from previous interview-based studies (Adeola, 2009; Morss & Hayden, 2010), as well as use a more traditional questionnaire methodology to test potential framing of evacuation messages. We were particularly interested in how the social relationship between the messenger and receiver affects the influence incoming information has on the decision-making process. In line with previous literature on hurricane evacuations, as well as examinations of the credibility of informal sources by Pornpitakpan (2004) and French and Raven (1959), we hypothesized that retrospective interviews on the evacuation decision process would focus on friends and family as central informants to the decision. Likewise, we hypothesized that in our prospective survey, messages from local figures would influence decisions to evacuate more than messages from traditional authority figures.

A comparison of the results from the current studies indicates that the conditions under which evacuation decisions are made may heavily influence the kinds of information and sources residents find most persuasive. Overall, interview participants did disproportionately remark on the role of informal sources such as friends and family, but survey respondents were influenced more heavily by messages from traditional authority figures like the local government. The apparent disparity between our two studies with regards to authority figures (local vs. traditional) can be reconciled in light of the ELM

(Petty & Cacioppo, 1986): interview subjects and survey participants were likely processing information very differently due to the different levels of motivation under which they were operating.

## Methods

### *Study 1: assessment of evacuation decisions*

*Overview.* The first step towards creating new evacuation messages should involve attempts to understand what sources and types of information residents are currently using. The current study focused on a retrospective analysis of evacuation decisions during ‘Superstorm’ Sandy, but sought to avoid the limitations and demand characteristics inherent in the standard questionnaire approach. To that end, we collected interviews from victims of ‘Superstorm’ Sandy to assess what they were thinking at the time of the storm.

*Participants.* Forty-six residents of Long Beach, NY were interviewed regarding their experience during ‘Superstorm’ Sandy (21 female, mean age = 42.63 (SD = 13.52)). Interviews were mostly conducted with individuals, but 10 participants were interviewed in pairs due to their relationship and interlocked decision during the storm (e.g. husband/wife). Interviewees were recruited by self-selection with flyers posted in various locations around Long Beach approximately one month after the storm (including storefront windows, restaurants, City Hall), a call posted on the project website (<http://www.longbeachsandy.org>), social media, and word-of-mouth. Interviews were conducted between December 2012 and April 2014 (mean delay between landfall and interview = 171.75 days). No one who expressed initial interest in doing an interview refused; there was no compensation in exchange for the interview.

Interviewees signed both a consent form, approved by the Institutional Review Board of Hofstra University, and a release form. The release form was required for archival purposes; the interviews will be made publicly available through the National Center for Suburban Studies for future researchers and historians.

*Collection of interviews.* Interviews were structured by a series of questions. Closed (yes/no) and direct questions aimed to elicit brief, focused responses (i.e. ‘Did you remain in Long Beach the night of the storm?’ and ‘Do you remember where you got your information about the storm?’). Open-ended follow-up questions (i.e. ‘Can you tell me more about your decision [not] to evacuate?’) allowed respondents freedom to elaborate about salient issues, including sources of information and competing claims about the storm, without leading them in a particular direction. After a series of specific questions regarding different aspects of the decision and information leading to that decision, participants were allowed to add any remaining information they felt was pertinent to the discussion. The interviews were conducted by one of the co-authors (MAT) and three trained Clinical Ph.D. graduate students; the recordings were then transcribed by a hired transcriptionist to facilitate language analysis. For the five interviews that included two participants, the discussion of the evacuation decision by each person was analyzed separately, in case there were differences in the kinds of information that factored into the decision.

*Hand-coding of transcriptions.* Hand-coding was conducted by three trained undergraduate research assistants overseen by a Clinical Ph.D. graduate student. All three



research assistants first completed hand-coding of two transcripts with agreed-upon coding by the graduate student and one of the authors (EJP) to confirm that the research assistants understood the coding system. After the initial assessment and discussion of any discrepancies, assistants were assigned a subset of transcripts to code on their own. Both the graduate student and author randomly spot-checked transcripts to ensure that the coding system was implemented as intended. In addition, one of the authors (EJP) served as the second coder on all transcripts, with the two remaining co-authors (ECF and MAT) serving as arbiters of disagreements between coders. Initial interrater agreement between EJP and the three research assistants, prior to arbitration by ECF and MAT, is noted below within the descriptions of each portion of the coding scheme.

Interviews were initially coded for the final evacuation decision (evacuated prior to the storm, evacuated during the storm, or did not evacuate); interrater agreement was almost perfect between each research assistant and the first author based on standards set by Landis and Koch (1977) (raw agreement and Cohen's kappa for each assistant: 100% ( $\kappa = 1.00$ ), 94.12% ( $\kappa = 0.89$ ), and 91.67% ( $\kappa = 0.85$ )). Interviews were also coded for retrospective assessment of the decision (presence or absence of regret, stated either explicitly or passively; interviews could be coded as 'unknown' if no clear retrospective statement was made). Interrater agreement ranged from fair to almost perfect between each research assistant and the first author (raw agreement and Cohen's kappa for each assistant: 55.56% ( $\kappa = 0.33$ ), 72.22% ( $\kappa = 0.57$ ), and 91.67% ( $\kappa = 0.85$ )).

The focus of the current project was to identify factors associated with evacuation decisions (either to complete an evacuation or to remain in the home). As such, coders first selected sentences directly discussing the decision, or sentences neighboring to a sentence discussing the decision. Interrater agreement was moderate between each research assistant and the first author (58.33–66.67% raw agreement comparing mutually chosen sentences to total number of sentences chosen by either or both coders). However, given the length of each transcript, this calculation of interrater agreement is an underestimation because it only accounts for sentences identified by one or both coders, not the substantial remaining portions of the transcripts mutually ignored by both coders.

After identifying an appropriate sentence, the sentence was coded for the evacuation decision discussed (for or against), the level of emotionality (e.g. strongly for evacuation vs. ambivalent), and any named sources of information. Information sources were coded for both an overarching category (e.g. media, personal relations, previous experience with large storms) and a specific factor within that category (e.g. for media: television, radio, social media, etc.). There were a total of 38 codes when all possible specific factors were accounted for; a list of the categories and specific factors can be found in the [appendix](#). Interrater agreement for sentences mutually identified by both coders was substantial (raw agreement and Cohen's kappa for each assistant: 73.33% ( $\kappa = 0.69$ ), 75.00% ( $\kappa = 0.72$ ), and 85.71% ( $\kappa = 0.84$ )). The subsequent analysis included both frequency counts per category (e.g. previous history with hurricanes) per participant and the percentage of participants who made remarks related to each category. The latter was then used to make both qualitative and quantitative comparisons between groups of participants who did and did not mention a particular source (e.g. those who mentioned family and friends vs. those who did not mention family and friends) to examine whether certain sources were more likely to result in a decision to evacuate.

## **Study 2: message development and testing**

*Grounding Study 2 in the preliminary results of Study 1.* Even when residents are adequately aware of the dangers posed by a storm, they often do not follow evacuation advisories (Horney, Macdonald, Van Willigen, Berke, & Kaufman, 2010; Meyer et al., 2014). As noted in the introduction, risk communication is more than just the presentation of accurate scientific information regarding approaching weather patterns with accompanying explanations from distant authorities. There are many other personal factors at play when asking someone to leave his/her home, however briefly, that are not typically addressed by those issuing evacuation orders. These personal factors may include presence of family, mobility issues, and a perceived lack of resources to follow through on a decision to evacuate.

From Study 1, residents affected by Hurricane Sandy emphasized the role that family and neighbors had on their evacuation decisions to a much greater extent than the impact of information from formal authorities. This suggests that we need to investigate the role of information from and interactions with local sources as part of the overall evacuation decision process. Addressing hyper-local and/or personal concerns in evacuation messages is currently an underdeveloped area of weather communication (Lazo, 2012), so it is unclear at this point exactly what this messaging might include. Interestingly, there are existing theories that local sources may be more likely to use concrete, specific details than sources farther away from the area (Trope & Liberman, 2010) and residents may be more likely to heed warnings from local sources (Stein, Duenas-Osorio, & Subramanian, 2010). For example, compliance is more likely when warnings are issued by local officials compared to sources in the federal government (Donahue, 2010, 2012). Other research indicates that community networks, such as religious organizations, may impact the decision process (Kim & Kang, 2010). Therefore, when considering changes to evacuation messages, it is important to include local sources potentially outside those considered traditional authorities.

For the purposes of Study 2, local (fictional) messages include references to other families in the immediate area, a professor of meteorology from a nearby university, and interviews with local individuals (e.g. the 'man-on-the-street' interview often used in television news coverage). These messages were tested against more traditional messages from the governor, city manager, and weather service, as well as messages from intermediate sources like the local police, community center, and school system. If post-storm reflections from residents truly indicate the relative importance of local sources, it was hypothesized that the local messages would be more persuasive than the messages sent by traditional authorities or those including technical descriptions of the oncoming storm. As the definition of 'local' is hard to define and likely varies from person to person, it is unclear whether messages from individual local residents will be more or less effective than descriptions of actions by intermediate authorities such as the local police department or community volunteer organization. Part of the goal of the current study is to further inform what constitutes a persuasive 'local source' in an emergency context.

In addition, there was a clear pattern from the interviews collected in Study 1 of residents evacuating after the storm due to damaged infrastructure (e.g. electricity, water, sewer) that made staying at home uncomfortable or impossible. This finding was

corroborated by discussions with the Long Beach City Manager, who estimated that 90% of residents evacuated after the storm due to the extreme damage present throughout the barrier island (Jack Schnirman, personal communication). Though Meyer et al. (2014) found that residents underestimate the number of days they might be without power, Morss et al. (2016) found that messages regarding potential utility outages could be persuasive in urging evacuation. As such, messages giving estimates of infrastructure damage and potential length of outages for basic utilities and general municipal functions (e.g. sanitation pickup, local railroad service) were also included in the survey.

*Participants.* To recruit a broad community sample from areas most affected by ‘Superstorm’ Sandy, undergraduate research assistants were equipped with iPads and sent to a variety of local businesses (e.g. coffee shops, gyms) and municipal locations (e.g. library branches), with permission from the appropriate supervisors of each location. Potential participants were approached and asked if they would be willing to complete a 10-minute survey on hurricane evacuation messaging in exchange for a small token of compensation (\$5 in cash, a \$2 lottery ticket, or a pen from the funding agency). Participation incentives varied based on approval of the location supervisor, as some locations (e.g. the train station) would not allow monetary compensation. Data collection occurred over an 8-week period during February–April 2015, with shifts throughout each day to capture as wide a population as possible. Recruitment, consent, and survey protocols were approved by the Institutional Review Board at Hofstra University.

The resulting sample included 283 participants, ranging from 18 to 78 years of age (mean = 41.5, SD = 15.8). Fifty-eight participants who either were not living on Long Island during ‘Superstorm’ Sandy or who did not supply a zip code for their place of residence during the storm were removed from the analysis. The remaining 225 participants who were living in the greater Long Island region during ‘Superstorm’ Sandy and supplied a verifiable zip code for the area were included in the current analysis.

*Messages.* Test messages were developed based on previous literature (as discussed in the Grounding section above), discussions with the Long Beach City Manager, an archival collection of actual messages relayed on television and via robo-calls during ‘Superstorm’ Sandy, and informal analysis of the interview data from Study 1. Unfortunately, due to funding time constraints, only approximately 50% of the formal transcription and analysis of the interview data was completed prior to the development of the test messages. However, the themes presented in the test messages for Study 2 closely match the coding protocol developed for Study 1 to allow for comparison of the results. To increase the likelihood of recruiting a broad community sample for greater external validity, the survey was structured to stay under 15 minutes in total participation time (response to message plus demographic information). This required limiting the number of test messages to 35 or fewer, with an assumption that it would take approximately 20 seconds to read and respond to each message, plus 3–4 minutes to fill out demographic information at the end of the survey.

The purpose of Study 2 was to examine the persuasiveness of varying levels of authority and information regarding an impending decision to evacuate. The final list of 34 messages was grouped into seven categories: distant authority figures (5 messages), alternate/intermediate authority figures (5), local sources (6), obstacles to evacuation (5), utility/municipal damage (5), weather descriptions (7), and comparison to ‘Superstorm’ Sandy (1). Comparison of responses to messages in the first three categories (distant authority

figures, alternate/immediate authority figures, and local sources) assessed how respondents reacted to varying levels of authority, while analysis of the messages regarding severity (utility/municipal damage, weather descriptions) assessed whether information other than direct pleas to evacuate could be influential to the decision process. The messages regarding solutions to obstacles to evacuation (e.g. the location of pet-friendly shelters) were developed specifically in response to obstacles identified through the interviews in Study 1 and were intended to assess whether offering solutions to those obstacles increases the likelihood of evacuation. Finally, the direct comparison to ‘Superstorm’ Sandy measured the influence of storm previous experience and the possibility of the cry-wolf effect among residents in a flood-prone area.

As a manipulation check, two pairs of messages within the weather category contained different descriptions of the oncoming storm in terms of wind speed and storm surge; the same general wording of the message was retained, while the magnitude of either the predicted wind speed (40–60 vs. 90–100 mph) or the predicted storm surge (1–4 vs. 6–12 feet) was altered. If respondents are appropriately reading the content of each message in the context of a hypothetical scenario 48 hours prior to the peak of the storm, there should be more ‘Evacuate’ responses to the higher magnitude phrases.

*Procedure.* Surveys were collected outside of hurricane season due to funding time constraints, so all reactions reflect participant actions in response to a hypothetical oncoming hurricane. After giving consent, participants were asked to imagine they were hearing the test messages on the news approximately 48 hours prior to a major oncoming storm event similar to ‘Superstorm’ Sandy, for which there has already been a mandatory evacuation order for the surrounding area.

For each message, participants indicated whether it would induce them to stay in their home without reservation (‘Stay’), consider evacuating with increased worry (‘Consider’), or evacuate elsewhere (‘Evacuate’). Messages were presented in random order to avoid carry-over effects from one message to the next.

At the end of the survey, participants were asked a series of questions relating to prior experience with Hurricane Irene and ‘Superstorm’ Sandy, including zip code of residence during each of those storms (if applicable), type of residence (e.g. single-frame house, apartment building), and members of the household. The survey ended with a single question regarding likelihood to evacuate in the case of a future real-life hurricane similar to ‘Superstorm’ Sandy, rated on a 1 (will never evacuate) to 5 (will always evacuate) scale.

## Results

### *Study 1: assessment of evacuation decisions*

*General characteristics of participants.* Interviews from six individuals were removed from analysis; two focused on their roles in local city government (not their personal decision regarding evacuation), one focused on his wife and daughter’s decisions but not his own, one was a local shopkeeper but not a resident of Long Beach, one was under 18 years of age and did not have direct decision-making capacity during the storm, and one did not make any direct statements about his evacuation decision. From the remaining 40 interviews, 12 evacuated prior to the storm, 3 evacuated during the storm, and 25 remained in their homes in Long Beach. Overall, the initial 37.5% evacuation rate prior to the storm is

not significantly different from that cited by the local city manager for the Long Beach area (33%; Jack Schnirman (Long Beach City Manager), personal communication;  $X^2(1, N = 40) = 0.44, p = 0.51$ ), though there may be other characteristics of our self-selected sample that set them apart from the general Long Beach community.

*Hand-coding analysis of language.* The transcriptions of the interviews were hand-coded for evacuation statements, including identification of any information or sources that contributed to their evacuation decision. It is important to note that for the following analyses, it was assumed that participants should have followed the evacuation order. Though there are situations in which evacuation may not always be warranted or wise, the vulnerable geographic location of the interviewed population, in concert with the converging models of the hurricane path in the days leading up to the storm, collectively indicated that evacuation prior to the storm was the preferred action from a public safety perspective as confirmed by multiple officials in the Long Beach city government.

From the 40 included interviews, participants made a total of 160 identifiable statements directly relating to evacuation decisions (average number of statements per participant: 4.00 (SD = 1.87)). Complete results of the hand-coding analysis for the major categories are presented in Table 1. Briefly, the categories with the highest number of statements were those involving previous history with hurricanes, the role of friends and family, and miscellaneous items unrelated to the major categories (e.g. visual inspection of rising water, ‘gut feeling’). Sample excerpts representing several of the most frequently coded factors are presented in Table 2. Surprisingly, very few residents mentioned traditional authorities (e.g. the governor, local police, emergency management officials) during their discussion of their evacuation decision.

A majority of participants who mentioned discussions of evacuation decisions with friends and family members decided not to evacuate (Table 3), particularly when the discussion involved a neighbor in close proximity. A chi-square collapsing across the two evacuate and remain columns (with and without ambivalence, respectively) indicates a significant asymmetry in the frequency when analyzing for 50% (or chance) distribution ( $X^2(1, N = 49) = 9, p = 0.003$ ); this indicates a disproportionate number of residents stayed assuming that at least 50% of the population should evacuate. This analysis is conservative, however, as the geographic vulnerability of this population should prompt 100% evacuation rates. Similarly, participants who discussed either personal or someone else’s prior experience with major storms also overwhelmingly decided to remain at home, though with some ambivalence regarding whether or not that was an appropriate decision (Table 4; chi-square test against 50% distribution:  $X^2(1, N = 43) = 25.33, p < 0.001$ ). These results highlight the uphill battle present in trying to combat personal prejudices

**Table 1.** Major category representation from hand-coded analysis.

Category	Total # statements	# Participants (% of total)
News source	16	13 (30.95%)
Authority source	7	7 (16.67%)
Friends/family/neighbors	49	29 (69.05%)
Prior storm experience	43	26 (61.90%)
Obstacles/resources	11	11 (26.19%)
Miscellaneous	34	23 (54.76%)

**Table 2.** Examples of excerpts identified with the most frequent codes.

Factor category	Specific factor	Participant	Excerpt	Decision
News source	Television news report	CC	I heard on the TV that there'd be a big backwash and the waves so then I figured yes, we have to evacuate.	Evacuate
		CA	... the morning of the storm, so it was what, the 29th, I watched a ten minute news report about how severe the tidal surge was going to be and what time the tidal surge was coming – it was coming at eight o'clock which is bedtime and I didn't want to be fighting off the water and trying to put my kids to bed at the same time so I evacuated that morning.	Evacuate
Authority source	Statements made by local/elected officials	BJ	We got a lotta automated phone calls from the City and – and – and, you know, they were very good about, you know, saying we, you know, and coming around evacuating and we just – we ignored it.	Remain
Informal sources	Significant other the participant was with	BI	Either I stayed or I leave so I wasn't going to let him go by himself.	Evacuate
		SJ	I had some resistance from my husband because he was afraid that our boat would get lifted off of our lift and hit one of our neighbors' homes or hit our house so he wanted to be home to kind of troubleshoot, you know, being the possibility of that kind of – of problem. So for no reason, really, we stayed.	Remain
	Child(ren) the participant was with	MM	And we were watching the news, they were talking about how first responders couldn't get to people and I said, 'You know, we have very young children, we should leave.'	Evacuate
		Parent(s) the participant was with	HJ	Well my father recently had a stroke and he was in the rehabilitation center and they called us and let us know that they gave the patients a opt – a choice to either to go home, or follow them to the next facility that they was going. And my dad wanted to come home; he wanted to be home with my mom, and so I was with them in our home.
	BS		Then that Monday I was having breakfast at the Laurel and I just started seeing water come, I guess salt water, in the street and I thought to myself it may be a good idea to get my mother outta here.	Evacuate
	SK		Our neighbors were saying that – that there's no water on the street in like decades, like people who'd lived here for thirty years, 'We never get water on Barnes Street, we're all staying,' you know; so we made the decision to stay home.	Remain
	BJ		We have a very, very tight-knit group on this street ... we're extremely close all of us, and basically the consensus was we were gonna stay; everybody was gonna stay.	Remain
	WP		First of all there were a lot of neighbors who were around – couple of doors down my neighbors were there, the deli owner which is their son was there, the VFW guys a block away were there, so I knew there were people around. So that – that – that was part of my decision.	Remain
	EA		[EA] ... we kinda had a feeling it was going to be bad; but all my immediate friends on Florida Street all stayed, everybody was here. [Int] So do you think that affected your decision to stay? [EA] Yes.	Remain
	Previous storm history	Personal experience of Hurricane Irene	BP	We were going to leave, like a lot of other people, but I think we all got fooled by Irene which was a year prior and we did leave ... and when we came back a lot of people even laughed at us that there was only a foot of water in the street and it went down in an hour ... So we stayed because we thought maybe it was too hyped up.
FT			No, we didn't evacuate. We thought that the, what do you call it, we thought that the – the warnings were all hype, okay. We – I grew up in Rockaway Beach, I've seen a lot of hurricanes, I saw Hurricane Irene which	Remain

(Continued)

**Table 2.** Continued.

Factor category	Specific factor	Participant	Excerpt	Decision
Uncategorized	Learned about another's storm experience	LS	kinda – really wasn't what everyone thought it would be, and we did not heed the warnings to evacuate; we just thought it was sensationalism, especially with the media and stuff like that. [Int] So can you tell me why you chose to stay? [LS] East Atlantic Beach is about an eight foot elevation differential between Long Beach, the middle of Long Beach and the East Atlantic Beach, and my neighbor, who's there – bought the house in 1971 said, 'We've never had water on this block.' But – so I, you know, I said okay I might get a couple of feet of water, I can live with it, you know, I – I didn't – I wasn't awaiting devastation that I saw.	Remain
		MS	Our side of town, we had a – a man across the street whose been there fifty-three years and there's never been water; Irene, there was never water over there. The winds didn't seem as high as they were gonna be during Irene, so, you know, we stuck it out – we were gonna hang out.	Remain
	Miscellaneous	MD	You know, again, we started out, as Melissa said, we tried to stay in the house and this was all centered around the fact that I had bought a generator.	Remain
		PA	We sandbagged all around; there were sandbags across our kitchen door which is where our main entrance and our living room door. I had a friend, [name redacted], that helped us out with the sandbags and stuff, and so we thought it was just like Irene – we put the bags in, we stayed in.	Remain
		RR	I think we went to the beach on Sunday night, we said well wait till Monday morning and I, you know, I took a photograph of that, a film of that night and then the next morning we looked at it and it was – it was crunchy at that point and we said you know what, let's just – let's get out of here because it looks like it's the real – the real deal.	Evacuate
		WL	And when we went to the boardwalk the night before and we saw that the water was already coming up to the boardwalk, then I was like okay, I'm ready to go.	Evacuate

**Table 3.** Breakdown of evacuation statements associated with familiar sources.

Source	Evacuate	Evacuate with ambivalence	Remain with ambivalence	Remain
Significant other in home	2	4	3	3
Child(ren) in home	2	0	1	1
Parent(s) in home	1	0	3	1
Other family in home	0	0	3	1
Friends in home	0	0	1	1
Parent(s) outside home	0	1	0	1
Other family outside home	1	0	0	0
Friends outside home	2	0	0	0
Neighbors, same block	0	0	11	3
Miscellaneous	1	0	3	0
Total	9	5	25	10

**Table 4.** Breakdown of evacuation statements associated with prior storm experience.

Experience	Evacuate	Evacuate with ambivalence	Remain with ambivalence	Remain
Hurricane Irene, personal	2	2	17	3
Another large storm, personal	0	1	7	0
Other's storm experience	0	0	6	1
Miscellaneous	0	0	4	0
Total	2	3	34	4

about the urgency of evacuation and the potential added referent power of surrounding community members.

Interviews were also coded for the final evacuation decision, the conviction of that decision, and any regret associated with that decision. Although arguably hindsight is imperfect, those who decided to evacuate prior to the storm did not regret the decision, whereas those who remained had more complicated reactions (Table 5). Interestingly, those who evacuated during the storm, after an initial decision to stay, regretted the decision. However, further examination of the associated statements revealed that the regret was associated with not leaving sooner (i.e. the individuals should have evacuated prior to the storm). It should be noted that though not explicitly coded due to the focus on pre-storm evacuation, many of the residents who remained in their homes during the storm did evacuate the next day due to the extent of damage to their homes and surrounding infrastructure, corroborating high post-storm evacuation estimates from local city government.

**Study 2: message development and testing**

*Initial division of respondents into Barrier Island and Long Island groups.* An initial analysis of responses indicated that 36 out of 225 participants used the same response for all of

**Table 5.** Relationship between evacuation decision and later regret.

Final decision	Yes, verbal	Yes, passive	No, passive	No, verbal	Unknown
Remain	3	4	6	1	2
Remain w/ ambivalence	3	2	0	1	3
Evacuate during storm	1	2	0	0	0
Evacuate prior to storm w/ ambivalence	0	0	2	0	0
Evacuate prior to storm	0	0	4	4	2

Note: For those who evacuated during the storm, the statements of regret were associated with regretting not evacuating earlier.



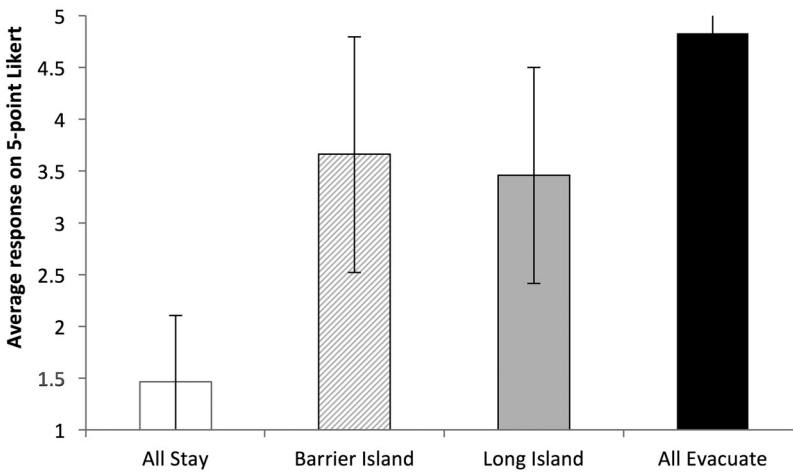
the test messages. Eighteen answered 'Evacuate' for each message, three answered 'Consider,' and 15 answered 'Stay.' These participants were retained for analyses regarding future evacuation intention and past evacuation behavior, but were removed from the messaging analysis. This decision was made based on the purpose of the study, which was to explore the persuasiveness of messages with regard to a pending evacuation decision. While it is possible that using the same response for all messages results from messages being so similar that respondents could not distinguish between them, we interpreted this behavior as indicative of a prior decision that is unlikely to change and therefore not relevant to the current purpose. It is interesting to note that 16% of our sample may represent a group of people who are unlikely to be persuaded by (or open to persuasion from) hurricane messaging. This result is similar to that of another recent study, and represents a topic that requires further research (Marlon, Rosenthal, Feinberg, Pal, & Leiserowitz, 2015).

The remaining 189 participants were divided into 2 comparison groups based on location: 121 participants supplied zip codes associated with municipalities on Long Beach Island ('Barrier Island' group) and 68 participants supplied zip codes associated with municipalities on Long Island proper ('Long Island' group). This division was intended to separate those residents consistently at higher risk for hurricane-related damage and mandatory evacuation orders (the population of interest) from those residing in relatively safer locations, who serve as a comparison group.

*Evacuation behavior: future intention and previous experience.* Before analyzing reactions to messages, an initial analysis of future evacuation intention and previous evacuation behavior was conducted to understand overall evacuation decisions among the sample. This analysis compared the single final overall likelihood of evacuation question for the non-varying 'Evacuate' and 'Stay' groups to the remaining participants in the Barrier Island and Long Island groups who used a variety of reactions to the test messages (the 'Consider' group is too small to analyze and were removed from the data analysis). There is a significant main effect regarding overall intention to evacuate ahead of a future storm ( $F(3, 218) = 29.79, p < 0.001, \eta^2 = 0.29$ ). Bonferroni-corrected *post-hoc* comparisons indicate the Barrier Island and Long Island groups are not statistically different from each other. However, the 'Stay' group has a significantly lower intention to evacuate in the future compared to the other three groups (Figure 1; all pairwise comparisons  $p < 0.001$ ) and the 'Evacuate' group has a significantly higher intention to evacuate in the future compared to all three other groups (Figure 1; all pairwise comparisons  $p < 0.001$ ). The participants in the Barrier Island and Long Island groups who used a variety of responses to the test messages have a neutral overall stance on evacuating in the future.

Next, a comparison was made among the four groups regarding evacuation decisions during 'Superstorm' Sandy, whether that evacuation was to a shelter, hotel, or home of a friend or family member (Table 6). Those participants who chose 'Stay' for all test messages regarding a hypothetical future storm also did not evacuate during Sandy. In contrast, participants who chose 'Evacuate' to all test messages had a variety of experiences during Sandy, as did the Barrier Island and Long Island groups. After combining all possible evacuation options into one 'evacuated' category and comparing the distribution of 'stayed' vs. 'evacuated' responses among the groups via chi-square, there was a significant asymmetry in the distribution of responses ( $X^2(3, N = 222) = 24.33, p < 0.001$ ). Interpretation of the frequency table indicates that the 'Stay' group chose to remain in their homes during

**In the event of another storm, how likely are you to follow the mandatory evacuation order and leave your home?**



**Figure 1.** Intention to evacuate for the next storm, measured from 1 ('I will never leave') to 5 ('I will definitely leave'). The 'Stay' and 'Evacuate' groups are significantly different from each other, the Barrier Island group, and the Long Island group (all the  $p < .001$  level with Bonferroni correction). The Barrier Island and Long Island groups are not significantly different from each other.

'Superstorm' Sandy at a higher frequency than the other three groups. Members of this group also almost universally chose to stay in their homes during Hurricane Irene during the previous year (14 out of 15). This suggests that there are some people who have never and will never choose to evacuate (6.67% of the current sample). This is important to consider when determining what constitutes 'success' in hurricane evacuation messaging and resulting evacuation rates.

For the remaining analyses regarding persuasiveness of messages to be meaningful, only the participants who varied their responses to the test messages (e.g. used more than one response option among Stay, Consider, and Evacuate) were used (Total  $N = 189$ ; Barrier Island  $N = 121$ , Long Island  $N = 68$ ); the 'Stay,' 'Consider,' and 'Evacuate' groups who selected a single response for all messages ( $N = 36$ ) were removed. A chi-square comparison of evacuation behavior during 'Superstorm' Sandy between the Barrier Island and Long Island groups still indicates a significant difference in the number of respondents who evacuated ( $X^2 (1, N = 189) = 10.40, p = 0.001$ ), with more respondents from the Barrier Island indicating evacuation prior to the peak of the storm (40.5% of Barrier Island respondents vs. 17.6% of Long Island respondents).

**Table 6.** Evacuation rates during 'Superstorm' Sandy.

	Evacuation decision during 'Superstorm' Sandy				Simplified response	
	Did not evacuate	Evacuated to friend/family	Evacuated to shelter	Evacuated to hotel	Stayed	Evacuated
Barrier Island ( $N = 121$ )	72	35	9	5	72	49
Long Island ( $N = 68$ )	56	12	0	0	56	12
All evacuate ( $N = 18$ )	7	5	3	3	7	11
All stay ( $N = 15$ )	15	0	0	0	15	0

Much of Long Island (including the barrier islands) is at risk for flooding and other hurricane-related damage (e.g. wind damage); this risk varies by geographic location, however. Importantly, the distribution of 'Superstorm' Sandy evacuation responses by the Barrier Island group is not significantly different from the interview sample recruited from the same communities in Study 1 (40.5% vs. 30.95% respectively;  $X^2(1, N = 163) = 1.21, p = 0.27$ ), suggesting shared decision characteristics between the two barrier island samples that are different from those living on Long Island proper (all barrier island respondents in Study 1 and Study 2 vs. Long Island respondents in Study 2:  $X^2(1, N = 231) = 9.16, p = 0.002$ ). Separating those respondents in the high-risk Barrier Island area from the variable risk general Long Island area will allow the following analyses to explore which messages are universally helpful and which messages may specifically target those that are most at-risk.

*Rating of test messages: manipulation check.* To confirm that participants were reading and considering each message, two pairs of similar messages with different descriptions of the oncoming storm in terms of wind speed and storm surge were included as manipulation checks. It is important to note that the risk of evacuation under high wind conditions is dependent on whether that evacuation is occurring prior to or during those conditions; it is often safer to shelter in place during ongoing high wind conditions. For the current scenario set 48 hours before landfall encouraging evacuation in the next 24 hours before conditions worsen, participants should shift in response towards evacuation for the higher predicted magnitude messages in each pair (see Methods for details). This was, in fact, the case. For storm surge, both the Barrier Island ( $X^2(2, N = 121) = 27.33, p < 0.001$ ) and Long Island ( $X^2(2, N = 68) = 11.91, p = 0.003$ ) groups were more likely to select 'Evacuate' in response to higher predicted flooding. Similarly, for wind speed, both the Barrier Island ( $X^2(2, N = 121) = 24.05, p < 0.001$ ) and Long Island ( $X^2(2, N = 68) = 18.69, p < 0.001$ ) groups were more likely to select 'Evacuate' in response to the higher magnitude message. This confirms that participants were reading and responding to messages selectively during the survey based on the included information.

*Rating of test messages: major categories.* After confirming the manipulation check, the test messages were then sorted into the seven categories specified in the Methods section and compared for overall persuasiveness by category of information. An average response was calculated for individual respondents for each group of messages by converting the 'Stay,' 'Consider,' and 'Evacuate' options into a 3-point Likert scale (higher numbers representing an increased likelihood of evacuation). A  $2 \times 7$  ANOVA was used to assess the variation in response to different categories of messages and the variation in response between the two groups of participants (see Table 7 for means). There was an overall main effect of category ( $F(6, 182) = 35.69, p < 0.001, \eta^2 = 0.16$ ), indicating a difference among mean ratings of the categories. There was no significant main effect of group (Barrier Island vs. Long Island;  $F(1, 188) = 1.67, p = 0.20$ ) indicating that overall reactions to the messages were similar between the two groups of respondents, but there was a significant interaction between group and message category ( $F(6, 1122) = 2.51, p = 0.02, \eta^2 = 0.01$ ). However, it was clear from the *post-hoc* pairwise comparisons (Table 8) that the single message comparing the hypothetical storm to 'Superstorm' Sandy was inducing a stronger evacuation response compared to all the other categories. To confirm the main effect of message category, a second  $2 \times 6$  ANOVA that removed the 'Superstorm' Sandy message was conducted. The new analysis did not result in a significant group

**Table 7.** Mean reactions to the seven message categories by Barrier Island and Long Island respondents.

Message category	Group	Mean	Std. dev.
Weather	Barrier Island	2.22	0.58
	Long Island	2.17	0.63
	Total	2.20	0.60
Obstacles	Barrier Island	2.12	0.63
	Long Island	2.04	0.62
	Total	2.09	0.63
Utilities/municipal services	Barrier Island	2.21	0.62
	Long Island	2.05	0.66
	Total	2.16	0.64
Local sources	Barrier Island	2.01	0.62
	Long Island	1.90	0.65
	Total	1.97	0.63
Intermediate authorities	Barrier Island	2.14	0.64
	Long Island	2.05	0.65
	Total	2.10	0.64
Distant authorities	Barrier Island	2.22	0.63
	Long Island	2.17	0.64
	Total	2.20	0.63
Comparison to 'Superstorm' Sandy	Barrier Island	2.54	0.73
	Long Island	2.28	0.90
	Total	2.44	0.80

by message category interaction ( $F(5, 935) = 1.28, p = 0.27$ ), indicating that the initial interaction was solely driven by the comparison message. Importantly, the revised ANOVA still found a significant main effect of message category ( $F(5, 183) = 22.54, p < 0.001, \eta^2 = 0.11$ ) without a main effect of group ( $F(1, 188) = 1.06, p = 0.30$ ). This indicates that certain message categories are more persuasive than others in prompting respondents to select 'Evacuate' as their response.

Bonferroni-corrected *post-hoc* comparisons among the message categories were conducted to identify which may be more or less persuasive than others (Table 8); the following interpretations exclude comparisons to the single message comparing the hypothetical storm to 'Superstorm' Sandy, as that message was significantly more persuasive than all other categories as described above. Contrary to the heavy reliance on local sources like neighbors in Study 1, evacuation messages including local sources were significantly less effective than all other messages groups. In contrast, evacuation messages citing distant sources (e.g. the governor) and specific descriptions of the weather (e.g. flooding risk, wind speed predictions) were not statistically different from each other, but were both significantly more effective than messages regarding potential obstacles and those from local and intermediate sources. The remaining categories (obstacles, utilities/municipal services, and intermediate authorities) have mixed results in comparison to the other groups (see Table 8 for comparison *p*-values). The next analysis assessed the efficacy of individual messages to further explore the persuasiveness of each category.

*Rating of test messages: individual message analysis.* Analysis of the effectiveness of each message in convincing respondents to select 'Evacuate' was conducted in two stages. First, the distribution of responses from the Barrier Island and Long Island groups were compared via chi-square to test if there were differences in the distribution depending on location. For the 29 messages that did not have significantly different response distributions between the 2 groups (Table 9), the frequencies of responses from the two groups were combined into one distribution and tested for asymmetry via chi-square

**Table 8.** Pairwise comparisons among the seven message categories, collapsed across respondent group.

	Obs	Util	Loc	Int	Dist	Sandy
Weather	0.01	0.42	<0.001	0.001	1.00	<0.001
Obstacles		1.00	<0.001	1.00	0.003	<0.001
Utilities/municipal services			<0.001	1.00	0.48	<0.001
Local sources				<0.001	<0.001	<0.001
Intermediate authorities					<0.001	<0.001
Distant authorities						<0.001

Note: Numbers in the table represent *p*-values; all comparisons were made with Bonferroni corrections for multiple comparisons.

for equal distribution among the response options (i.e. 33% per ‘Stay,’ ‘Consider,’ and ‘Evacuate’). For the remaining five messages with significance differences between the groups (Table 10), a second analysis was conducted looking at the distribution of responses within each group via chi-square testing for equal distribution.

Of the 29 messages that did not demonstrate significant differences between the 2 regional groups, 14 of those messages also did not have asymmetrical response distributions (i.e. responses were evenly distributed among ‘Stay,’ ‘Consider,’ and ‘Evacuate’). Among the remaining 15 messages that did have significantly asymmetrical distributions, 12 messages were skewed towards ‘Evacuate’ responses, with messages from the Distant Authorities, Weather, Intermediate Authorities, Utility/Municipal Services, and Obstacles categories. Two messages had a plurality of ‘Consider’ responses, one each from the Obstacles and Local Sources categories; but another message from the Local Sources category received a plurality of ‘Stay’ responses (see Table 9 for distributions and chi-square statistics). In general, it appears that the most persuasive messages are from traditional authority figures from county- and state-level governments, plus those messages indicating larger magnitude severe weather effects and the potential disruption of travel in the area.

For the five messages that demonstrated between group differences, each message was more persuasive to the Barrier Island group (or, in the case of one ‘man on the street’ message, less dissuasive) than to the general Long Island group (see Table 10 for distributions and chi-square statistics). This includes the overall comparison to ‘Superstorm’ Sandy, but also messages regarding flooding, community organizing, and municipal services. The stronger reactions to flooding, loss of municipal services, and the comparison to ‘Superstorm’ Sandy may not be surprising given the widespread devastation experienced by the Barrier Island group during that prior storm. However, the increased openness to listen to local community organizers and local weather amateurs is interesting. These findings corroborate evidence from Kim and Kang (2010) regarding the role of local social networks in hurricane preparation decisions, and may suggest that taking care to select appropriate local sources to feature on traditional media may help to encourage otherwise hesitant evacuator.

## Discussion

### Overview of findings

The current study attempted to address pre-storm messaging through the use of mixed methodology across two studies. First, in-depth interviews with survivors of ‘Superstorm’

**Table 9.** Frequency distributions and chi-square statistics for the combined responses of the Barrier Island and Long Island groups for messages that demonstrated no differences between those groups.

Message (category)	Comparison		Combined				$\chi^2$	<i>p</i>
	$\chi^2$	<i>p</i>	Stay	Consider	Evacuate	<i>p</i>		
The Governor has declared a state of emergency for all counties on Long Island. Coordination with the federal government for pre-storm evacuation is ongoing. All residents under mandatory evacuation warnings should relocate in the next 24 hours. (DA)	0.5	0.78	29	42	123	80.26	<0.001	
Flooding from the storm surge and daily tide is expected to be 6–12 feet above sea level. (W)	1.22	0.54	24	50	120	76.27	<0.001	
Members of the local fire department are going door to door explaining the mandatory evacuation order, including the locations of emergency shelters, to all residents in flood zones. Residents are urged to evacuate north of Sunrise Highway. (IA)	1.46	0.48	28	52	114	60.93	<0.001	
Mandatory evacuation is required for all residents living in a flood or storm surge zone. This area is defined as south of Sunrise Highway, from the Queens line to Rockville Centre and south of Merrick Road, from Rockville Centre to the Nassau-Suffolk border. (DA)	0.76	0.68	39	46	109	45.99	<0.001	
There are predicted sustained winds of 60–80 miles per hour, with intermittent gusts up to 90–100 miles per hour. (W)	0.54	0.76	28	62	104	44.84	<0.001	
The County Executive has issued a mandatory evacuation. To assist in the evacuation, the Atlantic Beach Bridge, Long Beach Bridge, and Meadowbrook Parkway have been adjusted for Northern traffic only. (O)	1.68	0.43	39	54	101	32.37	<0.001	
Storm surges are predicted to be 6–11 feet in Long Island Sound, Raritan Bay, and New York Harbor. The combination of an extremely dangerous storm surge and the tide will cause normally dry areas near the coast to be flooded by rising waters. (W)	2.41	0.3	37	56	101	33.43	<0.001	
The Governor has announced a travel ban to be put in place 12 hours before peak landfall. Anyone found driving during the travel ban will be issued a summons unless they have a demonstrable emergency. All evacuation activity should happen before the travel ban is put in place. (DA)	1.35	0.51	43	55	96	23.9	<0.001	
The County Executive has issued a mandatory evacuation. Long Beach schools and city court will be closed on Monday and sanitation pickup will be suspended. City Hall will be closed for routine business. (UM)	1.6	0.45	54	46	94	20.46	<0.001	
The Nassau County police force has asked all officers who live in flood zones to evacuate their families to community shelters and for the officers themselves to remain in local fire houses for the duration of the storm. (IA)	0.85	0.66	39	61	94	23.71	<0.001	
Southbound traffic on both the Robert Moses and Jones Beach causeways connecting Jones Beach and Fire Island to the mainland will be blocked in 24 hours in anticipation of widespread flooding and damage. (UM)	3.74	0.15	47	58	89	14.68	<0.001	
The Sheraton family of hotels has offered 50% off published room rates to evacuating residents from coastal flood zones. To take advantage of the offer, residents must check-in by 5pm tomorrow. (O)	2.33	0.31	47	66	81	8.99	0.01	
Many families have already evacuated to the local shelter, including two dozen families from Long	0.86	0.65	49	75	70	5.89	0.05	

(Continued)

**Table 9.** Continued.

Message (category)	Comparison		Combined				
	$\chi^2$	$p$	Stay	Consider	Evacuate	$\chi^2$	$p$
Beach who arrived at the shelter in Hempstead within the past 6 hours. (LS)							
The Long Island Volunteer Center has setup a hotline for residents under evacuation orders who do not have access to transportation. Residents should call 1-800-NEED-RIDE for more information and to request a free shuttle to the nearest shelter. (O)	0.95	0.62	56	83	55	7.8	0.02
Robin Carmichael, owner of a local coffee shop in Long Beach, has plans to close her shop on the day of the storm and is asking her employees to work on prepping the windows and door tomorrow instead of selling coffee. (LS)	4.92	0.08	88	63	43	15.72	<0.001
Residents under evacuation orders who have pets can bring those pets to the emergency animal shelters at Nassau County Mitchel Athletic Complex in Uniondale or the North Hempstead Animal Shelter in Port Washington. (O)	1.14	0.57	73	57	64	1.99	0.37
Hofstra University and Adelphi University have opened up extra dorm rooms and on-campus shelter facilities for commuter students, alumni, and their families who must evacuate from flood zones. Accommodations will be given on a first-come, first-served basis. (O)	4.75	0.09	64	68	62	0.29	0.86
The chaplain's association of Long Beach is spreading the word about evacuation through this weekend's services and ask congregation members to help each other find shelter outside of the flood zone. (LS)	1.55	0.46	59	70	65	0.94	0.63
Long-time coastal resident June Brassillo notes that this storm worries her more than the previous storms and she plans to evacuate to her friend's house in Woodbury 'just in case.' (LS)	1.31	0.52	73	72	49	5.7	0.06
The Long Island Railroad will be suspending service on the Long Beach and Far Rockaway lines 12 hours before the peak of the storm and suspension of service will continue until at least 12 hours after the storm has passed to allow for safety inspections. (UM)	3.95	0.14	78	63	53	4.89	0.09
The New York State Park system has officially closed all public beaches and will issue trespassing citations to anyone found on the beach or in the surf in anticipation of unpredictable storm surge. (DA)	4.45	0.11	80	60	54	5.73	0.06
Several power companies on Long Island, including PSEG, have sent out advance calls for extra crews and trucks from the south and midwest in anticipation of widespread wind damage leading to power outages. (UM)	4.05	0.13	73	64	57	1.99	0.37
Vincent Graves, professor of atmospheric sciences at Stony Brook University, notes that the oncoming storm is highly unpredictable in comparison to previous storms. (IA)	4.51	0.11	65	70	59	0.94	0.63
Robert Van Breuer, chief meteorologist for CNN, notes that in comparison to previous storms, the current storm system is highly unpredictable. (DA)	1.21	0.55	62	78	54	4.62	0.1
The superintendents of the Long Beach, Atlantic Beach, and Lido Beach school districts have canceled class for Monday and Tuesday in anticipation of widespread damage. (UM)	2.46	0.29	77	57	60	3.6	0.17
Power outages are expected to be widespread, including all areas affected by Sandy. High wind speeds are anticipated to cause damage to trees, resulting in downed power lines. Avoid downed power lines at all costs and report them promptly to your local power authority. (UM)	1.5	0.47	54	64	76	3.76	0.15

(Continued)

**Table 9.** Continued.

Message (category)	Comparison		Combined				
	$\chi^2$	<i>p</i>	Stay	Consider	Evacuate	$\chi^2$	<i>p</i>
Flooding from the storm surge and daily tide is expected to be 1–4 feet above sea level. (W)	1.43	0.49	65	62	67	0.2	0.91
There are predicted sustained winds of 40–60 miles per hour, with intermittent gusts up to 60–70 miles per hour. (W)	4.38	0.11	74	69	51	4.52	0.1
Despite lower wind speeds than Hurricane Irene, the oncoming storm is expected to have increased flooding due to its landfall coinciding high tide. (W)	2.97	0.23	52	74	68	4	0.14

Note: Categories are listed as follows: W – weather, DA – distant authority, IA – intermediate/alternative authority, LS – local sources, UM – utilities/municipal services, O – obstacles to evacuation.

**Table 10.** Frequency distributions and chi-square statistics for messages that demonstrated significant differences between the Barrier Island and Long Island groups.

Message (category)	Between groups		Within group				
	Chi-sq.	<i>p</i> -Value	Stay	Consider	Evacuate	Chi-sq.	<i>p</i> -Value
As we continue to monitor the development surrounding the storm, we expect to suffer widespread flooding in low-lying areas. We are urging residents in areas that typically flood during extreme weather events to secure their homes and stay north of Sunrise Highway until the storm has passed. (W)	6.14	0.05	Barrier Island			9.14	0.01
			26	42	53		
Community organizers from the Jewish Community Center in Long Beach are going door to door explaining the mandatory evacuation order and asking residents to indicate any obstacles they may have in leaving. (LS)	6.29	0.04	Barrier Island			8.93	0.01
			25	50	46		
Teddy Muscato, an avid local fisherman, has packed up and is planning to leave for safer ground after visiting the beach today. 'The surf is just not right. I don't trust it this time.' (LS)	6.19	0.05	Barrier Island			4.08	0.13
			39	50	32		
Municipal services such as electricity, water, and sanitation pickup are expected to have intermittent or interrupted service for 2–4 days following the storm. Residents are advised to plan for the inability to use water for cooking, showers, and toilets. (UM)	12.2	0.002	Barrier Island			5.95	0.05
			15	39	67		
This storm is forecast to be about the same size and strength as Superstorm Sandy. (SS)	8.67	0.01	Barrier Island			64.88	<0.001
			17	22	82		
			Long Island region, not on barrier island			21.15	<0.001
			23	9	41		

Note: Categories are as follows: W – weather, LS – local sources, UM – utilities/municipal services, SS – Superstorm Sandy comparison.

Sandy residing on the barrier island of Long Beach, NY were analyzed to assess the role of formal vs. local authorities in evacuation decisions prior to a major storm. Second, traditional surveys were used to test messages tailored to the same themes analyzed in the interview data. Of particular interest was the role of more personal factors or familiar sources in the decision process, especially given previous evidence regarding the influence of family members and neighbors in other studies using post-storm questionnaires (e.g. Adeola, 2009; Stein et al., 2010).



*Study 1: interviewees mentioned informal sources more than official sources.* As suspected, individuals recalling their decision process prior to the height of the storm focused on more local informal sources (e.g. discussions with family and neighbors) than information given by authorities or the media, supporting prior research on evacuation decisions (Adeola, 2009; Burnside et al., 2007; Morss & Hayden, 2010). In addition, though many residents knew of the call for evacuation, prior experience with Hurricane Irene and/or knowledge of historic flooding patterns surrounding their home either witnessed by themselves or neighbors mitigated the evacuation decision, again mimicking prior findings (Dillon et al., 2011; Meyer et al., 2013). Furthermore, the current study corroborates previous findings that despite the widespread availability of social media outlets, residents do not rely on those outlets in the face of evacuation decisions (Meyer et al., 2014).

Importantly, very few residents mentioned information given to them by traditional authorities (e.g. government officials, television or radio news) or related a sense of urgency regarding the official mandatory evacuation order. Instead, a majority of residents focused on discussions with friends, family members, and neighbors, with those discussions disproportionately resulting in decisions to remain in the home throughout the storm. This suggests that there should be more research conducted on how pre-storm messaging can address and possibly confront some of the more personal factors in evacuation decisions (e.g. social pressure, desire to protect one's home and belongings), as previously noted by Lazo, Waldman, Morrow, and Thacher (2010). Additionally, it is possible that local social networks, such as community centers and church groups, may be influential in encouraging pre-storm preparations (Kim & Kang, 2010). Studying the relative persuasiveness of pre-storm messaging from informal, local, and traditional sources was the focus of the second part of the current investigation.

*Study 2: official sources seem more persuasive.* Prospective reactions to hypothetical pre-storm messages indicated that respondents were more persuaded by information and actions of government authorities and the media compared to comments and actions taken by local community members. Although the adherence to traditional authorities may be considered an encouraging finding, these results are contrary to the predictions based on previous literature (e.g. Adeola, 2009; Burnside et al., 2007; Morss & Hayden, 2010) and to the results of the retrospective interviews gathered in Study 1. Several possible reasons for these unexpected results are discussed in the section below.

*Reconciling the two studies.* It appears that there is some disconnect between personal reflections on the evacuation decision process and prospective reactions to possible storm messaging. For example, although informal sources factored heavily into the decisions made by those interviewed, messages describing the actions of other local community members were among the least persuasive to those surveyed. On the other hand, despite very few mentions of traditional sources during the interview process, messages describing directives from these sources or actions taken by these sources were among the most effective in the survey.

There are several possible reasons for the seemingly contradictory results between the interviews and reactions to test messages. First and foremost, there is potentially an issue with testing messages outside of an actual storm event. The ELM (Petty & Cacioppo, 1986) suggests that respondents to the test messages and participants in the interviews were likely processing cues along different paths given their different emotional investment

and cognitive abilities at the time of the decision. In addition to general processing of information, previous research also suggests that heightened emotions may incline audiences to perceive greater risks in a crisis (Slovic, 2000; Westerman et al., 2012). Although survey participants were asked to imagine a large oncoming storm that would make land-fall within 48 hours, it is difficult to judge whether that scenario is enough to recreate the mindset of a true evacuation decision, particularly the perception of imminent risk and any associated emotions that might affect the decision process. According to ELM, if survey participants in the current study lacked the inherent pressure and emotions involved in confronting an oncoming major weather event, they would be more likely to process peripheral cues (perceived expertise) to convey the socially expected response of being more persuaded to evacuate by messages from traditional authorities vs. those from local sources, as found in the results here.

Interview subjects, in contrast, were describing their decision process in the days prior to an actual major weather event, during which they were highly motivated to refer to multiple sources and gather large amounts of information. High motivation combined with varying degrees of processing ability may have led to processing of either primary or peripheral cues (i.e. the inclusion of both authorities and informal sources during the decision process). This contrast in motivation between the prospective and retrospective studies is a difficult issue to reconcile experimentally, given that manipulating messaging during a storm event potentially treads on ethical lines (Gouran & Seeger, 2007). However, a lab-based survey (as opposed to the field survey conducted here) could use manipulation of the actual physical space to create a more immersive feeling of a pending storm. This has been done for fire emergencies using virtual reality (Kinateder & Warren, 2016), but new simulation studies are needed to address hurricane evacuations specifically.

Another possible explanation for the poor performance of the local source messages in the prospective survey is that the local sources used in the test messages were fictional in nature (e.g. 'June Brassillo, a long-time resident of Long Beach'). Although this mimics the general tenor of the 'man on the street' interview by local news, it is possible that residents actually need to know sources personally in order for a message to be more persuasive (e.g. teammate in a sports league, Kim & Kang, 2010). This is related to the five bases of power noted by French and Raven (1959). For an informal source to gain some level of authority over the decision process, the information seeker must experience some form of social identification, thus enabling referent power, and/or determine that the source has previous experience or knowledge that enables expert power. Unfortunately, if this is the case, there will be difficulty in identifying appropriate members of the local community who are well-known enough to make an impact during pre-storm messaging, because referent power is relative to each individual community member's experience.

### ***Implications for communication theory***

Despite the existence of 'mandatory' evacuation orders, there is no punishment for non-compliance; therefore, the decision to leave before a major weather event is always voluntary. Although government officials and other sources of storm-related messages lack coercion, power is nonetheless a factor in this communication context. Using French and Raven's (1959) categories of interpersonal power we have demonstrated that

legitimate power (i.e. authority) and traditionally recognized signifiers of expertise (i.e. titles and/or credentials) do not necessarily entail a high degree of social influence.

We propose that in a dynamic decision-making process, such as considering whether and where to evacuate before a storm, people may oscillate between one position and another (perhaps for a few days) because perceived authority – news/weather and political figures – is a peripheral cue, causing only temporary changes. A good example of this is a statement made by interviewee BJ regarding statements made by local elected officials to the public (Table 2). Despite hearing multiple ‘robo-calls’ from Long Beach city officials, in the end, that resident chose to ignore them and not evacuate. In contrast, relationships with friends and neighbors allow one to engage in (perhaps faulty) cognitive processing that leads to longer term attitude change and thus actual predictive behavior. A good example of this is a statement made by interviewee EA, who chose to stay because ‘all’ of the resident’s ‘immediate friends’ also chose to stay.

The suggestion that referent power may outweigh or combine with legitimate or expert power poses a unique challenge for communication researchers as well as emergency management personnel. No one communicator will hold the same power for all listeners. The challenge then is to identify key local figures who can motivate appropriate actions among members of their community during an emergency, an idea that will be elaborated below.

### ***Implications for emergency messaging***

Several results among the reactions to the test messages from survey participants are interesting to consider from the standpoint of improving pre-storm messaging. First, it is tempting to note that the most effective message was the one invoking ‘Superstorm’ Sandy in a direct comparison. However, as evidenced in the interview data regarding experience with Hurricane Irene and resulting evacuation decisions, prior experience with storms is a double-edged sword. The previously studied ‘cry wolf’ effect (Dow & Cutter, 1998; Whitehead et al., 2000) indicates that invoking previous storms should be used cautiously at best. Similarly, Dillon et al. (2011) indicated that ‘near-miss’ events can decrease the likelihood of preparation in the future, as evidenced here by how experience with Hurricane Irene impacted evacuation decisions prior to ‘Superstorm’ Sandy. Without knowing an individual’s personal experience with a previous storm, it is hard to predict whether invoking that storm in comparison will have a beneficial or detrimental impact to evacuation preparations. Instead, messages focusing on specific information regarding the current storm, especially estimates of storm surge height, were similarly effective in drawing large numbers of ‘Evacuate’ responses without the need to make comparisons to other storm experiences.

Second, messages regarding the potential loss of utilities and the imposition of travel bans were also high in effectiveness. This corroborates findings of Morss et al. (2016) and suggests the estimates of pre- and post-storm obstacles might improve evacuation compliance if included in storm warnings. Meyer et al. (2014) previously found general optimism in pre-storm surveys regarding potential lack of electricity, despite warnings to prepare for a week or more without power. However, Meyer et al. (2014) do not discuss preparation for lack of sewer and water capabilities. It is possible, given the availability and ubiquity of back-up generators for electricity, that certain threats to utilities are more disruptive than others. Future studies should focus on the importance of different

utilities/municipal services and whether warnings about potential disruption have more impact if targeted towards those utilities that are not easily replaceable by an individual resident in his/her home.

Finally, from both the interview and test message stages of the current study, there were participants who consistently stated they would never evacuate their homes. Furthermore, that rate might be approximately 10% of the population, given the rate of responses from the two samples here. This is consistent with the estimate that 22% of the coastal Connecticut population is highly unlikely to evacuate, even for very severe storms (Marlon et al., 2015). These are likely residents with a strongly 'individualistic' cultural worldview, as identified in Morss et al. (2016). For a densely populated area like the east coast of the United States, that could translate into thousands of people depending on the path of the storm. In combination with the heavy influence of familiar sources on personal evacuation decisions, a group of people who never intend to evacuate could have widespread effects on the evacuation rate of their local community. This highlights an interesting but important conundrum: should evacuation efforts focus on convincing those on the fence or instead focus on dissociating the community from those who will stay regardless of the danger? One potential solution is to identify the reasons for non-evacuation. Among those who are committed to staying within our interview sample were a priest and a nonprofit board member who commented on their roles as resources for others. Perhaps to avoid unconscious influence of their own behavior, people staying in a service capacity should be vocal about those reasons while simultaneously urging others to evacuate. This might mediate some of the influence of the actions of the community as a whole on individual evacuation behavior.

### ***Practical applications***

Among the more effective messages were descriptions of actions taken by local police, fire departments, and community organizations (e.g. going door-to-door, evacuating their own families). Though these are potentially labor-intensive endeavors, it could be beneficial to consider how traditional authority figures may act as role models for members of the community. In order for evacuation messages to be taken seriously, it may be necessary to make public displays of the gravity of the situation beyond repeated messaging on television and radio. This is not a new finding; Baker (1991) reported that door-to-door messaging in several major hurricane events (e.g. Frederic, Alicia) was associated with evacuation rates above 90%.

One possible idea to capitalize on these findings is to create civil hurricane preparedness patrols, similar to methods used during World War II for air raids. By identifying and training a group of community members who can then go door-to-door and serve as role models for evacuation, residents may be persuaded to evacuate more readily while fire and police departments are relieved to conduct other hurricane preparations. In addition, this method may actually reconcile part of the contradictory results; a civil hurricane patrol could be a clearly identified traditional source over time, but would be made up of hyper-local sources within each neighborhood. This combination should tap into both the respect for traditional sources found in reactions to pre-storm messaging in Study 2 and the respect for neighbors and other familiar local sources as described in the individual interviews from Study 1. A step in this direction is the national Community Emergency Response

Team (CERT) program under the auspices of the Federal Emergency Management Agency (FEMA, n.d.). The program trains local volunteer teams to prepare for disasters that their respective communities might face. It could easily be expanded to include training volunteers to deliver pre-storm information and evacuation warnings as well.

## Conclusions

In sum, the current study attempted to address the understudied role of personal influences on evacuation decisions as suggested by Lazo (2012) through the use of post-storm interviews and prospective messaging surveys. Participants in the interviews recollected their decision-making process during an actual hurricane, while survey respondents considered what action they might take in a hypothetical storm situation. Members of the two groups had different levels of motivation to process information and emotional involvement. Consistent with the ELM (Petty & Cacioppo, 1986), reactions to potential pre-storm communications did not match the themes identified in the post-storm interviews. Specifically, pre-storm messages from traditional sources were more persuasive in our tests, in contrast with the heavy involvement of local sources (e.g. friends, family members, and neighbors) in firsthand descriptions of evacuation decisions prior to 'Superstorm' Sandy. The results from the interviews highlight the need for more discussion about evacuation decisions, particularly with in-person interviews as close to a real hurricane event as possible.

Although it is difficult and potentially unethical to manipulate pre-storm messaging regarding evacuations, it is possible to mobilize teams of interviewers to gather descriptions of the decision process as it is ongoing during an actual storm event (as in Meyer et al., 2014). Information from those kinds of interviews might highlight whether traditional sources truly have an impact on the decision process, or if post-storm reflections of the role of familiar sources are accurate. Reconciling these differences may be key in creating more persuasive evacuation messages in the face of an oncoming storm.

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## Appendix. Hand-coding categories and specific factors

- A. News source
  - 1. Television news report (i.e. CNN, Weather Channel, etc.)
  - 2. Radio news report
  - 3. Newspaper article
  - 4. Online news article
  - 5. Social media (i.e. facebook, twitter, etc.)
  - 6. Miscellaneous
- B. Authority source
  - 1. Statements made by local/elected officials to the public
  - 2. Speaking personally with a local/elected official (i.e. someone going door to door)
  - 3. Police officers
  - 4. Fire department
  - 5. Other emergency personnel
  - 6. Miscellaneous
- C. Family/friends
  - 1. Significant other that the participant was with
  - 2. Child(ren) that the participant was with
  - 3. Parent(s) that the participant was with
  - 4. Other family member(s) the participant was with
  - 5. Friends the participant was with
  - 6. Significant other that the participant was not with
  - 7. Children that the participant was not with
  - 8. Parent(s) that the participant was not with
  - 9. Other family member(s) the participant was not with
  - 10. Friends the participant was not with
  - 11. Miscellaneous
- D. Previous storm history
  - 1. Personal experience with Hurricane Irene
  - 2. Personal experience with another storm
  - 3. Learned about others experience with Hurricane Irene or other storm
  - 4. Miscellaneous
- E. Pets
  - 1. Boarding of pets
  - 2. Transportation of pets
  - 3. Miscellaneous
- F. Finances/resources
  - 1. Financial capability to evacuate
  - 2. Financial difficulty with evacuating
  - 3. Hotel/motel availability
  - 4. Lack of hotel/motel availability
  - 5. Availability to evacuate to a friend/family's home
  - 6. Lack of places to evacuate to
  - 7. Miscellaneous
- G. Miscellaneous
  - 1. Any factor that does not fit into the above categories