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Factors Affecting Hurricane Evacuation Intentions

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Protective actions for hurricane threats are a function of the environmental and information context; individual and household characteristics, including cultural worldviews, past hurricane experiences, and risk perceptions; and motivations and barriers to actions. Using survey data from the Miami-Dade and Houston-Galveston areas, we regress individuals' stated evacuation intentions on these factors in two information conditions: (1) seeing a forecast that a hurricane will hit one's area, and (2) receiving an evacuation order. In both information conditions having an evacuation plan, wanting to keep one's family safe, and viewing one's home as vulnerable to wind damage predict increased evacuation intentions. Some predictors of evacuation intentions differ between locations; for example, Florida respondents with more egalitarian worldviews are more likely to evacuate under both information conditions, and Florida respondents with more individualist worldviews are less likely to evacuate under an evacuation order, but worldview was not significantly associated with evacuation intention for Texas respondents. Differences by information condition also emerge, including: (1) evacuation intentions decrease with age in the evacuation order condition but increase with age in the saw forecast condition, and (2) evacuation intention in the evacuation order condition increases among those who rely on public sources of information on hurricane threats, whereas in the saw forecast condition evacuation intention increases among those who rely on personal sources. Results reinforce the value of focusing hurricane information efforts on evacuation plans and residential vulnerability and suggest avenues for future research on how hurricane contexts shape decision making.

KEY WORDS: Hurricane evacuation decisions; risk communication and perception

1. INTRODUCTION

Hurricanes represent a substantial and recurring risk to a significant portion of the U.S. population, as well as to many other countries around the world. Improvements in hurricane forecasting over the last 100 years have contributed to forecasts and warnings about approaching storms that help people take protective actions, including evacuation from areas at high risk. However, although many members of the public take timely protective actions such as evacuation when a hurricane approaches, some do not, leading to adverse outcomes. This was exemplified by Hurricanes Katrina in 2005 and Sandy in 2012, which were well forecasted several days in advance yet resulted in significant loss of life and major societal and economic impacts.[1,2]

In response to such events, a growing community of researchers and practitioners recognizes the importance of improving communication and use of hurricane forecast and warning information. For example, the National Science Board emphasized the urgent need for investments in evacuation research "to better characterize the reactions of both the general public and government officials

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to hurricane-related information and the manner in which such information is most effectively processed and shared."[3, p. 20] More generally, the Subcommittee on Disaster Reduction highlighted promoting "risk-wise" behavior for all hazards, particularly with respect to forecasts and warnings, as one of the six grand challenges facing the science and technology research community.[4,5]

In this article, we focus on hurricane evacuation decision making by members of the public, using data from a survey. The manner in which individuals receive, interpret, and respond to hurricane information can contribute to—as well as mitigate—harmful behaviors (e.g., nonevacuation from high-risk areas). Research has shown that people's perceptions of and responses to approaching hurricane risks are multidimensional and influenced by a variety of factors, ranging from prior experience to vulnerability to risk preferences.[6–16] Moreover, the creation and communication of hurricane risk information is a complex scientific-social process across multiple institutions and jurisdictions,[17] which allows people to obtain different hurricane risk information from a plethora of information sources.[18–21]

Our study seeks to build understanding of why different members of the U.S. public respond to the risk of an approaching hurricane in the ways that they do, and what can be done to improve people's decisions about protective actions. We extend prior work on public hurricane evacuation decisions in several ways. First, we explicitly undertook survey development and interpretation of results based on mental models research, which informs a novel, more detailed examination of how hurricane risk perceptions and evacuation motivations influence evacuation decision making. Additionally, our analysis includes several influencing factors—such as cultural worldviews and sources and perceptions of risk information—that have been less well studied in the hurricane evacuation context. Further, recognizing that people receive many risk messages as a hurricane threat evolves, and that contrasting information conditions have been understudied (for an exception see, Meyer *et al.*[16]), we examine and compare the influence of these factors under two hurricane information conditions: *seeing a hurricane forecast* versus *receiving an evacuation order*. To advance understanding of how the influences of different factors may vary across hurricane evacuation contexts, our analyses investigate decision making in two coastal regions of the United States at risk from hurricanes—the Miami-Dade ($n = 457$) and Houston-Galveston ($n = 347$) areas.

Section 2 summarizes key findings from relevant past work and lays out the theoretical framing for the study. Section 3 presents the study methodology, including survey development, sampling, implementation, and analysis methods. Section 4 presents descriptive and comparative results for each study region and overall, and Section 5 presents results from regression analyse examining how the hypothesized influencing factors predict evacuation intention in the two study regions and information conditions. In Section 6, we use the findings from this study, along with results from our related research,[17,22–25] to provide suggestions for improvements to hurricane risk communication to reduce ineffective protective responses.

2. EXPLAINING EVACUATION DECISIONS

Our analysis focuses on explaining evacuation intentions under different information conditions as a hurricane develops and approaches. In the first phase of this project we used mental model interviews with professionals (hurricane forecasters, public officials, and broadcasters) in the Miami-Dade area to develop a decision model of the forecast and warning system.[22] Building on this model, prior related research,[6,12,14,15,20,21,26,27] and findings from mental model interviews and a pilot survey with Miami-Dade area residents[22] we developed Fig. 1 to illustrate how we theorize that warning messages and other factors influence evacuation decisions and actions.

Consistent with applications of the protective action decision model (PADM) to hurricane evacuations and in related risk contexts,[15,26] we theorize that threat appraisal and protective action decisions and behaviors are contingent on the specific information context. Protective action decisions are made under diverse hurricane information conditions. Prior studies indicate that receiving an evacuation order can be a strong motivator for hurricane evacuation,[10,21,28,29] and that hurricane forecast information can also be an important factor in evacuation decision making.[13,18,20] Protective action decision making can be self- or socially motivated in response to these and other types of information, to environmental cues like actual hurricane conditions, and to social cues. While evacuation orders result from policy decisions as well as forecasts, forecasts are a function primarily of predictive science. While in a real hurricane event these would not be truly independent information conditions, but more likely

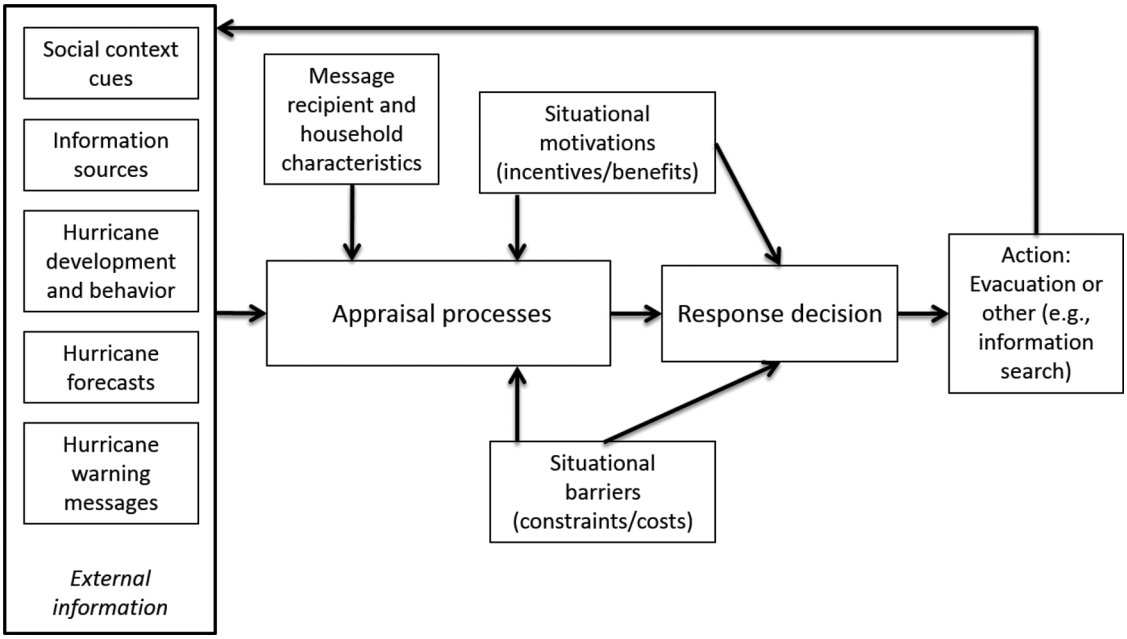

Fig. 1. Hurricane information appraisal and response model investigated in this article.

overlapping conditions that appear and evolve as an event unfolds over time, we investigate them separately to explore differences in behavioral responses to the different information conditions.

As suggested in Fig. 1, threat appraisal and response decisions are also influenced by individual and household characteristics including cultural factors. We examine threat perceptions, a component of appraisal processes, as perceived hurricane risk and vulnerabilities. We also examine the influence of prior hurricane experience and preparatory actions, which as part of message recipient and household characteristics, influence appraisal. Further, situational facilitators and barriers can directly motivate or inhibit actions, and information sources influence how people appraise available information as well as the broader hurricane response situation and thus their responses, decisions, and actions.

We differentiate the roles of external information and environmental cues—such as forecasts and storm behaviors, respectively—from the individual cognitive and affective processes that constitute appraisal processes. Appraisal includes attentional, cognitive, and evaluative processes, which together generate emotional responses.[30–32] We also theorize that cultural and situational factors relate to appraisal processes, resulting in culturally contingent selective use and attention to information sources. Guided by Fig. 1, our analysis includes the following independent variables (discussed in subsequent sections as noted): individual (i.e., message recipient and household) characteristics, discussed below under sociodemographics and cultural worldviews (Sections 2.1 and 2.2); threat perceptions, a component of appraisal processes, discussed below as perceived hurricane risk and vulnerabilities (Section 2.3); prior hurricane experience and preparatory actions (Section 2.4), which as part of message recipient and household characteristics influence appraisal; situational facilitators and impediments, discussed below as motivations or barriers to evacuation (Section 2.5); and sources and perceptions of hurricane forecast and warning information (Section 2.6).

2.1. Sociodemographics

Previous work suggests that sociodemographic characteristics, including gender, race and ethnicity, age, income and employment status, home ownership, and household composition may be associated with differences in hurricane protective responses.[27,33] Research in diverse risk contexts has shown that women as well as men of color tend to perceive greater risk than their white male peers,[34–36] which contributes to differences in

behavioral responses. For hurricanes, some studies have found that females are significantly more likely to evacuate;[8,9,11,12,37] however, the interaction between gender and hurricane evacuation behavior is complex and interacts with risk exposure, risk perceptions, household characteristics, and other factors.[38]

Although a few studies have found that white and/or Latino individuals were more likely to evacuate,[8,9] other studies have found race or ethnicity insignificant in explaining evacuation.[15,39–41] Regarding age, some studies have shown that older residents are more likely to evacuate,[42,43] but others have found an opposite effect[44] or no effect.[15,37,45] Higher educational level has also been found, in a few studies, to correspond to a higher likelihood of evacuation,[43] as well as to other differences in evacuation decision making.[9,46]

Prior studies have found that evacuation likelihood increases with income,[39,43] decreases with income,[44] or is insensitive to income.[9,15,37,45,47,48] Similarly mixed effects have been found regarding the influence on evacuation likelihood of differences in employment or job status.[18,29,37] Home ownership has been found to relate to decreased evacuation likelihood.[39,43,48] Type of residence (e.g., mobile homes[6,9,37,48,49]) and household composition can also either motivate or hinder evacuation. For example, while having children may help motivate evacuation,[11,37,48] increase responsiveness to warnings and evacuation messages,[50] and increase risk perceptions,[51] Peacock *et al.*[43] found that in single-parent households, children under 12 may be a factor contributing to not evacuating. We consider these previously studied sociodemographic characteristics as potential explanatory variables in this study.

2.2. Cultural Worldviews

Previous research suggests that risk perceptions may be the product of cultural beliefs, that is, beliefs about ideal social structure and legitimate social priorities also known as worldviews. Such beliefs structure the networks between individuals, or the degrees of insulation, autonomy, control, and competition between individuals.[52–55] Cultural factors interact with sociodemographic factors in ways that have been interpreted as identity-protective motivated reasoning, such as the example in Section 2.1 of white males discounting risks, known as the "white male effect,"[56] or "cultural cognition."[57]

One approach to understanding how culture influences risk perception is the cultural theory of risk, which holds that social organization is "logically prior to . . . . beliefs," [53, p. 159] and beliefs in turn reinforce social preferences. Following Leiserowitz *et al.*,[58–60] we examine how two cultural worldviews about ideal social organization—individualist and egalitarian—are associated with evacuation decisions. According to the cultural theory of risk, the ideal social structure in the individualist worldview prioritizes autonomy and competition, whereas the egalitarian worldview prioritizes cooperation and strong social ties. Risks are perceived when these social priorities are threatened. The worldviews also encompass interactions between society and the environment so that people with more individualist worldviews perceive lower risks arising from the environment while people holding more egalitarian worldviews perceive higher environmental risk. We anticipate that worldviews influence not only how people perceive risk, but also their evacuation intentions. We hypothesize that those with stronger individualist worldviews will be less inclined to evacuate in response to evacuation orders provided by authorities than will those holding stronger egalitarian worldviews.

2.3. Perceived Hurricane Risks and Vulnerabilities

Frameworks for appraisal of risks (Fig. 1) include appraisal of affect, certainty, human agency, and personal control[30–32] (see Keller *et al.*[61] for a general discussion), which correspond to findings in risk perception research on the primacy of affective responses to risk,[62] the role of uncertainty, and the importance of controllability,[63,64] as well as cognitive responses.[65] Further, based on previous related work on hurricanes and other hazards, we expect that appraisal processes generate risk perceptions. Several studies have found that perceived risk—rather than actual risk as determined by forecasters, emergency managers, or government scientists, for example—is a primary factor in hurricane evacuation decision making.[15,20,29,39,45,66] Although perceptions of vulnerability play a strong role in evacuation decision making, some residents may not know if they live in an evacuation zone or not know when there is an evacuation order, and thus will not evacuate.[6,41] Other studies have found that if residents expect to be personally impacted by the storm, they are more likely to leave.[15,29] Catastrophic potential and risk controllability are key components of risk

perceptions in many psychometric studies of risks, and controllability has been singled out as particularly important in perceptions of natural hazards, such as hurricanes.[67] In some postevent studies, nonevacuees have reported that they simply felt safe in their home or where they were.[18,29,37]

Hurricanes pose several types of threats—including winds, coastal flooding due to storm surge, and inland flooding—and differences in perceived risks from these threats can also influence evacuation decision making. Some studies have found that perceived risk of flooding influences evacuation decision making,[9,29] while others[41] have found that perceived wind risk was a more important motivating factor. In this study, we explore the relative influence of these types of hurricane risk perceptions, including measures derived from previous related research and from public interviewees' discussions of hurricane risks in our mental models analysis.

2.4. Prior Hurricane Experience and Preparatory Actions

In addition to sociodemographics and cultural worldviews, other individual and household characteristics that are relevant to protective decision making include people's prior experience and preparatory actions. Previous studies have produced mixed findings regarding the relationship between past hurricane experience with a hurricane and evacuation behaviors. Past experience with a hazard is generally thought to influence one's recognition that a risk exists and increases motivation to protect oneself. Although some studies in the hurricane context have found this positive relationship,[13,20,39,66,68] other studies have found a negative or no significant relationship between past hurricane experience and evacuation behaviors.[6,7,11,14] As Lindell *et al.*[11] note, a potential reason for the mixed empirical findings is because past hurricane experience has been measured in many different ways. Related to past experience, several studies have examined past preparatory actions as a predictor of protective actions when a hazard such as a hurricane threatens, so we explore this as well.[45,69]

2.5. Motivations and Barriers to Protective Action

As often emphasized in disaster and emergency response research, context-specific knowledge about actions and the ability to take those actions are important in risk response.[70,71] Related to discussion of hurricane risk perceptions in Section 2.3, prior research has shown perceptions of the vulnerability and safety of one's residence specifically to be a factor in hurricane evacuation decisions, as well as motivations to keep oneself or one's family safe.[6,8–11,13,66,68] Previous studies have also found that several different types of situational impediments can reduce likelihood of evacuation, including having pets,[9,48] having medical conditions (which may increase concerns about shelters or other facilities not being able to meet their needs),[37,72] perceiving that looters may threaten one's property,[11,37] and not having reliable transportation.[29,42] Hence this study also explores the relative influence of these types of situation-specific evacuation motivations and barriers, using measures adopted from previous research and derived from our hurricane mental models analysis.

2.6. Sources and Perceptions of Information

Recent research suggests that with the modern availability of hurricane forecast, warning, and protective information, many individuals commonly follow hurricane threats via multiple public or private information sources, consider the safety of their home and family, and weigh their protective options.[10,12,13,16,18,20] For some people, receipt of an evacuation order is an important factor in evacuation decision making,[10,21,29] as is trust in public officials.[45] Other studies have found that people's evacuation decision making is influenced by their reliance on personal information sources and the advice of family and friends.[6,11,13,14,20,39,41,46,73,74] Regarding information perceptions, Lazo *et al.*[14] found that increased perceived accuracy of forecasts predicted (weakly) intentions to evacuate, but that increased trust in the accuracy of forecasts had no influence on evacuation intentions. Hence we anticipate potentially complex relationships between use and perceptions of different information sources and evacuation decision making, and so examine multiple measures of the use and perception of information sources, in conjunction with the other potential influencing factors discussed above.

2.7. Summary

In sum, based on prior related work, we expect evacuation intentions to be greater for females; greater for those with higher egalitarian worldviews and lower for those with higher individualist

worldviews; and greater for those who perceive higher risk from hurricanes (e.g., higher likelihood, worse consequences, less controllability). We examine the effect of prior hurricane experience on evacuation intentions to compare our results with the mixed findings from past research, and we explore the effect of people's appraisals of their past experiences. We expect evacuation intentions to be greater for those who have an evacuation plan and greater for those who perceive higher situational motivations (such as wanting to keep their family safe) or lower situation barriers (such as having adequate transportation to evacuate). We expect that people's hurricane information sources will influence evacuation intentions, but because this has not been explored in previous studies we do not have prior expectations on how. Finally, we expect evacuation intentions to be greater for those with greater trust in forecasts or who find the information more useful or accurate.

3. RESEARCH METHODS

3.1 Survey Design and Instrument

The survey instrument design draws on the prior literature discussed above and on our related prior and concurrent research. This related research includes work on the sources, communication, perceptions, uses, and value of hurricane information using stated preference valuation and interview methods;[13,14,20,75,76] hurricane mental modeling work in Miami;[22] and work on a related project on communicating hurricane information.[17,23] Many of the survey questions were adopted from previous surveys implemented by the authors and colleagues. The survey was pretested in three cognitive interviews using a hard copy of the draft survey with individuals in Boulder who had previously lived in Miami. Following revisions based on the cognitive interviews, the survey was programmed online by Knowledge Networks (KN) and pretested with 33 individuals using a random subset of the full sample.[3] A review of data from the pretest determined that the survey was ready for full implementation (discussed in Section 3.2).

Evacuation intentions (represented in the "Action" box in Fig I) were measured as the subjective likelihood of evacuating in five information conditions, each of which is likely to prevail at some point in the event of a major, landfalling hurricane: (a) you *saw a forecast* that a hurricane would hit where you live; (b) you received a hurricane watch; (c) you received a hurricane warning; (d) you received an *evacuation order*; (e) your neighbors evacuated.

As explanatory variables of evacuation intentions, the survey included measures corresponding to the influencing factors discussed in Sections 2.1–2.6. Most of the sociodemographic data were derived from profile data provided by KN for all respondents. Additional sociodemographic information of specific interest for our work (e.g., length of residence in a hurricane-vulnerable area) were elicited at the end of the survey. Language in which the respondent took the survey (English or Spanish) was included in the analysis as a proxy for primary language spoken, which is related to ethnicity. We assessed worldviews related to the cultural theory of risk with nine items from Smith and Leiserowitz,[59] which characterize individualism and egalitarianism on two scales.[4]

For hurricane risk perceptions and vulnerabilities, we measured respondents' perceptions of (1) whether they reside in an evacuation zone, (2) likelihood of several different types of conditions and impacts during a hurricane, (3) likelihood of a hurricane occurring in the next year in the respondent's area, and (4) catastrophic potential and controllability of hurricane risks (using measures from the psychometric paradigm[63]).

We measured respondents' past hurricane experiences with two items—(1) whether one has past experience evacuating, and (2) how severe the impact of one's hurricane experiences have been. The first item assesses one's response to past hurricane threats, and the second item measures one's appraisal of one's overall experiences with hurricane threats.[78] We measured preparatory actions as whether or not respondents have developed an evacuation plan in the past.

As measures of motivations and barriers, we elicited respondents' ratings of agreement with several potential barriers (not knowing how to evacuate, having pets, not having transportation, and health or disability issues for the respondent or someone in his/her family) and motivations (wanting to keep their family safe or not be stuck in the area after the event), along with respondents' perceptions of

[3]The survey sampling, programming, and implementation was contracted with Knowledge Networks (now GfK Knowledge Networks).[77] Additional information on KnowledgePanel® is available at http://www.knowledgenetworks.com/ganp/.

[4]For most questions with multiple items (e.g., the cultural worldview items) were presented in random order to all respondents.

the vulnerability and safety of their residence to wind and storm surge.

For sources and perceptions of information, we elicited respondents' trust in hurricane information, their intended frequency of use of various potential sources of information during a hurricane threat, their ratings of perceived usefulness of 11 elements of hurricane forecasts (e.g., location of landfall, timing of landfall, maximum sustained winds), and their ratings of accuracy of hurricane forecasts.

3.2 Survey Implementation and Sample Characteristics

The target population consists of 18-year-old and older residents of three Florida counties (Broward, Miami-Dade, and Palm Beach) in the Miami area and four Texas counties (Brazoria, Galveston, Harris, and Matagorda) in the Houston-Galveston area. To sample the population, KN invited 1,311 of its 3,095 KnowledgePanel panelists in these seven counties. KnowledgePanel is a probability-based web panel designed to be statistically representative of the U.S. population. KnowledgePanel provides respondent sociodemographic data as supplemental data rather than having to collect them during the survey. [77] Since a significant portion of the sample is primarily Spanish speaking, the survey was translated into Spanish by KN and offered in English and Spanish to all respondents.

As can be seen in Fig. 2, southeast Florida has a smaller portion of coastal areas in evacuation zones than the Houston-Galveston area of Texas. The respondents are also distributed differently with respect to the coastal area (in Florida they follow the coast whereas in Texas many are further inland in the Houston area).

The survey was implemented from May 4, 2012, through May 24, 2012. Email reminders to nonresponders were sent on day 3 of the field period. The survey had 808 respondents, a survey completion rate of 61.6%. The median time for survey completion was 26 minutes; 21.6% of the respondents took the survey in Spanish (30.0% of those in Florida and 10.7% of those in Texas).

Using latitude-longitude information provided by KN (randomly shifted by up to 100 m, with respondent ID masked), we used GIS to geolocate each respondent and determine whether or not he/she resided in an official evacuation zone. Fig. 2 shows respondents' locations relative to evacuation zones for the relevant counties in Florida and Texas, color coded according to their perceived evacuation zone, and Table I presents cross-tabulation of respondents' actual versus perceived evacuation zone.

Table II presents the sociodemographic characteristics of the sample. Here and in subsequent tables we also test for significant differences in characteristics, perceptions, responses, etc. between the Florida and Texas subsamples as indicated by *t*-scores and *z*-scores from tests for differences in means between independent samples.

3.3 Analytical Methods

Following compilation of the data set, we checked for unreasonable values and assessed summary statistics and missing values. Of the 808 respondents, four did not answer the evacuation intentions questions and were dropped from further analysis. For the remaining 804 respondents, missing values were replaced with the median value, mean value, or more conservative response category as appropriate (e.g., respondents who answered "Don't know" to the prior evacuation question were coded as "no" for use in the regression analysis).

We combined individual survey items into scales using principal component and factor analyses where appropriate to more reliably characterize how the factors in Fig. 1 influence hurricane protective action. We then regressed evacuation intentions on hypothesized predictors. Because the dependent variables are ordinal in nature, we employ ordered probit regression analysis.

Other than in Table I and the factor analyses, we weight data from the respondents to be more representative of the populations in the Texas and Florida counties that were sampled.[5] Specifically, to reduce the effects of any nonresponse and noncoverage bias in the overall KnowledgePanel membership, KN provides two panel poststratification weights based on sociodemographics variables (gender, age, race/ethnicity, census region, education, income, and home ownership), applied to individual cases to make the sample "look like" the population of the seven counties in the sample geographic areas. Weight1 is used to balance the panel across all seven counties and Weight2 to balance the panel across relevant Texas counties for Texas respondents and relevant Florida counties for Florida respondents.

[5] Corresponding results with the unweighted data are available in the Supporting Information.

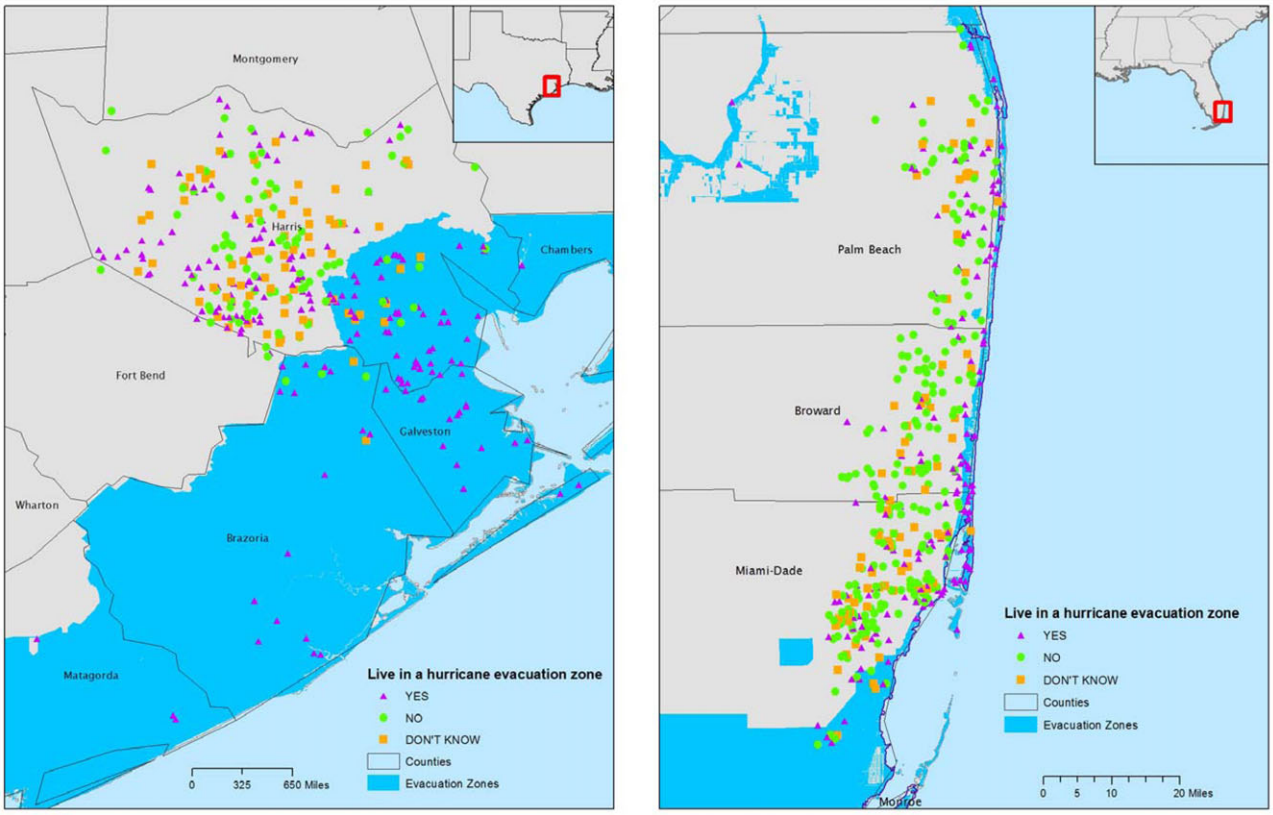

Fig. 2. Respondents' locations and their perceived evacuation zones (purple triangle = Yes, green circle = No, orange box = Don't Know), overlaid on the actual (dark blue area) evacuation zones in Florida (left) and Texas (right).

Table I. Cross-Tabulation of Actual Evacuation Zone by Perceived Evacuation Zone ($n = 804$)

		Actual Evacuation Zone			Perceived Evacuation Zone by State	
		Not in Evacuation Zone	In Evacuation Zone	Total	Texas ($n = 347$)	Florida ($n = 457$)
Perceived Evacuation Zone	Not in Evacuation Zone	36.3%	2.3%	38.7%	25.9%	48.4%
	In Evacuation Zone	24.4%	18.1%	42.4%	53.3%	34.1%
	Don't Know	17.0%	1.7%	18.9%	20.7%	17.5%
	Total	77.7%	22.3%	100.0%	100.0%	100.0%

Unweighted data. For weighted data, which vary little from these, see Table I in supplemental material.

4. INFLUENCING FACTORS: RESULTS

This section describes and analyzes data from our key variables (excepting sociodemographics), beginning with our dependent variables. Analysis includes the calculation of factor scores that are subsequently used in the regression models.

4.1. Evacuation Intentions

Fig. 3 presents respondents' mean reported evacuation intention in each of five information conditions. Fig. 3 shows the mean evacuation responses for the Texas and Florida subsamples in descending order. Averaged across both subsamples, intentions to

Table II. Sample Sociodemographics—Summary Statistics ($n = 804$)

Characteristic	Mean	Min	Max	Texas ($n = 347$)	Florida ($n = 457$)	|t-test| TX = FL
Age (Years)	47.11	18	88	44.11	49.87	4.96***
Total Years Residing in Hurricane-Vulnerable Area	25.29	0	86	25.01	25.55	0.44
Education (Years)	13.67	4	22	13.35	13.97	3.13**
Income (Thousands)	66.50	5	175	67.17	65.92	0.37
Household Size (Total Number in Household)	2.90	1	11	3.08	2.73	3.36***
Characteristic Summary Statistics						
	% Dummy = 1			Texas ($n = 347$)	Florida ($n = 457$)	|z-score|[a] TX = FL
Gender (Male = 1; Female = 0)	46.6%			49.1%	44.2%	1.75*
Own Residence (Yes = 1; No = 0)	68.4%			66.6%	70.0%	0.82
Children in House (Yes = 1; No = 0)	36.8%			43.1%	31.0%	3.37***
Took Survey in Spanish (Yes = 1; No = 0)	18.7%			19.0%	18.4%	1.00
House Type (Single Detached = 1; Other = 0)	55.4%			60.4%	50.9%	2.46**

[a]Z-score from Mann-Whitney U test for two independent samples (absolute value of Z; asymptotic significance).
All state-level data weighted to be representative of the areas sampled at the state level, and totals weighted to be representative of all areas sampled.
*, **, ***significant at the 10%, 5%, or 1% level, respectively

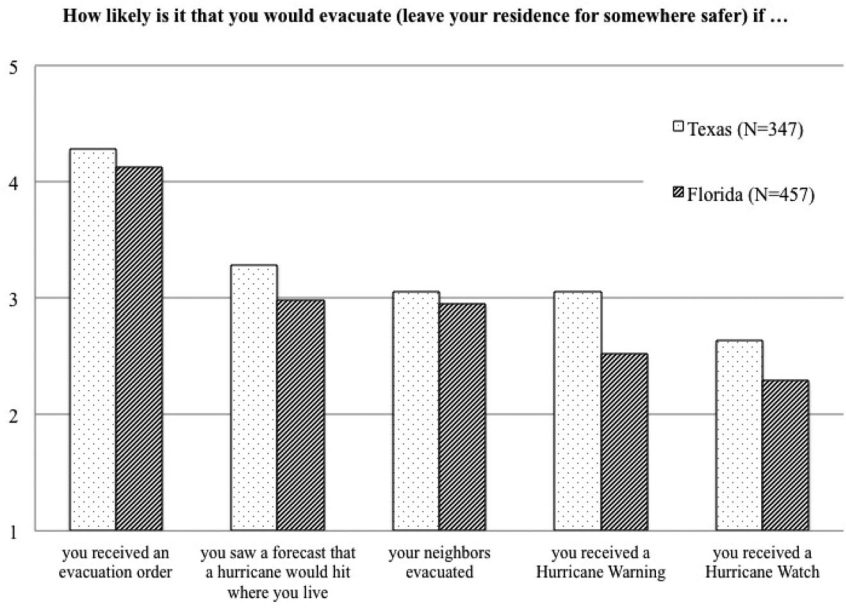

Fig. 3. Mean subjective likelihood of evacuation under differing hurricane information conditions (five-point verbally anchored response scale: 1 = Extremely unlikely, 3 = Somewhat likely, 5 = Extremely likely). Data weighted to be representative of the areas sampled at the state level.

evacuate are higher on receipt of an evacuation order than in other information conditions (e.g., testing the difference between "evacuation order" (mean = 4.13) and "saw a forecast" (mean = 3.09) yields a t-stat of = 21.24; $df = 803$, $p < 0.01$). For all information conditions, respondents in TX indicate a significantly higher intention to evacuate than those in FL (Mann-Whitney tests between states are all significant at well below the 1% level).

In the regression analysis reported in Section 5, we focus on predicting evacuation intentions in two of these conditions—"*evacuation order*" and "*saw a forecast*." As noted above, prior research suggests that both motivate evacuation intentions, but we hypothesize that reactions to them will differ. Evacuation intentions to "*saw a forecast*" are highly positively correlated with those for receiving a hurricane watch ($r = 0.60$, $p < 0.001$) and warning

($r = 0.67$, $p < 0.001$). We regress evacuation intentions on our hypothesized predictors separately by condition in order to explore and compare their influences under these two types of hurricane risk information conditions.

4.2. Cultural Worldviews

Principal components analysis (PCA) on responses to the nine worldview items suggested that two factors should be retained—Individualist and Egalitarian—as expected (Table III). There is no significant difference in (weighted) factor scores between Florida and Texas respondents on the Individualist factor ($t = 0.90$, $df = 802$, $p = 0.20$), but the mean factor score on the Egalitarian factor is significantly higher for Floridians than for Texans ($t = -2.21$, $df = 802$, $p = 0.03$).

4.3. Perceived Hurricane Risks and Vulnerabilities

Fig. 2 shows respondents' locations relative to evacuation zones, color coded according to their perceived evacuation zone, and Table I presents crosstabulation of respondents' actual versus perceived evacuation zone. As indicated in Table I, of those residing in an evacuation zone (22.3% of the total), 10.3% (i.e., 2.3%/22.3%) indicated that they were not and 7.6% indicated they didn't know. Of those not in an evacuation zone (77.7% of the total), 31.4% indicated that they were and 21.9% indicated they didn't know. In general, this suggests that most of those who actually are in an evacuation zone are aware of their status while those who are not are more uncertain of their status, which could lead to overevacuation. Overall, 42% of respondents indicate they believe they live in an evacuation zone—significantly more in Texas (53%) than in Florida (34%) ("no" and "don't know" responses were combined for regression analyses).

Of the hurricane conditions and impacts examined in the analysis (Table IV), respondents perceive high winds and blowing objects as most likely and inland flooding as the next most likely condition, followed by storm surge, which is considered only somewhat likely on average. Respondents judge looting the least likely of this set of impacts.

Regarding the likelihood of a major hurricane occurring in the general area where they live in the next year (Table IV), on average, respondents estimated a 47% chance of hurricane occurrence. Hurricane return periods for south Florida are between 14 and 19 years and for east coastal Texas about 25 years. This translates to roughly a 5–7% chance of a major hurricane passing within 50 nautical miles of Miami and a 4% chance in Texas in any given year (http://www.nhc.noaa.gov/climo/#returns). This suggests that respondents are significantly overestimating the likelihood of a hurricane in any given year, or else understanding the question differently than in the return period data. In response to the psychometric items, on average, respondents perceive that hurricanes are more likely to kill large numbers of people at once than one at a time, and they consider themselves to have relatively little personal control over harm (Table IV). For most of these variables, between-state differences are small (Table IV).

4.4. Prior Hurricane Experience and Preparatory Actions

Measures of people's past hurricane experiences reveal that twice as many Texas as Florida respondents have evacuated from a past hurricane (63% in Texas; 29% in Florida). These results likely reflect Hurricanes Rita (2005) and Ike (in 2008) that affected Texas and likely are also related to the larger percent of Texas respondents living in an evacuation zone. More than half of respondents indicated that they have an evacuation plan (66% in Texas; 51% in Florida). On average, respondents' appraisals of the severity of their prior hurricane experience are slightly less than "moderately severe" in both states, with 8% in both states reporting extremely severe experiences (mean of 2.76 in response to the question "Overall, how severe have the impacts of your own hurricane experience(s) been?" with "Not at all severe" = 1 to "Extremely severe" = 5).

4.5. Evacuation Motivations and Barriers

On average, respondents in both states agreed that family safety and concern about being stuck in the area after a hurricane are motivators for evacuation, with family safety being a stronger motivator (4.01 on the five-point scale).On average, there is not a high level of agreement (between 1.6 and 2.2 on the five-point scale) with any of the five barriers (Table V). However, for each of the barriers, a small percentage of respondents (between 4% and 10%) selected "strongly agree," indicating that this is a potentially important evacuation barrier for those individuals (as well as potentially for a similar percent of the 10.8 million people in the seven sample

Table III. Cultural Worldviews—Summary Statistics and Factor Analysis ($n = 804$)

Statement[a]	Mean	Texas[b] ($n = 347$)	Florida[b] ($n = 457$)	|z-score|[c] TX = FL	Factor1[d] Individualist	Factor2 Egalitarian
Government regulation of business usually does more harm than good.	3.32	3.34	3.31	0.60	0.83	−0.10
If the government spent less time trying to fix everyone's problems, we'd all be a lot better off.	3.38	3.34	3.42	2.99***	0.82	−0.18
The government interferes too much in our everyday lives.	3.41	3.42	3.41	1.69*	0.80	−0.23
Our government tries to do too many things for too many people. We should just let people take care of themselves.	3.09	3.1	3.08	0.38	0.77	−0.28
People should be allowed to make as much money as they can, even if it means some make millions while others live in poverty.	3.33	3.26	3.4	3.11***	0.49	−0.48
The world would be a more peaceful place if its wealth were divided more equally among nations.	2.79	2.75	2.83	0.57	−0.13	0.82
In my ideal society, all basic needs (food, housing, healthcare, education) would be guaranteed by the government for everyone.	2.72	2.64	2.79	0.95	−0.17	0.75
I support government programs to get rid of poverty.	3.33	3.18	3.48	3.44***	−0.29	0.73
Discrimination against minorities is still a very serious problem in our society.	3.32	3.25	3.38	1.52	−0.15	0.69
Variance explained by each factor					33.0%	29.6%

[a]For each item, the response scale was: Strongly Disagree = 1; Disagree = 2; Neither Agree nor Disagree = 3; Agree = 4; Strongly Agree = 5 (numerical labels were not provided with the response scale).
[b]All state-level data here and in subsequent tables are weighted to be representative of the areas sampled at the state level, and totals weighted to be representative of all areas sampled.
[c]Z-score from Mann-Whitney U test for two independent samples (absolute value of Z; asymptotic significance).
[d]Factor analyses carried out on unweighted data. Varimax orthogonal rotation produced the factor pattern in the right-most two columns.
*, **, *** significant at the 10%, 5%, or 1% level, respectively

counties[6]). For several of the motivations and barriers, Texas respondents agreed more strongly than Florida respondents.

When asked if their evacuation intentions are related to the vulnerability/safety of their house to wind and surge threats, on average, respondents neither agree nor disagree (Table V). However, 15–20% strongly agree that their stated intentions are related to their house being vulnerable to wind or surge. On average, the data suggests that Texan respondents perceive their houses to be significantly more vulnerable to both surge and wind than do Florida respondents (Table V). This may be related to the more recent hurricane experiences in Texas. With respect to surge threats, this may also relate to the larger number of respondents in Texas living in evacuations zones than in Florida.

Respondents on average agree that trust in hurricane forecasts and warnings is a motivator for their evacuation decisions, albeit weakly (Table V). There was not a significant difference between the two

[6]U.S. Census. 2013 Estimates from "State & County QuickFacts." http://quickfacts.census.gov/qfd/states/12/12086.html.

Table IV. Hurricane Risk Perceptions—Summary Statistics ($n = 804$)

Variable	Mean	Texas ($n = 347$)	Florida ($n = 457$)	$\lvert z\text{-score}\rvert$[e] TX = FL
Perceived to Live in Evacuation Zone (Yes = 1)	0.43	0.54	0.33	5.98***
Likely Conditions – High Winds and Objects Blowing[a]	4.29	4.15	4.42	5.15***
Likely Conditions – Storm Surge[a]	3.26	3.29	3.24	0.00
Likely Conditions – Inland Flooding[a]	3.84	3.85	3.84	0.09
Likely Impacts – Mortality and Morbidity[a]	3.24	3.23	3.25	0.38
Likely Impacts – Looting[a]	2.94	2.96	2.92	0.53
Likelihood of Hurricane in Next Year[b]	47.01	48.10	46.01	1.11
Hurricane Risks – Catastrophic[c]	3.82	3.86	3.78	0.90
Hurricane Risks – Controllability[d]	2.32	2.21	2.43	2.02**

[a]"How likely would each of the following conditions be in the general area where you live if a major hurricane (Category 3 or higher) hit your area?" (Extremely Unlikely = 1; Extremely Likely = 5)
[b]"Please move the blue marker to the place on the line that describes your best estimate of how likely you think a major hurricane (Category 3 or higher, that is winds of 110 mph or higher) will occur in the general area where you live in the next year?" (Respondents provided an open-ended response on a scale from 0–100%).
[c]"For each hazard listed, is it a risk that kills people one at a time (chronic risk) or a risk that kills large numbers of people at once (catastrophic risk)?" (Chronic (kills people one at a time) = 1; Catastrophic (kills large numbers of people at once) = 5)
[d]"How much personal control do people exposed to each hazard have over it? That is, to what extent can they prevent mishaps or illnesses to themselves from occurring, or reduce their severity if they do occur?" (No personal control = 1; Total personal control = 5)
[e]Z-score from Mann-Whitney U test for two independent samples (absolute value of z; asymptotic significance).
All state-level data weighted to be representative of the areas sampled at the state level, and totals weighted to be representative of all areas sampled.
*, **, *** significant at the 10%, 5%, or 1% level, respectively

subsamples on the trust variables, even though (as discussed in the next section) there were significant differences across the states in use of sources of this information.

4.6. Sources and Perceptions of Information

When asked "In the event of a hurricane threat, how often would you use the following to get information about the risk of an approaching hurricane?" on a scale of Never = 1 to Always = 5, in both states, people report heavy use of the National Weather Service (NWS) and National Hurricane Center (NHC) for hurricane information, followed by public officials, their own experience, and family and friends. Respondents in Florida indicate greater use of the NHC than those in Texas (4.33 in Florida; 4.20 in Texas; z-score = 3.66, $p < 0.01$), perhaps because the NHC is located in Miami. Texas respondents, on the other hand, report greater use of religious leaders or clergy than Florida respondents (1.75 in Florida; 1.40 in Texas; z-score = 5.61, $p < 0.01$). Factor analysis indicates that information sources fall into two types, for which we retained factor scores for regression analysis: "Information Sources Factor Scores – Public Sources" and "Information Sources Factor Scores – Personal Sources," with religious leaders among the personal information sources.

On average, respondents rate as useful all of the 11 different types of hurricane information provided with a hurricane forecast that we asked about on the survey, with 29% rating all 11 types of information extremely useful. We summed across the 11 types to create an "Information Usefulness" scale for use in the regressions. On average, Florida respondents rate the overall hurricane information as more useful than Texas respondents (67.98 in Florida; 64.68 in Texas, out of a maximum possible value of 77; $z = 3.77$, $p < 0.01$). Respondents also rate hurricane forecasts as fairly accurate overall, with a slightly higher average rating of hurricane forecast accuracy by Texas respondents (3.78 in Texas; 3.68 in Florida, out of 5; $z = 1.87$, $p < 0.10$). This suggests that usefulness and accuracy measure somewhat different aspects of perceptions of forecast information.

5. REGRESSION ANALYSIS

Regression analyses test the hypothesized influences on two stated evacuation intentions conditions—"if you saw a forecast that a hurricane would hit where you live" (hereafter referred to as Saw Forecast) and "if you received an evacuation order" (Evacuation Order). Since the hurricane risk,

Table V. Evacuation Motivations and Barriers—Summary Statistics ($n = 804$)

Item	Mean	Texas ($n = 347$)	Florida ($n = 457$)	$\lvert z\text{-score}\rvert$[a] TX = FL
Motivations[b]				
… because I want to keep my family safe	4.01	4.04	3.99	0.36
… so I would not be stuck in the area after the hurricane	3.35	3.54	3.18	3.84***
Barriers[c]				
… I do not know how to evacuate	1.66	1.70	1.63	1.69*
… my pet(s) make it difficult to evacuate	2.16	2.16	2.16	0.46
… I lack transportation	1.72	1.77	1.66	2.63***
… my health or disabilities make it difficult to evacuate	1.78	1.89	1.68	3.45***
… I have a family member whose health/disability makes it difficult to evacuate	1.82	1.95	1.70	3.81***
House Vulnerable / Safe				
… because my house is vulnerable to hurricane storm surge[b]	2.67	2.84	2.52	3.59***
… my house is safe from hurricane storm surge[c]	3.12	2.98	3.24	2.91***
House Vulnerable–Surge alpha-factor (from above two items)[d]	0.03	0.12	−0.06	3.91***
… my house is safe from hurricane winds[c]	2.88	2.72	3.03	3.30***
… because my house is vulnerable to hurricane winds[b]	2.99	3.15	2.85	3.18***
House Vulnerable–Winds alpha-factor (from above two items)[d]	0.00	0.11	−0.11	4.20***
Trust				
… because I trust hurricane warnings and forecasts[b]	3.51	3.54	3.48	0.93
… I distrust hurricane warnings and forecasts[c]	2.02	2.05	1.99	0.77
Trust Information alpha-factor (from above two items)[e]	−0.03	−0.03	−0.03	0.31

[a]Z-score from Mann-Whitney U test for two independent samples (absolute value of Z; asymptotic significance).
[b]For each of the following statements, please indicate how strongly you agree or disagree for your own personal situation. If a hurricane threatened, I would evacuate…"
[c]For each of the following statements, please indicate how strongly you agree or disagree for your own personal situation. If a hurricane threatened, I would shelter in place, and would NOT evacuate, because…"
[d]Alpha-factoring essentially reverse scores the "safe" item so higher factor score indicates a higher level of perceived vulnerability with respect to wind risks or surge risks.
[e]The alpha-factoring essentially reverse scores the "don't trust" item so a higher factor score indicates a higher level of trust in hurricane information.
For all individual items the response scale was: Strongly Disagree = 1; Disagree = 2; Neither Agree nor Disagree = 3; Agree = 4; Strongly Agree = 5.
All state-level data weighted to be representative of the areas sampled at the state level, and totals weighted to be representative of all areas sampled.
*, **, *** significant at the 10%, 5%, or 1% level, respectively

policy, and social contexts differ in the two regions, Table VI presents the regression results for the Texas and Florida subsamples as well as for the combined data set, to examine potential "structural" differences between the Florida and Texas respondents. All of the models are highly significant ($p < 0.001$) with between 72% and 79% of the fitted responses concordant with the observed responses.

5.1. Sociodemographics

Age is a significant predictor in most of the regression models, with older respondents more likely to intend to evacuate in the Saw Forecast information condition, but less likely to evacuate in the Evacuation Order information condition (Table VI). Additional analysis of our data suggests that the relationship between age and evacuation intention is nonlinear; for example, in the Saw Forecast condition, evacuation intentions increasing with age up to around age 60, then decrease. As discussed by Gladwin *et al.*,[10] older people may have different evacuation decision-making processes, and thus age may interact with other factors, affecting evacuation intention differently depending on the risk information context (e.g., whether there is an evacuation order or not). Our results may therefore help elucidate the mixed findings for the influence of age on hurricane evacuation in previous studies (Section 2.1).

Individuals who have lived in a hurricane-vulnerable area longer are less likely to evacuate (significant in the combined Saw Forecast model). Income and education did not play a significant role in

Table VI. Weighted Ordered Probit Regression Analysis on Subjective Likelihood of Evacuation

	Evacuation Order[a,c]			Saw Forecast[b,c]		
	Combined ($n = 804$)	Texas ($n = 347$)	Florida ($n = 457$)	Combined ($n = 804$)	Texas ($n = 347$)	Florida ($n = 457$)
Intercepts[d]	Weight1 Beta	Weight2 Beta	Weight2 Beta	Weight1 Beta	Weight2 Beta	Weight2 Beta
Intercept-2	−0.95	−0.60	−1.81	−3.75	−3.94	−4.09
Intercept-3	−0.47	0.01	−1.34	−3.24	−3.29	−3.63
Intercept-4	0.37	1.04	−0.49	−1.98	−1.65	−2.51
Intercept- 5	0.79	1.75	−0.19	−1.23	−0.66	−1.79
Sociodemographics						
Age	−0.24***	−0.38***	−0.16**	0.16***	0.24***	0.03
Education	0.03	0.15	−0.03	−0.03	−0.10	−0.01
Income	−0.01	−0.01	0.08	−0.07	0.07	−0.09
Gender (Male = 1)	−0.09*	−0.03	−0.20***	−0.08*	0.01	−0.15**
Children in House (Yes = 1)	−0.20***	−0.35**	−0.14	−0.04	−0.03	−0.15*
Household Size	0.08	0.06	0.13	0.14**	0.10	0.27***
Took Survey in Spanish (Yes = 1)	−0.03	0.22	−0.14*	−0.06	0.03	−0.05
Years Residing in Hurricane-Vulnerable Area	−0.05	−0.07	−0.03	−0.10**	−0.11	−0.07
House Type (Single Family Detached = 1)	−0.08	0.28**	−0.21***	0.04	0.24**	−0.07
Own Residence (Yes = 1)	0.14**	−0.44***	0.33***	0.00	−0.35***	0.23***
Cultural Theory						
Culture Theory Factor Score – Individualist	−0.05	0.03	−0.14**	0.04	−0.09	0.09
Culture Theory Factor Score – Egalitarian	0.01	−0.13	0.13*	0.07	−0.08	0.15**
Perceived Risk and Vulnerabilities						
Perceived to Live in Evacuation Zone (Yes = 1)	0.03	−0.05	0.06	0.04	0.08	0.01
Likely Conditions – High Winds and Objects Blowing	0.05	0.26**	−0.02	−0.10*	−0.12	−0.12*
Likely Conditions – Storm Surge	−0.11*	−0.12	−0.14*	−0.01	0.00	−0.02
Likely Conditions – Inland Flooding	−0.03	−0.11	0.04	0.02	0.02	0.09
Likely Impacts – Mortality and Morbidity	0.03	−0.11	0.12	0.10*	−0.05	0.23***
Likely Impacts – Looting	0.08	−0.07	0.14	−0.07	−0.10	−0.14**
Likelihood of Hurricane in Next Year	0.02	−0.03	0.02	0.01	0.01	−0.05
Hurricane Risks – Catastrophic	0.08	0.02	0.07	0.07	0.12	0.00
Hurricane Risks – Controllability	0.05	0.06	0.10	0.06	0.13*	0.00
Prior Experience						
Prior Response – Evacuated	0.10**	0.12	0.02	0.15***	0.11	0.23***
Prior Experience Severity Scale	−0.12**	−0.42***	0.03	0.03	−0.12	0.06
Developed an Evacuation Plan	0.18***	0.38***	0.16**	0.11**	0.09	0.16**
Perceived Motivations and Barriers						
Motivations: Keep Family Safe	0.41***	0.50***	0.43***	0.11**	0.11	0.10
Motivations: Don't Want to be Stuck in Area After Storm	−0.09	−0.32**	−0.02	0.42***	0.43***	0.45***
Barriers: Do Not Know How to Evacuate	0.19***	0.33***	0.15**	0.07	0.13	0.02
Barriers: Have Pets	−0.21***	−0.19*	−0.23***	−0.07	−0.11	−0.03
Barriers: No Transport	−0.09	−0.19	−0.15*	0.16***	0.19*	0.16**
Barriers: My Health or Disability	−0.03	0.02	−0.02	0.00	−0.02	0.08
Barriers: Family Member Health or Disability	−0.03	−0.02	−0.03	−0.02	-0.09	0.05
House Vulnerable Alpha-Factor – Surge	−0.09	−0.08	−0.10	0.11*	0.38***	−0.04
House Vulnerable Alpha-Factor – Wind	0.21***	0.52***	0.10	0.26***	0.21**	0.35***
Sources of Information						
Information Sources Factor Scores – Public Sources	0.25***	0.37***	0.19***	−0.06	−0.07	−0.07
Information Sources Factor Scores – Personal Sources	0.03	0.04	0.07	0.11**	0.26***	0.05
Trust – Alpha Factor	0.16***	0.16	0.11	0.06	0.12	0.03
Information Usefulness	0.09*	0.28***	0.06	−0.01	0.04	0.00
Information Accuracy	−0.03	−0.03	-0.01	0.08*	0.11	0.09

(*Continued*)

Table VI. (Continued)

	Evacuation Order[a,c]			Saw Forecast[b,c]		
	Combined ($n = 804$)	Texas ($n = 347$)	Florida ($n = 457$)	Combined ($n = 804$)	Texas ($n = 347$)	Florida ($n = 457$)
	Weight1	Weight2	Weight2	Weight1	Weight2	Weight2
Model Fit						
Likelihood Ratio – Chi-Square (DF = 38)	316.22	210.33	195.62	495.21	289.56	292.75
Association of Predicted Probabilities and Observed Responses						
Percent Concordant	74.5	78.5	72.8	76.4	76.5	75.4
Percent Tied	0.3	0.5	0.3	0.2	0.2	0.2
Somers' D	0.494	0.576	0.46	0.531	0.532	0.51

[a]"How likely is it that you would evacuate (leave your residence for somewhere safer) if ...you received an evacuation order." five-point verbally anchored response scale: 1 = Extremely unlikely, 3 = Somewhat likely, 5 = Extremely likely.
[b]"How likely is it that you would evacuate (leave your residence for somewhere safer) if ...you saw a forecast that a hurricane would hit where you live."
[c]Standardized regression coefficients (beta coefficients) reported, where the independent variables have been standardized with variances equal to one. The parameter estimates thus indicate how many standard deviations agreement with the dependent variable changes per one standard deviation increase in each predictor variable.
[d]The intercepts are not standardized regression coefficients but retained from parallel nonstandardized regression analysis. Significance levels on intercepts are not reported as they have no substantive meaning.
All state-level data weighted to be representative of the areas sampled at the state level, and totals weighted to be representative of all areas sampled.
*, **, *** significant at the 10%, 5%, or 1% level, respectively.

explaining evacuation intentions in any of the models in Table VI, controlling for other factors.

As expected, males are less likely to evacuate, although gender does not have a significant effect on evacuation intention among Texas respondents, controlling for other variables. Taking the survey in Spanish is weakly associated with increased evacuation intentions in the Texas models and decreased evacuation intentions in the Florida models ("took survey in Spanish" is only significant in the Florida Saw Forecast model). This suggests that different dynamics between ethnicity and evacuation decision making may operate in the two regions.

Having more people in the household is associated with higher evacuation intentions. However, having children (17 years of age and under) in the household is associated with lower evacuation intentions, after controlling for household size. This finding may be because, as discussed in Section 2.1, children and other family members can help motivate evacuation, but children can also make evacuation more challenging.

For housing type and ownership, several of the models showed significant relationships, but of different signs in the two states. Homeowners were less likely than nonhomeowners to evacuate in Texas, but more likely in Florida. Residents of single-family detached housing, on the other hand, were more likely to evacuate in Florida (compared to residents of other housing types) but less likely in Texas. The reasons for these differences are unclear, but may be due to social and policy contextual factors that we did not measure.

5.2. Cultural Worldviews

In the Evacuation Order model for Florida, respondents who are higher on the individualist factor are less likely to evacuate. This is consistent with expectations that individualists are more likely to react more negatively to civil authorities and information from them, such as evacuation orders. Those higher on the egalitarian factor in Florida are more likely to evacuate in both information conditions, even when other risk perception measures are included in the regressions. This suggests that worldviews are measuring an important aspect of culture in Florida that influences evacuation intentions. However, the two worldviews measured did not reach the 10% level of significance as predictors in any of the combined or Texas models.

5.3. Hurricane Risk Perceptions

The regressions suggest complex relationships between perceived hurricane risks and vulnerabilities

and evacuation intentions. Perceived evacuation zone status does not explain evacuation intentions in our regressions, contrary to some prior research (see Section 2.3). In the Evacuation Order model for Texas, higher perceived likelihood of high winds is associated with higher hurricane evacuation intentions. However, counter to expectations, higher perceived likelihood of high winds has a negative influence on evacuation intentions in other models, as does higher perceived likelihood of storm surge impacts. These results suggest that further research is needed to disentangle how different types of risk perceptions influence evacuation intentions, especially in conjunction with the motivations and barriers tested in this study. Together, these results also provide some support for concerns that some individuals may evacuate in response to wind threats (when they should likely shelter in place) but not in response to surge threats (which can be more deadly in a focused geographical area).

In the Florida and combined Saw Forecast models, evacuation intentions were higher for respondents who had higher expectations of mortality and morbidity from a major hurricane in their area. In the Saw Forecast model for Florida, evacuation intentions were lower for respondents who perceived higher likelihood of looting. This agrees with results from a few previous studies (Section 2.5) that some individuals may stay in place rather than evacuate in order to protect their property from looters.

As might be expected, perceived likelihood of hurricanes in the next year is not a significant predictor of evacuation intentions. Respondents who perceive hurricane risks to be more controllable have weakly higher evacuation intentions in the Saw Forecast model for Texas. This is opposite expectations, and may be because increased perceived controllability is associated more with stronger evacuation response efficacy beliefs than with weaker threat perceptions.

Overall, as discussed below, we suspect that perceived hurricane risks and vulnerabilities are not as influential in explaining evacuation intentions as motivations and barriers because they are a byproduct of appraisal processes. Motivations and barriers (see Section 5.5), on the other hand, more directly and specifically influence protective action decisions.

5.4. Prior Hurricane Experience and Preparatory Actions

Respondents with prior evacuation experience generally have higher intentions to evacuate (Table VI). This may be because prior evacuation experience indicates a predisposition to evacuate in any hurricane threat,[10] even when the other factors examined here are included in the analysis. Alternatively, this result may indicate that experience with evacuation reinforces intentions to evacuate in the future, by influencing efficacy.

Counter to expectations, severity of impacts from prior hurricane experiences is negatively related to evacuation intentions in both the Texas and combined Evacuation Order models. On average, respondents have experienced less than moderately severe impacts from hurricanes (Section 4.4). Some areas of Texas have experienced more severe impacts from recent hurricanes in the last decade, however, including traffic gridlock in the Houston-Galveston area during the evacuation from Hurricane Rita in 2005 (which occurred less than a month after Hurricane Katrina). The desire to avoid similar evacuation impacts in the future therefore may explain the negative results if respondents were recalling those major traffic problems when responding about the severity of their past experiences. Another possible explanation is that some Texas respondents may have a false sense of invulnerability due to "false experiences" from weaker parts of a storm (e.g., on the periphery of a hurricane)[6] or to "near-misses" where good fortune intervenes,[81] both of which have been shown to be associated with decreased hurricane evacuation intentions. Generally, the results suggest the need to extract more specific aspects of people's past hurricane experiences to better understand their association with behavioral intentions.

Across the models, respondents who have previously developed an evacuation plan are more likely to intend to evacuate. Similar to prior evacuation, this measure could indicate a predisposition to evacuate. However, this result also suggests that having individuals systematically think about and plan for potential evacuation in advance of an event may increase evacuation intentions.

5.5. Evacuation Motivations and Barriers

Across the models, respondents who agree more strongly with wanting to "keep my family safe" as a motive for evacuation are more likely to intend to evacuate; this influence is especially strong in the three Evacuation Order models. This suggests that an evacuation order may influence evacuation intention by helping motivate respondents to protect their families and themselves. In all three Saw Forecast models, respondents who agree more strongly

with not wanting to be stuck in the area after the storm have higher evacuation intentions, controlling for other motivations and barriers in the regressions. This suggests that individuals' perceptions of the poststorm situation are an important influence when they are making evacuation decisions based on their own evaluations of forecasts. In the Evacuation Order model in Texas, on the other hand, this variable has the unexpected opposite influence, for unclear reasons.

Regarding potential barriers to evacuation, people who agree more strongly that their pets make it difficult to evacuate have lower evacuation intentions in all of the Evacuation Order models, as expected based on prior research (Section 2.5). In the Florida Evacuation Order model, lacking transportation had the expected, negative influence on evacuation intention. Contrary to expectations, in the Saw Forecast models, respondents who agree more strongly with lacking transportation as a reason for nonevacuation reported being more likely to evacuate. Also counterintuitive, in the Evacuation Order models, respondents who agree more strongly with not knowing how to evacuate as a reason for nonevacuation reported being more likely to evacuate. However, overall only 8.2% of respondents agreed with a statement that they would shelter in place and not evacuate because they personally lack transportation, and only 8.6% agreed with a statement that they do not know how to evacuate (two-thirds of whom have not developed evacuation plans). Perceptions that personal or family health or disabilities make it difficult to evacuate do not predict evacuation intentions significantly in our analyses, controlling for other factors.

Across the models, respondents who more strongly agree with house vulnerability to wind as a reason to evacuate have higher evacuation intentions. One of the standardized coefficients for this variable (Texas, Evacuation Order) is the largest in the regressions (0.52), indicating that it is a very important influence on evacuation intentions. As discussed earlier, for most coastal residents, emergency management officials view vulnerability to storm surge as a more important reason for evacuation than vulnerability to wind. Perceived vulnerability of one's house to storm surge is a significant, positive predictor in the Texas and combined Saw Forecast models. However, it is not a significant predictor in the Evacuation Order or Florida models. These results suggest that perceived storm surge vulnerability may be less of a motivation for evacuation in the coastal Florida counties we sampled than in the coastal Texas counties.

5.6. Sources and Perceptions of Information

Use of public sources of hurricane information is positively related to evacuation intentions in the three Evacuation Order models, but not in the Saw Forecast models. Use of personal sources of information, on the other hand, is positively related to evacuation intention in the Texas and combined Saw Forecast models, but not in the Evacuation Order models. This suggests that, controlling for the other variables in the regressions, people who use more public sources of information are more likely to evacuate in response to evacuation orders, which originate from public officials. This appears to substantiate that people are influenced by the official status of an evacuation order. When individuals are making evacuation decisions based on forecasts, however, use of sources such as family, friends, and their own experience appears to be more important, even though the public sources factor includes prominent official sources of forecast information such as the National Hurricane Center.

Trust in hurricane forecasts and warnings is positively related to evacuation intentions, but significantly so only in the combined Evacuation Order model. Perceived usefulness of forecast information is also positively related to evacuation intentions in the Texas and combined Evacuation Order models. Perceived accuracy of hurricane forecast information, on the other hand, has a significant, positive relationship with evacuation intentions only in the combined Saw Forecast model. This suggests that respondents' perceptions of different attributes of forecast information influences evacuation decisions in different ways.

6. SUMMARY AND DISCUSSION

These findings begin to cast light on the complex relationships between individuals' perceptions, personal situations and characteristics, and use of hurricane information and their evacuation decision making under different hurricane risk information scenarios. Many of the results from this study are consistent with expectations based on the discussion in Section 2. For example, the observed overestimation of the likelihood of a hurricane in the next year is consistent with a general tendency for overestimation of low-probability risks, and this

judgment is not predictive of evacuation intentions in any of our analyses. In support of Fig. 1 and similar to Whitehead's[9] results, we also find that many influences vary by hurricane information condition and geographic location. Some factors show consistent relationships across risk information and geography, however. These include higher evacuation intentions among females, those who have past experience evacuating from a hurricane, and those who have undertaken past preparatory actions, measured here as development of an evacuation plan.

Additional research is needed to understand how and why these types of past hurricane experience link to people's protective decision making for future threats. One aspect of this is that evacuation behavior appears to be co-determined by prior behaviors, such as evacuation planning and preparedness, and the determinants of those behaviors. A recent systematic review of disaster preparedness research[83] finds that preparedness is a function of prior experience and perceived threat, as well as sociodemographics such as age and having children at home. However, findings are mixed regarding how sociodemographics influence disaster preparedness.[83]

Responses to seeing a forecast and receiving an evacuation order can be viewed as part of a continuum of evacuation decision making as a hurricane develops and different types of risk information are created and communicated. Responses to seeing a forecast may represent more self-motivated and active decision processes, in which reliance on personal sources of information, a desire to avoid getting stuck in the area after a hurricane, and lacking transportation are associated with stronger evacuation intentions, whereas factors such as having pets are less influential. In contrast, evacuation intentions in response to an evacuation order appear to be more motivated by protecting one's family, whereas having pets impairs compliance with evacuation orders. Indeed, protecting one's family is one of the strongest correlates of evacuation intentions in response to evacuation orders, which reinforces its value as a focus of communication efforts.

With regard to geographic variability, the differences in influences on evacuation intentions between Texas and Florida are indicative of differences in culture, vulnerability, experience, information, motivations, and barriers. For example, egalitarian worldviews are associated with higher evacuation intentions and individualist worldviews with lower evacuation intentions, but only in Florida, suggesting cultural differences between the survey subsamples. Texans may well have a different view of hurricanes than Floridians in part because of the recent and very different impacts of Hurricanes Rita and Ike in Texas.

We suspect that perceived evacuation zone is not significant in this modeling effort because the reasons for its influence on evacuation behavior are also better captured by one or more of the other measures included in our models (e.g., other risk/vulnerability variables, prior evacuation experience, motivations). The general perceived risk and vulnerabilities variables we tested were drawn from prior research and formative research including mental models interviews. However, none of these variables has a strong, consistent influence on evacuation intentions across multiple models once we include other variables—such as perceived motivations for and barriers to actions—in the regressions. This may be due to the specific, direct influence motivations and barriers have on particular evacuation decisions. Another possible reason may be that the judged vulnerability or safety of one's house is simply a more concrete measure of perceived risk and vulnerability.

Among perceived motivations and barriers, one of the strongest influences on evacuation intentions in our analysis is the desire to keep one's family safe, especially in the Evacuation Order condition. In keeping with findings of Lindell *et al.*,[11] evacuation intentions are also strongly related to the perceived vulnerability or safety of one's home, with perceived vulnerability to wind a more general strong predictor than vulnerability to storm surge. A concern of emergency officials is that individuals may evacuate their residences if they perceive a high wind threat when sheltering in place is actually more desirable (because it is safer or creates less traffic for people evacuating from higher-risk areas), whereas individuals may be less responsive to a potential storm surge threat (which tends to be the more deadly hazard). Our findings suggest that emergency officials' concern may be warranted in some geographical areas.

Implications of our findings for hurricane information provision include the conclusion often found in risk communication research[84] that it is critical for risk information to be sensitive to the specific risk and decision contexts. Trust, usefulness, and accuracy of hurricane information have different meanings in different contexts, and these differences appear to interact with use of information in evacuation decision making. Use of different sources of forecast information also appears to interact with evacuation decision making differently in different

contexts. Further, the strong positive influence that having developed an evacuation plan has on evacuation intentions reinforces the value of encouraging evacuation planning as a continued focal point for hurricane education and risk communication efforts. Our findings on the importance of individuals' perceived resilience and vulnerabilities of their residences to hurricane wind and storm surge (echoing Lindell *et al.*[11]) suggests that specific information on these, which can help address potential related misperceptions, may prove useful for those facing evacuation decisions, with the proviso that research would be required to develop and evaluate such information.[76,85,86]

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REFERENCES

1. NOAA. 2006. Service Assessment: Hurricane Katrina August 23–31, 2005. Available at: http://www.nws.noaa.gov/om/assessments/pdfs/Katrina.pdf, Accessed June 26, 2014.
2. NOAA. 2013. Service Assessment: Hurricane/Post-Tropical Cyclone Sandy, October 22–29, 2012. Available at: http://www.nws.noaa.gov/os/assessments/pdfs/Sandy13.pdf, Accessed June 26, 2014.
3. NSB (National Science Board). Hurricane Warning: The Critical Need for a National Hurricane Research Initiative, 2007. Available at: www.nsf.gov/nsb/committees/archive/hurricane/initiative.pdf, Accessed June 6, 2013.
4. SDR (Subcommittee on Disaster Reduction). Grand Challenges for Disaster Reduction, 2005. Available at: http://www.sdr.gov/docs/SDRGrandChallengesforDisasterReduction.pdf, Accessed June 6, 2013.
5. SDR (Subcommittee on Disaster Reduction). Grand Challenges for Disaster Reduction Implementation Plan: Hurricane. 4 pp. 2008. Available at: http://www.sdr.gov/docs/185820_Hurricane_FINAL.pdf. Accessed April 14, 2015.
6. Baker EJ. Evacuation behavior in hurricanes. International Journal of Mass Emergencies and Disasters, 1991; 9:287–310.
7. Dow K, Cutter SL. Crying wolf: Repeat responses to hurricane evacuation orders. Coastal Management, 1998; 26:237–252.
8. Riad JK, Norris FH, Ruback RB. Predicting evacuation in two major disasters: risk perception, social influence, and access to resources. Journal of Applied Social Psychology, 1999; 29(5): 918–934.
9. Whitehead J, Edwards B, Van Willigen M, Maiolo J, Wilson K, Smith K. Heading for higher ground: Factors affecting real and hypothetical hurricane evacuation behavior. Global Environmental Change, 2000; 133–142.
10. Gladwin CH, Gladwin H, Peacock WG. Modeling hurricane evacuation decisions with ethnographic methods. International Journal of Mass Emergency and Disaster, 2001; 19(2):117–143.
11. Lindell MK, Lu JC, Prater CS. Household decision making and evacuation in response to Hurricane Lili. Natural Hazards Review, 2005; 6:171–179.
12. Dash N, Gladwin H. Evacuation decision making and behavioral responses: Individual and household. Natural Hazards Review, 2007; 8(3):69–77.
13. Zhang F, Morss RE, Sippel JA, Beckman TK, Clements NC, Hampshire NL, Harvey JN, Hernandez JM, Morgan ZC, Mosier RM, Wang S, Winkley SD. An in-person survey investigating public perceptions of and responses to Hurricane Rita forecasts along the Texas coast. Weather and Forecasting, 2007; 22:1177–1190.
14. Lazo JK, Waldman DM, Morrow BH, Thacher JA. Assessment of household evacuation decision making and the benefits of improved hurricane forecasting. Weather and Forecasting, 2010; 25(1):207–219.
15. Huang S, Lindell M, Prater C, Wu H, Siebeneck L. Household evacuation decision making in response to hurricane Ike. Natural Hazards Review, 2012; 13(4): 283–296.
16. Meyer R, Broad K, Orlove B, Petrovic N. Dynamic simulation as an approach to understanding hurricane risk response: Insights from the Stormview Lab. Risk Analysis, 2013; 33:1532–1552.
17. Demuth JL, Morss RE, Morrow BH, Lazo JK. Creation and communication of hurricane risk information. Bulletin of the American Meteorological Society, 2012; 93(8): 1133–1145.
18. Dow K, Cutter SL. Public orders and personal opinions: Household strategies for hurricane risk assessment. Environmental Hazards, 2000; 2:143–155.
19. Lee KL, Meyer RJ, Bradlow ET. Analyzing risk response dynamics on the web: The case of Hurricane Katrina. Risk Analysis, 2009; 29:1779–1792.
20. Morss RE, Hayden MH. Storm surge and "certain death": Interviews with Texas coastal residents following Hurricane Ike. Weather, Climate, and Society, 2010; 2:174–189.
21. Sherman-Morris K. The public response to hazardous weather events: 25 years of research. Geography Compass, 2013; 7/10:669–685.
22. Bostrom A, Morss RE, Lazo JK, Demuth JL, Lazrus H. A mental models study of hurricane forecast and warning production, interpretation and decision making. Working Paper, University of Washington, Seattle, in preparation, 2014.
23. Lazrus H, Morrow BH, Morss RE, Lazo JK. Vulnerability beyond stereotypes: Context and agency in hurricane risk communication. Weather Climate and Society, 2012; 4(2): 103–109.
24. Lazrus H, Bostrom A, Morss RE, Demuth JL, Lazo JK. The whole point of flash floods is the flash part: A mental models approach to improving flash flood risk communication and decision making. National Center for Atmospheric Research, Boulder, CO, in preparation.
25. Morss RE, Demuth JL, Bostrom A, Lazo JK, Lazrus H. Flash flood risks and warning decisions in Boulder, Colorado: A mental models study of forecasters, public officials, and media broadcasters. Risk Analysis, doi: 10.1111/risa.12403.
26. Lindell MK, Perry RW. The protective action decision model: Theoretical modifications and additional evidence. Risk Analysis, 2012; 32: 616–632.

27. Lindell MK. Response to environmental disasters. Pp. 391–412 in Clayton SD (ed.). The Oxford Handbook of Environmental and Conservation Psychology. England: Oxford University Press, 2012.
28. Sarangi S, Krief J. An integrated approach to modeling evacuation behavior: Hyperbolic discounting and peer effects. Final Report. Gulf Coast Research Center for Evacuation, 2011.
29. Gudishala R. Development of a Time-Dependent, Audio-Visual, Stated Choice Method of Data Collection for Hurricane Evacuation Behavior. Dissertation. Louisiana State University. Department of Civil and Environmental Engineering, 2011. Available at: http://etd.lsu.edu/docs/available/etd-11022011-165822/unrestricted/gudishala_diss.pdf, Accessed July 12, 2014.
30. Smith CA, Ellsworth PC. Patterns of cognitive appraisal in emotion. Journal of Personality and Social Psychology, 1985; 48(4): 813–838.
31. Ellsworth PC, Smith CA. From appraisal to emotion: Differences among unpleasant feelings. Motivation and Emotion, 1988; 12(3): 271–302.
32. Ellsworth PC, Scherer KR. Appraisal processes in emotion. Pp. 572–595 in Davidson RJ, Scherer KR, Goldsmith H (eds.). Handbook of Affective Sciences. UK: Oxford University Press, 2003.
33. Phillips BD, Thomas DSK, Fothergill A, Blinn-Pike L (eds). Social Vulnerability to Disasters. Boca Raton, LA: CRC Press, 2010.
34. Bord RJ, O'Connor RE. The gender gap in environmental attitudes: The case of perceived vulnerability to risk. Social Science Quarterly, 1997; 78:830–840.
35. Finucane ML, Slovic P, Mertz CK, Flynn J, Satterfield TA. Gender, race, and perceived risk: The "while male" effect. Health, Risk, and Society, 2000; 2:159–172.
36. Flynn J, Slovic P, Mertz CK. Gender, race, and perception of environmental-health risks. Risk Analysis, 1994; 14(6):1101–1108.
37. Smith S, McCarty C. Fleeing the storm(s): An examination of evacuation behavior during Florida's 2004 hurricane season. Demography, 2009; 46(1):127–145.
38. Adeola FO. Katrina cataclysm: Does duration of residency and prior experience affect impacts, evacuation, and adaptation behavior among survivors? Environment and Behavior, 2009; 41: 459–489.
39. Bateman JM, Edwards B. Gender and Evacuation: A closer look at why women are more likely to evacuate for hurricanes. Natural Hazards, 2002; 3(3):107–117.
40. Horney J, MacDonald P, Berke P, Van Willigen M, Kaufman J. Factors associated with hurricane evacuation in North Carolina. Chapter 22 in Lupo A (ed). Recent Hurricane Research—Climate, Dynamics, and Societal Impacts. Vienna: InTech Publications, 2011.
41. Stein R, Dueñas-Osorio L, Subramanian D. Who evacuates when hurricanes approach? The role of risk, information, and location. Social Science Quarterly, 2010; 91(3):816–34.
42. Aguirre BE. Planning, Warning, Evacuation, and Search and Rescue: A Review of the Social Science Research Literature. Department of Sociology, Texas A&M University, College Station, TX, USA, April 4, 2014. Available at: http://www.cs.rice.edu/~devika/evac/papers/Lit%20Review%20_Evacuation.pdf, Accessed July 14, 2014.
43. Peacock W, Grover H, Mayunga J, Van Zandt S, Brody S, Kim HJ. The Status and Trends of Population Social Vulnerabilities Along the Texas Coast with Special Attention to the Coastal Management Zone and Hurricane Ike: The Coastal Planning Atlas and Social Vulnerability Mapping Tools. Hazard Reduction and Recovery Center, College of Architecture. Texas A&M University, USA, 2011. Retrieved from http://hrrc.arch.tamu.edu/media/cms_page_media/558/11-02R.pdf.
44. Trumbo C, Meyer M, Marlatt H, Peek L, Morrissey B. An assessment of change in risk perception and optimistic bias for hurricanes among gulf coast residents. Risk Analysis, 2014; 34(6):1013–1024.
45. Burnside R. Leaving the Big Easy: An examination of the hurricane evacuation behavior of New Orleans residents before Hurricane Katrina. Journal of Public Management and Social Policy, 2006; 12(1):49–61.
46. Norris F, Smith T, Kaniasty K. Revisiting the experience-behavior hypothesis: The effects of Hurricane Hugo on hazard preparedness and other self-protective act. Basic and Applied Social Psychology, 1999; 21(1):37–47.
47. Smith K. Estimating the Costs of Hurricane Evacuation: A Study of Evacuation Behavior and Risk Interpretation Using Combined Revealed and Stated Preference Household Data. Department of Economics. East Carolina University, Greenville, NC, USA, 1999. Retrieved from http://www.cs.rice.edu/~devika/evac/papers/kevinsmith.pdf.
48. Solis D, Thomas M, Letson D. Determinants of household hurricane evacuation choice in Florida. Selected paper prepared for presentation at the Southern Agricultural Economics Association Annual Meeting, Atlanta, GA, January 31–February 3, 2009.
49. Horney J, Snider C, Malone S, Gammons L, Ramsey, S. Factors associated with hurricane preparedness: Results of a pre-hurricane assessment. Journal of Disaster Research, 2008; 3(2):143–149.
50. Peek L. Age. Pp 155–185 in Phillips BD, Thomas DSK, Fothergill A, Blinn-Pike L (eds). Social Vulnerability to Disasters. Boca Raton, LA: CRC Press, 2010.
51. Peacock WG, Brody SD, Highfield W. Hurricane risk perceptions among Florida's single family homeowners. Landscape and Urban Planning, 2005; 73(2–3):120–135.
52. Douglas M. Natural Symbols: Explorations in Cosmology. London, UK: Barrie & Rockliff, 1970.
53. Spickard JV. A guide to Mary Douglas's three versions of grid/group theory, Sociological Analysis, 1989; 50(2):11–170.
54. Douglas M. Cultural Bias. London: Royal Anthropological Institute, 1978 (reprinted in Douglas M. Effects of modernization on religious change. Daedalus, 1982; 111: 1–19).
55. Douglas M, Wildavsky A. Risk as Culture: An Essay on the Selection of Technical and Environmental Dangers. Berkeley, CA: University of California Press, 1982.
56. Kahan DM, Braman D, Gastil J, Slovic P, Mertz, CK. Culture and identity-protective cognition: Explaining the white male effect in risk perception. Journal of Empirical Legal Studies, 2007; 4(3):465–505.
57. Kahan DM. Cultural cognition as a conception of the cultural theory of risk. Chapter 28, pp. 725–759 in Roeser S, Hillerbrand R, Sandin P, Peterson M (eds). Epistemology, Decision Theory, Ethics, and Social Implications of Risk, Springer, 2012.
58. Leiserowitz A, Maibach E, Roser-Renouf C, Smith N, Dawson E. Climategate, public opinion, and the loss of trust. American Behavioral Scientist, 2013; 57(6):818–837.
59. Smith N, Leiserowitz A. The role of emotion in global warming policy support and opposition. Risk Analysis, 2014; 34: 937–948.
60. Leiserowitz A. Global Warming in the American Mind: The Roles of Affect, Imagery, and Worldviews in Risk Perception, Policy Preferences and Behavior. Doctoral Dissertation, Environmental Studies Program and the Graduate School of the University of Oregon, December 2003.
61. Keller C, Bostrom A, Kuttschreuter M, Savadori L, Spence A, White M. Bringing appraisal theory to environmental risk perception: A review of conceptual approaches of the past 40

years and suggestions for future research. Journal of Risk Research, 2011; 15(3):237–256.
62. Finucane ML, Alhakami A, Slovic P, Johnson SM. The affect heuristic in judgments of risks and benefits. Journal of Behavioral Decision Making, 2000; 13(1): 1–17.
63. Fischhoff B, Slovic P, Lichtenstein S, Read S, Combs B. How safe is safe enough? A psychometric study of attitudes toward technological risks and benefits. Policy Sciences, 1978; 9:127–152.
64. Slovic P. The Perception of Risk. New York: Earthscan, 2000.
65. Slovic P, Peters E, Finucane ML, MacGregor DG. Affect, risk, and decision making. Health Psychology, 2005; 24(4):S35–S40.
66. Dash N, Morrow B. Return delays and evacuation order compliance: The case of Hurricane Georges and the Florida Keys. Global Environmental Change Part B: Environmental Hazards, 2000; 2(3):119–128.
67. Brun W. Cognitive components in risk perception: Natural versus manmade risks. Journal of Behavioral Decision Making, 1992; 5:117–132.
68. Burnside R, Mille DS, Rivera JD. The impact of information and risk perception on the hurricane evacuation decision making of greater New Orleans residents. Sociological Spectrum: Mid-South Sociological Association, 2007; 27(6):727–740.
69. Nagele DE, Trainor JE. Geographic specificity, tornadoes, and protective action. Weather, Climate, and Society, 2012; 4(2):145–155.
70. NRC (National Research Council). Tsunami Warning and Preparedness: An Assessment of the U.S. Tsunami Program and the Nation's Preparedness Efforts. Washington, DC, USA: National Academies Press, 2011.
71. Eiser JR, Bostrom A, Burton I, Johnston DM, McClure J, Paton D, van der Pligt J, White MP. Risk interpretation and action: A conceptual framework for responses to natural hazards. International Journal of Disaster Risk Reduction, 2012; 1:5–16.
72. Horney J, Ricchett-Masterson K. Quick Response Report: Explaining Hurricane Evacuation Failure: The Role of Social Factors as Modifiers. Boulder, CO, USA: Natural Hazards Center, 2012. Available at: http://www.colorado.edu/hazards/research/qr/submitted/horney_2012.pdf.
73. Taylor K, Priest S, Fussell Sisco H, Banning S, Campbell K. Reading Hurricane Katrina: Information sources and decision-making in response to a natural disaster. Social Epistemology, 2009; 23:361–380.
74. Widener MJ, Horner MW, Metcalf SS. Simulating the effects of social networks on a population's hurricane evacuation participation. Journal of Geographical Systems, 2013; 15(2): 193–209.
75. Lazo JK, Waldman DM. Valuing improved hurricane forecasts. Economics Letters, 2011; 111(1):43–46.
76. Morrow BH, Lazo JK, Rhome J, Feyen, J. Improving storm surge risk communication: Stakeholder perspectives. Bulletin of the American Meteorological Society, forthcoming.
77. Rodkin S, Lawrence M. GfK Knowledge Networks Project Report: WDEWE. Submitted to Jeff Lazo, University Corporation for Atmospheric Research July 2, 2012.
78. Grothmann, T, Reusswig F, People at risk of flooding: Why some residents take precautionary action while others do not. Natural Hazards, 2006, 38, 101–120.
79. Bartholomew D, Bartholomew DJ, Knott M, Moustaki I. Latent Variable Models and Factor Analysis: A Unified Approach, 3rd edition. Chichester, West Sussex, UK: Wiley & Sons, 2011.
80. Kaiser HF, Derflinger G. Some contrasts between maximum likelihood factor analysis and alpha factor analysis. Applied Psychological Measurement, 1990; 14(1): 29–32.
81. Dillon R, Tinsley C, Cronin M. Why near-miss events can decrease an individual's protective response to hurricanes. Risk Analysis, 2011; 31(3):440–449.
82. Fischhoff B. Risk perception and communication. Pp. 940–952 in Detels R, Beaglehole R, Lansang MA, Gulliford M (eds). Oxford Textbook of Public Health, 5th ed. Oxford: Oxford University Press. Reprinted in N.K. Chater (Ed.), Judgement and Decision Making. London: Sage, 2009.
83. Kohn S, Eaton JL, Feroz S, Bainbridge AA, Hoolachan J, Barnett, DJ. Personal disaster preparedness: An integrative review of the literature. Disaster Medicine and Public Health Preparedness, 2012; 6(3): 217–231.
84. Fischhoff B, Brewer NT, Downs JS (eds). Communicating Risks and Benefits: An Evidence-Based User's Guide. Dept. of Health and Human Services, Food and Drug Administration, Silver Spring, MD, USA, 2011. Available at http://www.fda.gov/downloads/AboutFDA/ReportsManualsForms/Reports/UCM268069.pdf.
85. Morrow BH, Lazo JK. Coastal emergency manager's preferences for storm surge information. Journal of Emergency Management, 2014; 12(2):153–160.
86. Wong-Parodi, G. and Strauss B.H. Team science for science communication. PNAS 2014:111(4):13658–13663.

SUPPORTING INFORMATION

Additional Supporting Information may be found in the online version of this article at the publisher's website:

Table I-S. Cross-Tabulation of Actual Evacuation Zone by Perceived Evacuation Zone (n = 804) (Weighted to be Representative of the Counties Sampled)
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