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Abstract

This study examined the perceived attributes, behavioral expectations, and expected implementation timing of 11 organizational emergency response actions for hurricane emergencies. The perceived attributes of the hurricane response actions were characterized by two hazard-related attributes (effectiveness for person protection and property protection) and five resource-related attributes (financial costs, required knowledge/skill, required equipment, required time/effort, and required cooperation). A total of 155 introductory psychology students responded to a hypothetical scenario involving an approaching Category 4 hurricane. The data collected in this study explain previous findings of untimely protective action decision making. Specifically, these data reveal distinctly different patterns for the expected implementation of preparatory actions and evacuation recommendations. Participants used the hazard-related and resource-related attributes to differentiate among the response actions and the expected timing of implementation. Moreover, participants' behavioral expectations and expected implementation timing for the response actions were most strongly correlated with those actions' effectiveness for person protection. Finally, participants reported evacuation implementation times that were consistent with a phased evacuation strategy in which risk areas are evacuated in order of their proximity to the coast. However, the late initiation of evacuation in risk areas closest to the coast could lead to very late evacuation of risk areas farther inland.

Keywords: Preparatory actions, evacuation, response action attributes, trigger timing, hurricane

1. INTRODUCTION

During Hurricane Katrina in 2005, local authorities responded inadequately even though the National Weather Service had accurately forecasted information about wind speed, storm surge, and rainfall (Basher 2006; Kent 2006). The storm's aftermath contributed to continuing discussions about appropriate emergency responses by local authorities (e.g., Basher 2006; Kent 2006; Kamarck 2007; Spencer 2013). This was not the first time that a disaster had generated extensive conversations about emergency response. The problems that arose during the 1979 Three Mile Island accident led to the development of guidance for preparedness and response at nuclear power plants (USNRC/FEMA, 1980) and the 1984 release of methyl isocyanate at Bhopal India led to similar guidance for the release of toxic chemicals (National Response Team, 1987). Similarly, problems with the multi-departmental response to Southern California wildfires resulted in the development of the Incident Command System (Irwin, 1989).

There has also been progress in the development of criteria for making protective action recommendations (PARs) for radiological (Conklin and Edwards, 2000; Lindell 2000; McKenna 2000) and toxic chemical (National Research Council, 2001) emergencies. However, there remain unresolved issues concerning PARs for other hazards such as hurricanes. Discussions about PARs have focused on three questions: (1) who should be in charge (e.g., Badiru and Racz, 2013; Barnhill 2013; Cova et al., in press; Kamarck 2007)? (2) what should they do (e.g., Cova et al. in press; Kim, Cova and Brunelle 2006; Lindell and Perry 1992; Wu, Lindell and Prater 2015)? and (3) when should they do it (Badiru and Racz 2013; Baker 2000; Lindell 2008, 2013; Murray-Tuite and Wolshon 2013; Sorensen 2000; Sorensen and Rogers 1988; Tummala and Schoenherr 2011; Wu et al. 2015; Cova et al. in press)?

Participants in this discussion agree that state law and local emergency operations plans call for local authorities, such as emergency managers (EMs) and elected officials, to provide households with timely warnings that include PARs because households generally lack the ability to monitor hazard onset and assess the time at which protective action should be taken. However, as Cova et al. (in press) noted, local authorities tend to struggle with PAR selection and, especially, determining what situational cues should trigger the change from "wait and see" to "take immediate action" (see also Czajkowski 2011; Dye, Eggers, and Shapira 2014). Unfortunately, few studies have examined PAR selection and implementation. Moreover, in addition to issuing PARs for the general population, EMs also need to take preparatory actions such as activating Emergency Operations Centers (EOCs) to coordinate the actions of different agencies and organizations that are supporting households' emergency responses. To better understand the problem of determining what response actions EMs should take and when they should initiate them, this study examines the selection of emergency response actions for a hurricane emergency, the expected timing of their implementation, and the attributes of those emergency response actions that are correlated with their selection and implementation timing.

2. LITERATURE REVIEW

2.1 Studies of PARs and Preparatory Response Actions

A number of authors have proposed lists of emergency response actions that vary in their comprehensiveness (Alexander 2002; Barnhill 2013; Kim et al. 2006; Kreps, 1991; Lindell and Perry, 1992) and FEMA has identified 15 response core capabilities (www.fema.gov/mission-areas). One critical category of response actions is population protection, which seeks to minimize human impacts by sheltering people in hazard-resistant structures or evacuating them from risk areas (Lindell, Prater and Perry 2006, 2007, Chapter 10). Cova et al. (in press) reported that evacuation and sheltering are the most common protective actions and these are supported by households' preparatory actions such as packing bags and securing the home (Kang, Lindell and Prater 2007), as well as organizational preparatory actions such as activating public shelters.

Many studies of evacuation have focused on household compliance with evacuation warnings (for reviews, see Baker 1991; Huang et al. 2016; and Sorensen 2000) and, to a substantially lesser degree, the timing of their departures (Fu et al. 2007; Huang et al. 2012; Lindell, Lu and Prater, 2005; Huang, Lindell and Prater, in press; Sorensen 1991). In addition, EMs in coastal jurisdictions are concerned about the geographical extent of an evacuation PAR, with many jurisdictions defining risk areas (also called evacuation zones) that indicate who should evacuate from an approaching hurricane of a given intensity. For example, households in the Houston-Galveston Study Area's Zone A should evacuate for all hurricanes whereas those in Zone C only need to evacuate for major hurricanes in Categories 4-5 (see www.h-gac.com/taq/hurricane/).

Unlike evacuation, sheltering—whether sheltering in-place or sheltering in a nearby refuge—has been recommended to achieve safety in a structure that provides sufficient protection from an approaching hazard (Sorensen et al. 2004; Kim et al. 2006; Cova et al. in press). Sheltering allows people to remain in or near their homes so they can protect their property, as well as avoid the cost and disruption of evacuation (Lindell, Kang and Prater 2011; Wu et al. 2012, 2013). In the context of hurricanes (Ruch 1984; Ruch et al 1991) and tsunamis (Wood et al. 2014), sheltering—also known as vertical evacuation—can facilitate the evacuation of others by reducing the demand for space on evacuation routes.

For those who do evacuate, public shelter is needed to provide emergency accommodations (Quarantelli 1995) for those who lack peers (friends and relatives) to stay with or funds to pay for commercial facilities (hotels or motels). Even so, Mileti, Sorensen and O'Brien (1992) reported that the usage of public shelter was usually less than 15% of the evacuees and shelters were primarily occupied by ethnic minorities, vulnerable households (e.g., low income family and elders), and later departures. Baker (2000) reported a similar percentage of public shelter usage in his review of unpublished post-storm assessments, but other studies have reported even smaller percentages that range 1-3 percent (Whitehead 2003; Lindell et al. 2011; Wu et al. 2012; 2013). However, even if the percentages are small, some evacuations are very large so five percent of a million people is 50,000. Such a substantial number of shelter occupants requires a significant amount of time to prepare for, so shelters need to be activated well in advance of evacuees' arrival.

Emergency operations centers (EOCs) serve an important role in coordinating community emergency response actions and should be activated in the very beginning of an emergency (Drabek 1985; Perry 1985). In addition, the Emergency Alert System (EAS) is needed to deliver warning messages (Barnhill 2013; Lindell and Perry 1987; Perry 2007). It is especially important to warn individuals having high levels of vulnerability, such as coastal tourists who are unfamiliar with the area, and people with special needs such as limited mobility (Lindell 2013; Lindell and Prater 2007).

2.2 Studies of Response Action Timing

In addressing when PARs should be initiated, Cova et al. (in press) suggested that EMs establish warning triggers to define the times that PARs should be initiated. They also indicated that warning triggers allow EMs to introduce environmental cues into the protective action decision process, to communicate their risk assessments to the public, and to connect geographic characteristics with trigger timing. Consistent with the recommendation to use observations of environmental cues as signals to trigger PARs (Cova et al. in press; Drews et al. 2014), Kim et al. (2006), who studied a wildfire emergency, recommended developing spatiotemporal models in which environmental cues, such as the distance from a fire to a community, can be converted into PAR triggers. Similarly, Lindell and Prater (2007) noted that hurricane planners have advocated initiating evacuations by the time that the radius of Tropical Storm wind reaches an *evacuation decision arc* defined by multiplying the storm's forward movement speed by the evacuation time estimate (ETE). Using this evacuation trigger should ensure that the last vehicle leaves the risk area by the time that hazardous storm conditions arrive. Moreover, Lee County Florida has extended this concept by developing the *Time Delineating Schedule*, which identifies a comprehensive list of response actions that local EMs should take at successive times before a hurricane's forecast landfall.

In comparison to the relatively large number of empirical studies of household evacuation decision making, there have been few studies of organizational evacuation decision making. One exception is Wu, Lindell and Prater (2015, 2016), who examined the timing of emergency response actions by assigning experiment participants to play the role of a local EM for one of two Texas Gulf coast jurisdictions—either Jefferson or Cameron County (see Figure 1). Participants began by reading *The Local Official's Guide to Making Hurricane Evacuation Decisions*, after which they monitored and responded to four hurricane scenarios, each having six forecast advisories and each striking a different location—Brownsville, Corpus Christi, Beaumont/Port Arthur, or New Orleans. Participants began each forecast advisory by accessing graphic, numeric, and text information about the hurricane's past, current, or forecast behavior. After completing their information search, they judged the hurricane's probability of striking five cities around the Gulf of Mexico and checking which actions they would take at that forecast advisory. The 11 response actions that participants could choose were selected from the Lee County Time Delineating Schedule. The first six actions were preparatory actions: (1) activate the EOC, (2) activate the EAS, (3) advise beach motel/hotel businesses of the potential storm and that emergency evacuation may be required, (4) recommend schools to close tomorrow, (5) recommend immediate activation of public shelter, and (6) recommend immediate evacuation of the following residents: people with special needs, people without transportation, tourists, mobile homes, and recreational vehicles. The last five emergency response actions were evacuation PARs for the general population: (7) recommend immediate evacuation of Risk Area 1—the area at risk from a Category 1 hurricane, (8) recommend immediate evacuation of Risk Area 2, (9) recommend immediate evacuation of Risk Area 3, (10) recommend immediate evacuation of Risk Area 4, and (11) recommend immediate evacuation of Risk Area 5—the area at risk from a Category 5 hurricane (see Figure 1).

Wu et al. (2015) found that, although participants increased the number of response actions over time as the hurricane approached their assigned jurisdiction, participants only chose 4-6 actions within the first three days of the exercise, which was the time interval from six days before landfall to four days before landfall. Moreover, they had only initiated about eight of the 11 actions by the time the approaching Category 4 hurricane was 48 hours from landfall.

Participants' timing of preparatory actions was problematic because this should be based on the principle that tasks are sequenced so each can be completed before the ones that depend on it are initiated. Thus, the EOC should be activated early to coordinate other response actions, schools should be closed in time for students to return home in time for their families to evacuate, and public shelters should be activated in time to receive evacuees who lack alternative accommodations. However, only 52% of the participants decided to activate the EOC during the first forecast advisory of the first hurricane they tracked and this percentage only increased to 76% during the fourth hurricane they tracked. Their timing of the evacuation PARs was even more problematic because, even though a table posted in the participants' workstations displayed the ETEs for each of the five risk areas (which was 32 hours for the

Category 4 hurricane that occurred in all four hurricane scenarios) and the *Official's Guide* indicated that they should evacuate the Risk Area corresponding to the hurricane category, only about 50% of the participants assigned to Jefferson County and 33% of those assigned to Cameron County recommended evacuating people in Risk Areas 1-4 more than 32 hours before landfall. Thus, it is important to conduct further studies to find out why so many participants delayed their emergency response actions or failed to take them at all.

2.3 Studies of Response Action Attributes

The repeated finding of failures to take timely preparatory actions or issue timely evacuation PARs in field (Berg 2009; Dye et al., 2014; Knabb et al. 2005) and laboratory (Wu et al. 2015) settings suggests that researchers need to assess not only the behavioral expectations and expected implementation time for each response action, but also perceptions of the attributes of those response actions (Lindell et al. in press; Lindell and Prater 2002; Lindell and Whitney 2000; Terpstra and Lindell 2013; Wei et al in press). This research has found that people often evaluate response actions in terms of hazard-related attributes such as efficacy in avoiding casualties, property damage, and societal disruption (Barnhill 2013; Basher 2006; Cova et al. in press; McKenna 2000). In addition, they examine the feasibility of implementation by considering response actions' resource-related attributes (Barnhill 2013; Lindell, Arlikatti and Prater 2009; Lindell and Prater 2002; Terpstra and Lindell 2013; Lindell et al. in press; Wei et al. in press). For example, previous research has documented that implementation of some hurricanes response actions incur significant financial costs (e.g., Chen et al. 2007; Weiler and Engel 2012; Wilson, Dantas, and Cole 2009), and requirements for specialized expertise (e.g., Canestraro et al. 2009; Chen et al. 2007; Perry 2007; Davis and Robbin 2015; Weiler and Engel 2012), specialized tools and equipment (e.g., Chen et al. 2007), significant time and effort (e.g., Chen et al. 2007; Horan et al. 2006; Weiler and Engel 2012; Wilson et al. 2009), and cooperation with others (e.g., Canestraro et al. 2009; Chen et al. 2007). Finally, this line of research has suggested that EMs would select response actions that are high on hazard-related attributes and low on resource-related attributes (Cova et al. in press; Tummala and Schoenherr 2011). Dye et al. (2014), who used a cost-benefit model to evaluate response action decisions, suggested that thresholds for initiating PARs such as evacuation should be defined by the balance between the expected costs of unnecessary response and the expected hurricane damage (see also Lindell and Prater 2007).

There have been a number of studies that have systematically examined the hazard-related and resource-related attributes of different hazard adjustments and these studies have reported five major findings. First, people use these attributes to differentiate among hazard adjustments, as indicated by differences in mean ratings among adjustments on each of the attributes. Second, these attributes have shown systematic differences in the pattern of interrater agreement on the attributes, with the highest agreement on hazard-related attributes, lower agreement on the resource-related attributes, and least agreement on behavioral expectation. Third, these attributes demonstrate construct validity (Campbell and Fiske, 1959), as evidenced by high correlations among the hazard-related attributes, high correlations among the resource-related attributes, and low correlations between the hazard-related and resource-related attributes. Fourth, people's expectations of adopting household hazard adjustments for earthquakes and floods are more strongly correlated with hazard-related attributes than resource-related attributes (Lindell et al. in press; Lindell and Prater 2002). Finally, there have been relatively low and inconsistent correlations of the hazard-related and resource-related attribute ratings with demographic variables (Lindell et al. 2009; Lindell et al. in press; Lindell and Whitney 2000; Lindell and Prater 2002; Terpstra and Lindell 2013; Wei et al. in press).

One of the limitations of this research on the perceived attributes of hazard adjustments is that it all has been conducted on perceptions of household hazard adjustments that are quite familiar to the respondents. However, it is also important to determine if these findings for household hazard adjustments generalize to organizational emergency response actions. Such examination is needed because coastal residents are unlikely to comply with evacuation PARs if they think those protective actions are unnecessary or are being initiated too soon (Cova et al. in press).

3. PRELIMINARY TEST

There are two limitations of previous research on organizational emergency response actions that should be addressed before proceeding with a study of the perceived attributes of response action attributes. First, it is unclear if people who have received a modest amount of training for hurricane evacuation decision making—comparable to the level of training the chief administrative officer of a coastal jurisdiction might have—can make effective use of triggers for hurricane response actions. This issue can be addressed by examining whether there were specific forecast advisories at which most participants in the Wu et al. (2015) experiment implemented each response action. Second, even though Wu et al. (2015) examined the number of response actions issued in response to a hurricane threat, it is unclear whether participants in that experiment considered all of the response actions to be equally appropriate. Further analysis of their data provides an opportunity to examine those issues. Figure 2a indicates that there was substantial variation in participants' endorsement of the six preparatory actions on Day 1 (the sixth day before landfall), ranging from 13% for closing schools to 55% for activating the EOC. However, the variation in endorsement of those six response actions narrowed by Day 6, ranging from 78% for closing schools to 93% for notifying public accommodations (hotels/motels) of a likely evacuation. Conversely, Figure 2b reveals that there were low percentages of participants (13%-23%) issuing an evacuation PAR for any of the risk areas on Day 1. These percentages increased substantially on Day 6 to a range from 38% (in RA5) to 78% (in RA1). A McNemar's test of the increase in proportions for each response action from Day 1 to Day 6 reveals a significant increase in the proportion of participants endorsing each response action over time ($\chi^2_{\text{McNemar}} = 8.07\text{-}22.53$, all $p < .01$).

Two additional McNemar's tests examined the differences in the proportions for EOC activation (the most common preparatory action) and school closure (the least common preparatory action) on Day 1 and Day 6 and also the differences in the proportions for evacuation of RA1 and RA5 on Day 1 and Day 6. The results indicate a significantly greater proportion of participants activating the EOC than recommending school closure on Day 1 ($\chi^2_{\text{McNemar}} = 17.00$, $p < .001$), but the difference in proportions was nonsignificant on Day 6 ($\chi^2_{\text{McNemar}} = 1.80$, *ns*). On the other hand, there was a nonsignificant difference in the proportions for an evacuation PAR in RA1 and RA5 on Day 1 ($\chi^2_{\text{McNemar}} = 5.00$, *ns*) but a significantly greater proportion for RA1 than for RA5 on Day 6 ($\chi^2_{\text{McNemar}} = 14.22$, $p < .001$).

The pattern of evacuation PARs is interesting because it is the opposite of the pattern for preparatory actions—a diverging fan rather than a converging fan. That is, the difference between the percentage of evacuation PARs for RA1 and RA5 increases, over time, rather than decreases as was the case for the preparatory actions. The fact that the differences in percentage of actions initiated decrease over time for the preparatory actions appears to be a "ceiling effect" but it is surprising that the "ceilings" are well below 100% because all of these actions should be initiated to protect those in the coastal area. Conversely, the fact that the differences in percentage of actions initiated increase over time for the evacuation PARs might be due to some participants being concerned about an "unnecessary" evacuation, but most of them considered evacuation to be necessary by Day 6. Unfortunately, the overall response was inadequate because the guidance participants had been given in the *Local Official's Guide to Making Hurricane Evacuation Decisions* indicated that the number of risk areas evacuated should be determined by the storm category. Thus a Category 4 hurricane should have produced evacuation PARs for RA1-RA4. Moreover, the ETE table indicated that it would take 32 hours to complete the evacuation, so all participants should have initiated an evacuation of RA1-RA4 by Day 5. Consequently, an important research objective is for further research to determine why nearly half of the participants thought it unnecessary to evacuate RA4 and almost a quarter thought it was unnecessary to evacuate any of the risk areas. More generally, these results confirm that there are differences among the response actions in their patterns of implementation. In turn, these results indicate a need to identify the attributes of those response actions that account for the observed differences.

4. RESEARCH HYPOTHESES AND RESEARCH QUESTIONS

The literature review and preliminary tests above lead to the following research hypotheses and research questions.

RH1: Participants will differentiate among response actions, as indicated by significant differences among the PARs in participants' mean ratings on the hazard-related and resource-related attributes.

RH2: Participants will rate evacuation as a more effective response action than any others and will be more likely to issue an evacuation PAR than any other response action.

RH3: Participants will have higher agreement on resource-related attributes than hazard-related attributes which, in turn, will have higher agreement than behavioral expectations.

RH4: Hazard-related attributes will be strongly positively correlated with each other, as will the resource-related attributes, but the hazard-related attributes will be minimally correlated with the resource-related attributes.

RH5: Hazard-related attributes will be more strongly correlated than resource-related attributes with behavioral expectations and expected implementation time.

RH6: Participants will differentiate among response actions by significant differences in their expected implementation time.

RQ1: Are demographic characteristics correlated with hazard-related and resource-related attributes, behavioral expectations and expected implementation times?

RQ2: Do participants follow the NHC recommendations by evacuating the appropriate number of risk areas before the ETE deadline?

5. RESEARCH METHOD

5.1 Participants

This study involved 155 introductory psychology students who participated in the study as part of a course requirement. Overall, the participant sample was 52% female, had an average age of 18.6 (ranging 17-22), and all were single. In addition, 65.2% of the participants identified themselves as Caucasians, while 21.3% were Hispanics, 5.8% were Asian/Pacific Islanders, 3.9% were African Americans, and the remaining 3.9% were Mixed race/ethnicity.

5.2 Study Design

The study began by showing participants the Texas *Valley Study Area* Risk Area map (see Figure 1) on a screen at the front of the room. Next, participants were asked to imagine themselves as the Cameron

County EM when their jurisdiction is threatened by an approaching hurricane. This hurricane has Category 4 intensity (130-156 mph wind speed), is traveling directly toward Brownsville, and is 36 hours from landfall. After reading the scenario, participants received three sets of questions, the first of which followed the procedures in previous protective action attribute perception studies by asking participants to rate each of the 11 response actions with respect to two hazard-related attributes (protect persons very effectively, and protect property very effectively), five resource-related attributes (cost a lot of money, require specialized knowledge and skill, require specialized tools or equipment, require a lot of time and effort, and require a lot of cooperation from others), and their expectation of taking each response action using a 1-5 rating scale of *Not at all* (= 1) to *Very great extent* (= 5). The second set of questions asked participants to report how many hours before the hurricane landfall they would initiate each response action. Finally, the third set of questions asked participants to report their age, gender (*Male* = 0, *Female* = 1), ethnicity (*African American* = 1, *Asian or other Pacific Islander* = 2, *Caucasian* =3, *Hispanic* = 4, and *Native American* = 5). Because of the distribution of ethnicities, this variable was recoded to *White* (=1) and *Minority* (=0).

5.3 Analytic Methods

For the tests of RH2 and RH3, evacuation PAR attribute scale scores were computed by averaging each attribute rating (the two hazard-related attributes, the five resource-related attributes, behavioral expectation, and implementation timing) over all five risk areas. Similarly, for the tests of RH4, RH5, and RQ1, preparatory action scale scores were computed by averaging across the preparatory response actions. RH1 and RH6 were tested using Multivariate Analysis of Variance (MANOVA) and RH2 was tested using dependent *t*-tests. RH3 was tested by assessing r_{WG} (LeBreton and Senter 2008), which is an index of interrater agreement that ranges $-1 \leq r_{WG} \leq +1$—with $r_{WG} = +1$ indicating perfect agreement, $r_{WG} = 0$ indicating no agreement (a uniform distribution) and $r_{WG} = -1$ indicating polarized subgroups (a bipolar distribution). An assessment of interrater agreement is important because mean ratings at the midpoint of a response scale can be ambiguous; it is possible to have a mean rating of 3 on a 1-5 rating scale when all respondents give the same rating (i.e., there is no variance), when there is a uniform distribution over the five categories (essentially, random responding), or when the ratings are equally distributed between the two extremes of 1 and 5—a bipolar distribution (Lindell and Brandt 2000). Statistical significance of each r_{WG} value was assessed using the $\chi 2$ test described in Lindell, Brandt and Whitney (1999) and the tables in Dunlap, Burke and Smith-Crowe (2003), both of which yielded similar results. RH4, RH5, and RQ1 were tested by calculating intercorrelations (r_{ij}) among the variables. Finally, the correlation analyses involved a substantial number of statistical tests, so a Bonferroni correction was used to control the experiment-wise error rate. Selecting $p < .01$ level for each test of correlation coefficients yields a suitably conservative experiment-wise error rate, which classifies only correlations of $r \geq .19$ as statistically significant.

6. RESULTS

6.1. Research Hypotheses

Consistent with RH1 (Participants will differentiate among PARs, as indicated by significant differences among the response actions in participants' mean ratings on each attribute.), a MANOVA revealed significant effects for response actions (Wilks $\Lambda = 0.36$, $F_{10, 145} = 25.38$, $p < .001$), attributes (Wilks $\Lambda = 0.25$, $F_{6, 149} = 75.63$, $p < .001$), and interaction (Wilks $\Lambda = 0.18$, $F_{60, 95} = 7.10$, $p < .001$). As Figure 3a indicates, participants produced consistently high ratings over all preparatory actions on person protection and behavioral expectations as well as consistently moderate ratings of protection of property. However, there were notable differences among preparatory actions in the ratings of financial cost, knowledge/skill, specialized equipment, required effort, and required cooperation. By contrast, Figure 3b indicates trivial differences among the risk areas in the ratings of evacuation PARs on all attributes except person protection and behavioral expectations—and even these differences were small. All evacuation PARs were rated high on protecting persons, required cooperation, and behavioral expectations, somewhat lower on required effort, and moderate on protecting property, knowledge/skill, and specialized equipment.

The differences among the response actions in the attributes are summarized in Table 1, which reveals statistically significant differences between the ratings of the lowest rated and highest rated response actions on each attribute. The range from 13-39% of the rating scale indicates that these attributes provided meaningful distinctions among the response actions. Overall, the differences among preparatory actions were greater on the five resource-related attributes (an average of 30% of the response scale) than on the two hazard-related attributes (an average of 15% of the response scale) or behavioral expectations (14% of the response scale). Specifically, shelter activation, EAS activation, and school closure were defining alternatives (either the highest or lowest rated) on seven of the eight attributes. Shelter activation received the highest ratings on four of the five resource-related attributes but the lowest rating on one hazard-related attribute (property protection). EAS activation received the highest ratings on one hazard-related attribute (property protection) and behavioral expectations, but the lowest rating on required cooperation. On the other hand, school closure received the lowest ratings on three of the five resource-related attributes. Surprisingly, issuing an evacuation PAR received the lowest ratings on effectiveness for protecting persons and behavioral expectations. Moreover, Table 1 indicates that the difference in ratings between the lowest rated and highest rated evacuation PARs for the risk areas was only significant on one hazard-related attribute (person protection), two resource-related attributes (financial cost and required cooperation), and behavioral expectations. Evacuating residents from Risk Area 1 had the highest ratings on those four attributes and behavioral expectations, whereas evacuating residents at Risk Area 5 had the lowest ratings. The differences were greater on property protection (15.6%) and behavioral expectations (14.8%) than on the other attributes (1.5-6.6%).

Contrary to RH2 (Participants will rate evacuation as a more effective response action than any others and will be more likely to issue an evacuation PAR than any other response action), Figure 3a indicates that issuing an evacuation PAR (M = 3.98) has a rating that is similar to EOC activation (M = 4.06) on person protection, but lower than the other five preparatory actions (M = 4.34-4.51; t_{154} = 4.86-7.49, $p < .001$). In addition, participants rated issuing an evacuation PAR (M = 2.54) as low on property protection as activating public shelters (M = 2.51) and closing schools (M = 2.61, t_{154} = -.94, *ns*, t_{154} =.32, *ns*, respectively), which had lower ratings than other the other four preparatory actions (M = 2.83-3.17; t_{154} = 3.60-7.12, $p < .001$). Consequently, issuing an evacuation PAR had the lowest behavioral expectations (M = 3.69). Apart from activating the EOC (M = 3.85), the behavioral expectation of evacuation PARs was significantly lower than any of the six preparatory actions (M = 4.05-4.24; t_{154} = 4.78-6.78, $p < .001$).

Partially consistent with RH3 (Participants will have higher agreement on resource-related attributes than hazard-related attributes which, in turn, will have higher agreement than behavioral expectations), Table 2 shows that participants did, indeed, have slightly higher levels of agreement on resource-related attributes (mean r_{WG} = .41 for preparatory actions, .34 for evacuation PARs) than on hazard-related attributes (mean r_{WG} = .36 for preparatory actions, .31 for evacuation PARs). Surprisingly, however, they had the highest levels of agreement on behavioral expectations (r_{WG} = .49 for preparatory actions, .37 for evacuation PARs). Moreover, there was an unexpectedly large difference in the levels of agreement on the two hazard-related attributes; participants had extremely high agreement regarding person protection (mean r_{WG} = .65 for preparatory actions, .46 for evacuation PARs), but virtually no agreement in their ratings of property protection (mean r_{WG} = .06 for preparatory actions, .16 for evacuation PARs). Furthermore, required cooperation had a higher level of agreement (r_{WG} = .54 for preparatory actions, .55 for evacuation PARs) than any other resource-related attribute.

Partially consistent with RH4 (Hazard-related attributes will be strongly positively correlated with each other, as will the resource-related attributes, but the hazard-related attributes will be minimally correlated with the resource-related attributes), Table 3 shows that there was a significant and moderately high correlation between the two hazard-related attributes (preparatory actions: r = .39; evacuation PARs: r = .21) and high intercorrelations among the resource-related attributes (preparatory actions average correlation: $\bar{r}$ = .72; evacuation PARs: $\bar{r}$ = .63). However, even though participants were expected to distinguish the hazard-related attributes from the resource-related attributes, there were moderately high correlations between the hazard-related and resource-related attributes (preparatory actions: $\bar{r}$ = .40; evacuation PARs: $\bar{r}$ = .24). Moreover, property protection had stronger correlations with four of the five resource-related attributes (financial cost, knowledge/skills, equipment, and effort; preparatory actions: $\bar{r}$ = .50; evacuation PARs: $\bar{r}$ = .38) than with person protection. On the other hand, person protection had weaker correlations than property protection with the four resource-related attributes ($\bar{r}$ = .32) for the preparatory actions and nonsignificant correlations with the four resource-related attributes ($\bar{r}$ = .12) for the evacuation PARs. Unexpectedly, required cooperation was moderately correlated with person protection (r = .41) and property protection (r = .34) for preparatory actions and was significantly correlated with person protection (r = .34) but not property protection (r = .07) for evacuation PARs. Finally, required cooperation had lower correlations with the other four resource-related attributes (preparatory actions: $\bar{r}$ = .64; evacuation PARs: $\bar{r}$ = .42) than those attributes had with each other (preparatory actions: $\bar{r}$ = .72; evacuation PARs: $\bar{r}$ = .63).

Partially consistent with RH5 (Hazard-related attributes will be more strongly correlated than resource-related attributes with behavioral expectations and emergency response implementation times), Table 3 indicates behavioral expectations had a strong correlation with person protection (preparatory actions: r = .59; evacuation PARs: r = .69) and a moderately high correlation with required cooperation (preparatory actions: r = .37; evacuation PARs: r = .30). These correlations were higher than those for property protection (preparatory actions: r = .21; evacuation PARs: r = .14). On the other hand, behavioral expectations had only marginal (preparatory actions: $\bar{r}$ = .20) or nonsignificant (evacuation PARs: $\bar{r}$ = .10, *ns*) correlations with the four resource-related attribute other than required cooperation.

In addition, Table 3 indicates expected implementation time had a significant correlation with person protection (preparatory actions: r = 18; evacuation PARs: r = .31). These correlations were much higher than those for property protection (preparatory actions: r = -.13; evacuation PARs: r = -.08) or the five resource-related attributes (preparatory actions: $\bar{r}$ = .07; evacuation PARs: $\bar{r}$ = .05). In addition, there were significant correlations of behavioral expectations and expected implementation times (preparatory actions: r = .27; evacuation PARs: r = .32).

Although not proposed as a research hypothesis or question, it is noteworthy that hazard-related attributes for the preparatory actions were highly correlated with the corresponding hazard-related attributes for the evacuation PARs ($\bar{r}$ = .69) and the resource-related attributes for the preparatory actions were similarly highly correlated with the corresponding resource-related attributes for the evacuation PARs ($\bar{r}$ = .72), demonstrating convergent validity for these attributes.

Consistent with RH6 (Participants will differentiate among response actions by significant differences in their expected implementation times), a MANOVA revealed a significant effect for response actions (Wilks Λ = 0.62, $F_{10,\,145}$ = 8.98, p < .001). Specifically, there were significant differences in expected implementation times among the six preparatory actions (Wilks Λ = 0.82, $F_{5,\,150}$ = 6.79, p < .001) and also among the five evacuation PARs (Wilks Λ = 0.76, $F_{4,\,151}$ = 11.84, p < .001). As Table 4 indicates, participants reported the earliest implementation time for beach business advisories (M = 29.58 hr before landfall) and the latest implementation time for closing schools (M = 24.74 hr) and activating public shelters (M = 24.38 hr)—about one day before the landfall. The reported evacuation PAR implementation times were earliest for Risk Area 1 (27.54 hr) and latest for Risk Area 5 (17.63 hr), with the other risk areas having implementation times that were consistent with the rank order of their distance from the coast.

6.2. Research Questions

Regarding RQ1 (Are demographic characteristics correlated with hazard-related and resource-related attributes, behavioral expectations, and expected implementation times?), Tables 3 shows that Whites expected to initiate each response action earlier than minorities in both preparatory actions (r =.21) and evacuation PARs (r =.22). Other than that, the correlations of demographic characteristics with hazard-related and resource-related attributes, behavioral expectations, and expected implementation time were nonsignificant.

Regarding RQ2 (Do participants follow the NHC recommendation by evacuating the appropriate number of risk areas before the ETE deadline?), Table 5 indicates that participants tended to issue an evacuation PAR for Risk Area 1 between 24-36 hours before the landfall, which is consistent with the NHC recommendation. However, they tended to delay issuing evacuation PARs for the remaining risk areas until about 17-25 hours before landfall. Thus, evacuation of all four risk areas could not be completed before hurricane landfall.

7. DISCUSSION

7.1 Research Hypotheses

RH1 (Participants will differentiate among response actions, as indicated by significant differences among the response actions in participants' mean ratings on each attribute) was supported by statistically significant differences among the preparatory actions with respect to the hazard-related and resource-related attributes but did not distinguish among the five resource-related attributes of evacuation PARs for the five risk areas. Thus, participants' ratings of hurricane response actions were generally consistent with findings from residents' ratings of protective actions for other hazards—earthquakes (Lindell et al., 2009), floods (Terpstra and Lindell, 2013), water contamination (Lindell et al., in press), and influenza (Wei et al., in press). This result is important because it indicates that these hazard-related and resource-related attributes are a meaningful way to describe people's beliefs about response actions for a wide variety of hazards.

The lack of support for RH2 (Participants will rate evacuation as a more effective response action than any others and will be more likely to issue an evacuation PAR than any other response action) indicates that that evacuation was neither perceived to be the most effective response action nor the most likely response action to be taken. This is surprising because evacuation, especially in response to a hurricane emergency, has long been recognized as an effective way of protecting human life (Drabek 1986; Perry and Lindell 2007; Huang et al. 2012). It implies that even though evacuation is the most common PAR (Sorensen, 2000), it is not an easy decision for emergency managers. One reasonable explanation for this result can be seen in the steadily decreasing ratings of person protection and behavioral expectations as a function of risk area. This suggests that participants thought there was declining risk as a function of distance from the coast. Although that is true in general, a Category 4 hurricane is, nonetheless, a substantial hazard for inland areas. Thus, the ratings of person protection and behavioral expectations should have been much higher for RA1-RA4 and even relatively high for RA5.

A related explanation concerns the cost of false alarms. Consistent with the Dye et al. (2014) analysis of hurricane evacuation decision making, Nolan (2005) reported that emergency managers in Louisiana were hesitant to make evacuation decisions as Hurricane Katrina approached because of an unnecessary evacuation from Hurricane Ivan during the previous year. The cost of such an evacuation not only includes businesses' lost sales and households' lost wages and out-of-pocket expenses for transportation, food, and accommodations, but also the costs of implementing a complex set of actions that require substantial coordination among multiple emergency management functions (e.g., warning, emergency public information, traffic management, shelter activation, and reentry planning) by different city, county, and state—and sometimes federal—agencies (Lindell et al. 2007; Perry and Lindell 2007). Hence, people's negative perceptions of the resource-related attributes of different evacuation PARs might significantly affect EMs' willingness to initiate these actions. However, further research on EMs' hurricane decision making is needed to test this explanation.

There was partial confirmation of RH3 (Participants will have higher agreement on resource-related attributes than hazard-related attributes which, in turn, will have higher agreement than behavioral expectations) because there was stronger agreement on the resource-related attributes (median r_{WG} = .38) than on the hazard-related attributes of protective actions (median r_{WG} = .36). However, the difference was extremely small and overshadowed by the fact that the level of agreement on person protection was higher (median r_{WG} = .65 for preparatory actions and median r_{WG} = .46 for evacuation PARs) than on the resource-related attributes (median r_{WG} = .41 and .34, respectively), whereas agreement on property protection was much lower (median r_{WG} = .06 on preparatory actions and median r_{WG} = .16 for evacuation PARs) than for the resource-related attributes. Moreover, contrary to hypothesis, there was stronger agreement on behavioral expectations (r_{WG} = .49) than on the resource-related attributes. One possible reason for these results is that this study examined attribute ratings for protective actions that were relatively unfamiliar to the study participants. By contrast, other studies have examined actions that were quite familiar to the respondents. Specifically, Lindell and Whitney (2000) studied 16 household earthquake hazard mitigation (e.g., strapped heavy objects) and preparedness (e.g., have a first aid kit) actions, Lindell et al. (2009) studied a slightly different set of 16 household earthquake hazard adjustments, Terpstra and Lindell (2013) studied six household flood preparedness (e.g., emergency kit) actions, and Lindell et al. (in press) studied safe sources of drinking water (bottled water, boiled water, and personally chlorinated water) for a water contamination incident. Future research should examine whether there would be a different pattern of agreement on the attributes of hurricane response actions when EMs rate them. Nonetheless, the data from this study provide some insights into how the risk area population, who would also be relatively unfamiliar with these actions, views them. Given the modest levels of agreement on the hazard-related and resource-related attributes of the response actions, EMs who initiate them should be sure to explain why they are taking these actions because low levels of agreement on perceptions of response actions could produce conflict among household members, thus leading to delays or noncompliance with evacuation PARs. In addition, the observed variation in the attribute ratings suggests that EMs in adjacent jurisdictions could avoid confusion during an emergency by establishing an advance consensus during the preparedness period on their perceptions of response actions and when they will initiate them.

Agreement on behavioral expectations for RA1-RA3 evacuation PARs was similar to that for the preparatory actions. However, there was somewhat lower agreement on the RA4 evacuation PAR and very little agreement on the RA5 evacuation PAR. The systematically declining levels of agreement for the latter two risk areas explain why their mean ratings of behavioral expectations are lower than those for the RA1-RA3 evacuation PARs. The participants did not necessarily believe that evacuation of RA4 and RA5 were less desirable. Instead, there was less agreement that evacuation of these risk areas would protect anyone (because some participants apparently believed these risk areas were not threatened by the storm) and so there were simply more participants who had very low expectations of recommending evacuation for those risk areas.

The lack of complete support for RH4 (Hazard-related attributes will be strongly positively correlated with each other, as will the resource-related attributes, but the hazard-related attributes will be minimally correlated with the resource-related attributes) is a bit puzzling. Although the two hazard-related attributes (person protection and property protection) had the expected significant positive correlation, as did the resource-related attributes (financial cost, knowledge/skills, equipment, effort, and cooperation), the correlation between person protection and property protection ($\bar{r}$ = .39 for preparatory actions and .21 for evacuation PARs) was much smaller than the average correlation among the resource-related attributes ($\bar{r}$ = .72 for preparatory actions and .63 for evacuation PARs). In addition, property protection had higher correlations with financial cost, knowledge/skills, equipment, and effort than with person protection, whereas person protection had a higher correlation with required cooperation than with property protection. Although this result differs from the findings of most other studies on protective action perceptions (Lindell & Whitney 2000; Lindell et al. 2009; Lindell et al. in press; Terpstra & Lindell, 2013), the significant correlation between one hazard-related attribute and some resource-related attributes had been reported in a study of a rapid-onset water contamination emergency (Lindell et al. in press). One possible explanation is that people focus more on person protection than any other attribute and that participants did not understand how to rate the effectiveness of response actions in protecting property when their main purpose would be to protect persons. That is, it is possible that participants saw no relevance of this attribute to the response actions so they responded randomly rather than producing consistently low ratings on this attribute.

The partial support for RH5 (Hazard-related attributes will be more strongly correlated than resource-related attributes with behavioral expectations and expected implementation times) extended the finding from RH4 that person protection was more strongly correlated with behavioral expectation than any other attributes ($\bar{r}$ = .64). The strongly positive correlation of person protection with behavioral expectations is consistent with previous protective action studies (Lindell & Whitney 2000; Lindell & Prater 2002; Terpstra & Lindell, 2013; Wei et al. in press; Lindell et al. in press) that the motivation to initiate a response action is based primarily on whether the participants believe the response action can protect persons effectively. Moreover, the findings regarding the four resource-related attributes of cost, knowledge/skill, specialized equipment, and required effort are consistent with previous findings that resource-related attributes have weak correlations with behavioral expectations for protective actions. Finally, the finding that participants who had stronger behavioral expectations initiated earlier implementation of preparatory actions (r = .27) and evacuation PARs (r = .32). These results are rather counter-intuitive from an economic perspective because they suggest that "cost is no object" when making decisions about emergency response to an approaching hurricane (Dye et al. 2014; Lindell and Prater 2007). One possible explanation is that participants had unrealistically low estimates of evacuation cost and complexity. Thus, future studies could provide explicit information about the resource requirements of organizational emergency response actions in terms of their cost and implementation times to see this changes behavioral expectations and expected implementation times.

The support for RH6 (Participants will differentiate among response actions by significant differences in their expected implementation times) by statistically significant differences among the preparatory actions and evacuation PARs and among the risk areas is important because a well-timed response action trigger can play a crucial role in emergency response (Cova et al. in press). However, the participants' sequence of preparatory actions was flawed because school closures (M = 24.74 hr) and shelter activation (M = 24.38 hr) lagged RA1 evacuation (M = 27.54 hr) rather than led it and special needs evacuation (M = 23.40 hr). This would be a problem because schools should be closed before an evacuation PAR in order to avoid the congestion that would result from parents arriving at schools to pick up their children. In addition, it takes time to activate shelters so this should be done in advance of any evacuation PARs so evacuees can register as soon as they arrive. Of course, this study's participants would not necessarily be aware of these constraints so further research should be conducted to assess EMs' response action timing and examine how this is related to their perceptions of the costs of false positive (a "false alarm" in which residents evacuate for a hurricane that does not strike their jurisdiction) and false negative (failing to initiate an evacuation for a hurricane that does strike their jurisdiction) errors.

7.2. Research Questions

The findings of RQ1 (Are demographic characteristics correlated with hazard-related and resource-related attributes, behavioral expectations, and expected implementation times) were generally consistent with the finding of previous reviews of disaster studies that demographic characteristics have minimal or nonsignificant correlations with response action attributes and response action decisions. The only significant correlation was that White participants consistently tended to initiate preparatory actions and evacuation PARs earlier than ethnic minorities but there are no previous studies that have examined the timing of organizational response actions, so further studies are needed to determine if this finding can be replicated.

The findings regarding RQ2 (Do participants follow the NHC recommendations by evacuating the appropriate number of risk areas before the ETE deadline?) revealed that participants tended to initiate evacuations later than the NHC recommendations. One plausible explanation is that participants wanted to reduce the possibility of a false alarm, especially for those response actions that would disrupt local residents. According to this explanation, they advised beach businesses and activated the EOC and EAS first because these actions do not require direct contact with the public. However, the delay of Risk Area 4 evacuation until 19 hours before landfall would be problematic because the Cameron County population requires an estimated 32 hours to clear Risk Areas 1-4 (Lindell, Prater and Wu, 2002). Consequently, a late evacuation PAR could trap many evacuees in areas that struck by high wind and inundated by storm surge. In addition, the results from the PAR implementation times suggest that participants assumed the risk areas should be evacuated in sequence. That is, the evacuation of RA1 should be completed before the evacuation of RA2 is initiated, the evacuation of RA2 should be completed before the evacuation of RA3 is initiated, and so on. Alternatively, participants might have assumed a weaker version of this strategy, in which risk areas closer to the coast would only be given a "head start" rather than a completed evacuation. In either case, this strategy would be problematic because it severely underestimates the differences in ETEs for these risk areas. Both of these explanations warrant further examination in future research.

It is important to note that, unlike the participants in Wu et al. (2015), those in the present study were not given any information about the number of hours before landfall that these response actions should actually be implemented. However, the present results provide a useful comparison to the Wu et al. data displayed in Figure 2, which show that participants recommended evacuating Risk Area 4 24 hours before landfall whereas the mean lead time in this study was 19 hours. The fact that the "informed" estimates in Wu et al. (2015) data were approximately the same as the "uninformed" estimates in the present study suggest that the ETEs Wu et al. (2015) provided on the wall of the simulated EOCs had virtually no impact on the timing of evacuation PARs. One possible reason for this lack of information impact is that participants in the Wu et al. (2015) study were overloaded with information and unable to process it all effectively. Thus, the ETEs were neglected because they did not change over time. By contrast, information about the approaching storm was displayed on the computer—which became the focus of participants' attention.

Even more significant is the fact that the tardy evacuation recommendations in this study are so similar to those in New Orleans as Hurricane Katrina approached. In that event, the National Hurricane Center (NHC) issued a hurricane warning at 11:00 p.m. CDT on Saturday, August 27 but the mayor failed to issue an evacuation order until 10:00 a.m. CDT on Sunday, August 28. This was only 20 hours before Katrina made landfall close to Buras, Louisiana, at 6:10 a.m. on Monday, August 29, virtually identical to the 19 hour mean lead time in this study. The similarity of this study's results to those in Hurricane Katrina are not unique. Cova et al. (in press) report that local authorities tend to struggle with PAR selection and, especially, determining what situational cues should trigger the change from "wait and see" to "take immediate action" (see also Czajkowski 2011; Dye, Eggers, and Shapira 2014). The finding that university students are no worse than some local officials in deciding when to issue evacuation recommendations indicates that research is needed to develop better methods of training local officials to select and implement PAR for extreme events that might occur only once in their professional careers.

7.3. Study Limitations

It is important to acknowledge that this study has some limitations. First, it used students responding to a hypothetical scenario, so it is unclear how much the results would generalize to coastal residents or local elected officials responding in an actual hurricane. There is some evidence that students' responses to hypothetical hurricane evacuation scenarios do produce results that are similar to those from evacuees from actual hurricanes (for a review, see Huang et al. 2016). Conversely, as noted above, it appears that there are cases—perhaps many—in which local officials have no more experience or training than the participants in this experiment. Nonetheless, future studies should survey representative samples of households in coastal areas to determine if greater diversity in demographic characteristics would yield significant correlations of these variables with emergency response action perceptions, behavioral expectations, and expected implementation times.

In addition, future studies should examine professional local officials' perceptions of these hurricane response actions, much as Ge and Lindell (2016) examined land use planners' perceptions of land use planning tools for environmental hazard mitigation. Second, this study provided participants with information about the approaching hurricane but not scientific estimates of the resource requirements for implementing response actions such as evacuation costs and ETEs. Consequently, future studies should provide more detailed information about evacuation costs (e.g., Wu et al, 2012, 2013) as well as the total amount of time needed to complete each of those response actions (e.g., Lindell et al., 2002). Such studies could also assess participants' mental models of the appropriate sequencing of emergency response actions in terms of PERT/CPM networks (Kerzner, 2013, Chapter 12). Finally, this study—like all cross-sectional designs—is unable to assess the stability of participants' perceptions over time. Hence, conducting a study at multiple points in time could support an assessment of the test-retest reliability of people's perceptions of hurricane emergency response actions.

8. CONCLUSIONS

Notwithstanding its limitations, this study does have some theoretical and practical implications. First, this appears to be the first study that has examined people's perceptions and expected implementation of organizational response actions for a hurricane emergency. The results are consistent with previous studies of household responses to other hazards in showing that people can use hazard-related and resource-related attributes to differentiate emergency response actions. In addition, person protection was by far the most important correlate of behavioral expectations and expected implementation times for both preparatory actions and evacuation PARs.

Second, the construct validity of the distinction between hazard-related and resource-related attributes was only partially supported in this context because none of the response actions could achieve a meaningful reduction in property protection. This would explain why property protection had relatively low correlations with person protection but not why it had somewhat larger correlations with the resource-related attributes. It is unclear if this is due to the distinctive nature of the organizational response actions, the unfamiliarity of the study participants with these actions, or a combination of the two. Thus, additional research using samples of coastal residents and local officials is needed to clarify this question.

Finally, there were misconceptions about the implementation timing of the response actions, especially evacuation PARs for RA4 and RA5. This finding indicates that the sequencing of hurricane response actions is not intuitively obvious which, in turn, suggests that problems could arise in jurisdictions that lack hurricane experience if they do not use decision aids such as the Time Delineating Schedule.

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10. REFERENCES

Alexander, D. (2002). *Principles of emergency planning and management*. New York: Oxford University Press.

Badiru, A.B. and Racz, L. (2013). Coordinated project systems approach to emergency response. In Bariru, A.B. and Racz, L. (eds). *Handbook of emergency response: A human factors and systems engineering approach* (pp 413-438). Boca Raton: CRC Press.

Baker, E.J. (1991). Hurricane evacuation behavior. *International Journal of Mass Emergencies and Disasters*, 9, 287-301.

Baker, E. J. (2000). Hurricane evacuation in the United States. In R. Pielke, Jr. and R. Pielke, Sr. (eds.) *Storms, Vol. 1* (pp. 306-319). New York: Routledge.

Barnhill, J. (2013). The tyranny of time: The challenge of first response. In J.A. Larsen (ed). *Responding to Catastrophic Events* (pp. 29-49). New York, NY: Palgrave Macmillan.

Basher, R. (2006). Global early warning systems for natural hazards: systematic and people-centred. *Philosophical Transactions of the Royal Society A.* 364 (1845), 2167–2182.

Berg, R. (2009). *Tropical Cyclone Report—Hurricane Ike. Final Report 23 Jan. 2009-18 Mar. 2014*. Report TCR-AL092008. Miami, FL: National Hurricane Center.

Campbell, D.T., & Fiske, D.W. (1959). Convergent and discriminant validation by the multitrait-multimethod matrix. *Psychological Bulletin*, *56*(2), 81-105.

Canestraro, D.S., Pardo, T.A., Raup-Kounovsky, A.N., and Taratus, D. (2009). Regional telecommunication incident coordination: Sharing information for rapid response. *Information Polity,* 14(1, 2), 113-126.

Chen, R., Sharman, R., Raghav. Rao, H., and Upadhyaya, S. (2007). Design principles for emergency response management systems. *Journal of Information Systems and e-Business Management*, 5, 81-98.

Conklin, C., & Edwards, J. (2000). Selection of protective action guides for nuclear incidents. *Journal of Hazardous Materials, 75*, 131-144.

Cova, T.J., Dennison, P.E., Li, D., Siebeneck, L.K., and Lindell, M.K. (in press). Warning triggers in environmental hazards: Who should be warned to do what and when? *Risk Analysis* DOI: 10.1111/risa.12651

Czajkowski, J. (2011). Is it time to go yet? Understanding household hurricane evacuation decisions from a dynamic perspective. *Natural Hazards Review*, *12*, 72-84.

Davis, G.L., and Robbin, A. (2015). Network disaster response effectiveness: The case of ICTs and Hurricane Katrina. *Journal of Homeland Security and Emergency Management*, 12, 437-467.

Drabek, T.E. (1985). Managing the emergency response. *Public Administration Review*, 45, 85-92.

Drabek, T. E. (1986). *Human system responses to disaster*. New York: Springer.

Drews, F.A., Musters, A., Siebeneck, L.K., and Cova, T.J. (2014). Environmental factors that influence wildfire protective-action recommendations. *International Journal of Emergency Management, 10*, 153-168.

Dunlap, W. P., Burke, M. J., & Smith-Crowe, K. (2003). Accurate tests of statistical significance for r_{WG} and average deviation interrater agreement indexes. *Journal of Applied Psychology*, *88*, 356-362.

Dye, K.C., Eggers, J.P., and Shapira, Z. (2014). Trade-offs in a tempest: Stakeholder influence on hurricane evacuation decisions. *Organization Science*, *25*, 1009-1025.

Fu, H., Wilmot, C., Zhang, H., and Baker, E. (2007). Modeling the hurricane evacuation response curve. *Transportation Research Record*, 2022, 94-102.

Ge, Y. & Lindell, M.K. (2016). County planners' perceptions of land use planning tools for environmental hazard mitigation: A survey in the U.S. Pacific states. *Environment and Planning B: Planning and Design*, *3,* 716-736.

Horan, T.A. and Schooley, B.L. (2007). Time-critical information services. *Communications of the ACM*, *50*, 73-78.

Huang, S-K., Lindell, M.K. and Prater, C.S. (2016). Who leaves and who stays? A review and statistical meta-analysis of hurricane evacuation studies. *Environment and Behavior*, *48*, 991-1029.

———. (in press). Toward a multi-stage model of hurricane evacuation decision: An empirical study of Hurricanes Katrina and Rita. *Natural Hazards Review*.

Huang, S-K., Lindell, M.K., Prater, C.S. Wu, H-C., and Siebeneck, L.K. (2012). Household evacuation decision making in response to Hurricane Ike. *Natural Hazards Review*, *13*, 283-296.

Irwin, R.L. (1989). The Incident Command System. In E. Auf der Heide. *Disaster response: Principles of preparation and coordination* (pp. 133-163). St. Louis MO: Mosby.

Kamarck, E. (2007). When first responders are victims: Rethinking emergency response, *Harvard Law and Policy*, 1:1. Retrieved 31 July, 2016 from: http://harvardlpr.com/wp-content/uploads/2013/05/1.1_8_Kamarck.pdf

Kang, J.E., Lindell, M.K., and Prater, C.S. (2007). Hurricane evacuation expectations and actual behavior in Hurricane Lili. *Journal of Applied Social Psychology*, *37*, 887–903.

Kent, E.F. (2006). Where's the cavalry? Federal response to 21st century disasters. *Suffolk University Law Review*, *40*, 181-213.

Kerzner, H. (2013). *Project management* (11th ed.). Hoboken NJ: Wiley.

Kim, T., Cova, T.J., and Brunelle, A. (2006). Exploratory map animation for post-event analysis of wildfire protective action recommendations. *Natural Hazards Review*, *7*, 1-11.

Knabb, R., Brown, D.P., and Rhome, J.R. (2005). *Tropical cyclone report—Hurricane Katrina. Final Report 20 Dec 2005-14 Sept 2011.* Report TCR-AL122005, Miami: National Hurricane Center.

Kreps, G. A. (1991). Organizing for emergency management. In T.E. Drabek and G.J. Hoetmer (eds.) *Emergency Management: Principles and Practice for Local Government* (pp. 30-54). Washington DC: International City Management Association.

LeBreton, J.M. and Senter, J.L. (2008). Answers to 20 questions about interrater reliability and interrater agreement. *Organizational Research Methods*, *11*, 815-852

Lindell, M.K. (2000). An overview of protective action decision making for a nuclear power plant emergency. *Journal of Hazardous Materials, 75,* 113-129.

———. (2008). EMBLEM2: An empirically based large-scale evacuation time estimate model. *Transportation Research A*, 42, 140-154.

———. (2013). Evacuation planning, analysis, and management. In A.B. Bariru and L. Racz (eds). *Handbook of emergency response: a human factors and systems engineering approach* (pp 121-149). Boca Raton: CRC Press.

Lindell, M.K., Arlikatti, S. and Prater, C.S. (2009). Why people do what they do to protect against earthquake risk: Perceptions of hazard adjustments and their attributes. *Risk Analysis, 29*, 1072-1088.

Lindell, M.K. and Brandt, C.J. (2000). Climate quality and climate consensus as mediators of the relationship between organizational antecedents and outcomes. *Journal of Applied Psychology, 85*, 331-348.

Lindell, M.K., Brandt, C.J. & Whitney, D.J. (1999). A revised index of interrater agreement for multi-item ratings of a single target. *Applied Psychological Measurement*, *23*, 127-135.

Lindell, M.K., Kang, J.E. and Prater, C.S. (2011). The logistics of household evacuation in Hurricane Lili. *Natural Hazards*, *58,* 1093-1109.

Lindell, M.K., Lu, J.C. & Prater, C.S. (2005). Household decision making and evacuation in response to Hurricane Lili. *Natural Hazards Review*, *6*, 171-179.

Lindell, M.K., Mumpower, J.L., Huang, S-K., Wu, H-C., Samuelson, C.D., and Wei., H-L. (in press). Perceptions of protective actions for a water contamination emergency. *Journal of Risk Research*, DOI: 10.1080/13669877.2015.1121906.

Lindell, M.K. & Perry, R.W. (1987). Warning mechanisms in emergency response systems. *International Journal of Mass Emergencies and Disasters, 5,* 137-153.

Lindell, M.K. and Perry, R.W. (1992). *Behavioral foundations of community emergency planning*. Washington, DC: Hemisphere Press.

Lindell, M.K. and Prater, C.S. (2002). Risk area residents' perceptions and adoption of seismic hazard adjustments. *Journal of Applied Social Psychology, 32*, 2377-2392.

Lindell, M.K. & Prater, C.S. (2007). A hurricane evacuation management decision support system (EMDSS). *Natural Hazards, 40*, 627-634.

Lindell, M.K., Prater, C.S. & Perry, R.W. (2006). *Fundamentals of Emergency Management.* Emmitsburg MD: Federal Emergency Management Agency Emergency Management Institute. Available at www.training.fema.gov/hiedu/aemrc/booksdownload/fem/ or hrrc.arch.tamu.edu/publications/books%20and%20monographs/

Lindell, M.K., Prater, C.S., and Perry, R.W. (2007). *Introduction to Emergency Management.* Hoboken NJ: John Wiley.

Lindell, M.K., Prater, C.S. & Wu, J-Y. (2002). *Hurricane Evacuation Time Estimates for the Texas Gulf Coast.* College Station TX: Texas A&M University Hazard Reduction & Recovery Center. [Available at www.txdps.state.tx.us/dem/downloadableforms.htm]

Lindell, M.K. and Whitney, D.J. (2000). Correlates of seismic hazard adjustment adoption. *Risk Analysis, 20,* 13-25.

McKenna, T.J. (2000). Protective action recommendations based upon plant conditions. *Journal of Hazardous Materials*, *75*, 145-164.

Mileti, D., Sorensen, J., and O'Brien, J. (1992). Towards an explanation of mass care shelter use in evacuations.' *International Journal of Mass Emergencies and Disasters*, *10*, 25-42.

Murray-Tuite, P. and Wolshon, B. (2013). Evacuation transportation modeling: An overview of research, development, and practice. *Transportation Research Part C*, *27*, 25-45.

National Research Council. (2001). *Standing operating procedures for developing acute exposure guideline levels for hazardous chemicals*. Washington, DC: National Academy Press

National Response Team. (1987). *Hazardous materials emergency planning guide.* Washington DC: Author.

Nolan, B. (2005). Katrina takes aim. *The Times-Picayune (New Orleans),* August 28, 2005, 1.

Perry, M. (2007). Natural disaster management planning: A study of logistics managers responding to the tsunami. *International Journal of Physical Distribution and Logistics Management, 37,* 409-433.

Perry, R. W. (1991). Managing disaster response operations. In T.E. Drabek and G.J. Hoetmer (eds.) *Emergency Management: Principles and Practice for Local Government* (pp. 201-223). Washington DC: International City Management Association.

Perry, R.W. & Lindell, M.K. (2007). *Emergency Planning.* Hoboken NJ: John Wiley.

Quarantelli, E.L. (1995). Patterns of sheltering and housing in US disasters. *Disaster Prevention and Management: An International Journal*, *4*, 43-53.

Ruch, C. (1984). Human response to vertical shelters: An experimental note. *International journal of mass emergencies and disasters*, *2,* 389-401.

Ruch, C. E., Miller, H. C., Haflich, M., Farber, N. M., Berke, P. R., and Stubbs, N. (1991). *The feasibility of vertical evacuation: Behavioral, legal, political, and structural considerations*. Boulder CO: University of Colorado Institute of Behavioral Science.

Sorenson, J.H. (1991). When shall we leave: factors affecting the timing of evacuation departures. *International Journal of Mass Emergencies and Disasters*, *9*, 153-164.

Sorensen, J.H. (2000). Hazard warning systems: Review of 20 years of progress. *Natural Hazards Review*, *1*, 119-125.

Sorensen, J.H. and Rogers, G.O. (1988). Local preparedness for chemical accidents: A survey of U.S. communities. *Industrial Crisis Quarterly, 2*, 89-108.

Sorensen, J.H., Shumpert, B.L., and Vogt, B.M. (2004). Planning for protective action decision making: evacuate or shelter-in-place. *Journal of Hazardous Materials*, *109*, 1-11.

Spencer, M.L. (2013). Resilience to WMD: Communication and active participation are key. In Bariru, A.B. and Racz, L. (eds). *Handbook of emergency response: A human factors and systems engineering approach* (pp. 339-360). Boca Raton: CRC Press.

Terpstra, T. and Lindell, M.K. (2013). Citizens' perceptions of flood hazard adjustments: An application of the Protective Action Decision Model. *Environment and Behavior, 45*, 993-1018.

Thomalla, F. & Schmuck, H. (2004). We all knew that a cyclone was coming': disaster preparedness and the cyclone of 1999 in Orissa, India. *Disasters*, *28*, 373-87.

Tummala, R. and Schoenherr, T. (2011). Assessing and managing risks using the Supply Chain Risk Management Process (SCRMP). *Supply Chain Management: An International Journal, 16*, 474-483.

USNRC/FEMA—U.S. Nuclear Regulatory Commission/Federal Emergency Management Agency. (1980). *Criteria for preparation and evaluation of radiological emergency response plans and preparedness in support of nuclear power plants*. NUREG-0654/FEMA-REP-1. Washington DC: Author.

Wei, J-C. Wang, F., Huang, S-K, Lindell, M.K., Ge, Y & Wei, H-L. (in press). Public reactions to the 2013 Chinese H7N9 influenza outbreak: Perceptions of risk, stakeholders, and protective actions. *Journal of Risk Research*.

Whitehead, J.C. (2003). One million dollars per mile? The opportunity coasts of Hurricane evacuation. *Ocean Coast Management, 46*, 1069-1083.

Wilson, T., Dantas, A., and Cole, J. (2009). Livestock evacuation or not: An emergency response assessment of natural disasters. *Journal of the Eastern Asia Society for Transportation Studies* 7: Online, 16pp. https://www.jstage.jst.go.jp/article/eastpro/2009/0/2009_0_8/_pdf.

Wei, J-C. Wang, F., Huang, S-K, Lindell, M.K., Ge, Y & Wei, H-L. (in press). Public reactions to the 2013 Chinese H7N9 influenza outbreak: Perceptions of risk, stakeholders, and protective actions. *Journal of Risk Research*.

Weiler, M. and Engel, A. (2012). *Risk management processes – A quantitative model for fusing cost and time of risks and risk response actions*. Bernard M. Gordon Center (BMGC) The Technion – Israel Institute of Technology.

Wood, N., Jones, J., Schelling, J., and Schmidtlein, M. (2014). Tsunami vertical-evacuation planning in the US Pacific Northwest as a geospatial, multi-criteria decision problem. *International Journal of Disaster Risk Reduction, 9*, 68-83.

Wu, H-C., Lindell, M.K., and Prater, C.S. (2012). Logistics of hurricane evacuation in hurricanes Katrina and Rita. *Transportation Research Part F, 15*, 445-461.

———. (2015) Strike probability judgments and protective action recommendations in a dynamic hurricane tracking task. *Natural Hazards, 79*, 355-380.

Wu, H-C., Lindell, M.K., Prater, C.S., and Huang, S-K. (2013). Logistics of hurricane evacuation in hurricane Ike. In J. Cheung and H. Song (eds.) *Logistics: Perspectives, approaches and challenges* (pp 127-140). New York, NY: Nova Publishers.

Wu, H-C., Lindell, M.K. & Prater, C.S. (2015). Strike probability judgments and protective action recommendations in a dynamic hurricane tracking task. *Natural Hazards, 79*, 355-380.

Wu, H-C., Lindell, M.K. & Prater, C.S. (2015). Process tracing analysis of hurricane information displays. *Risk Analysis, 35*, 2202-2220.

Figure 1. Valley Study Area Hurricane Risk Area Map

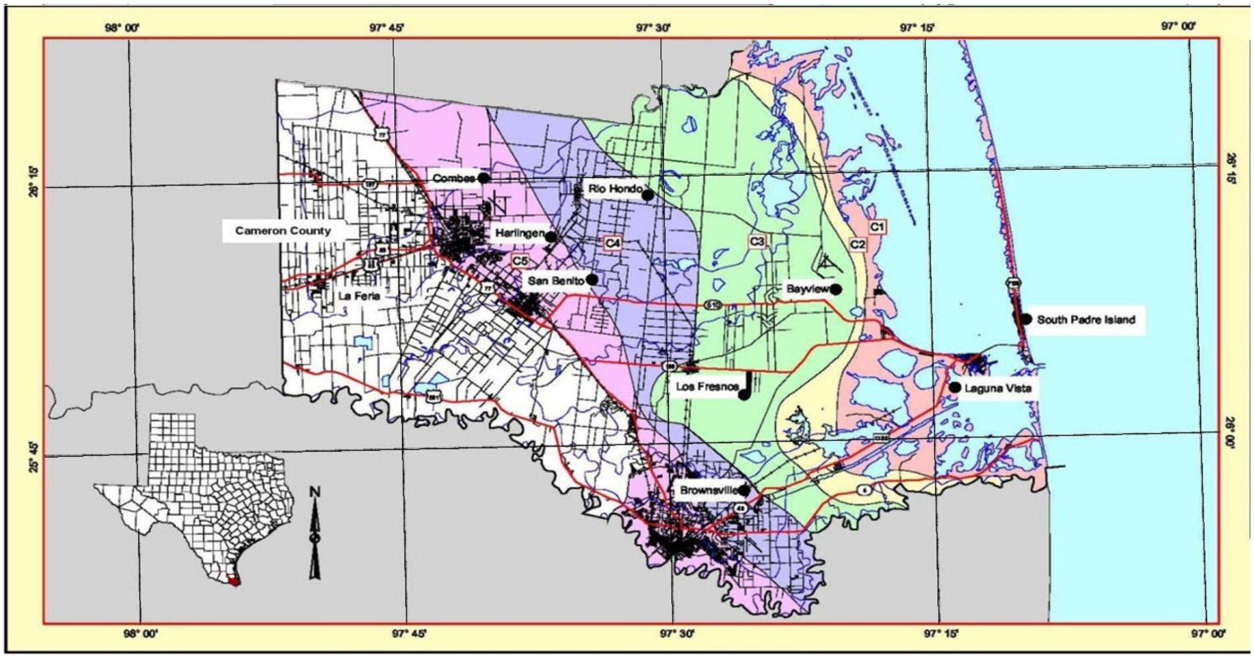
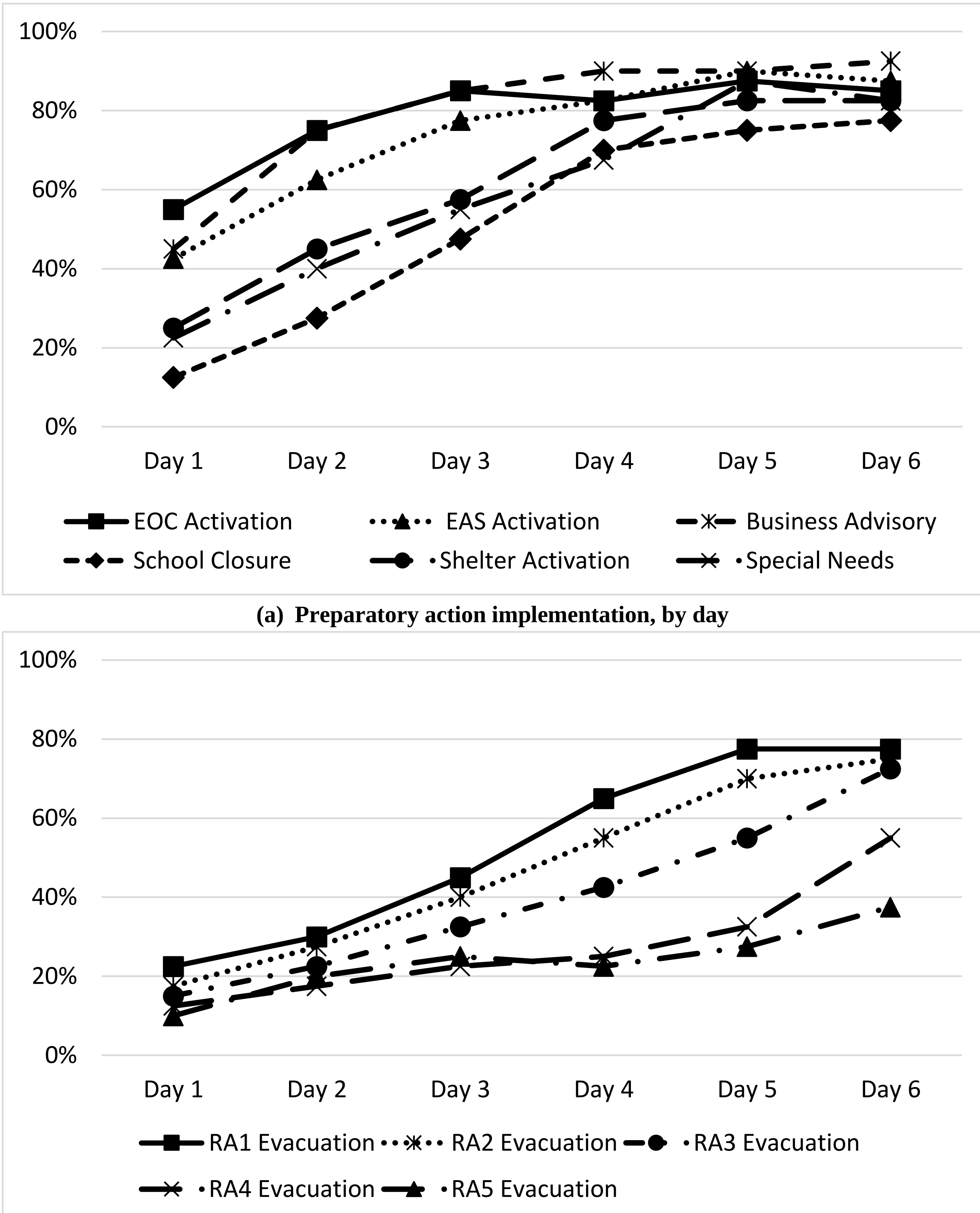
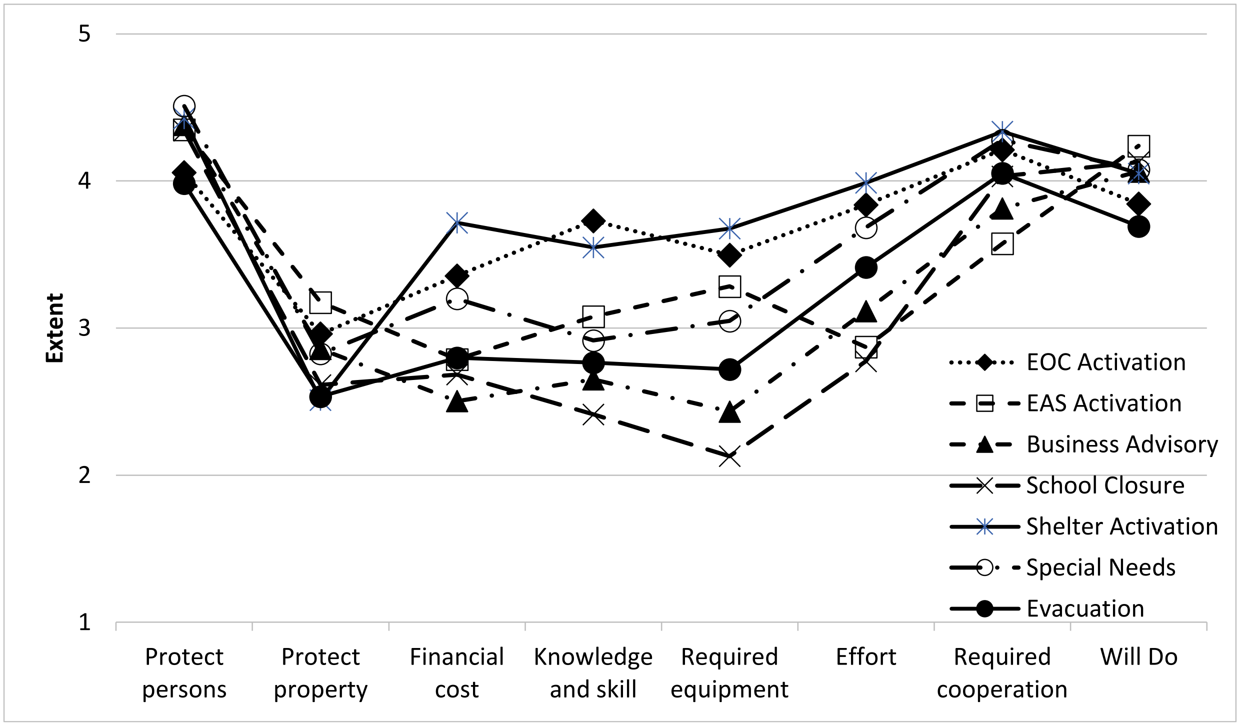


Figure 2. Percentages of participants initiating each response action, by forecast advisory. Preparatory actions in the upper panel and evacuation recommendations in the lower panel.

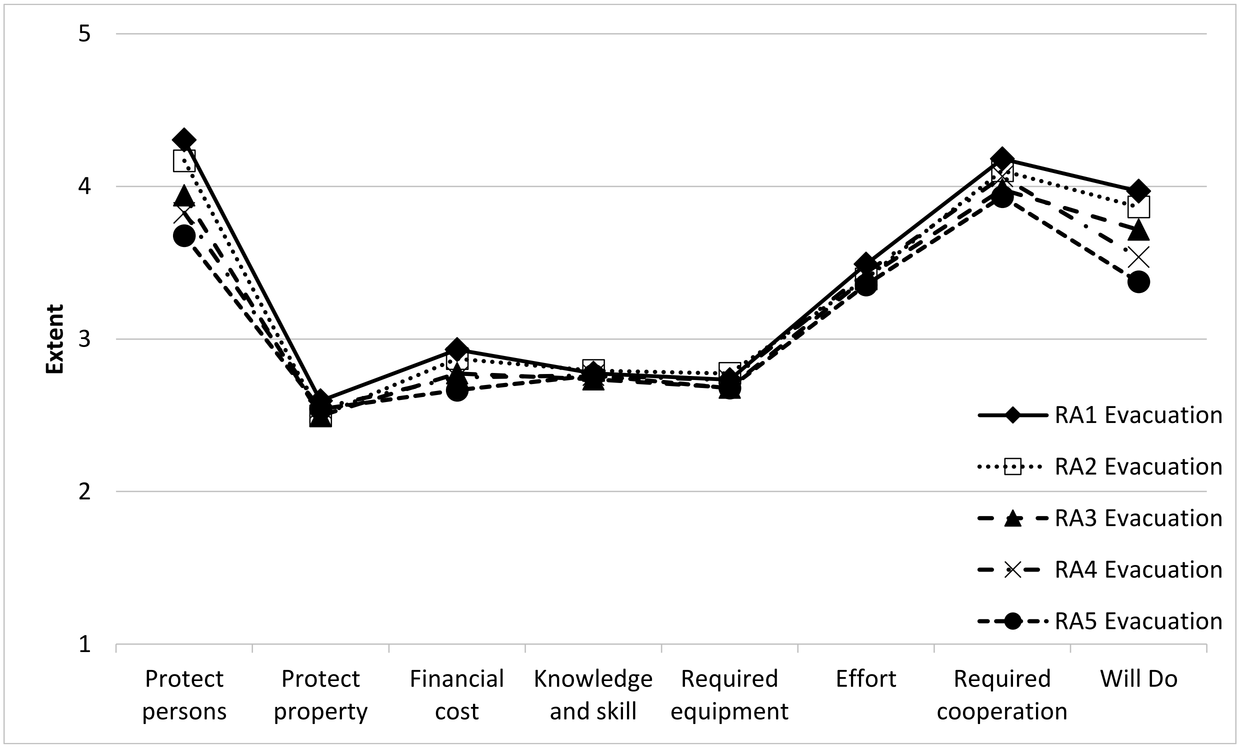


(b) Evacuation recommendations for risk areas, by day

Figure 3. Perceptions of response actions, by attribute.



(a) Preparatory action implementation and evacuation recommendation, by day



(b) Evacuation recommendations for Risk Areas 1-5

Table 1. Profile analysis results for response actions.

Preparatory Actions and Evacuation						
Attributes	Low	Mean	High	Mean	Difference	% of scale
1. Person protection	Evacuation	3.98	Special Needs	4.51	0.53*	13.2
2. Property protection	Shelter Activation	2.51	EAS Activation	3.17	0.66*	16.6
3. Financial cost	Business Advisory	2.50	Shelter Activation	3.72	1.21*	30.3
4. Knowledge and skill	School Closure	2.41	EOC Activation	3.73	1.32*	32.9
5. Required equipment	School Closure	2.13	Shelter Activation	3.68	1.55*	38.7
6. Effort	School Closure	2.77	Shelter Activation	3.99	1.21*	30.3
7. Required cooperation	EAS Activation	3.57	Shelter Activation	4.34	0.76*	19.0
8. Behavioral expectation	Evacuation	3.69	EAS Activation	4.24	0.55*	13.7
Evacuation Recommendations for Risk Areas 1-5						
Attributes	Low	Mean	High	Mean	Difference	% of scale
1. Person protection	RA5	3.68	RA1	4.30	0.63*	15.6
2. Property protection	RA2&3	2.50	RA1	2.59	0.10	2.4
3. Financial cost	RA5	2.66	RA1	2.93	0.26*	6.6
4. Knowledge and skill	RA3	2.74	RA2	2.79	0.06	1.5
5. Required equipment	RA5	2.68	RA2	2.77	0.10	2.4
6. Effort	RA5	3.35	RA1	3.49	0.14	3.4
7. Required cooperation	RA5	3.93	RA1	4.18	0.25*	6.2
8. Behavioral expectation	RA5	3.37	RA1	3.97	0.59*	14.8

* Significant at $p < .05$

Table 2. Levels of interrater agreement (r_{WG}) for response actions, by attribute.

Preparatory Actions and Evacuation								
	EOC Activation	EAS Activation	Business Advisory	School Closure	Shelter Activation	Special Needs	Evacuation	Row Mean
1. Person protection	.59	.59	.61	.60	.70	.72	.71	.65
2. Property protection	.17	-.01	-.04	.02	.02	-.13	.35	.06
3. Financial cost	.56	.51	.37	.22	.43	.13	.41	.38
4. Knowledge and skill	.50	.34	.37	.40	.34	.19	.40	.36
5. Required equipment	.45	.37	.38	.45	.34	.06	.43	.35
6. Effort	.61	.35	.35	.31	.50	.36	.48	.42
7. Required cooperation	.65	.30	.35	.48	.67	.60	.70	.54
8. Behavioral expectation	.48	.47	.42	.45	.51	.49	.63	.49
Column Mean	.50	.36	.35	.37	.44	.30	.51	

Evacuation Recommendations for Risk Areas 1-5						
	RA1	RA2	RA3	RA4	RA5	Row Mean
1. Person protection	.58	.57	.49	.42	.25	.46
2. Property protection	.11	.19	.26	.16	.10	.16
3. Financial cost	.23	.25	.32	.26	.28	.27
4. Knowledge and skill	.25	.29	.30	.29	.25	.27
5. Required equipment	.21	.28	.33	.34	.28	.29
6. Effort	.30	.33	.37	.34	.27	.32
7. Required cooperation	.59	.59	.54	.57	.44	.55
8. Behavioral expectation	.43	.43	.46	.36	.18	.37
Column Mean	.34	.37	.38	.34	.25	

*Statistical significance at $p < .05$ is $r_{WG} = .18$, at $p < .01$ is $r_{WG} = .25$, and at $p < .001$ is $r_{WG} = .32$

Table 3. Means (M), standard deviations (SD) and intercorrelations (r_{ij}) among variables.

Var	M	SD	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1	18.63	.84																					
2	.52	.50	**-.26**																				
3	.65	.48	.14	.13																			
4	34.5	16.9	.02	.16	.13																		
5	4.34	.64	-.08	.15	.07	.04																	
6	2.82	1.18	-.02	.17	-.12	.05	**.39**																
7	3.04	.76	.02	.13	.06	.15	**.26**	**.50**															
8	3.06	.84	.02	.15	.00	.11	**.32**	**.47**	**.73**														
9	3.01	.79	.03	.20	-.05	.09	**.33**	**.53**	**.72**	**.86**													
10	3.38	.75	.04	.17	.01	.12	**.36**	**.48**	**.78**	**.76**	**.76**												
11	3.94	.70	.05	.06	.05	.13	**.41**	**.34**	**.55**	**.60**	**.60**	**.80**											
12	4.07	.80	-.03	.07	.06	.09	**.59**	**.21**	.16	**.20**	**.21**	**.21**	**.37**										
13	27.48	17.92	.03	-.03	**.21**	.07	.18	-.13	.02	.11	.03	.06	.12	**.27**									
14	3.98	.76	-.10	.02	.06	.01	**.57**	.09	.11	.13	.13	.14	.19	**.45**	**.25**								
15	2.54	1.14	.01	.02	-.01	.04	**.32**	**.81**	**.43**	**.40**	**.45**	**.43**	**.27**	.16	-.11	**.21**							
16	2.80	1.09	.12	-.03	.01	.13	.15	**.39**	**.72**	**.64**	**.66**	**.62**	**.47**	.18	-.01	.12	**.37**						
17	2.77	1.10	.09	.10	-.05	.18	.16	**.41**	**.62**	**.78**	**.72**	**.63**	**.47**	.16	.03	.07	**.38**	**.76**					
18	2.72	1.07	.11	.12	-.05	.13	.16	**.43**	**.60**	**.71**	**.78**	**.62**	**.48**	.14	.01	.10	**.43**	**.79**	**.87**				
19	3.41	1.02	.12	.03	.03	.15	**.19**	**.33**	**.59**	**.60**	**.61**	**.67**	**.61**	.18	.02	**.20**	**.34**	**.77**	**.71**	**.69**			
20	4.05	.77	.12	-.08	.01	.13	**.23**	.03	**.26**	**.32**	**.34**	**.41**	**.64**	**.32**	.11	**.34**	.07	**.39**	**.33**	**.35**	**.60**		
21	3.69	.86	-.05	-.06	.01	.07	**.35**	.03	-.03	.10	.09	.01	.10	**.65**	**.23**	**.69**	.14	.09	.11	.10	.08	**.30**	
22	22.44	16.36	-.03	.02	**.22**	.10	**.22**	-.16	.02	.09	.04	.00	.10	**.25**	**.82**	**.31**	-.08	.01	.05	.08	.00	.12	**.32**

1 = Age, 2 = Female, 3 = White, 4 = Income ($1,000), 5 = Person protection: Preparatory Actions, 6 = Property protection: Preparatory Actions, 7 = Cost: Preparatory Actions, 8 = Knowledge/Skill: Preparatory Actions, 9 = Equipment: Preparatory Actions, 10 = Effort: Preparatory Actions, 11 = Cooperation: Preparatory Actions, 12 = Behavioral expectation: Preparatory Actions, 13 = Initial timing: Preparatory Actions, 14 = Person protection: Evacuation Actions, 15 = Property protection: Evacuation Actions, 16 = Cost: Evacuation Actions, 17 = Knowledge/Skill: Evacuation Actions, 18 = Equipment: Evacuation Actions, 19 = Effort: Evacuation Actions, 20 = Cooperation: Evacuation Actions, 21 = Behavioral expectations: Evacuation Actions, 22 = Initial timing: Evacuation Actions; Correlations in bold are $r \geq .19$ which are significant at $p < .01$, 2 tailed.

Table 4. Means (M), standard deviations (SD), and confidence intervals of expected implementation times.

Response action	M	SD	Confidence Intervals	
			Lower	Upper
1. EOC Activation	28.59	19.51	25.50	31.69
2. EAS Activation	29.17	22.18	25.65	32.69
3. Business Advisory	29.58	21.58	26.16	33.01
4. School Closure	24.74	19.72	21.61	27.87
5. Shelter Activation	24.38	19.57	21.28	27.49
6. Special Needs	28.40	21.39	25.01	31.79
7. RA1 Evacuation	27.54	21.75	24.09*	30.99*
8. RA2 Evacuation	25.37	21.04	22.04*	28.71*
9. RA3 Evacuation	22.62	19.46	19.53*	25.71*
10. RA4 Evacuation	19.02	15.48	16.56*	21.48*
11. RA5 Evacuation	17.63	15.62	15.15*	20.10*

* Confidence intervals that do not include the 32 hr ETE for a Category 4 hurricane.