An Assessment of the Return-Entry Process for Hurricane Rita 2005

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Return-entry is the movement of an evacuated population back to an area following the issuance of an all-clear message. This research examines the geographic, communication, and demographic factors that affect return-entry compliance rates using Hurricane Rita 2005 as a case study. Surveys were mailed to 1,200 households in a twelve county area comprising the Texas Department of Transportation (TxDOT) return-entry plan. The results show that compliance with the Hurricane Rita return-entry plan was low, as 46.4% of respondents returned home on or after their scheduled return date, while only 23.2% returned on their exact scheduled return date. In addition, communication of the return-entry plan was relatively poor as 54.0% of evacuees reported receiving the all-clear message and 19.5% of respondents reported being aware of the TxDOT staggered return-entry plan. In regard to factors that affect the return process, a relationship was found between distance evacuated and return-entry date, in that the farther a household evacuates, the more likely it will return at a later date. A relationship was also found between scheduled return-entry date and compliance, as people scheduled to return to the zone that sustained damage (Day 3) had a higher rate of compliance than those evacuees who returned to the undamaged zone (Day 2). Finally, female respondents were more likely to comply with the return-entry orders than males respondents, and individuals of lower education levels were more likely to comply with return-entry orders than individuals of higher education levels.

Key Words: Return-entry, Hurricane evacuation, Warning compliance

Introduction

Fires, floods, disease, and war have led to the evacuation of many cities throughout the world. However, between 1100 and 1800 AD, only 42 cities were abandoned following their destruction (Allenby and Fink 2005). Historical examples of return-entry processes repeatedly confirm the desire of a population to return and rebuild following a disaster. This process has caused numerous and significant problems throughout history including lack of resources to support the returning population, too many returning at once, and uncertainty associated with whether it is safe to return (Kendrick 1955; Salih 1996; Waller 2004). Sorensen, Vogt and Mileti (1987) note that the most common problem during the return process is evacuees returning prior to the issuance of an all-clear message. Despite the potential problems that may arise in returning, many cities and states lack a uniform and effective plan for repopulating evacuated areas.

There is little mention of the return process in the hazards literature, and more specifically, the degree to which people comply with return-entry orders when returning home. Stallings (1990) published the only paper entirely dedicated to return-entry as a research topic and noted that the return-entry process has generated little interest within the hazards community. He notes that the decision to evacuate and the management of pre-disaster strategies are viewed as more problematic than events in the aftermath of a disaster (Stallings 1990). Zelinski and Kosinski (1991), however, contend that the single greatest problem associated with the management of hurricane-induced evacuations may indeed be managing the return movement. An example of research related to the return process is provided by Dash and Morrow (2000), who found that delays in issuing the all-clear message may have a negative impact on compliance with future evacuation orders by those who learned of negative return-entry experiences through secondary sources. However, this did not hold for those who actually experienced the delayed return-entry. The results of this research suggest that the management of return-entry can impact evacuee decision-making behavior in future evacuations. Smith and McCarty (1996) examined how damage to homes resulting from Hurricane Andrew in 1992 affected who returned to Dade County, Florida following the storm and when evacuees returned. Their study is an example of how the demographic characteristics of an area can be altered by a disaster. More recently, Mitchell et al. (2005) found that evacuee return dates varied between areas that were under a mandatory evacuation order and areas comprising the evacuation shadow in the 2005 Graniteville, South Carolina, chlorine spill incident.

Strategies for conducting research on returning have been suggested in several papers. Stallings (1990) suggests that researchers investigate conditions and standards that must be met prior to issuing an all-clear message. In addition, Stallings suggests that studies of the decision-making process to issue an all-clear message, and the intra- and inter-family dynamics of the process of deciding whether or not to return, would assist emergency managers in the creation of plans that consider individual and group behavior. Sorenson

et al. (1987) describe various strategies to conduct research on the return process. They suggest that research be performed on existing evacuation data in order to see if any underlying evidence exists that would suggest a pattern in return-entry behavior. In addition, surveys on evacuees of recent disaster events could be conducted in order to analyze their behavior in the return-entry process and determine the problems experienced while returning.

Hurricane Rita in 2005 in Houston, Texas, provides an excellent opportunity to study the return process of a major metropolitan area. While the process of evacuating threatened populations has been studied for decades and much is known about the factors that affect compliance (Mileti and Sorensen 1990; Zelinsky and Kosinski 1991; Dash and Gladwin 2007), there are numerous unanswered questions regarding compliance in regards to the return process. The focus of this paper is return-entry compliance using the events following Hurricane Rita of 2005 as a case study. Following Stallings (1990), this study will treat the all-clear message and return-entry order as the inverse of the evacuation order. However, it is important to note the evacuation and repopulation of an area are two separate processes, and the factors that affect compliance with evacuation orders likely differ from those that affect return-entry compliance. The return-entry process will be examined using methods commonly utilized in evacuation research. The objective of this study is to examine how geographic, communication, and demographic factors affect one's likelihood to comply with return-entry orders.

The three hypotheses in this study are as follows: (1) compliance with return-entry orders varies geographically, (2) people are more likely to comply with return-entry orders if they view a map representing the return-entry plan, and (3) demographic characteristics of returnees affect return-entry compliance.

Method

Study Area

Tropical Storm Rita developed on September 18, 2005, in the Atlantic Ocean. As a Category 2 storm, Hurricane Rita made its first landfall near the Florida Keys on September 20 and entered into the Gulf of Mexico on September 21. That same day, Rita reached Category 5 strength, with maximum winds ranging between 165 and 175 mph. Hurricane Rita was recorded as the third lowest minimum central pressure reading of all time as it continued its track through the Gulf of Mexico, and on the morning of September 24, it made landfall near the Texas and Louisiana border as a Category 3 hurricane with sustained winds of 120 mph.

As Hurricane Rita was projected to make landfall near Houston, Texas, officials issued a mandatory evacuation order for more than 1.2 million residents. An additional 1.3 million residents comprising an evacuation shadow also left the area in fear of encountering the same difficulties residents of New Orleans experienced after Hurricane

Katrina (Murphy 2005). An evacuation shadow is the area where there is an over-response to limited protective action orders (Zeigler and Johnson 1984). The evacuation of the city of Houston and its surrounding area marked the first time in Texas history that a city was evacuated using contra-flow. Contra-flow involves reversing lanes on interstates in order to facilitate large-scale evacuations (Wolshon, Urbina, and Levitan 2001). The evacuation of 2.5 million residents was the largest evacuation recorded in world history (TxDOT 2006).

The State of Texas has a documented procedure directing the return-entry of an evacuated population following a disaster. TxDOT's plan has two phases. The first phase consists of the initial re-entry phase, in which a minimum number of roadways are opened to allow law enforcement officials, public works, utility workers, and relief vehicles to enter the disaster-stricken area. Routes that lead to hospitals and emergency centers are cleared first, followed by interstate highways and other important state highways. The second phase consists of removing debris and opening all other possible routes. Following the completion of the second phase, residents are allowed to return (Wolshon, et al. 2005). In the case of Hurricane Rita, TxDOT conducted a staged return-entry in which various geographic regions reopened on different days, thus attempting to manage the large number of evacuees and shadow-evacuees from returning to the Houston area at one time.

Four return-entry zones were established, and the plan was disseminated through various media sources. In particular, a map was created and posted on the TxDOT website depicting the four return-entry zones and the day residents in each zone were advised to return (Figure 1). Zone 1 is the inland undamaged zone west of Houston that corresponds with Day 1 of the scheduled return-entry plan (September 25). Zone 2 comprises the cities of Houston and Galveston and is considered to be the coastal undamaged zone. It also includes counties south and west of Houston and is the geographic area of the Day 2 scheduled return-entry plan (September 26). Zone 3 includes 11 counties northeast of Houston that were in the Hurricane Rita impact fringe area. Because this area experienced some storm damage, it was assigned Day 3 of the scheduled return-entry plan (September 27). Zone 4 on the map is the impact core area that includes the city of Beaumont. This area was classified as a pending area in the return-entry plan and residents were not allowed to return until the area was deemed safe. This plan was intended to ensure there would be less congestion on the freeways, the area's residents would be safe upon arriving home, and adequate fuel supply would be available to the returnees.

Procedure

Questionnaire packets were mailed to residents who live in one of the following twelve counties: Brazoria, Chambers, Fort Bend, Galveston, Harris, Liberty, Matagorda, Montgomery, Polk, Tyler, Waller, and Wharton. These questionnaires were sent out 14

months after Hurricane Rita. The questionnaire created for this study is modeled after an evacuation survey conducted by the Texas A&M University Hazard Reduction and Recover Center following the evacuation of the Lake Sabine area of Southeastern Texas and Southwestern Louisiana during Hurricane Lili in 2002 (Lindell, Lu, and Prater 2005). As noted earlier, modeling the return-entry questionnaire after an evacuation questionnaire is possible because the "all-clear" message can be viewed as analogous to an evacuation order issued prior to the onset of a disaster (Stallings 1990).

Figure 1. Hurricane Rita Return-Entry Plan Map Provided by TxDOT.

The sample size was approximately 1,200 households, with 100 questionnaire packets mailed to each of the 12 counties. Questionnaires were randomly sent to households within each county and participation was voluntary. The questionnaire was two pages in length. After completing the questionnaire, the respondent mailed their responses back to the researcher. This process was conducted in three steps using a modified version of Dillman's Tailored Design Method (Dillman 1990). Two postcards were sent to remind the eligible participant to fill out the survey. The first postcard reminders were mailed out two and a half weeks following the distribution of the initial questionnaire. A second postcard reminder was sent to individuals who had not yet responded to the questionnaire five weeks after the original survey mail-out date. If the participant had not returned the questionnaire after two reminders, no further attempt was made to contact the household.

The survey includes both open-ended and closed-ended questions regarding the evacuation and return-entry processes. Of the 1,200 questionnaires mailed out, a total of 239 were returned. Ninety-nine were also sent back due to insufficient addresses, thus achieving an overall response rate of 21.7% (239 / 1101). Twenty of the 239 returned were not sufficiently completed, thus reducing the number of usable surveys to 219. However, of the 239 surveys returned, only 133 survey respondents indicated that they evacuated from Hurricane Rita, limiting the return-entry analysis to this number of respondents. The following description of returned surveys reflects the 219 surveys that were used to conduct the analysis. A total of 170 surveys were mailed to Zone 1, and a response rate of 17.1% (n = 29) was achieved. Zone 2 was sent a total of 564 surveys, and 106 residents responded, thus achieving a response rate of 18.8%. Finally, 471 surveys were mailed to residents in Zone 3, and 84 residents responded, resulting in a return rate of 17.8%.

The survey respondents were primarily middle-aged (arithmetic mean age $M = 55.5$), married (61.2%), Caucasian (73.7%), homeowners (82.6%) with a mean annual income of $50,000. The households averaged 2.5 people and two-thirds of the households responding to the questionnaire reported having children at home. There was no significant bias in the respondents' gender (50.2% male, 49.8% female). This sample was compared with 2005 census estimates and is closely representative of the actual study area population demographics.

Respondents were asked about their evacuation experiences in order to conduct comparisons between the evacuation and return-entry processes. Secondary evacuations, or evacuees re-evacuating the area after returning home due to lack of utilities or damage to homes, were not examined in this study. Questions pertaining to date and time of departure, method of transportation, number of people evacuated with, distance evacuated, time to reach evacuation destination, name of their evacuation destination, and evacuation route were asked.

Respondents rated on a scale of one to five, one being the least and five being the greatest, the extent to which they relied on different information sources when making their decision to return home. Sources included local authorities, local media, national media, Internet, and peers. They were also asked to identify the sources from which they received the all-clear message and to indicate if they were aware of TxDOT's return-entry map (1 = Yes). Questions pertaining to the origin of the respondents' return-entry trip, date and time of return, method of transportation (0 = Personal Vehicle, 1 = Got a ride with someone else, 2 = Public Transportation, 3 = Other), distance traveled, time to reach the return destination, location returned to first, and route used during the return journey were asked in order to compare the return-entry trip with the evacuation trip. In addition, respondents were asked: (1) if they returned home with the same group (1 = Yes), (2) their estimated expenses associated with evacuating, their duration of stay, and

returning, and (3) if they were aware they returned home prior to their scheduled return date.

A definition for return compliance was needed, as no definition exists in the literature. In the end, two definitions of return compliance emerged. *Exact compliance* with return-entry orders is defined as the case in which an evacuated person or household returns on the scheduled return-entry date. *Relaxed compliance* with return-entry orders is defined as the case wherein an evacuated person or household returns on either the scheduled return date or thereafter. The second definition was needed to handle the much less problematic case—from an emergency management perspective—in which evacuees do not return on their designated return date but generally comply with the all-clear message by returning later. The inverse of relaxed compliance is therefore the set of evacuees who returned prior to receiving an all-clear message, the most dangerous form of non-compliance with return orders. This is problematic due to the inability of officials to determine whether the area is safe for repopulation.

Compliance with return-entry orders was calculated by identifying each respondent's scheduled return-entry zone and comparing it to the actual return-entry date the respondent indicated on the returned questionnaire (1 = complied). The findings regarding compliance with return-entry orders were then compared with findings regarding evacuation compliance to demonstrate similarities and differences in the factors that affect compliance rates for both processes.

Results

An analysis of the factors affecting one's decision to evacuate from Hurricane Rita was conducted in order to test whether compliance factors demonstrated during the evacuation are similar to other findings established in the evacuation literature. All results are reported at a 95% confidence level, unless otherwise noted. Factors tested against the decision to evacuate include gender, age, ethnicity, income, education, number of individuals in a household, number of children in a household, home ownership, and home type. This study found that the larger the household, the more likely it was to evacuate ($p < 0.05$), and households with children were more likely to evacuate (75.4%) than households without children (52.9%, $p < 0.01$). These findings increased our confidence in the survey results, as they are both established relationships in the evacuation literature (Quarantelli 1980; Carter et al. 1983; Houts et al. 1984, Edwards 1993).

In regards to the return-entry procedure, results from this survey indicate that 23.2% of respondents ($\pm$ 10.6%) complied with the return-entry plan under the exact definition of return compliance, whereas 46.4% ($\pm$12.6%) complied with return-entry orders under the definition of relaxed compliance. This means that 76.8% of the respondents returned on a date other than their designated date, and just over half of the surveyed households

(100 – 46.4% = 53.6%) violated the return-entry order by returning prior to their scheduled return date. Table 1 displays a breakdown by zone of when evacuees returned.

Table 1. Reported return dates of evacuees based on return-entry zone and date (Shaded cells indicate the scheduled return date for each zone)

Zone Name	Number	09/24 (or earlier)	09/25	09/26	09/27	09/28 (or later)	Did not Evacuate	Total
Inland undamaged	1	1	2	2	0	0	24	29
Coastal undamaged	2	16	23	13	4	5	45	106
Impact fringe	3	0	5	5	11	15	48	84
Total		17	30	20	15	20	117	219

A total of 54.9% ($\pm$ 8.8%) of respondents indicated that they received an all-clear message. Of those who received an all-clear message, local authorities (26% $\pm$ 10.5) and local media (26% $\pm$ 10.5%) were relied on the most, followed by peers, to include friends, relatives, neighbors and coworkers (24% $\pm$ 10.2%), national media (19% $\pm$ 9.4%), and the Internet (5 % $\pm$ 5.3%). Respondents were asked to rate (1 = *No extent* and 5 = *A great extent*), the extent that they relied on a particular source in making their decision to return home. The source most relied on was peers ($M = 3.5 \pm .30$), followed by local news media ($M = 3.0 \pm .29$), national news media ($M = 2.7 \pm .28$), local authorities ($M = 2.5 \pm .31$), and the Internet ($M = 1.6 \pm .25$).

A total of 123 respondents replied to the question pertaining to their awareness of the map produced by TxDOT that illustrated the return-entry plan. The responses indicated that only 19.5% ($\pm$ 7%) reported seeing it. There appeared to be no geographic pattern based on evacuation destination of those who viewed the TxDOT map, although more respondents in the San Antonio and Austin areas indicated viewing the map when compared to those who evacuated to other areas.

The following descriptive statistics reflect the responses of the return-entry participants. It is important to remember that this sample of the return-entry population includes only those that had the motivation and resources to evacuate from Hurricane Rita. The average evacuation distance per household was 197.7 miles ($\pm$ 28.9 miles), and the average evacuation trip lasted 11.5 hours ($\pm$ 2.1 hours at 95% confidence). Respondents evacuated over four days. Results indicate that 9.4% ($\pm$ 5.3%) evacuated on September 20, 33.3% ($\pm$ 8.5 %) on September 21, 40.2% ($\pm$ 8.9%) on September 22, and 17.1 % ($\pm$ 6.8%) evacuated on September 23. Thus, the majority of respondents (73.5%) evacuated on either September 21 or September 22 (two to three days before landfall).

Personal vehicles were the most common form of transportation (90.5% ± 5.1%). The average evacuation group consisted of 3.2 people (± .5) and 1.5 (± .35) vehicles. The primary evacuation destinations in Texas were Dallas (10), San Antonio (8), Houston (7), Austin (5), and Lufkin (4). It is important to mention that only the areas within Houston that are threatened by storm surge and inland flooding from heavy rain were ordered to evacuate, thus making inland areas of Houston a possible choice as an evacuation destination for some. Ten additional respondents fled to other states including Arkansas (3), Alabama (2), Colorado, Georgia, Louisiana, Mississippi, and Oklahoma (1 each).

Geographical Questions

There was a significant relationship ($\chi2$ = 10.44, $p < 0.01$) between a the scheduled return date for Zones 2 and 3 and respondents' likelihood to comply with the return-entry orders based on the relaxed definition of compliance. The scheduled return dates were divided into three groups where Zone 1 corresponded with September 25, Zone 2 with September 26, and Zone 3 with September 27. As the next to last column of Table 1 indicates, individuals residing in Zone 1 (17.2% ± 13.7%) had significantly lower evacuation rates than those in Zones 2 (57.5% ± 9.4%) or 3 (42.8% ± 10.6%). Although the return compliance rate for Zone 1 cannot be estimated reliably because of the small number of evacuees (5), the compliance rate for Zone 2 (36.1% ± 12.1%) is significantly lower than that in Zone 3 (72.3% ± 14.7%). Twenty-nine surveys were returned from Zone 1, but only five respondents evacuated. This area was not part of the mandatory evacuation zone; therefore the residents were not ordered to leave. This area was included in the return-entry plan, despite not being an area that was under a mandatory evacuation order, in order to accommodate shadow evacuees. No relationship was found between scheduled return date and likelihood to comply with return-entry orders based on exact compliance (χ^2 = 1.26, $p > .05$).

An exact return hour was calculated in order to more precisely identify when evacuees returned. The exact return hour was calculated using the equation:

$$R = 24d + h \tag{1}$$

where R is the exact return time, d is the number of days following the first evacuation date, and h is the time of day (24 hour clock) on that date. The numeric values assigned for each date (d) begin with the first day of the evacuation and ends on the last day of the return-entry. For example, Tuesday, September 20 is 0; Wednesday, September 21 is 1; and Thursday, September 22 is 2. This is calculated through Wednesday, September 28, (or 8). These date values are multiplied by 24 (hours in a day) and are added to the hour (h) at which the respondent indicated returning home.

A positive relationship was found between evacuation distance and the exact return time (r = 0.30, $p < 0.01$). In other words, the farther a household evacuated, the more

likely it was to return at a later date as shown in Figure 2. On average, people who returned on September 24 had evacuated half as far as those who returned four days later on September 28.

Figure 2: Evacuation distance versus the exact date of return.
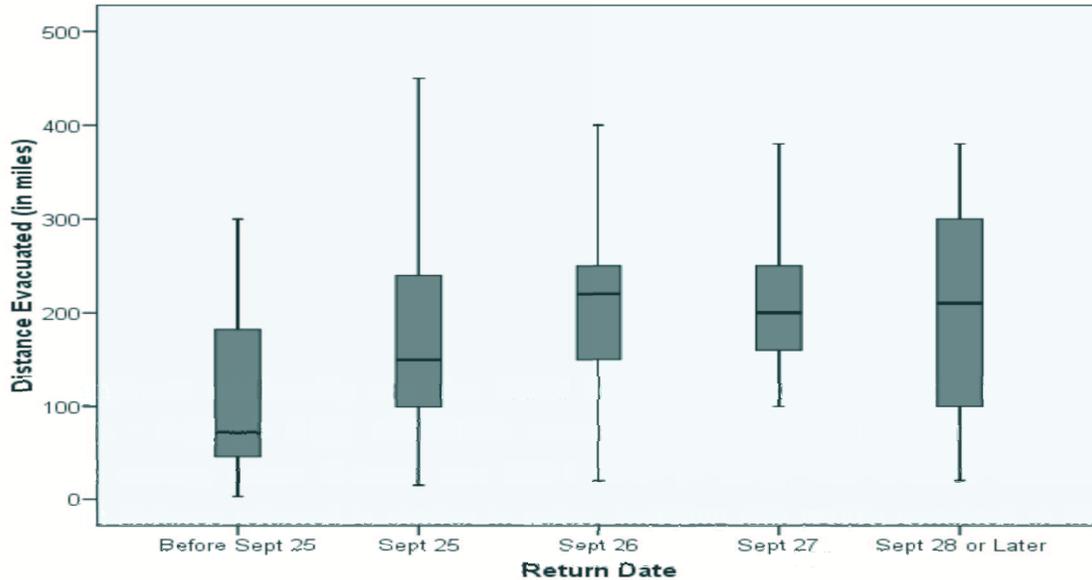
Communication and Compliance

The second hypothesis is that viewing a map of the return-entry plan affects compliance with return-entry orders. There was no significant relationship between viewing the TxDOT return-entry map and relaxed compliance with return-entry orders $\chi2$ = 0.64 ($p > 0.05$). Similarly, no relationship was found between viewing the TxDOT map and exact compliance (χ^2 = 0.016, $p > 0.05$). These tests imply that the TxDOT map did not affect compliance with return-entry recommendations.

Bivariate correlation analyses were conducted on the data to determine the demographic factors that enhance or weaken return compliance. An understanding of who relies on what source may benefit emergency managers in creating and distributing more effective warning messages to citizens while they are evacuated. The results of the bivariate correlation analyses are presented in Table 2.

A statistically significant negative relationship was found between age and reliance on peers for the all-clear message ($r = -0.20$, $p < 0.05$). Respondents under the age of 55 indicated that they were more likely to rely on peers for information regarding the all-clear message than were respondents over the age of 55. A statistically significant negative relationship was also found between education level and reliance on national news media for information regarding the all-clear message ($r = -0.21$, $p < 0.05$). People of a lower education level indicated that they relied more on national media than people of a higher education level.

Table 2. Means (*M*), Standard Deviations (SD) and Correlations among Variables

	M	SD	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1. Age	53.5	15.95	1.00																							
2. Sex	N/A	N/A	-.23**	1.00																						
3. Mstat	N/A	N/A	.18*	.19*	1.00																					
4. Nhous	2.71	1.53	-.46**	.05	-.36**	1.00																				
5. Nkids	0.82	1.06	-.57**	.07	-.20*	.75	1.00																			
6. Edlev	N/A	N/A	.05	-.08	-.22*	-.10	-.10	1.00																		
7. Inc	N/A	N/A	-.08	-.06	-.46**	.13	.10	.49**	1.00																	
8. Orent	0.85	.42	.01	-.23**	-.03	-.08	-.16	.28**	.20*	1.00																
9. Egroup	3.24	2.79	-.17	.02	-.03	.37**	.34**	-.24**	-.14	-.06	1.00															
10. Disevac	198,0	160.0	-.02	-.12	-.22*	.22*	.17·	-.03	.19	.15	.07	1.00														
11. Ttravel	11.5	11.6	-.07	-.14	-.08	.20*	.19*	-.08	.14	.02	.22*	.41**	1.00													
12. Edate	1.1	1.2	.00	.09	.02	-.04	.01	.09	.11	.04	-.01	-.06	-.07	1.00												
13. Locauth	2.48	1.7	-.06	.00	.02	.07	.03	-.10	-.04	.21*	.05	.20*	.09	-.09	1.00											
14. Locmed	2.97	1.5	-.14	.08	.10	.04	-.07	-.10	.03	.04	.04	.01	.02	-.13	.29**	1.00										
15. Natmed	2.71	1.6	-.14	.13	.18	-.06	-.01	-.21*	-.10	.05	.16	.23*	.12	.02	.28**	.44**	1.00									
16. Internet	1.57	1.3	-.19	-.02	-.05	-.02	.07	-.13	-.06	.06	.20	.53**	.28*	-.05	.20*	.18	.40**	1.00								
17. Peers	3.51	1.6	-.21*	-.00	.08	.11	.22*	-.15	-.04	-.04	.07	.10	.15	-.15	.18	.12	.15	.14	1.00							
18. Txdot	.20	.4	-.14	.13	.01	.01	.06	.18*	.10	.08	-.08	.08	-.11	-.05	.00	-.09	-.02	.17	-.07	1.00						
19. Dreturn	201.1	157.6	-.00	-.06	-.19*	.20*	.15	.01	.21*	.11	.09	.96**	.39**	-.28**	.17	-.01	.22*	.45**	.06	.10	1.00					
20. Treturn	5.5	7.7	.05	-.03	-.06	.16	.08	-/17	.00	-.06	.21*	.58**	.45*	-.01	-.05	-.15	.09	.15	-.02	-.02	.61**	1.00				
21. Strans	.98	.15	.14	-.15	-.03	-.07	-.18	-.04	-.03	.07	-.16	-.02	.09	.01	-.00	-.22*	-.25**	-.17	-.12	.08	-.09	.04	1.00			
22. Cevac	228.3	382.8	-.09	-.06	-.17	.35**	.21	-2.5*	-.09	.05	.57**	.38**	.32*	.02	.21	.21	.34**	.43**	.21	-.06	.32**	.28**	-.07	1.00		
23. Cstay	866.5	4923.0	.07	-.11	-.08	.08	.11	.18	.13	.04	-.02	.03	-.03	-.22	-.11	-.17	.02	-.07	.12	-.07	.01	.06	.03	.01	1.00	
24. Creturn	148.0	216.9	.08	-.04	-.07	-.04	-.08	-.14	.04	-.03	.07	.36**	.33*	-.03	.06	-.08	.17	.10	.14	.00	.35**	.50**	.04	.20	.15	1.00

* Correlation is significant at the 0.05 level (2-tailed). ** Correlation is significant at the 0.01 level (2-tailed). Age=respondents age; Sex= respondent indicates male or female; Mstat= marital status; Nhouse= number in household; Nkids= number of kids at household; Edlev=education level; Inc=Average household earnings; Orent= Own or rent home; Srdate= scheduled return date; Rcomp= relaxed compliance; Ecomp= exact compliance;). Egroup=evacuation group size; Disevac=distance evacuated; Ttravel=time to reach evacuation location; Edate=evacuation date; Locauth=local authorities as message source; Locmed=local media as message source; Natmed=national newsmedia as message source; Internet=used internet as message source; Peers= used peers as message source; Txdot= viewed Texas DOT return-entry map; Dreturn=distance to return in miles; Treturn=time to return in hours; Strans=same transport used in evacuation as in return; Cevac=monetary cost to evacuate; Cstay=monetary cost of evacuation stay; Creturn=monetary cost of returning

There was also a statistically significant positive relationship between day returned and reliance on peers as a source of the all-clear message ($r = 0.23$, $p < 0.05$). Respondents who relied more on peers for the all-clear message returned later than those individuals who did not rely as heavily on peers for the all-clear message. Finally, a statistically significant positive relationship was found between having children at home and reliance on peers as a source of the all-clear message ($r = 0.22$, $p < 0.05$). This test shows that households with more children were more likely to rely on peers as a source for the all-clear message than those with fewer or no children.

Demographic Compliance

The third hypothesis of this study is that returnee demographics affect compliance with return-entry orders. However, gender, age, ethnicity, marital status, number of people per household, households with children, number of children, income level, home ownership status, and home type were not significantly related to relaxed compliance with return-entry orders. A statistically significant relationship was found between education level and the likelihood to comply with return-entry orders based on the relaxed definition of compliance. Individuals without a college degree had a higher compliance rate with return-entry orders than those who obtained a college degree ($\chi^2 = 4.68$, $p < 0.05$). Of those individuals who did not have a college degree, 58.1% ($\pm$ 14.8%) complied with the return-entry plans, while only 27.8% ($\pm$ 20.7 %,) of respondents with college degrees complied with the orders.

Similar analyses comparing population demographics to respondents' compliance with return-entry orders based on exact compliance revealed that gender was the only statistically significant predictor of compliance with return-entry orders. Female respondents (32.4%, $\pm$ 11.1%) were more likely than male respondents (8.3%, $\pm$ 15.1%) to comply with return-entry orders based on the exact definition of return compliance. In short, female respondents were just under four times as likely as male respondents to return on their scheduled return date.

Discussion

Evacuation research has repeatedly found that risk perception influences evacuation compliance. Baker (1979) notes that the greater an individual's perception of risk, the more likely a person is to respond to a warning message. In a study done on bushfire threat, it was determined that the starting evacuation time is dependent on the perception of threat and advice provided by emergency personnel (Brennan 1998). Lindell et al. (2005) found that risk perception also affects evacuation decision-making. Their study indicated that respondents considered social and environment cues to be more important than past experience and evacuation impediments when making the decision to evacuate from Hurricane Lili in 2002.

Similar to the relationship between risk perception and evacuation compliance, return-entry compliance of the three zones may be lower due to a lack of perceived risk associated with returning home. In addition to changes in levels of risk perception affecting return-entry decisions, evacuees may change the amount of risk they are willing to accept. Factors such as impatience, inconvenience, fear of looting, financial hardships, and traffic may not change evacuees' risk perceptions, but instead provide reasons for accepting the risks associated with returning early.

This provides a challenge for emergency managers striving to achieve high rates of compliance with return-entry orders. The overall compliance rates with the return-entry orders were low in the case of Hurricane Rita, as was the evacuees' awareness of the return-entry plan. Unless the return-entry orders are communicated effectively to evacuees and the risks associated with returning home early are emphasized, there is little motivation for the evacuees to comply with the return-entry orders. Furthermore, the absence of any perceived risk during the return-entry may account for differences between evacuation compliance and return-entry compliance. This study also illustrates that demographic factors known to predict evacuation compliance (e.g., age, economic status, household size) were not found to affect return compliance.

Research was conducted on the relationships between geographical factors and compliance to determine if location influences the return-entry decision-making process. Dash and Gladwin (2007) note that more accurate and geographically-focused research on evacuation compliance may benefit emergency managers in the creation of more effective evacuation plans. Similarly, this project examined how geographic factors influenced the Hurricane Rita return-entry compliance rates.

A significant relationship was found between one's assigned return-entry zone and rates of relaxed compliance. Thus, it may be possible to predict one's likelihood to comply with return-entry orders based on their return-entry zone. It was expected that the rate of compliance would decrease with later return dates, but Zone 3 had a higher compliance rate than Zone 2. The compliance rate for Zone 1 could not be estimated reliably because of the small number of evacuees.

This study found that residents from Zone 2 (undamaged coastal) complied significantly less than residents from Zones 3 (impact fringe). One possible reason for the higher compliance rates for Zone 3 than Zone 2 may be related to the evacuees' perception of risk associated with the return-entry. Zone 3 is geographically closer to where Hurricane Rita made landfall; thus areas within this zone sustained greater damage from the storm. Zones 1 and 2, which include the Houston and Galveston areas, received minimal damage. The low compliance rate for Zone 2 may be explained by a low perception of risk. Respondents in Zone 2 may have perceived the risk associated with returning early to be minimal; therefore, they felt more comfortable returning home before their scheduled return date than those respondents who lived in the more damaged Zone 3.

Another possible explanation for the low compliance in Zone 2 is that those respondents were ordered to evacuate before residents of the other zones. Therefore, it is possible that Zone 2 respondents were able to find shelter closer to home than those who evacuated later and, as a consequence, had a shorter distance to travel in order to return. This is in line with the finding that people who evacuated farther returned later than those who did not evacuate as far. In addition, because residents from Zone 2 were away from their homes longer than respondents from Zone 1 and Zone 3, they may have been more impatient and therefore returned prior to their scheduled return date. It is important to remember that even though the relationship between compliance and geographic zone was significant, the number of respondents who evacuated from Zone 1 was low. Thus, inferences of return-entry behavior from zones with early scheduled return dates should be tested in future research studies of staggered return-entry processes in order to gain a better understanding of how scheduled return-dates impact compliance with return-entry orders.

A positive relationship was found between the distance evacuated and the exact return date. On average, individuals who evacuated farther returned later than respondents who did not evacuate as far. Evacuation studies indicate that a relationship may exist between evacuation distance and risk perception (Sorenson et al. 1987). Individuals who evacuated farther from Hurricane Rita may have perceived the storm to be a greater threat than those who did not evacuate as far. One possible reason individuals who evacuated farther returned later may be related to their risk perception of the hurricane. It is possible that individuals who have a higher perception of risk during the evacuation phase also have a higher perception of risk during the return-entry phase. Another possible explanation is that respondents' likelihood of receiving the all clear message and return-entry plan may have diminished with distance, thus delaying their decision to return home.

A positive relationship was found between distance evacuated and distance returned. Respondents evacuated an average of 197.9 miles while the average return distance was 201.1 miles. This implies that after reaching their destination, respondents from Hurricane Rita generally remained at this location rather than relocating to other areas. This has several implications for emergency managers. If emergency managers are aware of the location of evacuees, they can construct return-entry plans that are customized to where evacuees are located. For example, if an emergency planner knew that the majority of Houston evacuees fled to San Antonio as opposed to Austin, he or she could create a return-entry plan that takes into account heavier traffic along the highways from San Antonio to Houston. In addition, information regarding the relationship between evacuation distance and return distance, as well as information regarding the location of evacuees, may also be used in determining if contra-flow techniques would be beneficial in assisting the return-entry.

The second hypothesis of this research is that viewing a map of the return-entry plan affects return-entry compliance. Based on the results of the survey, no significant relationship was found between viewing the TxDOT return-entry map and one's likelihood to comply with return-entry orders. This finding appears to be contradictory of evacuation research findings, demonstrating that people are more likely to respond to evacuation orders if they view a visual representation of the plan, such as a map, along with the evacuation message (Sorenson et al. 1987). A more significant problem is that return-entry publicity appears to have been ineffective, as the majority of survey respondents indicated that they were unaware of the map. This is despite the fact that TxDOT distributed the map to the public using national and local news media, newspapers, the Internet, and a press conference conducted by Governor Rick Perry. Low compliance rates despite viewing the TxDOT return-entry plan may be associated with low perception of risk. Therefore, low perception and awareness of the risks associated with returning prior to the all-clear message may have resulted in the low compliance rates achieved during the Hurricane Rita return-entry process.

Emergency managers need to improve communication of return-entry plans to evacuees. A study conducted on the 1999 Cyclone Rona in Australia found that including local information or televised maps in the warning message assisted the public in better understanding the warning message (Berry 1999). With an increase in accessibility to communication devices, such as cell phones, wireless Internet capabilities, satellite radio, text messaging, as well as the established news media and newspaper outlets, more effort needs to be placed on making sure the return-entry message is effectively distributed to evacuees. Understanding the source for the all-clear message that evacuees relied on the most may assist emergency managers in targeting the sources that will most effectively distribute the all-clear message to evacuees.

Communication of the return-entry message is more problematic than issuing evacuation orders. In an evacuation, emergency managers know where the threatened population is located, and they can concentrate communication efforts on a very specific area. In the return-entry case, however, evacuees can be distributed over a very large geographic area. This means it may more difficult to target evacuees and communicate with them. One possible solution may be informing a population of how to get information regarding the return-entry plan prior to a disaster. If emergency managers inform people where information regarding the return-entry orders may be obtained (e.g., Internet addresses, telephone hotline numbers, radio stations, new stations), evacuees may be more likely to receive the all-clear message and subsequently follow return-entry orders. In addition, informing evacuees of the risks that are associated with returning home early, such as lack of utilities, transportation hazards, and other hazards directly related to returning to one's residence, need to be communicated as well. Individuals may be more likely to comply with return-entry orders if they are aware of the potential hazards of returning home early. Therefore, better methods of communicating return-

entry plans with evacuees, more effective return-entry orders that emphasize the risks associated with returning home early, and better implementation and management of the return-entry process are necessary in order to increase evacuee compliance rates with return-entry orders.

Emergency managers also need to be realistic in their return-entry planning. This study found that 76.8% of the respondents returned on a date other than their designated return date. The results of this study suggest that the three-day staggered return-entry plan may have been too long and too costly for some evacuees. Return-entry planners may consider making more flexible return-entry plans and ensuring that evacuees receive the return-entry plan and have enough time to plan their return trip. In addition, return-entry plans should ensure that evacuees are able to return to their homes as quickly and as safely as possible.

The correlation analyses identified a number of factors that could improve return-entry communication. Reliance on peers was a common pattern among evacuees in determining when they would return home. In particular, the results indicate that younger people were more likely to rely on peers for information regarding the all-clear message than older people. In addition, individuals having children living with them also relied more heavily on peers as a source for information regarding the all-clear message than others. Finally, individuals who relied more on peers as a source for information in making their decision to return home returned later than respondents who relied less on peers as a source for information. This behavior may have resulted from respondents discussing possible risks associated with returning home early, or that respondents who sought out information regarding the disaster may have been generally more cautious about making the decision of when to return home. In addition, poor communication of the return-entry plan may have caused confusion as to when respondents were allowed to return home, thus respondents who relied on peers as a source of information may have been the ones more actively seeking out information regarding when to return.

Awareness of the heavy reliance on peers for information regarding return-entry may benefit emergency managers in transmitting return-entry messages. Reliance on peers demonstrates that evacuees have the capability to communicate with others and gather information about the return-entry. Knowledge that younger individuals and individuals with children gather information from secondary sources such as peers is indicative of several potential problems. First, because the information from peers is second-hand information, evacuees relying on peers may not get the most accurate information. Second, younger people may rely more on peers for information because they are not aware of where they can obtain information regarding the return-entry. Third, individuals who relied heavily on peers for information regarding the return-entry returned home later than those who did not rely on peers as an information source, although returning later does not necessarily mean that they complied with return-entry orders. For all these reasons, emergency managers must be made aware that many evacuees relied on peers as

their primary source for information rather than official information sources. More efforts need to be placed on informing residents which sources they should consult for information regarding the return-entry prior to an evacuation.

Understanding which demographic characteristics of a population influence compliance with return-entry orders can assist emergency managers in better targeting those people less likely to comply with return-entry orders. We expected to find that the demographics that influence evacuation compliance would be similar to the demographics that influence return-entry compliance. However, unlike some previous evacuation studies (Cutter and Barnes 1982; Perry and Lindell 1997; Fothergill, Maestes, and Darlington 1999), demographic characteristics did not appear to be a good predictor of compliance with return-entry orders.

Some prior evacuation research demonstrates that women are more likely to comply with evacuation orders than men (Bateman and Edwards 2002). Similarly, this return-entry research found that women are more likely than men to comply with return-entry orders and return home on the exact day specified in the return-entry plan than males. However, the overall compliance of both groups is relatively low compared to typical compliance rates with evacuation orders which can reach 90% when the threat is perceived as substantial.

Cutter and Barnes (1982) reported that elderly people are more likely to comply with evacuation orders than are younger people. This return-entry study found that age was not a significant predictor of compliance with return-entry orders. Moreover, earlier research demonstrates that there is no correlation between household income and compliance with evacuation orders (Perry and Lindell 1991). Similar to this conclusion, income had no effect on compliance with return-entry orders. However, there was a significant relationship between education level and the relaxed definition of compliance. Respondents who did not have a college degree complied more with return-entry orders than respondents with college degrees. This finding is contradictory to evacuation studies that conclude evacuees with higher education are more likely to comply with return-entry orders than evacuees of lower education (Edwards 1993; Farley, Barlow, Finkelstein, and Riley 1993). One important distinction between evacuation research and return-entry research is that, when sampling a return-entry population, only those individuals that evacuated can be included in the return-entry study. Hence, return-entry studies by definition focus on a narrow slice of a population with the resources, means, and capabilities to evacuate. Farley et al. (1993) found that individuals with lower education are more likely to believe a warning message. Therefore, the respondents with lower education levels that had the capability to evacuate may have believed the warning message associated with the return-entry plan more than those respondents with higher education levels and thus complied more with the return-entry orders.

Conclusions

This research examined the geographic, communication, and demographic factors that affect return-entry compliance rates using Hurricane Rita 2005 as a case study. Surveys were mailed to residents in a twelve county area around Houston, Galveston, and Beaumont in order to gather information regarding residents' experiences with the evacuation and return-entry. This study's findings, such as variations in geographic compliance, identification of difficulties in risk communication to a diffuse population, and using demographics of a population to predict return-entry compliance, may be useful to emergency managers in the creation and implementation of return-entry orders. In addition to the results of this study, many new questions arose that may lead to further research into the return-entry process.

Future research pertaining to return-entry is necessary in order to increase understanding of all the variables that affect return-entry compliance. Studies concerning how damage and associated threats in a disaster impact area affect compliance rates would be beneficial in improving our understanding of return compliance. Also, more research examining the factors that evacuees' consider when making the decision to return home could aid emergency management efforts. Research on how hurricane intensity affects risk perception and overall return-entry compliance would be beneficial in making better predictions of return-entry compliance rates based on evacuees' perceived damages associated with storm. The study area for this research was spared significant damage from Hurricane Rita; therefore, studying areas impacted by different intensities could better gauge risk perceptions associated with returning home. Furthermore, comparisons between differences in risk perceptions associated with evacuation decision-making processes and return-entry processes may assist emergency managers in identifying which risks need to be emphasized when communicating evacuation and return-entry orders to an at-risk population, in order to best increase compliance of evacuation and return-entry plans.

The field of emergency management can benefit greatly from return-entry research. History has demonstrated that the mass movement of a population back home following a disaster can be problematic. As Stallings (1990) notes, more attention must be devoted to return-entry research. The return-entry associated with Hurricane Rita demonstrates that more research needs to be conducted on the factors that affect compliance rates. More effective means of distributing the all-clear message and return-entry orders need to be created and implemented in order to maximize compliance rates.

Gathering information regarding the return-entry proved to be a challenging endeavor. Unlike evacuation studies in which surveys are mailed out to residences in disaster-stricken areas and the researcher is able to determine who evacuated and who did not, return-entry analyses can only be conducted by using surveys in which the respondents evacuated from the disaster. This problem greatly reduces the number of

survey responses that can be used in the analyses. Useable response rates for return-entry surveys may increase if the researcher knows, prior to conducting the surveys, if the survey recipient did evacuate from a disaster. Conducting return-entry studies simultaneously with evacuation studies may make return-entry research less costly to researchers. Other challenges exist in gathering return-entry information. For example, the timing of a population's return following a disaster may affect when surveys can be conducted. In areas that have sustained significant disaster damage, gathering information about the return may be delayed until residents have been able to return to their homes.

The topic of return-entry has been neglected in the scientific literature. The lack of research on this topic provides a great opportunity for researchers to make advancements in this area of emergency management. Research on return-entry not only benefits the academic community, but implementation of the research can aid millions of evacuees in achieving a safe and efficient return home following a disaster.

Acknowledgements

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