

INDIVIDUAL AND HOUSEHOLD RESPONSE TO HURRICANE HUGO:

PROGRESS REPORT

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## INTRODUCTION

On September 21, 1989, six hours of the most destructive force South Carolina has experienced since the Charleston earthquake of 1886 smashed into the state with 135 mile per hour winds and a 12-20 foot surge of water. Hurricane Hugo left in its wake extensive damage region wide, estimated at well over \$4 billion in South Carolina alone. Loss of life was minimal for a hurricane of this magnitude, at 26 casualties in South Carolina and 39 throughout the region. South Carolina citizens had days to prepare and a full 24 hours to evacuate threatened areas. News reports suggest that Charleston residents took warnings seriously and readily evacuated threatened areas.

Prior studies of natural disasters have revealed several factors which tend to be related to disaster preparedness and warning response. A number of researchers have found, for example, that prior disaster experience is an important factor differentiating those who take protective action and those who do not (e.g., Demerath, 1957; Fritz, 1961; Moore et al., 1963). Studies have also found that warning response is related to the social context in which one is located when the warning message is heard. Specifically, adaptive behavior is more likely when with family than with peer groups or other contexts (Mack and Baker, 1961); and that evacuation is almost always done in the family unit (Drabek and Boggs, 1968; Drabek and Stephenson, 1971; Moore et al., 1963). In addition, income and educational levels, age and sex have all been found to be related to the likelihood of evacuation (Friedsam, 1962; Mack and Baker, 1961; Moore et al., 1963). Finally, there has been an extended literature on the importance of disaster subcultures in facilitating appropriate preparedness and response (Moore, 1964; Weller and Wenger, 1972; Wenger, 1978). A major component of disaster subcultures presumed to facilitate preparedness and response is the increased level of knowledge on the part of individuals in these communities. Indeed, Wenger et al. (1985) found that while individuals in disaster subculture communities maintained a belief in many of the "myths" regarding typical behavior in disaster (widespread panic and looting, etc.), these individuals were indeed much more knowledgeable regarding appropriate instrumental action that should be taken preparing for and responding to disasters than were a sample of persons from a non-disaster subculture community. Two caveats are in order here, however. First, there is some question as to how effectively knowledge is translated into appropriate action (Perry and Lindell, 1986). Second, the kind of knowledge accumulated for a response to one particular disaster agent may not necessarily be transferrable to other agent types. Wenger (1978) suggests that knowledge gained from experience in one type of disaster may actually thwart response if an individual or community is confronted with a disaster which falls outside of their repertoire of experience. Hence, the question of how effectively knowledge regarding appropriate response activities to one type

of disaster can be applied to other disaster agents calls for continued empirical examination.

## PURPOSE OF THIS STUDY

The primary goal of this study is to examine how effectively earthquake education in the Charleston, South Carolina area transferred to appropriate preparedness activities for Hurricane Hugo. In 1983, at the request of the Federal Emergency Management Agency, the Earthquake Education Center was established at Baptist College at Charleston. Located between Charleston and the smaller community of Summerville, the EEC is situated in the immediate environment of a rather active fault line which sent noticeable shock waves throughout the area in 1988 and 1989. Since 1986, over 100 earthquake education programs were conducted by the EEC with representatives of various organizations throughout the greater Charleston area. These programs were highly variable in the amount of information conveyed. There were a small number of highly intensive one and two day workshops conducted for educators, firefighters, ham radio operators and some civic organizations. There were also several in-service trainings for teachers and nurses which lasted from two to four hours. Finally, numerous presentations were made to civic groups and churches on what to do in case of an earthquake. It would be expected, of course, that preparedness activities will be more strongly affected by the intensive workshops than in-service trainings or program presentations.

This information was specifically oriented to earthquake preparedness activities. While there is certainly overlap between the kinds of activities that these two types of agents require, earthquakes are substantially different from hurricanes in several respects. Hurricanes provide a long warning period; earthquakes provide almost no time. Many of the property protection measures such as taping windows, securing lawn furniture, etc. have little relevance for an earthquake. Moreover, it is not at all certain how long people remember information that they have learned. Finally, it is not clear as to how effectively hazards awareness and knowledge is translated into appropriate action (Perry and Lindell, 1986).

The purpose of this research is to examine how effectively earthquake education is ultimately manifest in appropriate hurricane preparedness and response activities. More specifically, we seek to examine whether those individuals who participated in the earthquake education program during the previous year exhibited more appropriate responses to the hurricane threat than did a control group of residents who did not participate in the education program. Hypothesizing that the earthquake educated group will score higher on hurricane response assumes three intervening conditions which cannot be adequately measured post hoc: (1) knowledge acquired in the earthquake education program is transferrable to hurricane situations; (2)

that this information was retained and remembered at the time Hugo struck; and (3) that response behavior was in fact a function of knowledge. While a longitudinal design with baseline data of prior knowledge is obviously a superior approach, this data does not exist. We will, however, be controlling for a number of pertinent variables such as prior disaster education, as well as pertinent demographic information such as education and income which has been shown in the literature to account for differences in response behavior.

### Focus of This Paper

The fieldwork for this study was completed in late March, 1990. Consequently, we do not have definitive data to report. The focus of this paper, rather, is to acquaint the reader with the procedures employed in the study, and to provide some very preliminary findings which may be suggestive of the impact of education on levels of preparedness among population groups. These findings are not conclusive, however, and should be regarded only as initial indicators of some of the factors associated with emergency preparedness.

### METHODOLOGY

The data consists of telephone interviews with a sample of participants in the earthquake education programs, and a control sample of residents in the greater Charleston area who did not participate in these programs. Supplemental data were obtained through more extensive phone interviews with a smaller subsample of persons who participated in the phone survey.

### The Samples

The samples drawn represent two distinct populations. The first population consists of those individuals who participated in the Earthquake Education Center programs. All participants whose phone numbers could be verified were included in this sample. The final sample consists of 198 respondents, which, excluding bad (non-working or changed) numbers and unsuccessful attempts because the appropriate respondent would not be available during the fieldwork period, yielded a response rate of 73.1 percent. The specific type of educational program was further specified for future analyses. Broadly, we distinguished between those who participated in one or two day workshops, those who received in-service training sessions, and those who heard short program presentations.

The second control sample consists of residents of the Greater Charleston area residing in Charleston, Berkeley and Dorchester counties. The sample was selected by using the residential section of the white pages of area phone directories using the following procedure. First, a random numbers table was used to select a starting point for a systematic draw. Upon locating the starting point, every nth number was drawn for a total draw of 1500 (three times the projected final sample). In

order to insure an equal chance that households without listed numbers would be included, a "plus one" method was used whereby one digit was added to each number drawn from the phone directory. Hence, if the number drawn was 844-2820, we dialed 844-2821. This technique has been found to increase the efficiency (proportion of good numbers to total numbers dialed) over random digit dialing by as much as 30 percent (Landon and Banks, 1977), while at the same time guarantees equal chance for unlisted numbers. In addition, in order to insure random distribution for age and sex within households, we asked to speak with the adult in the household who last had a birthday. This was necessary because, in addition to the household level data reported here, we asked a series of questions regarding stress response to the hurricane. The response rate for the control sample, after excluding business and non-working numbers, was 59.1 percent. This is slightly less than that for the workshop sample, but still quite respectable. This yielded a total of 520 interviews. Response rates for both samples were enhanced by (1) making at least six call-backs for unanswered or busy numbers until the sample quota was reached; (2) carefully following up on call-backs where a respondent was temporarily unavailable. Care was taken to make these call-backs within 15 minutes either way of the suggested time; and (3) making one initial attempt at first responder refusals (refusals by the selected respondent who last had a birthday were not called back). When calling back refusals, care was taken to stagger the time to hopefully reach a party other than the original first responder, and when possible to make the call-back with a different sex interviewer than the original. This strategy resulted in interviews with nearly 30 percent of first refusals.

Follow-up interviews were conducted with 20 percent subsamples of both workshop and general population samples. These subsamples serve two important functions. First, they provide a valuable reliability check as they included virtually all of the items from the original telephone interview. Second, some additional open-ended questions were included, allowing us to explore some critical areas in greater detail than in the more structured interviews. Due to the preliminary nature of this report, information from these interviews is not included here.

### The Instruments

The interviews for the workshop and general population samples are identical except that the workshop samples have a series of three questions regarding the workshop. In addition, the questionnaires addressed: (1) specific actions that the respondent's household did or did not take in preparedness for the hurricane; (2) when, how and and who the respondent was with when the hurricane warning was first heard; (3) sources of information regarding hurricanes and other natural disasters (besides the workshop); (4) the nature of prior disaster experience; (5) a series of items related to stress responses; and (6) standard demographic information, including age, sex, ethnicity, education, income level, and occupation. In addition,

because we were interested in how households prepared for and responded to Hugo, respondents were asked whether anyone in their household had prior disaster experience or had participated in any disaster education programs; the highest education represented in the household; household income level; and the occupation of the primary wage earner in the family. These are "forced choice" questions, using pre-coded categories to facilitate data entry. The interviews took, on average, about twelve minutes to complete. The follow-up interviews replicated the phone interviews, but also asked the respondent to elaborate on some items.

### Data Collection

Training interviewers. The phone interviews were conducted by undergraduate students under the direct supervision of one of the Co-PI's. Hence, it was necessary to spend several hours training these interviewers as to how to introduce the project, how to probe for specific information, etc. Students were given a three hour training session, which involved both didactic and role playing exercises. In addition, each student was responsible for conducting one pre-test, which also served as a valuable training technique.

Pretesting the instruments. The interview instruments were pre-tested on several individuals in the Charleston area who were informed of the purpose of the project and their role in it. The pre-tests served two important functions: (1) they provided a valuable training mechanism for students conducting the phone interviews; and (2) they identified several confusing questions. We were also concerned about the length of the interview, not wanting them to exceed 15 minutes. This turned out not to be a problem.

Phone interviews. The phone interviews were conducted by trained undergraduate students under the direct supervision of the Co-PI's. A total of 17 students participated in the data collection process, which took place over a one month period, from late February to late March. A phone bank was established consisting of six phones located in the same room. The interviews were conducted between the hours of 4 pm and 10 pm.

Data entry and analysis. Data have been entered directly from the questionnaires onto PC's. Most of the data entry and analysis is being conducted at Baptist College under the direction of one of the Co-PI's, Susan Kelley. Analyses of variance and possibly some logistic techniques are planned.

### PRELIMINARY FINDINGS

Because of the early stage of data analysis, findings to date are restricted to frequency distributions and cross tabulations of select variables. These preliminary analyses do reveal some patterns calling for closer scrutiny. First,

however, let us examine some of the demographic features of the samples.

Table 1 reports the demographic distributions of the samples. Two levels of interpretation are required for Table 1. First, comparison of the workshop sample with the general (control) sample reveals that the workshop sample is almost exclusively white (94.4 percent) and has a higher representation of females (76.8 percent compared with 62.2 percent of the general sample). Significantly, the workshop sample is much more highly educated than the general sample (79.3 percent with college degree or higher, compared with 29.3 percent of the general sample), and substantially more wealthy. The workshop sample is also slightly older (median age 42 compared to 39) and more likely to be married (84.3 percent compared to 65.2 percent). These differences are not surprising. It is typically higher educated, mid to high income range persons who are involved in the kind of organizations the Earthquake Education Center has reached. These differences do, however, require caution in the interpretation of any differences found between the two samples. Perhaps even more importantly, it is suggested that disaster education initiatives such as the Earthquake Education Center need to be more consciously targeting lower income, minority families, as well as younger and single individuals who may not be reached through traditional channels.

Second, because we are interested in how workshop participants compare with the general population, it is important to know how representative the general (control) sample is of the population we are studying. Compared with 1984 census estimates our sample overrepresents whites by about 10 percent (79.1 percent in our sample compared with 68.4 percent in the general population). We also have a higher percentage of persons with at least 16 years of education, about double that in the general population (29.3 percent compared with 14.6 percent). Females are also overrepresented as are households with higher incomes. We were successful in approximating the geographical distribution of the population over the three county area.

While we wish that our sample more closely represented the population of our study area, these divergences do not appear to be exceptional among studies using the phone survey technique. Lower income and minority populations are less likely to have phones. Moreover, using the "plus one" method we avoided the problem of omitting unlisted numbers from our sampling pool, the net result being an overrepresentation of those at the upper end of the income scale. Furthermore, those with higher education tend to be more responsive to phone surveys such as this. We do not have an explanation for the heavy overrepresentation of females. We tried to randomize household respondents by asking to speak with the person who last had a birthday. This should have resulted in approximately equal representation of males and females. Because our preparedness measures use households as the unit of analysis, this overrepresentation is not particularly

Table 1: Demographic Characteristics of Samples

	Total Sample (N=709)		Workshop (N=198)		General (N=511)	
	N	%	N	%	N	%
Median Age	40		42		39	
<u>Ethnicity</u>						
White	591	83.4	187	94.4	404	79.1
Black	102	14.4	9	4.5	93	18.2
Hispanic	3	.4	-	-	3	.6
Oriental	7	1.0	-	-	7	1.4
Native Amer.	6	.8	2	1.0	4	.8
<u>Education</u>						
Less than HS	73	10.3	1	.5	72	14.1
HS or GED	155	21.9	18	9.1	137	26.8
Some College	174	24.5	22	11.2	152	29.7
Col. Degree	137	19.3	53	26.8	84	16.4
Grad Degree	170	24.0	104	52.5	66	12.9
<u>Marital Status</u>						
Single	105	14.8	16	8.1	89	17.4
Married	500	70.5	167	84.3	333	65.2
Div/Sep	63	8.9	12	6.1	51	10.0
Widowed	41	5.8	3	1.5	38	7.4
<u>County of Residence</u>						
Charleston	376	53.0	70	35.4	306	59.9
Berkeley	189	26.7	68	34.3	121	23.7
Dorchester	143	20.2	60	30.3	83	16.2
(No Data)	(1)	(.1)	-	-	(1)	(.2)
<u>Household Income</u>						
LT \$15,000	81	11.4	2	1.0	79	15.5
15-25,000	132	18.6	16	8.1	116	22.7
25-35,000	150	21.2	42	21.2	108	21.1
35-50,000	167	23.6	67	33.8	100	19.6
50-100,000	138	19.5	64	32.3	74	14.5
GT 100,000	12	1.7	-	-	12	2.3
(No Response)	(29)	(4.1)	(7)	(3.5)	(22)	(4.3)
<u>Sex</u>						
Male	235	33.1	46	23.2	189	37.0
Female	470	66.3	152	76.8	318	62.2
(No Data)	(4)	(.6)	-	-	(4)	(.8)



problematic here. It is more problematic for assessing individual level response, such as stress reactions, which we shall be reporting at a later time.

### Levels of Preparedness

A "preparedness index" consisting of 12 items was constructed in an additive fashion. These variables consisted of "yes-no" responses to questions regarding specific preparedness activities in which the respondent or anyone in their household may have engaged. The twelve items constituting the preparedness index are listed in Appendix A. These 12 items were simply summed. Those answering "yes" to 9 or more of these questions were coded as being "high" in preparedness; those answering "yes" to 5-8 were coded as "moderate"; and those with 4 or less "yes" responses were coded as "low." Table 2 reports the differences between the workshop sample and the general sample on the preparedness index.

Table 2: Preparedness Index by Sample

Level of Preparedness	Workshop Sample (N=184)		General Sample (N=450)	
	N	%	N	%
Low	3	1.6	9	2.0
Moderate	35	19.0	134	29.8
High	148	80.4	307	68.2

Chi Square = 8.02  
p= <.05

Table 2 reveals that there are substantial and significant differences between the two samples. The workshop sample demonstrates a much higher level of preparedness, significant at the .05 level. Because the workshop sample is higher educated and at the higher end of the socio-economic spectrum, we have also controlled for education and household income (not shown). When these controls are introduced, any relationship between the preparedness index and sample disappears. Hence, it would appear that, preliminarily at least, the differences reported above are spurious, and that preparedness is more a function of socio-economic status than disaster education per se. Stated differently, disaster education programs may attract people who are already more prone to preparedness behavior.

This line of reasoning also suggests that those who have participated in the earthquake education programs have probably availed themselves of other disaster education opportunities, including community workshops, in-service training, etc. Hence, we examined the differences between the workshop and general

samples, controlling for whether or not these individuals had participated in any disaster education programs other than those provided by the Earthquake Education Center. These results are reported in Table 3.

Table 3: Preparedness Index by Sample, Controlling for Preparedness Education Index

Level of Preparedness	No Other Preparedness Education (N=106)				Other Preparedness Education (N=471)			
	Workshop		General		Workshop		General	
	N	%	N	%	N	%	N	%
Low	0	0.0	6	6.1	3	2.0	7	2.2
Moderate	0	0.0	45	45.9	33	21.9	94	29.4
High	8	100.0	47	48.0	115	76.2	219	68.4

Chi Square = 8.02  
p= <.05

Chi Square=3.03  
p= >.05

This analysis reveals that, as predicted, among those who had participated in other disaster education programs, there were no significant differences between the workshop and general samples. Among those who had not participated in any other disaster education program, however, the workshop sample was much more likely to score high on the preparedness index (100 percent compared with 45.6 percent). Importantly, however, there were but eight individuals in the workshop sample who had never participated in any other disaster education program. These data suggest that workshop participants were not receiving their information exclusively from the Earthquake Education Center. Moreover, those in the general sample who had participated in other disaster education opportunities were significantly more likely to be highly prepared than those who had not ( $p < .001$ , not shown). Hence, the data do suggest that disaster education is important to preparedness activities, regardless of the source of this education. Importantly, however, in light of the findings controlling for education and income, it would appear that those who need this education the most are not receiving it.

#### Evacuation

The most appropriate response to a disaster the magnitude of Hurricane Hugo is to evacuate, particularly if a household is located directly in the path of the hurricane. Over 40 percent of our respondents evacuated their homes in response to the impending threat (39.4 percent of the workshop sample; 46.6 percent of the general sample). Evacuees travelled a median of 90 miles--many to Columbia, others to Atlanta, Charlotte and

other points west and north. Ironically, only 36.9 percent of those who evacuated succeeded in evacuating out of the path of the hurricane. No one had predicted that the hurricane would maintain such force for such a long distance inland.

Table 4: Evacuation Response by Evacuation Recommendation

Evacuate?	No Evacuation Recommended		Evacuation Strongly Suggested		Evacuation Mandatory	
	N	%	N	%	N	%
Yes	72	19.7	142	63.7	93	88.6
No	294	80.3	81	36.3	12	11.4

Chi Square = 207.36  
 p = <.001

Table 4 reveals that response to official evacuation recommendations was very positive. Over 71 percent of those households who lived in areas with mandatory or strongly suggested evacuation did indeed evacuate. Nearly 90 percent of those in mandatory evacuation areas responded to these warnings.

#### SUMMARY AND IMPLICATIONS FOR FUTURE ANALYSIS

The data presented here suggest that disaster education does have an impact on preparedness activities, although the earthquake education workshops do not appear to have a specific effect on preparedness when controlling for education and household income level. Moreover, because only eight workshop participants had never participated in any other disaster education forum, it is difficult to discern how important the EEC workshops were, independent of other types of disaster education.

One of the positive findings of this study was the responsiveness of the local population to official recommendations to evacuate threatened areas. Particularly those households on the barrier islands and other areas of direct hit where evacuation was mandatory, evacuation response was quite impressive. Unfortunately, many of these individuals still found themselves assaulted by the hurricane after they arrived at their destinations.

These findings are very preliminary, and need to be interpreted cautiously. They do, however, suggest further areas of analysis which we shall be pursuing. First, the workshop sample is comprised of individuals participating in a variety of programs, ranging from intense one and two day workshops to simple program presentations at civic club luncheons. Clearly, those participating in intensive workshops should exhibit stronger preparedness than those attending civic club programs.

Similarly, other disaster education ranges from intense workshops to reading brochures. Future analyses will differentiate levels of intensity of disaster education.

There are, in addition, many variables which have been shown to be related to disaster preparedness and response which we have not included in this preliminary analysis. Prior disaster experience, the presence of other family members, and (in the case of evacuation) race and source of warning information have all been linked to preparedness activities.

Finally, while one of the goals of this research is to examine the transference of knowledge from an earthquake education program to hurricane preparedness behavior, there is a more general theoretical issue here as well. Namely, how well does disaster education generally result in appropriate preparedness activity? Indeed, this is logically the first question we should be asking. Fortunately, we do have individual and household data regarding prior disaster education that our respondents may have experienced. Thus, an important focus of future research will address the impact of prior disaster education generally on preparedness behavior.

There is at least one policy implication which emerges from these preliminary findings. Disaster education needs to be consciously targeted to lower income, minority populations. Current strategies do not reach these populations. Program presentations to civic clubs, in-service workshops for teachers and nurses, and intensive workshops for teachers, ham radio operators and the like, all target, in effect, white middle class professionals. These individuals also tend to be more highly educated than the general population and probably more generally knowledgeable of what to do in preparation for a disaster. Lower income, minority populations, which also tend to be less educated, could benefit substantially from programs such as those offered by EEC. Given the findings presented here, it is suggested that disaster education initiatives will make a much stronger impact if they target these otherwise overlooked segments of the population.

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#### APPENDIX A:

#### ITEMS COMPRISING THE PREPAREDNESS INDEX

1. Did you have a battery powered radio?
2. Did you have a first aid kit?
3. Had you established a safe spot in your home?
4. Had you established an evacuation route?
5. Did you have extra batteries on hand?
6. Did you have adequate water stored?
7. Did you cut off the main electrical switch?
8. Did you unplug electrical appliances?
9. Did you have a supply of non-perishable food?
10. Did you put tape or plywood over your windows?
11. Did you have a full tank of gas in your car?
12. Did you have a working flashlight?

The number of "yes" responses to these questions were simply summed. For purposes of this paper, those answering "yes" to 9 or more of these questions were coded as "high preparedness." Those answering "yes" to 5-8 questions were coded as "moderate preparedness." Those answering "yes" to less than 5 questions were coded as "low preparedness."