INDIVIDUAL AND HOUSEHOLD RESPONSE TO HURRICANE HUGO

Final Report

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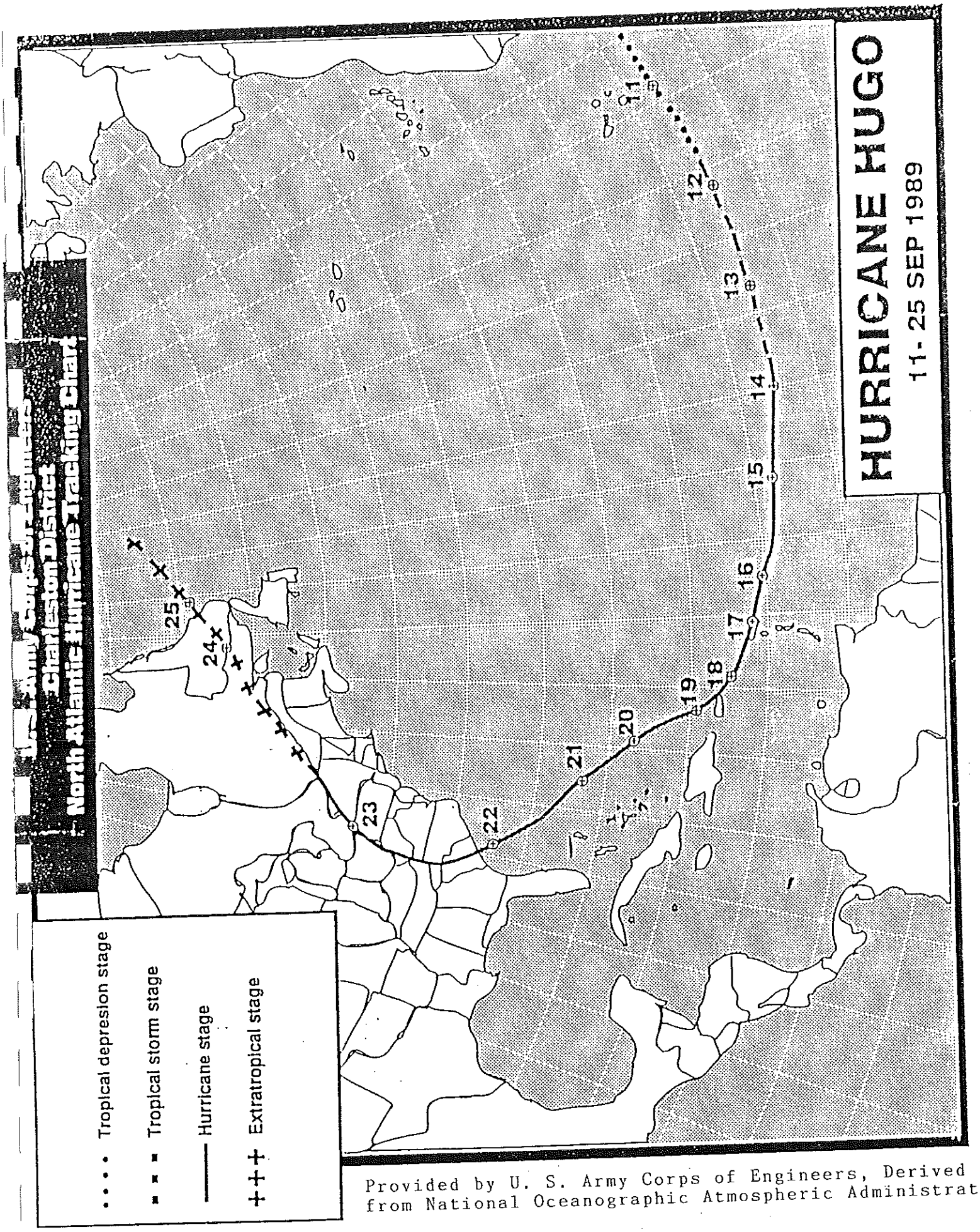
THE RESEARCH PROBLEM

Hurricane Hugo: South Carolina's Deadly Storm

At about midnight Friday, September 22, 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. The storm had been developing for nearly two weeks, originating southeast of the Cape Verde Islands just off the coast of Africa (see Figure 1-1). The storm then moved across the Atlantic, and by Wednesday, September 13th it had been upgraded to hurricane status. It struck the Leeward Islands, the Virgin Islands and Puerto Rico before making landfall on the United States coast. By the time Hugo reached the Virgin Islands it was packing winds of 150 miles per hour, diminishing to 138 miles per hour before passing directly over Puerto Rico on September 18th. These Caribbean islands suffered the worst of Hugo, with nearly 50 people killed and hundreds more injured.

Already by Monday afternoon, September 18, the Charleston County Emergency Management Agency had placed all departments on condition four alert, preparing for a possible hit and developing scenarios for coordinated response. By Tuesday, September 19, it was known that Hurricane Hugo would hit the U. S. coast and a hurricane watch was issued at 6 pm on September 20 for the eastern coast between St. Augustine, Florida to Cape Hatteras, North Carolina. By 6 o'clock the next morning the watch had been upgraded to a warning for coastal

Figure 1-1: Tracking Hurricane Hugo



Provided by U. S. Army Corps of Engineers, Derived from National Oceanographic Atmospheric Administration

areas between Fernandina Beach, Florida and Cape Lookout, North Carolina. This provided residents in these areas eighteen hours to evaucuate threatened areas, although many had been leaving before the warnings were issued. Evacuation orders for Folly Beach, Sullivans Island and the Isle of Palms, barrier islands off the coast around Charleston, were given Thursday morning. Later that day, residents of low lying areas in Charleston were also ordered to evacuate, although Charleston proper was not under mandatory evacuation.

The evacuation was, by all accounts, a success. Local newspapers reported that by evening the barrier islands were ghost towns as residents packed Interstate 26, bound for Columbia and points beyond. It has been estimated that evacuation rates ranged between 62 percent in Charleston and 96 percent on Sullivan's Island and the Isle of Palms (Post, Buckley, Schub & Jernigan, 1990). These figures approximate what was found in the present survey of the three county area consisting of Charleston, Berkeley and Dorchester Counties. The Federal Emergency Management Agency (1989) estimates that a total of about 264,500 persons evacuated from an eight county area. The timing of this evacuation was also impressive. Residents did not, for the most part, wait until the last minute to leave. According to the Post et al. (1990) report, by the time the warning was issued and the governor ordered evacuation of the barrier islands at 6 am Thursday morning, 50 percent of the evacuees indicated that they had already left their homes. By noon, between 75 and 90 percent had left, and by 4 pm virtually all of the evacuees had already left a full 6 hours before the hurricane reached landfall.

This overwhelming response to the hurricane threat played an important part in the small number of deaths experienced in the hurricane. Death tolls vary, largely because it is difficult to determine how strongly the hurricane is implicated in all but direct deaths. The coroner of Charleston County reported a total of 13 direct deaths in the county, but that there were an additional 15-20 storm related deaths. Berkeley County reported only two direct

deaths and eight additional storm related deaths. No one in Dorchester County was killed in the hurricane, although there were four later deaths that might be considered storm-related according to Ken Harrell, Emergency Management Director. State-wide, 28 direct deaths were reported, although as many as 56 storm related deaths have been estimated.

While Hugo's toll on human life was minimal for a storm of this magnitude, its economic impact was widespread and profound. Statewide, there was an estimated $5 billion in property damage. Some 23,000 homes were destroyed or seriously damaged in the state. The Department of Education estimates over $55 million in damages to South Carolina school systems, and research conducted by Clemson University claims that the agricultural industry suffered damages in excess of $322 million (Federal Emergency Management Agency, 1989). Over 10,000 miles of secondary roads were damaged. The forest industry was particularly hard hit, losing over 6.7 billion board feet of lumber valued at $1.04 billion. Nearly 4.5 million acres of timber was destroyed, representing more than 36 percent of South Carolina's total woodland. Dennis Clark, Emergency Management Director for Charleston County remarked that timber damage in South Carolina was 100 times greater than that caused by the eruption of Mt. St. Helens. These monetary damages represent only part of the economic costs. An estimated 64,000 people were left homeless throughout the state, and between 200,000 and 300,000 people found themselves without jobs.

The trident area consisting of Berkeley, Charleston and Dorchester counties took the brunt of the property damages with estimated losses as much as $3 billion and $455 million in timber loss. Most of this was in the Marion National Forest where nearly a billion board feet were destroyed. Graham (1990a) points out that in the form of a 1x12 inch board, this timber loss alone would be enough to circle the globe seven times. An estimated 60,000 persons were left jobless in the tri-county area. In Charleston alone, nearly 1,000 homes received extensive structural damage, although homes in the historic district received relatively little damage.

The barrier islands were even harder hit. Reportedly, over 60 percent of the homes on the Isle of Palms and Sullivans Island were destroyed; over 80 percent of the homes on the island of Folly Beach were devastated. The small fishing town of McClellanville in the northern part of Charleston County was almost totally devastated.

Berkeley and Dorchester Counties received less total damage due primarily to the fact that they are less densely populated. Damage estimates in Berkeley County were set at between $300 and $400 million dollars. This represents significant damage to over half of the homes in that county, leaving more than 20,000 people homeless. Moreover, this figure does not include over $200 million in timber damage to the county. Dorchester County received an estimated $750 million in damages, destroying or damaging over 6,200 homes.

The impact of Hurricane Hugo was felt far beyond the Charleston area. The hurricane churned its way through South Carolina, North Carolina and even into the southernmost portion of West Virginia before it finally subsided. In addition to the $5 billion in damages that it wreaked on South Carolina, Hugo caused an estimated $1 billion in damages in North Carolina, and in Virginia, $50 million. A total of 13 hurricane related deaths were reported in these two states.

The Focus of this Study

This study investigated how individuals and households in the Charleston, South Carolina area prepared for and responded to this, perhaps the most devastating hurricane to assault the United States mainland in the twentieth century. Each year millions of dollars are spent by hundreds of organizations throughout the country on educational programs and materials designed to facilitate public preparedness for natural disasters of all types. Yet, we know

relatively little about how effective these efforts are in terms of protective and/or adaptive behaviors that people take in preparation for and response to disasters. Specifically, we are interested in: (1) whether participation in disaster education programs enhances appropriate preparedness activities; and (2) whether participation in these educational programs appreciably reduces the level of stress experienced by disaster victims.

Hurricane Hugo provides something of a natural laboratory to examine the effectiveness of these programs. This was a storm of unequaled proportion on the eastern seaboard. While South Carolina has suffered hurricanes before, none have been of this intensity or scope. Moreover, the most recent hurricane even approaching the destruction of Hugo was Hurricane Gracie, some thirty years earlier in 1959. There is not, in short, a broad base of experience with hurricanes which might otherwise mask whatever independent effect formal disaster education programs might have. Furthermore, since 1983 the Earthquake Education Center located at Charleston Southern University, formerly Baptist College at Charleston, has been conducting various disaster education programs throughout the Charleston area as well as in many communities throughout South Carolina. Hence, there is an identifiable population in the Charleston area who have participated in formal disaster education programs. These programs have specifically focused on earthquake preparedness. Our data will thus not permit us to assess the effectiveness of hurricane specific (or other disaster specific) programs for that focal agent type. There is however, an important advantage to examining the contribution of a disaster education that does not focus on the specific agent type in question. Many areas of the country are subject to more than one agent type, as is the case with Charleston which is vulnerable to both hurricanes and earthquakes. Hence, it may often be necessary to apply principles learned for one particular agent to other disaster scenarios. Examining the impact of earthquake education on hurricane preparedness and response therefore allows us to make what is perhaps

a more realistic assessment of the value of formal disaster education on adaptive behavioral response.

Disaster Preparedness

Preparedness is a central concept used by disaster researchers and practitioners to refer to a series of activities which should directly or indirectly mitigate loss of life and property in a disaster. Having a family disaster plan or establishing an evacuation route are examples of preparatory activities in which families or individuals might engage. Research assessing the extent to which individuals and households engage in pre-disaster planning reveals varying levels of preparedness. Hodler (1982), for example, found that 81 percent of the sample he studied had a family disaster plan and nearly all these individuals responded according to their plan when a tornado struck Kalamazoo, Michigan. Perry and Lindell (1986) found slightly less, but still substantial levels of household planning for the Mt. St. Helens volcano eruption with 69.9 and 48.8 percent of the individuals in their sample indicating high levels of personal planning activity. Bourque et al. (1973), by contrast, found very few people who had made any preparations prior to the 1971 California earthquake. Similarly, Worth and McLuckie (1977) found that only three percent of their study population had developed any family disaster plans for Colorado floods in 1965.

Planning activities are usually distinguished from adaptive response behavior which comprises protective behaviors in which individuals and households engage as a result of knowing that a disaster is impending. Hence, populations directly threatened with a hurricane will evacuate from their homes, potential tornado victims will seek protection in their basement or other secure place in their household, etc. Several decades of social science research have addressed several factors which tend to be related to adaptive response behavior.

This research has found, for example, that prior disaster experience is an important factor differentiating those who take appropriate protective action from those who do not (e.g., Demerath, 1957; Fritz, 1961; Moore et al., 1963; Sorensen, 1983; Sorensen & White, 1980). These findings have been confirmed by Perry et al. (1981) and Hutton (1976) in studies of flood evacuation. Studies have also found that adaptive response is greatly enhanced when warning messages are from a credible source (Mileti, 1975; Perry and Greene, 1983). The social context in which one is located when the warning message is heard also affects the likelihood of appropriate mitigative response. Specifically, adaptive behavior is more likely when with family than with peer groups or other contexts (Mack and Baker, 1961; Perry and Greene, 1982); and evacuation is almost always done in the family unit (Drabek, 1983; 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).

Planning and response activities are, of course, closely linked, and it is almost axiomatic that higher levels of planning will result in more appropriate response activities. Indeed, the one factor that Perry and his colleagues have consistently found to be related to favorable response to impending disaster is prior planning and preparedness activities on the part of individuals and households (Perry, 1979; Perry and Greene, 1982, 1983; Perry, Lindell & Greene 1981).

> Studies of evacuation behavior often overlook the fact that in order to effectively clear an area, residents must either have prior knowledge of some adaptive plan or develop or learn of such a plan as part of the warning process. The problem of families <u>not</u> evacuating, or mistakenly evacuating to an even more dangerous location, when evacuation routes are

> either not well known or not publicized has been widely documented. Therefore, the possession of an adaptive plan, at a minimum some idea regarding a route of egress and safe destination, is necessary for an individual to comply with an evacuation warning (Perry and Greene, 1982: 319-320; emphasis in the original).

In point of fact, of course, both planning and response activities are intended to reduce life and property loss. While this is an important conceptual distinction, usually temporally related to the onset of a disaster (planning activities taking place sometime prior to the direct threat of a disaster), both types of activites are mitigative in nature. People who engage in these activities are behaving in an adaptive manner to reduce the threat to life and property. Hence, planning and adaptive response are regarded as but separate indices of preparedness.

The impact of disaster education. Our concern in this study is the extent to which disaster education positively affects preparedness behavior. There is a noted paucity of literature on this subject. Saarinen (1982:8) suggests that "except for communication research, the proposition that education may lead to more adaptive behavior has rarely been investigated." The literature cited earlier which finds a positive relationship between disaster experience and adaptive response provides some positive preliminary evidence, as experience is, in fact, a type of educational experience. There has, in addition, been an extended literature on the importance of disaster subcultures in facilitating appropriate preparedness and response behavior (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.

These studies raise important questions which we attempt to address in the present study. Prior disaster experience, particularly when it is of a repeated nature such as that found in disaster subcultures, certainly acts of a teacher of sorts in the school of hard knocks. This is perhaps the best school. But is is possible to learn the same lessons in a less costly manner, through participation in formal disaster education programs? Ideally, disaster education should provide participants greater knowledge of the threat itself, and of appropriate protective actions that can be taken. This knowledge should, in turn, result in appropriate adaptive behavior.

The impact of disaster education on adaptive behavior is, however, less clear than this ideal scenario would suggest. While there is some evidence to suggest that exposure to educational materials may increase knowledge and awareness of the threat (McKay, 1984; Ruch, 1978; Ruch & Christensen, 1980; Waterstone, 1978), other research has questioned how important disaster education programs are in informing one's knowledge and beliefs about disasters. Roder (1961), for example, found that the distribution of flood plain maps had no effect on citizen awareness of flood plain zones in Topeka, Kansas. Likewise, Haas and Trainer (1974) found no significant differences in knowledge regarding tsunamis following an educational program. Furthermore, Sorensen (1983) found that most of his respondents did not regard educational information obtained through formal channels such as schools or brochures as very useful. Wenger, et al. (1980) report that of those respondents who had received information from public education programs, only about one-third mentioned them as a source of information.

Moreover, even if disaster education programs are successful in enhancing knowledge and awareness, we can by no means assume that this knowledge will be translated into

appropriate behavior. Social scientists have long recognized this disparity between cognitive and behavioral manifestations. That is, people do not always do what they say they will do. As early as 1934, LaPeirre discovered that people who expressed racially prejudiced attitudes didn't necessarily discriminate behaviorally and vice versa. These findings were later confirmed by others (e.g., Deutscher, 1966). Similar discrepencies were found with regard to cheating (Freeman and Ataov, 1960) and drinking behavior (Warriner, 1958). More recently, O'Riordan (1976) found very little relationship between environmental attitudes and behavior. Hence, we cannot presume that simply because people know what to do in a disaster that they will necessarily act on the basis of that knowledge.

There is some evidence, in fact, to suggest that they may. Drabek's (1986) exhaustive review has presented findings which suggest that the more information people have available to them, the greater will be the level of preparedness. These results obtained both in the United States (Perry and Greene, 1983) and in Japan (Okabe et al., 1979). Similarly, more impressionistic data from Regulska (1982) suggest that respondents receiving hurricane information kits from the Texas Insurance Information Center found this information helpful. Waterstone (1978) also found that respondents receiving brochures about flooding risks not only displayed a much higher level of flood awareness, but also engaged in more preparedness activity than those who did not.

Other research is less optimistic. Recent reviews of the literature by Sims and Bauman (1983) and by Sorensen and Mileti (1990) reveals that, for any number of reasons, knowledge learned in disaster education programs does not always translate into appropriate behavior. Summarizing research conducted by Slovic et al. (1977), Saarinen (1982) suggests knowledge is not always translated into appropriate behavior. Three reasons are suggested why public education programs are not as effective as might otherwise be hypothesized. First, people are resistant to change. Habits and perceptions, once formed, are not readily changed, even with

exposure to new information. Second, making decisions that involve risk is not easy, and rather than cognitively engaging in these difficult processes, it is much easier to ignore the problem, hoping that it will go away. Finally, otherwise intelligent individuals are not always fully aware of the risks to which they are exposed. Good public education, of course, should address this deficiency if it exists. Moreover, it is not certain how long people will retain the information that they learn. Waterstone (1978) found that while those residents receiving educational material on floods were more highly aware of the threat than those who did not, within four to six weeks, only 62 percent even remember receiving it, and after a year, only 37 percent remember receiving this information.

There is, furthermore, a question as to whether knowledge accumulated for a response to one particular disaster agent will 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. Sorensen and Mileti (1987, 1990) summarize their extensive review of the literature by noting that "the experience gained with one program at a single location "may not be useful in designing protective action schemes for different locations or for the entire country" (Sorensen and Mileti, 1987: 225). 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. The specific 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. 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.

This research, then, empirically examined the impact of earthquake education on adaptive behavior in disaster. More specifically, whether education for one type of disaster (earthquakes) effectively transfers to appropriate response activities for other disaster agents (hurricanes) was examined. Hypothesizing that those individuals who participated in the earthquake education programs will have responded more adaptively to Hurricane Hugo than those who did not 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. A number of pertinent variables were controlled, however, such as prior hurricane experience, and relevant demographic variables which has been shown in the literature to account for differences in response behavior. These findings are presented in Chapter Three.

Stress

The extent to which victims of disaster experience symptoms of stress has been debated in the literature. It was once quite commonly believed that victims experienced what Wallace (1956) has termed the "disaster syndrome." This stress response was characterized by a dazed, withdrawn response accompanied by insomnia, digestive problems and irritability (Hocking, 1965). Some such as Flynn and Chalmers (1980) have suggested that such post-traumatic stress reactions are quite common in communities following disasters. Shore et al. (1986) reported that approximately 11% of men and 21% of women reported symptoms characteristic

of single-episode depression, generalized anxiety disorder or post-traumatic stress disorder during the first year after the Mount St. Helens volcano disaster. These authors did not report results for the three disorders separately, so that it was impossible to determine what percentage of their subjects reported stress symptoms alone. Madakasira and O'Brien (1987) report that 59% of their subjects who experienced a devastating tornado in rural North Carolina met the criteria for acute post-traumatic stress disorder five months after the disaster. Similar stress responses were observed following an Australian bushfire (McFarlane, 1986, 1987, 1988), earthquakes (Dufka, 1988) and flooding (Earls et al., 1988). The severity of stress responses following natural disasters has been found to correlate with loss of a family member as a result of the disaster (Murphy, 1986) and significant property loss (Shore et al., 1986). In contrast to these studies Mileti et al. (1984) have found little evidence that stress increases substantially following major threats to the community. Mileti et al. (1984) employed a rather unique measure of stress--observable behavioral and physiological symptoms such as an increase in alcohol consumption and cardiac arrests--which may account for their findings.

Investigators have utilized several models to explain stress responses to natural disaster as outlined by Warheit (1985). These include stress responses as a function of exposure to and the severity of the event, as a function of community/societal structures in place at the time of the event and of individual characteristics. There is evidence to suggest that stress responses are more severe as a function of an individuals level of exposure to the disaster (Maida, et al., 1989). In regard to community and societal structures, Warheit (1985) points out that stress responses are maximized when a community has no experience with a particular disaster agent and when a community lacks the organizational structure or resources to respond to the disaster appropriately. Finally, it appears that there are individual variables that mediate the development of Post-Traumatic Stress disorder including pre-morbid psychological functioning

and the ability to cognitively process memories and images related to the disaster experience (McFarlane, 1988a, 1988b, 1989).

There is, however, a noticable absence of literature that examines the relationship between appropriate preparedness activities and subsequent stress responses. With regard to stress, therefore, the goals of the present study are to: 1) examine the relationship between preparedness activities and subsequent stress responses; and 2) to examine the relationship between prior disaster education and subsequent stress responses.

CHAPTER TWO
THE RESEARCH METHODOLOGY

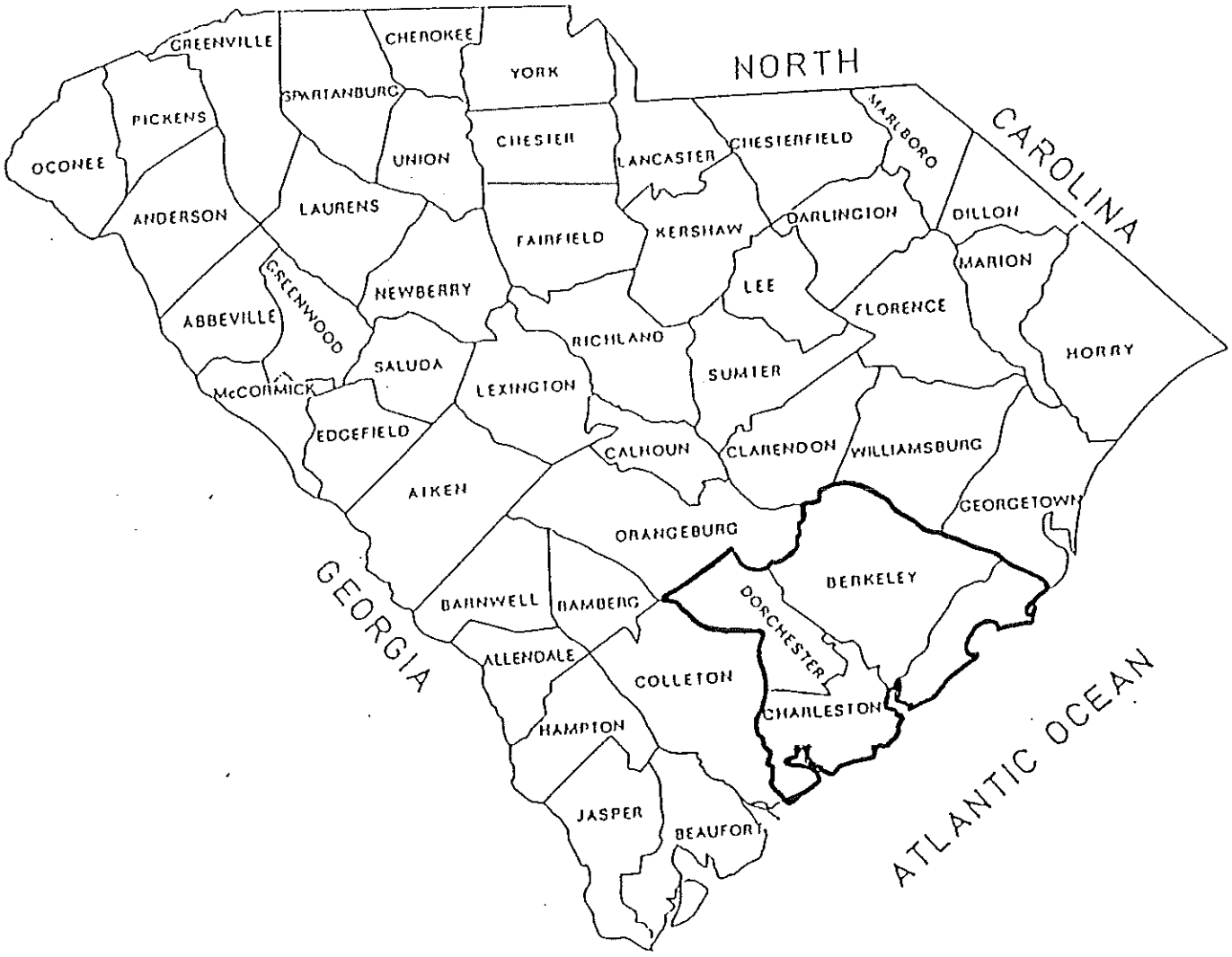
The Research Setting

The study population resides in Berkeley, Charleston, and Dorchester Counties, commonly referred to as the Charleston Trident Area. This three county area comprises 2,600 square miles, including some 90 miles of Atlantic coastline stretching along the central and southern coast of South Carolina. The city of Charleston is located on a low-lying peninsula between the Ashley and Cooper Rivers. The most populous of the three counties is Charleston County with 302,200 people and host to the historic city of Charleston. The population of Berkeley and Dorchester Counties are 127,100 and 81,500 respectively. Racially, whites comprise 67.3 percent of the population and blacks 31 percent. Other nationalities make up the remaining 1.7 percent. There are 24 incorporated areas within the Charleston Trident Area ranging in size from Jamestown with a population of 200 to Charleston with a population of 68,900. All of these communities operate under a mayor/council form of government, although day to day operations vary from city to city (Charleston Trident Chamber of Commerce, 1989).

The median income in the three county area is $20,736, although Dorchester is somewhat more affluent than Berkeley and Charleston Counties with a median of $22,910. The area is fortunate in suffering from a relatively low, 3.9 percent unemployment rate. The largest and dominant employer in the area is the United States Navy, employing over 42,000 military and civilian personnel. The Charleston Naval Base is the Navy's largest submarine base, and third largest home port for the Navy, following only Norfolk, Virginia and San Diego, California. The base holds sixty shore based commands and seventy warships stationed in the

Figure 2-1

Map of South Carolina Showing Berkeley, Charleston and Dorchester Counties



Provided by U. S. Army Corps of Engineers

area. The Charleston Naval Shipyard, itself employing over 8,800 people, is the southeast's largest industrial complex. Charleston is also home to the United States Air Force's 437th military airlift wing which employs some 5,500 civilian and military employees. The military bases have a combined payroll exceeding $1 billion annually, contributing to a strong economic base in the area (Charleston Trident Chamber of Commerce, 1989).

Tourism is the other major area industry. Most of the over 4.5 million people that came to visit the area are attracted to Charleston's historic district with its large old homes, quaint shops, restaurants and other attractions such as Market Street, a trading center several blocks long where local and regional craftspersons market their goods. The importance of tourism to the area is reflected in the fact that the services and wholesale and retail trade sectors, which are both heavily dependent on tourism account for 21 and 23.9 percent of total employment in the region respectively (Graham, 1990b).

The Trident Area is serviced by two major interstate highways: I-26, connecting Charleston with Columbia and Greenville to the northwest; and I-95, the major interstate highway on the east coast extending from Maine to Florida. The major evacuation route during Hugo was Interstate 26. In addition, the Charleston area is serviced by a Class 6 international airport, servicing about 1 million passengers annually with over 75 daily departures by six major airlines. The Charleston area also has ready access to water transportation. The Port of Charleston handles over 6.6 million tons of cargo annually, making it the second largest cargo port on the Atlantic and Gulf Coasts. Finally, over 100 trucking companies maintain terminals in the area, and the Norfolk-Southern and CSX railway systems provide transportation service to the area (Charleston Trident Chamber of Commerce, 1989).

History of Disasters in the Area

Disasters are not new to the Charleston Trident Area. Legend has it that in 1670 when Charleston was established, the Indians told the founders of a storm that had raised the water level higher than the tops of the trees. The truth of the Indians warning was not long in being realized. The Charleston area was devastated by a hurricane in 1686, destroying homes, cattle, crops, and driving ships far inland. An even greater hurricane struck in September of 1752 which is considered by many to be the worst hurricane in the Charleston area during colonial times. Many people drowned in the storm surge and hundreds others were injured. With the exception of a single warship, every boat in the harbor was driven ashore during this storm.

In terms of lives lost, the most devastating hurricane to strike the area occurred in August, 1893, killing between 1,000 and 2,000 people. Property damage was estimated at $10 million, which at this time, represented an overwhelming loss. This was only a Category 3 storm, with wind speeds recorded at 120 mph in Charleston. The last significant hurricane to strike the Charleston area was Hurricane Gracie in 1959. With sustained winds over 100 mph and gusts up to 138 mph, Gracie was responsible for seven deaths and considerable property damage. More recently, in 1979, Hurricane David made landfall near Savannah, spawning five tornadoes as it crossed South Carolina. No deaths were recorded in the state, but property damages reached as high as $10 million.

Since that first recorded hurricane in 1686, no less than 40 major hurricanes have struck the South Carolina Coast. Indeed, in the 111 year period from 1871 to 1981, a total of 894 tropical storms and hurricanes have been recorded over the North Atlantic area. Twenty-three of these have struck within a 50 mile radius of Charleston. Hurricanes are indeed very much a part of the corporate biography of this area. It has, however, been ten years since a hurricane has struck the general area, and 30 years since the Charleston area has suffered a

direct hit of a major hurricane. There is, furthermore, a fairly sizable population turnover in the area. Hence, this is not an area which disaster researchers characterize as a "disaster subculture" with an extensive knowledge base for how to prepare for and respond to a major event of this nature.

The Charleston area is also prone to a great deal of seismic activity. The earliest recorded earthquake in the state struck Charleston in 1698 (Visvanathan, 1980). The greatest and most well known earthquake, however, occurred on August 31, 1886. This earthquake measured between 6.6 and 6.9 on the Richter Scale and had an estimated Modified Mercalli Intensity of X and IX in the City of Charleston. Cities as far as 160 kilometers away experienced damage, and tremors could be felt as far away as New York City, Boston, Milwaukee and even Havana, Cuba. The earthquake killed between 60 and 110 people and caused more than $5 million. (This is equivalent to about $500,000,000 1985 dollars. Some estimates place the damage as high as $23 million.) These figures make the Charleston earthquake of 1886 one of the most devastating earthquakes in United States history.

The area was shaken again in 1903 with an Intensity VI tremor, and then again in 1907 with an Intensity VII. Indeed, while we do not usually think of the east coast as an earthquake hazards area, South Carolina has experienced at least 20 earthquakes of Intensity V or greater. In the last 14 years alone, the tri-county area has experienced more than 20 felt tremors ranging in magnitude from 2.0-3.3 on the Richter Scale. There have been more than 100 recorded earthquakes statewide during the same period. Experts predict that two magnitude 6.0 or greater earthquakes could occur in the southeast over the next two to three decades. It was in response to this threat that the Federal Emergency Management Agency helped to create the Earthquake Education Center (EEC) at Charleston Southern University in 1983.

Charleston Southern University and the Earthquake Education Center

Charleston Southern University (CSU) was established in 1965. CSU is the only church-affiliated college in the Trident area, currently enrolling 2,158 students. The college is located approximately 16 miles northeast of the Charleston historic district and about eight miles from Summerville. The University employs 75 full-time faculty to provide instruction in 28 undergraduate and three graduate degee programs. The Department of Behavioral Sciences from which the interviewers were drawn consists of 108 Psychology and 48 Sociology majors with 79 and 48 minors, respectively. Facilities for instructional and research computing consist of microcomputers distributed in various laboratories around the campus as well as one IBM System 36.

The Earthquake Education Center was established at the university in 1983 with a grant of approximately $60,000. Since 1986, the Center has been jointly sponsored by the South Carolina Emergency Preparedness Division and Charleston Southern University. During the eight years of its existence, the Earthquake Education Center has had one director, Joyce Bagwell who, with her team, has sponsored over 500 programs reaching some 40,000 individuals. Additionally, the Center has distributed over 100,000 brochures and responded to thousands of requests for information by phone and mail.

The programs sponsored by the EEC fall approximately into three broad types. There are, first, intensive one and two-day workshops which entail detailed discussions of the history of earthquakes in the area, seismology, the measurement of earthquake magnitudes and intensities, and extended information on appropriate preparatory and response actions. These workshops are attended by a variety of groups including school teachers and administratiors, ham radio operators, and fire fighters. A second type of program, less intense than the workshops are two to four hour in-service training sessions which are attended primarily by

teachers and health care workers. These sessions focus primarily on appropriate preparedness and response activities. Finally, personnel from the center make numerous presentations to church and civic groups which constitute the third type of program. These presentations are tailored to the needs of the group, but usually involve at least brief instructions on how to prepare for and respond to an earthquake. We shall use this tripartite taxonomy in the analysis of the data in this study.

The Subjects

The subjects are 198 individuals who had participated in an earthquake preparedness workshop conducted by the Earthquake Education Center, and 511 individuals selected using a modified random digit dialing procedure from a telephone directory including Charleston, Berkeley and Dorchester counties in South Carolina. Twenty percent of the subjects in each sample were randomly selected and re-called in order to collect test-retest data as well as additional information.

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. This sample was further subdivided according to the type of educational program participated in. 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 that included all three counties in a single listing (i.e., they were not divided according to geographical area). The following procedure was used to select the sample: 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 of the workshop sample, but still quite respectable. This yielded a total of 511 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 fifteen 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.

Table 2-1 reports the demographic distributions of the samples. Two levels of interpretation are required for Table 2-1. 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 substancially 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 the 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. This will be discussed at greater length in Chapter Five.

TABLE 2-1: Demographic Characteristics of Samples Compared with General Population

	Population (Percent)	Workshop (N=198) N	%	General (N=511) N	%
Median Age*	30	42		39	
Ethnicity*					
White	67.8	187	94.4	404	79.1
Black	29.7	9	4.5	93	18.2
Other	2.5	2	1.0	14	2.8
Education*					
Less than HS		1	.5	72	14.1
HS or GED		18	9.1	137	26.8
Some College		22	11.2	152	29.7
Col. Degree		53	26.8	84	16.4
Grad Degree		104	52.5	66	12.9
Median:	12.4 Years	Grad. Degree		Some College	
Marital Status					
Single	No Data	16	8.1	89	17.4
Married		167	84.3	333	65.2
Div/Sep		12	6.1	51	10.0
Widowed		3	1.5	38	7.4
County of Residence*					
Charleston	57.6	70	35.4	306	59.9
Berkeley	25.8	68	34.3	121	23.7
Dorchester	16.6	60	30.3	83	16.2
(No Data)		-	-	(1)	(.2)
Household Income*					
LT $15,000	26.9	2	1.0	79	12.5
15--25,000	20.9	16	8.1	116	22.7
25--35,000	17.5	42	21.2	108	21.1
35--50,000	18.9	67	33.8	100	19.6
GT 50,000	14.6	64	32.3	86	16.9
(No Response)		(7)	(3.5)	(22)	(4.3)
Sex**					
Male	50.4	46	23.2	189	37.0
Female	49.6	152	76.8	318	62.2
(No data)		-	-	(4)	(.8)

*Population data for these items obtained from 1990 estimates published in CACI Marketing Systems, The Sourcebook of County Demographics, 1990.

**Population data for this item obtained from the Division of Research and Statistical Services, State Data Center, Columbia, South Carolina, 1988.

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 the present sample overrepresents whites by about 10 percent (79.1 percent in our sample compared with 68.4 percent in the general population). Our sample also has a higher percentage of persons with at least 16 years of education, about double that in the general population (29.3 percent compareed with 14.6 percent). Females are also overrepresented as are households with higher incomes. The geographical distribution of the population over the three county area was successfully approximated. While it was hoped that our sample more closely represented the population of the 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 avoided the problem of omitting unlisted numbers from the 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. The heavy overrepresentation of females is difficult to explain. Randomizing household respondents by asking to speak with the person who last had a birthday was attempted which should have resulted in approximately equal representation of males and females.

Measurement Instruments

Three versions of a questionnaire were used, which had a common corpus of questions. The instruments are described below, and are available from the authors upon request.

General Sample Questionnaire

This questionnaire was developed by the Co-PI's and consists of 76 items measuring several broad areas, including: (1) specific actions that the respondent's household did or did not take in preparedness for the hurricane; (2) when, how 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 how households prepared for and responded to Hugo was of interest, 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.

Workshop Questionnaire

This questionnaire is identical to the General Sample Questionnaire with an additional three items that ask respondents to indicate (1) the year that they participated in the workshop conducted by the Earthquake Education Center; (2) why they attended the workshop; and (3) its effectiveness in helping the respondent prepare for Hurricane Hugo.

Follow-up Questionnaire

The follow-up interviews replicated the general and workshop interviews, respectively, but also asked the respondents to elaborate on some items.The follow-up questionnaire was developed to gather test-retest data as well as to gather additional information of a more open-ended nature to augment the forced choice questions. These questions requested information concerning (1) why respondents did not evacuate if they lived in a mandatory or strongly suggested evacuation area but did not leave; (2) what types of activities the respondent engaged in after learning that Hugo was likely to hit the Charleston area; (3) the three major problems encountered as a result of Hugo; and (4) (for those in the workshop sample) what items of information from the workshops were most helpful during Hugo and suggestions for future workshops. In addition to these open-ended questions, follow-up interviews included additional stress items, and presented a series of potential problems (such as availability of drinking water, food, shelter, etc.) and asked respondents to indicate whether these were problems during Hugo. These items were not included in the original general and workshop sample questionnaire in order to keep the length of the interview reasonable.

Preparing for Data Collection

Selection of Telephone Interviewers

The telephone interviewers were 12 female and 6 male Charleston Southern University students, most of whom were majoring in one of the behavioral science disciplines. Interviewers were selected on the basis of a GPA of 3.0 or better, good interpersonal

communication skills upon initial interview with one of the Co-PI's, and an interest in gaining research experience. The students were paid minimum wage for their time.

Training Interviewers

All interviewers completed three hours of training which involved both didactic and role-playing exercises. The training was conducted by the Co-PI's and consisted of a general overview of the research project, an introduction to the measurement instruments, and an overview of general telephoning principles. This included, for example, how to introduce the project, how to probe for specific information, how to handle uncooperative respondents, and ethical standards for conducting research with human subjects. Two training sessions of three hours each were held on two consecutive days. The interviewers were required to attend one of the scheduled training sessions. In addition, each interviewer 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 indivuduals in the Charleston area who were informed of the purpose of the project and their role in it. Each student conducted one pre-test interview as if he or she were calling an actual subject. The participant was informed that an investigator would be calling them back requesting feedback about the interview that they had participated in. Following the interview, one of the Co-PI's contacted the participant requesting feedback regarding the clarity of interview questions, as well as information about the quality of the interviewer's style. 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. As it turned out, this was not a problem.

Data Collection and Analysis

A phone bank consisting of a room with six touch tone phones was established on the campus of Charleston Southern University. Telephone interviewers reported to the phone bank shortly before 4 pm during the data collection period, which lasted from approximately mid-February to late March, 1990. This time was used to debrief and instruct interviewers during the data collection procedure. Each student was positioned at a station bank that had a telephone, questionnaires, fall-back sheets, a standardized introduction sheet and ten call sheets which contained a single telephone number and a space to record the time called and disposition of that call. (These documents and forms are available upon request.) Positioned close to the interviewers was a box in which they discarded call sheets of uncompleted interviews. The students picked up the call sheet on top of their pile and dialed the phone number. They were instructed to allow the phone to ring seven times. If they received no answer, they were instructed to call back a second time and again let it ring seven times to insure that they had dialed the correct number. When they did get an answer, the interviewer began the standard introduction for the General, Workshop, or Follow-up samples.

In order to insure standarization of administration of the interview, interviewers were instructed to read everything on the introduction sheet and questionnaire that was printed in capitals. If the subject asked them a question regarding a series of anticipated concerns (purpose of the research, how they could obtain copies of the results, etc.), a Fall Back sheet was available to coach them on an appropiate response. If they were asked a question not on the

Fall Back sheet, interviewers consulted one of the Co-PI's who was always present. Following completion of the interview, the respondent was thanked for participating and asked if they had any further questions. If the respondent requested further information about the study they were given the name and address of one of the Co-PI's.

A series of codes were developed for determining disposition of completed interviews and unsuccessful attempts. Separate codes were assigned for completed interviews, requested call backs, busy lines, non-working numbers, refusals, etc.

Reliability

In order to gather reliability data on the questionaires, a 20 percent sub-sample (143 respondents) of the general and workshop samples were randomly selected for call-backs. Follow-up interviews were conducted with 143 respondents (about 20 percent of each sample) approximately two weeks after the original interviews were conducted. The purpose of these follow-up interviews was to provide a basis for assessing the reliability of the responses, as well as providing some additional information which was not included on the original interview schedule. Follow-up interviews were always conducted by a different interviewer than the original, and when possible by a different sex interviewer. When called, the interviewer asked to speak to the person in the household who had originally completed the interview. If that person was unavailable, the interviewer asked for a convenient time to call back and an interviewer attempted to contact that person at the designated time. If the person refused to be interviewed a second time, their number was discarded. The interviewer explained that we were calling a select number of households back in order to test the reliability of the questionnaire as well as to gather additional information. Reliability estimates were conducted using Pearson's Product Moment Correlation. This analysis revealed that only 17 of the 79 variables on the original questionnaires failed to attain a correlation of .60 or greater. Examining these 17

variables reveals that most were nominal-level or ordinal-level variables, making the use of correlation questionable. Furthermore, most of these variables were highly skewed, with as many as 94 percent of the cases falling into a single category. Consequently, the variables were further analyzed by simply calculating the percentage of the follow-up interviews that provided identical information as their initial interview. This analysis revealed that, with a single exception, there was greater than 67 percent correspondance in all of these variables. In fact, in all but three variables, there was greater than 70 percent correspondance between the original and follow-up interviews. It appears, therefore, that the low correlations attained are primarily a function of the inappropriateness of Pearson's r to these particular variables. This further analysis reveals that, even for those variables failing to attain a .60 correlation, there is, in fact, a strong correspondence between the original and follow-up interviews.

Data entry and analysis

Data were entered directly from the questionnaires onto IBM PC's and analyzed using the SPSS statistical software package. Data entry was conducted at Charleston Southern University. Analysis of the data was conducted both at Auburn University and at Charleston Southern University. The specific procedures used and employed for the analyses are discussed in each of the chapters on preparedness and stress respectivey.

CHAPTER THREE:

DISASTER EDUCATION AND EMERGENCY PREPAREDNESS

This chapter examines the level of emergency preparedness among the households that were interviewed. Of interest here are those activities carried out by households which might either mitigate loss of life and property, or which might facilitate response activity. A total of 12 items were used as preparedness measures. Table 3-1 compares the percentage of the workshop and general samples who indicated that they engaged in each of these preparedness activities, as well as whether or not any differences were statistically significant. It should be noted that not all items were relevant to all respondents, and some respondents did not know whether or not specific preparedness measures were taken. When either of these situations occurred, these cases were dropped from the analysis.

Table 3-1 reveals that on six of the twelve items there were significant differences between the two samples, with the workshop sample being more likely to have engaged in these behaviors. Generally, the workshop sample was more likely to have engaged in family planning meetings, to have identified a safe spot in their home, to have a battery powered radio, to have taken the time to secure yard items and to have adequate food stored. There are no significant differences between the two samples, however, with regard to such things as having adequate water stored, filling one's car with fuel, having a working flashlight with extra batteries, etc. This pattern is not particularly surprising. These latter types of activities are typically emphasized in the media during the period preceding a hurricane. Citizens are urged to store plenty of water, to stock up on needed supplies such as batteries for flashlights, and to fill their cars with gas. Moreover, cues from neighbors engaging in these activities alert residents to the importance of these activities. The media also publicizes major evacuation routes out of the

Table 3-1: Comparison of General and Workshop Samples on Specific Preparedness Items

Preparedness Item	General Sample (% Yes)	Workshop Sample (% Yes)	X^2
Have Family Planning Meetings	45.9	54.9	4.12[c]
Have Family Plan for what to Do if Separated	26.6	33.5	2.80
Identify Safe Spot in Home	77.7	85.1	4.30[c]
Plan Evacuation Route	51.6	54.1	0.26
Have Battery Powered Radio	87.2	93.4	4.98[c]
Have First Aid Kit	63.5	78.3	13.52[a]
Have Extra Batteries	81.9	87.9	3.30
Have Adequate Water Stored	81.7	86.4	1.84
Secure Items in Yard	86.4	99.0	22.44[a]
Have Adequate Food Stored	92.3	98.0	6.99[b]
Have Full Tank of Gas in Car	90.8	93.9	1.40
Have a Working Flashlight	97.0	100.0	4.61

a: $p<.001$
b: $p< .01$
c: $p< .05$

area. Hence, it would not be expected that educational workshops would affect these behaviors as greatly. Other activities, such as having first aid kits, having family planning meetings, and keeping a portable radio, are not as likely to be stressed by the media (particularly television) at the time of an impending threat. Hence, it would be expected that the education workshops might make more of an impact encouraging these activities.

The 12 items used as preparedness measures were determined by using a factor analysis procedure. Principal axis factoring techniques were employed in order to examine the interrelationships among these variables, and more specifically to determine if these variables could be scaled (Kim and Mueller, 1978a). Items with factor loadings failing to exceed .30 for any given factor were dropped from the analysis (Kim and Meuller, 1978b). This procedure yielded two factors which were used as the basis for the construction of two indices. For both factors, individual items which were dichotomously coded (1=yes; 2=no), were summated to form the indices.

The first index, Household Planning (alpha =.544), is made up of of four items from the survey which measure longer term planning activities in which households might engage to prepare for the threat of a hurricane. These activities, detailed in Figure 3-1, include having family meetings, having a plan for what to do if the family is separated, identifying a safe spot in one's home, and establishing an evacuation route. The values for the Household Planning Index range from 0 to 4, with low values indicating low planning and high values indicating high levels of planning. Adaptive Response (alpha =.576), the second index, consists of eight items which measure activities usually undertaken upon hearing of a specific hurricane threat. These items, also described in Figure 3-1, include having a battery powered radio, a working flashlight, a first aid kit, a supply of nonperishable food, securing loose items in one's yard, having adequate water stored and having a full tank of gas in the car. The values for this index

Figure 3-1
ITEMS AND WORDING FOR VARIABLES USED IN ANALYSES

VARIABLE		ITEMS USED IN CONSTRUCTING VARIABLE
HOUSEHOLD PLANNING	1.	Did you have family meetings to establish emergency procedures?
	2.	Did you have a safe spot identified in your home?
	3.	Did you have an established evacuation route?
	4.	Did you have a plan for what to do if your family was separated at the time the hurricane struck?
ADAPTIVE RESPONSE	1.	Did you have a battery powered radio?
	2.	Did you have adequate water stored?
	3.	Did you have a working flashlight?
	4.	Did you have a first aid kit?
	5.	Did you secure items in your yard?
	6.	Did you have a supply of non-perishable food?
	7.	Did you have extra batteries on hand?
	8.	Did you have a full tank of gas in your car?

range from 0 to 8, with low scores corresponding to a low adaptive response and high scores indicating a high adaptive response.

Two types of analyses were conducted on the two dimensions of preparedness. First, a tabular analysis was conducted, providing broad comparisons between the workshop and general samples. For purposes of the tabular analysis, the four items on the household planning index were collapsed into three categories and defined as "low" (engaging in one or less activities), "medium" (engaging in two activities) or "high" (engaging in three or four activities). Because the level of adaptive response was much higher overall than preparedness, "low" response is defined as engaging in six or less response activities; "medium" response is defined as engaging in seven of the response activities; and "high" response is defined as engaging in all eight of the response activities.

Table 3-2 reveals that prior disaster education is significantly related to both dimensions of preparedness. Hurricane experience is significantly related to adaptive response but not to household planning. Table 3-3 reveals, however, that both prior disaster education and hurricane experience are also related to participation in the earthquake education programs. That is, the workshop sample is significantly more likely to have been exposed to other disaster education programs and to have experienced prior hurricanes. It is possible, therefore, that there is a self-selection process at work, the workshops attracting individuals who already have knowledge and/or experience with disasters. (It should be noted, however, that the only type of prior disaster education which is significantly related to sample is in-service training. Attending community workshops and high school or college class presentations were not significantly related to sample.) Because of the importance of these two variables, and their relationship to workshop participation, their impact on the relationship between participation in the earthquake education workshops and the planning and response indices were examined in special detail in the tabular analysis.

Table 3-2: Household Planning and Adaptive Response by Prior Disaster Education and Hurricane Experience

Prior Experience	Low	Medium	High	Sig.
		Household Planning		
Prior Education	24.5% (70)*	31.1% (89)	44.4% (127)	X^2=26.97 p <.001
Prior Hurricane Experience	34.0% (138)	27.1% (110)	38.9% (158)	X^2=1.13 p >.05
		Adaptive Response		
Prior Education	15.7% (46)	22.2% (65)	62.1% (182)	X^2=34.39 p <.001
Prior Hurricane Experience	18.5% (74)	25.4% (102)	56.1% (225)	X^2=11.32 p <.01

*No responses and not applicables are not included in calculation of percentages. Hence, the N's vary with each variable.

Table 3-3: Prior Disaster Education and Hurricane Experience by Sample

	Sample		
Education	General	Workshop	Sig.
Attend Community Workshop	18.5% (70)*	25.3% (42)	X^2=2.89 p >.05
Attend In-Service Training	51.0% (203)	73.7% (132)	X^2=25.29 p <.001
Attend High School/ College Class Presentation	39.4% (149)	39.2% (58)	X^2=0.00 p >.05
Any Prior Disaster Education	55.1% (166)	73.7% (98)	X^2=12.53 p <.001
Any Prior Hurricane Experience	61.8% (248)	78.7% (118)	X^2=13.11 p <.001

*No responses and not applicables are not included in calculation of percentages. Hence, the N's vary with each variable.

The impact of the earthquake education workshops on preparedness and adaptive response will likely be affected by other variables. It was suggested, for example, that education and income are variables which affect the likelihood of engaging in preparedness activities. Furthermore, as pointed out in Table 2-1, the workshop sample tends to be more highly educated and have a higher income than does the general sample. Hence, it is important to control for these variables when assessing the impact of the earthquake education programs. These and other variables are examined in regression models following the tabular analysis for each dimension.

The final section of the chapter briefly examines evacuation behavior, which is, in fact, a form of adaptive response. It is a special type of adaptive response, however, which has received extensive treatment in the literature, particularly by Perry and his colleagues (e.g., Perry et al., 1981). Furthermore, the data suggest that evacuation was primarily a function of the location of one's residence relative to the impact zone. Hence, it is treated separately in this analysis.

Household Planning

This section is concerned specifically with those household planning activities which generally take place prior to the time of the actual threat of a hurricane. Table 3-1 suggests that for two of these planning items, workshop participants are significantly more likely to have indicated an affirmative response than did the general sample. The following section addresses whether or not the relationship between household planning and workshop participation holds when controlling for prior disaster education and prior hurricane experience.

The Impact of Earthquake Education on Household Planning Controlling for Prior Disaster Education and Hurricane Experience

Table 3-4 reports the relationship between household planning and earthquake education controlling for prior disaster education. The data reveal that the relationship between workshop participation and planning is significant only among those households which have participated in other disaster education programs. Similarly, when controlling for prior hurricane experience (Table 3-5), participation in the earthquake education workshops significantly affects household planning only among those who have previously experienced a hurricane. Assuming that prior hurricane experience also serves an educational function, these findings raise some very interesting questions. We expected to find exactly the opposite, that participation in the disaster education workshops would more significantly impact preparedness behavior for those who had no prior disaster education or experience. In the absence of any prior disaster education we reasoned that the earthquake workshops represent one's only formal exposure to appropriate preparedness activities. Among those who have had prior disaster education, however, participation in the workshops represents only incrementally more education than those who did not participate. Similarly, if hurricane experience is understood as a source of education, it would be expected that the same dynamics be operative: the workshops should have their greatest impact where there is a void of any other education or first hand experience.

The fact that the earthquake education workshops had their greatest impact among those who have had prior disaster education or hurricane experience requires further explanation. One possible explanation is simply that there is a self-selection process at work. Individuals who have experienced a hurricane may naturally be more interested in how to protect

Table 3-4: Household Planning Index by Sample Controlling for Prior Disaster Education

Planning	Sample			
	No Prior Disaster Education		Prior Disaster Education	
	General	Workshop	General	Workshop
Low	47.4% (79)	43.6% (17)	29.0% (53)	16.5% (17)
Medium	24.4% (41)	30.8% (12)	31.7% (58)	30.1% (31)
High	28.6% (48)	25.6% (10)	39.3% (72)	53.4% (55)
	X^2=0.66 p >.05		X^2=7.36 p <.05	

Table 3-5: Household Planning Index by Sample Controlling for Prior Hurricane Experience

Planning	Sample			
	No Prior Hurricane Experience		Prior Hurricane Experience	
	General	Workshop	General	Workshop
Low	36.7% (55)	35.9% (14)	38.6% (100)	25.9% (38)
Medium	29.3% (44)	28.2% (11)	27.0% (70)	27.2% (40)
High	34.0% (51)	35.9% (14)	34.4% (89)	46.9% (69)
	X^2=0.05 p >.05		X^2=8.40 p <.05	

themselves against future invasions of the environment. Similarly, workshop participants who have attended other disaster education programs may be more avid consumers of disaster education, and hence participated in the workshops for different reasons than those without prior disaster education, who may be participating only because it is required for their jobs or some other civic organization. It is therefore reasonable to expect that the earthquake workshops will be more salient to connoisseurs of disaster education programs than to participants who attend only because it is required.

The data, however, do not support this explanation. The workshop sample was also asked whether their participation in the workshop was (1) required for their job; (2) recommended for their job; (3) required for a voluntary organization of which they were a member; (4) recommended for a voluntary organization of which they were a member; (5) as an interested citizen; or (6) as part of coursework. No significant differences were found when comparing those who took it because it was a required activity (items 1, 3 and 6 above) and those who took it because it was a voluntary activity (items 2, 4 and 5). Furthermore, comparing those whose participation was job related (items 1 and 2) with those who participated for other reasons (items 3, 4, 5 and 6), no significant differences were obtained.

A second possible explanation relates to the specialized nature of the earthquake education workshops. It may be that because the workshops specifically address earthquake preparedness measures, workshop participants did not readily apply this knowledge to the hurricane situation. Those who had other educational experiences, however, or those who had been in a hurricane before, had a broader base of experience from which to apply the knowledge they gained in the earthquake workshops. Stated differently, prior disaster education or hurricane experience provides a greater level of general (or hurricane specific) knowledge, thereby facilitating one's ability to generalize from the earthquake specific workshops. Insofar as this is the case, these data suggest that agent-specific education is not readily transferred to

other types of disasters, particularly in the absence of a broader base of disaster knowledge. Unfortunately, the accuracy of this explanation can not be tested without comparing the samples in an earthquake situation.

There is still a third possible explanation, related to the rationale above. It is possible that a threshold or cumulative effect is being observed. That is, it may be that disaster knowledge, at least as it is expressed in household planning activities, is disporportionately enhanced the more education one has. That is, prior disaster education may provide a valuable knowledge base which maximizes the effectiveness of the earthquake education programs by providing a basis to more readily interpret the material provided in the workshops. This explanation will be explored further below.

The Impact of Intensity of Earthquake Education on Preparedness Controlling for Prior Disaster Education and Hurricane Experience

The earthquake education programs sponsored by the EEC consist of programs with various levels of intensity (see Chapter Two). Broadly categorized, there were very intense one and two day community workshops; in-service training programs consisting of two to four hour sessions; and a number of one hour classroom presentations. This section examines each of these workshop "clusters" individually, examining their impact on preparedness when controlling for prior education and hurricane experience. These results are reported in Tables 3-6 and 3-7. For purposes of interpretation, each of the clusters in the top three rows were compared individually with the general sample. The significance tests thus reflect the difference between each respective cluster and the general sample. Caution must be exercised when interpreting these results because of the extremely small N's among each of the workshop clusters which have not participated in any prior disaster education or experienced a hurricane (left side of each table).

Table 3-6: The Impact of Workshop Intensity on Household Planning Controlling for Prior Disaster Education

	Household Planning							
	No Prior Education				Prior Education			
Workshop Intensity	High	Medium	Low	Sig.	High	Medium	Low	Sig.
Community Workshops (N=53)	23.1% (3)	38.5% (5)	38.5% (5)	X^2=1.16 p >.05	62.5% (25)	22.5% (9)	15.0% (6)	X^2=7.44 p <.05
In-Service Training (N=70)	25.0% (5)	25.0% (5)	50.0% (10)	X^2=0.12 p >.05	48.0% (24)	38.0% (19)	14.0% (7)	X^2=5.07 p >.05
Classroom Presentation (N=19)	33.3% (2)	33.3% (2)	33.3% (2)	X^2=0.47 p >.05	46.2% (6)	23.1% (3)	30.8% (4)	X^2=0.46 p >.05
No Workshop (Gen. Sample) (N=351)	28.6% (48)	24.4% (41)	47.0% (79)		39.3% (72)	31.7% (58)	29.0% (53)	

Table 3-7: The Impact of Workshop Intensity on Household Planning Controlling for Hurricane Experience

	Household Planning							
	No Hurricane Experience				Prior Hurricane Experience			
Workshop Intensity	High	Medium	Low	Sig.	High	Medium	Low	Sig.
Community Workshops (N=68)	35.0% (7)	20.0% (4)	45.0% (9)	X^2=0.91 p >.05	56.3% (27)	27.1% (13)	166.7 (8)	X^2=11.25 p <.05
In-Service Training (N=94)	41.2% (7)	29.4% (5)	29.4% (5)	X^2=0.45 p >.05	44.2% (34)	28.6% (22)	27.3% (21)	X^2=3.80 p >.05
Classroom Presentation (N=24)	- (0)	100.0% (0)	- (0)	X^2=4.84 p >.05	366.4 (8)	22.7% (5)	40.9% (9)	X^2=0.20 p >.05
No Workshop (Gen. Sample) (N=409)	34.0% (51)	29.3% (44)	36.7% (55)		34.4% (89)	27.0% (70)	38.6% (100)	

These tables mirror the results in Tables 3-4 and 3-5 for the first cluster, the highly intensive "community workshops." Among those participating in these programs, household planning levels were significantly higher for those individuals who had participated in other disaster education programs. Similarly, having participated in community workshops sponsored by the EEC was significantly related to household planning among those with prior hurricane experience. The failure to obtain significance among the in-service training and classroom presentation clusters suggest that the greater the intensity of the educational experience provided by the EEC, the greater the impact on household planning. That is, the "community workshop" cluster, which is the most intense of the earthquake education workshops, generally has the strongest and the only significant association with household planning, but only among those who have had other educational or direct hurricane experience. These tables therefore suggest that more intensive educational workshops may indeed affect household planning. They do so, however, under those conditions when participants have a prior knowledge base on which to build, either other disaster education participation or prior hurricane experience.

Regression Analysis of the Impact of Education and Control Variables on Household Planning

In addition to prior disaster education and hurricane experience, there are several variables that may impact household planning, thereby affecting the relationship between workshop participation and planning. It has been suggested, for example, that education and income have both been found to be related to adaptive behavior in disasters (e.g., Bourque et al., 1973; Neal et al., 1982; Mack and Baker, 1961; Moore et al., 1963). Similarly, race is frequently cited as a factor in adaptive response, particularly evacuation (e.g., Drabek and Boggs, 1968; Perry et al., 1981, 1982; Perry and Mushkatel, 1984). Finally, variables such

as home ownership, marital status and the number of dependents in one's household all suggest some level of social integration, thereby increasing the likelihood of protective behavior.

The impact of these variables along with prior disaster education and hurricane experience on preparedness were assessed by using an ordinary least squares regression technique. This is a more sophisticated measure, allowing for an examination of the impact of prior disaster education and hurricane experience on household planning controlling for several relevant variables in the same model. Because the workshop and general sample are estimates of distinct populations (i.e., workshop participants and the general population), they were kept separate for analytical purposes. That is, separate regression models were employed for the workshop sample and the general sample respectively, examining the impact of prior disaster education, hurricane experience, and the control variables on household planning and adaptive response among each of these samples. Comparisons between the two samples are then made using a test for parallelism of slopes, an alternate form of the t-test. This test employs the intercept term (the constant) from the regression models (Kleinbaum et al., 1988). This technique thus allows for an examination of the impact of the earthquake education workshops controlling for all other pertinent variables, a level of examination which is not possible with the tabular analysis.

For purposes of these models, the four item household planning index, (PLANNING) the dependent variable, was left intact and not collapsed into three categories as in the tabular analysis. Prior disaster education (OTHER EDUC), and prior hurricane experience (HURRICANE EXP), the independent variables were dummy coded so that "yes" was scored a 1 and "no" was scored 0. Control variables include whether or not respondents own their own home (OWNHOME), race (WHITE), marital status (MARRIED), income (INCOME), education (EDUCATION) and the number of dependents living in the respondent's household (DEPENDENTS). Home ownership was dummy coded so that "yes" was scored a 1 and "no" was

scored 0. Race was dummy coded such that "white" received a score of 1 and "other" was scored 0. Marital status was also dummy coded with "married" equal to 1 and "not married" equal to 0. Income was coded as follows: 1=less than $15,000; 2=$15,000-$25,000; 3=$25,000-$35,000; 4=$35,000-$50,000; 5=$50,000-$100,000; 6=greater than $100,000. Education was coded in the following manner: 1=8th grade or less; 2=some high school; 3=high school or equivalent; 4=some college; 5=four year college degree; 6=graduate work or graduate degree. Both education and income are technically ordinal level data as they were collected as categorical data; however, the categories are approximately equal in increment, allowing the treatment of these variables as near interval level measures. Finally, the number of dependents was coded directly as the number of dependents living in the household.

The correlation matrices in Tables 3-8 and 3-9 are combined matrices comprising all of the variables that are used in the models in this chapter for the workshop and general samples respectively. As the matrices demonstrate, there appears to be no concern for any multi-collinearity between the variables in this analysis with either the workshop or general sample, including the adaptive response index which will be discussed later. The highest correlation between any two variables appearing in any single model is .419 (between home ownership and marital status for the workshop sample). This is well within acceptable limits for regression procedures.

The results of the regression analysis (Table 3-10) indicate that only prior disaster education significantly predicts household planning among the workshop sample ($b=.622$, $\beta=.225$, $p<.01$). No other variable, including hurricane experience, approached statistical significance. The slope coefficient indicates that having had prior disaster education experience results in about 2/3 of a unit increase (of a total of 4 units in the model) in household planning. Stated differently, prior disaster education enhanced household planning by more than 15 percent among the workshop sample.

Table 3-8: Correlation Matrix of Variables Used Analysis of the Workshop Sample

	1	2	3	4	5	6	7	8	9	10	X	SD
1. PREPARE	1.000	.211	.211	.088	-.005	.146	.003	-.120	-.031	-.121	5.69	1.23
2. RESPONSE		1.000	.242	-.035	.109	.074	.087	.027	.050	-.024	8.53	0.77
3. OTHER EDUC			1.000	-.017	.075	.170	.083	.032	-.098	-.011	0.75	.44
4. HURRRICANE EXP				1.000	.031	-.022	-.067	-.075	-.125	-.012	0.79	.41
5. INCOME					1.000	.170	.111	.265	.040	.365	4.13	1.39
6. EDUCATION						1.000	.053	-.028	-.036	-.140	5.32	1.03
7. WHITE							1.000	.004	-.052	.183	0.94	0.23
8. OWNHOME								1.000	.150	.419	0.91	0.29
9. DEPENDENTS									1.000	.194	1.43	1.30
10. MARRIED										1.000	0.86	0.35

Table 3-9: Correlation Matrix of Variables Used Analysis of the General Sample

	1	2	3	4	5	6	7	8	9	10	X	SD
1. PREPARE	1.000	.266	.210	-.026	-.031	.004	-.055	-.087	.171	-.026	5.92	1.18
2. RESPONSE		1.000	.233	.172	.158	.140	.223	.152	.053	.169	9.03	1.34
3. OTHER EDUC			1.000	.043	.090	.261	.020	.034	.063	.131	0.58	.49
4. HURRRICANE EXP				1.000	.113	.083	.158	.103	-.014	.141	0.39	.48
5. INCOME					1.000	.364	.171	.288	.010	.203	3.49	1.70
6. EDUCATION						1.000	.026	.115	.066	.100	4.28	1.28
7. WHITE							1.000	.132	-.170	.166	0.82	0.38
8. OWNHOME								1.000	.011	.333	0.69	0.46
9. DEPENDENTS									1.000	.266	1.50	1.41
10. MARRIED										1.000	0.75	0.43

TABLE 3-10: Regression Analysis of Household Planning Index on Disaster Education, Hurricane Experience, and Control Variables

	WORKSHOP SAMPLE			GENERAL SAMPLE		
Variable	b	ß	SE	b	ß	SE
Other Disaster Educ.	.622[b]	.225	.201	.510[a]	.214	.117
Hurricane Experience	.277	.093	.217	-.003	-.001	.116
Marital Status	-.244	-.069	.303	-.157	-.060	.139
Race	-.029	-.005	.399	.001	.001	.145
Education	.099	.083	.090	-.007	-.007	.048
Number of Dependents	.043	.046	.070	.163[a]	.193	.042
Income	.018	.021	.072	.012	.018	.035
Home Ownership	-.453	-.110	.326	-.069	-.028	.127
	R^2= .092	F= 2.245[c]		R^2= .081	F=4.654[a]	

a: $p<.001$
b: $p<.01$
c: $p<.05$

Table 3-10 also reveals that prior disaster education is a significant predictor of household planning for the general sample (b=.510, ß=.214, p <.001). Among the general sample, having had prior disaster education increases household planning by more than 12 percent, or a unit increase of slightly more than one-half a response item. Like the workshop sample, hurricane experience fails to achieve significance in predicting household planning activities. The number of dependents in a household, however, is significant among the general sample (b=.163, ß=.193, p <.001). The number of dependents is a less powerful predictor, however, accounting for only about a 4 percent increase (.163 units) in household planning.

Beyond examining the effects of the variables within samples, this study also seeks to examine the unique impact of the earthquake education workshops on household planning after controlling for the possible effects of all other relevant variables. As explained above, this is accomplished by comparing the slopes of the household planning index for the workshop and general samples respectively. While the differences between the two samples was significant prior to controlling for the other variables ($\overline{X}_{workshop}$=2.285, $\overline{X}_{general}$=2.023; t=2.92; p <.05), this difference virtually disappeared when the control variables were introduced (alpha $_{workshop}$=1.588, alpha $_{general}$=1.644; t=-.048; p >.05).

These data thus provide further support for the importance of disaster education in household planning activities. Indeed, this variable is a stronger predictor of preparedness than any other single variable for either sample. The specific impact of workshop participation, however, when controlling for other variables was negligable. Indeed, the workshop sample scored slightly worse when the controls were introduced, although the differences between the two samples was not significant.

Summarizing Household Planning

The data presented in this section suggest three important observations. First, there is clear and compelling evidence that disaster education does indeed facilitate household planning for hurricanes. Indeed, this was the single most important predictor of household planning for both the workshop and the general samples. Moreover, the contingency tables suggest that the earthquake education workshops are most effective among those individuals who have participated in prior disaster education programs or who have had prior hurricane experience. Second, the earthquake education programs specifically did not contribute to houshold planning in a significant fashion. While the tabular analysis suggests that there is a significant relationship between workshop participation and planning among those with prior disaster education and hurricane experience, this relationship does not hold up under the more rigorous regression analysis which controls for various demographic variables simultaneously. The tabular analysis does, however, suggest that the more intensive day-long earthquake education workshops may have had some independent effect on household planning. When examining the specific type of earthquake education programs in which respondents participated (Tables 3-6 and 3-7) it was the more intensive workshops which were significant when controlling for prior education and hurricane experience. In-service training sessions and classroom presentations were not significant.

Finally, the fact that the earthquake education programs were significantly related to household planning in the tabular analysis, but only where respondents had prior disaster education, suggests that there may be a cumulative effect operative whereby disaster education becomes most effective with repeated exposure. A single encounter may not be sufficient to overcome a lifetime of preconceptions and behavior patterns which have not been built upon

accurate knowledge. Only after repeated encounters with the same or mutually reinforcing information is a level of knowledge sufficiently reached such that it significantly impacts planning behavior. It is not possible to directly test this hypothesis with the present data. However, we did ask respondents if they had participated in any of the following types of disaster education programs (other than the earthquake education programs): community workshops, in-service training, or high school or college classroom presentations.[1] Responses were then summed and given a value of 0 to 3 depending on whether they had participated in none, one, two, or all three types of programs. The results of this analysis (not reported in tabular form) provides preliminary and indirect evidence that such an effect may indeed be occurring. The wider the variety of disaster education programs in which one has participated, the greater the level of household planning (Workshop sample: b=.438, ß=.346, $p < .001$; General Sample: b=.319, ß=.260, $p < .001$). This data must be interpreted cautiously, however, because measures of the actual frequency of disaster education participation was not collected. Further research is needed, measuring the direct effect of frequency of disaster education participation on household planning. The implications of these findings will be discussed more fully at the end of this chapter and in the final chapter of this report. Next, however, let us examine the impact of disaster education on adaptive response activities.

Adaptive Response

In addition to the planning measures contained in the household planning index, respondents were asked to report about various protective and mitigative actions they may have taken after they learned of the hurricane threat. Specific items addressed are described in Figure 3-1, and include such things as securing loose items in one's yard, filling one's car with

gas, stocking up on food and water as well as batteries for flashlights and portable radios. These were called "adaptive response" behaviors because they are usually mitigative in nature, done in response to a hurricane threat, as opposed to the longer term planning activities discussed in the prior section. A total of eight items were summed in an "adaptive response index." Interestingly, in contrast to the household planning index, both samples scored much higher on the adaptive response index.

The Impact of Earthquake Education on Adaptive Response

Controlling for Prior Disaster Education and Hurricane Experience

Adaptive response behavior relates somewhat differently to workshop participation under separate conditions of prior disaster education and hurricane experience. In contrast with household planning, adaptive response is not significantly affected by workshop participation regardless of whether or not one has been involved in prior disaster education programs (Table 3-11). The lack of any significant relationship is probably due to the nature of response activities relative to the content of the earthquake education programs. Many of the adaptive response measures are not appropriate or at least not relevant in earthquakes (e.g., filling car with gas, tying down lawn furniture, etc.). Hence, unlike most of the household planning items which are much more generic in their application, these hurricane specific adaptive responses were not affected by participation in earthquake specific education programs.

Workshop participation does affect adaptive response when controlling for prior hurricane experience, but quite differently than was the case for household planning activities. Here, participation in the workshops has a stronger impact on response for those individuals who have not had prior hurricane experience (Table 3-12). This finding is not surprising

Table 3-11: Adaptive Response Index by Sample Controlling for Prior Disaster Education

Response	Sample: No Prior Disaster Education		Sample: Prior Disaster Education	
	General	Workshop	General	Workshop
Low	39.4% (61)	25.6% (10)	18.6% (35)	10.5% (11)
Medium	22.6% (35)	35.9% (14)	23.4% (44)	20.0% (21)
High	38.1% (59)	38.5% (15)	58.0% (109)	69.5% (73)
	X^2=3.75 p >.05		X^2=4.81 p >.05	

Table 3-12: Adaptive Response Index by Sample Controlling for Hurricane Experience

Response	Sample: No Prior Hurricane Experience		Sample: Prior Hurricane Experience	
	General	Workshop	General	Workshop
Low	36.6% (52)	10.5% (4)	21.3% (53)	13.8% (21)
Medium	23.9% (56)	21.1% (8)	24.1% (60)	27.6% (89)
High	39.4% (56)	68.4% (26)	54.6% (136)	58.6% (89)
	X^2=12.39 p <.01		X^2=3.69 p >.05	

since the kinds of activities measured in the adaptive response index are those which should be directly learned from hurricane experience, with readily apparent consequences. Hence, we would not expect the workshops to contribute that much to response behaviors among individuals who have experienced a hurricane. They may, and apparently do, contribute more substantially to adaptive response among those households with no prior hurricane experience.

The Impact of Intensity of Earthquake Education on Adaptive Response Controlling for Prior Disaster Education and Hurricane Experience

Examining the relationship between the individual workshop clusters and adaptive response when controlling for prior disaster education, it is only the in-service training programs which are significantly related to adaptive response, but only among those who have been exposed to prior disaster education. (Table 3-13). This contrasts with household planning, where it was participation in the more intense community workshops that made a significant impact among those who had prior disaster education. This finding is somewhat anomalous, although the relationship is not particularly strong.

Both the in-service training sessions and the more intensive community workshops are significantly related to adaptive response when controlling for prior hurricane experience (Table 3-14). Specifically, where there is no prior hurricane experience, participation in these earthquake education programs did have a significant impact on adaptive response behaviors. Classroom presentations did not significantly affect this preparedness measure. Again, these findings must be interpreted with great caution due to the extremely small number of individuals in the sample who have never experienced a hurricane. None of these cells contains more than 13 individuals. Nevertheless, considered in the context of Table 3-12,

Table 3-13: The Impact of Workshop Intensity on Adaptive Response Controlling for Prior Disaster Education

	Response							
	No Prior Education				Prior Education			
Workshop Intensity	High	Medium	Low	Sig.	High	Medium	Low	Sig.
Community Workshops (N=55)	35.7% (5)	50.0% (7)	14.3% (2)	X^2=5.87 p >.05	61.0% (25)	24.4% (10)	14.6% (6)	X^2=0.38 p >.05
In-Service Training (N=68)	42.1% (8)	26.3% (5)	31.66 (6)	X^2=0.45 p >.05	77.6% (38)	14.3% (7)	8.2% (4)	X^2=6.96 p <.05
Classroom Presentation (N=21)	33.3% (2)	33.3% (2)	33.3% (2)	X^2=0.35 p >.05	66.7% (10)	26.7% (4)	6.7% (1)	X^2=1.68 p >.05
No Workshop (Gen. Sample) (N=343)	38.1% (59)	22.6% (35)	39.4% (61)		58.0% (109)	23.4% (44)	18.6% (35)	

Table 3-14: The Impact of Workshop Intensity on Adaptive Response Controlling for Hurricane Experience

	Response							
	No Hurricane Experience				Prior Hurricane Experience			
Workshop Intensity	High	Medium	Low	Sig.	High	Medium	Low	Sig.
Community Workshops (N=73)	55.0% (11)	35.0% (7)	10.0% (2)	X^2=6.68 p <.05	54.7% (29)	32.1% (17)	13.2% (7)	X^2=2.62 p >.05
In-Service Training (N=91)	81.3% (13)	6.3% (1)	12.5% (2)	X^2=10.63 p <.05	62.7% (47)	22.7% (17)	14.7% (11)	X^2=2.06 p >.05
Classroom Presentation (N=26)	100.0% (2)	- (0)	- (0)	X^2=3.68 p >.05	54.2% (13)	33.3% (8)	12.5% (3)	X^2=1.63 p >.05
No Workshop (Gen. Sample) (N=378)	39.4% (56)	23.9% (34)	36.66 (52)		54.6% (136)	24.1% (60)	21.3% (53)	

these data do suggest that there are quite different dynamics operative with regard to adaptive response behaviors as compared with the more long term household planning activities. Whereas the cumulative effect of prior disaster education seems to enhance the effectiveness of the earthquake education workshops on household planning, the EEC programs seem to affect adaptive response most where there is a void of past experience, especially where there has been no direct hurricane experience. More precise analysis of the impact of workshop participation on adaptive response relative to other variables is possible with the multiple regression models discussed below.

Regression Analysis of the Impact of Education and Control Variables on Adaptive Response

The multiple regression reveals that, as with the household planning index, the general disaster education variable is the most powerful predictor of adaptive response of all of the variables in the model (Table 3-15). Among the workshop sample, having had prior disaster education results in an increase of nearly half a unit on the scale ($b=.461$, $\beta=.218$, $p<.01$). (It should be noted that while the disaster education also resulted in about a half item increase in the household planning index, this represented a much higher percentage increase in performance for that index. Because the adaptive response index contains eight items, a .461 unit increase resulting from prior disaster education represents only about a six percent increase in adaptive response.) Similar to the household planning index, hurricane experience does not significantly impact on adaptive response among the workshop sample. Race, however, is significant, with whites more likely to score high on adaptive response ($b=.567$, $\beta=.143$, $p<.05$).

Examining the results for the general sample (in the right-hand columns of Table 3-15), prior disaster education is once again significant in predicting adaptive response

TABLE 3-15: Regression Analysis of Adaptive Response Index on Disaster Education, Hurricane Experience, and Control Variables

	WORKSHOP SAMPLE			GENERAL SAMPLE		
Variable	b	ß	SE	b	ß	SE
Other Disaster Educ.	.461[b]	.218	.150	.543[a]	.199	.132
Hurricane Experience	-.092	-.040	.165	.341[c]	.122	.132
Marital Status	.245	.097	.218	.113	.038	.159
Race	.567[c]	.143	.287	.664[a]	.185	.175
Education	-.025	-.028	.067	.008	.008	.053
Number of Dependents	.064	.090	.052	.046	.048	.049
Income	.048	.071	.053	.041	.052	.049
Home Ownership	-.278	-.088	.246	.321[c]	.109	.145
	R^2= .109	F= 2.777[b]		R^2= .144	F=8.536[a]	

a: $p<.001$
b: $p<.01$
c: $p<.05$

(b=.543, ß=.199, p <.001). The other independent variable, hurricane experience, does contribute significantly to adaptive response for the general sample as well, albeit less strongly than the education variable (b=.341, ß=.122, p <.05). In addition, the control variables race (b=.664, ß=.185, p <.001) and home ownership (b=.321, ß=.109, p <.05) are also significant here. Finally, as with household planning, a primary focus of this research is to examine the unique impact of the earthquake education programs, controlling for other pertinent variables. Similar to the household planning index, comparing the means of the two samples on adaptive response prior to controlling for other variables reveals a statistically significant difference ($\bar{X}_{workshop}$=7.411; $\bar{X}_{general}$=6.961; t=6.70, p <.05). Again, however, this significance of this comparison disappears when control variables are introduced (alpha $_{workshop}$=6.504; alpha $_{general}$=5.339; t=1.095, p >.05). Hence, once again, when controlling for other pertinent variables, particularly prior disaster education and hurricane experience, the workshops did not have a significant impact on adaptive response. The tabular analysis suggesting a strong positive relationship between workshop participation and response among those without prior hurricane experience, is thus negated in this more stringent test.

Summarizing Adaptive Response

Like household planning, adaptive response activities are profoundly affected by disaster education experience. Moreover, among the general sample, who did not participate in the earthquake education workshops, hurricane experience was significantly related to adaptive response (Table 3-15). In contrast to household planning, however, adaptive response activities are not affected by participation in the earthquake education programs when controlling for prior disaster education (Table 3-11). It was found, however, that the

workshop sample scored significantly higher on adaptive response where there was no prior hurricane experience (Table 3-12). It should be noted, however, that it was the more intensive community workshops and in-service training sessions which most affected adaptive response among this group lacking hurricane experience (Table 3-14). Finally, while the tabular analysis does suggest that the workshop sample scored higher under certain conditions of prior disaster education and hurricane experience, any differences disappeared when controlling for other relevant variables such as marital status, income and education levels, home ownership, etc. (Table 3-16).

Although the tabular analysis did not suggest that prior disaster education provided a more fertile milieu for the earthquake education programs to positively impact adaptive response (as it did for household planning), we did test for the possibility of a cumulative effect of education on adaptive response with the regression procedure. Surprisingly, these data do reveal that having a broader background of disaster education does indeed contribute more strongly to adaptive response behavior (Workshop sample: b=.183, ß=.222, p <.05; General Sample: b=.354, ß=.268; p <.001). Interpreted in the context of the tabular analysis, these data would suggest that there is probably a cumulative effect operative here, but which does not function as a "threshold" that might magnify the impact of the earthquake education programs. That is, as with household planning, it appears that the wider one's exposure to disaster education, the greater the appropriate response behavior. However, unlike household planning, where prior disaster education seems to provide valuable background information which allows EEC participants to more readily assimilate the information in these programs, adaptive response behaviors do not seem to require a "threshold" or critical level of background information to benefit from educational efforts.

Evacuation

Evacuation is an adaptive response behavior which has received special attention in the literature. Hence, it is examined separately here. Evacuation is the most appropriate response to a disaster the magnitude of Hurricane Hugo, particularly if a household is 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.

The 40 percent evacuation rate tells only part of the story, however. It has generally been reported that residents of the Charleston area were very responsive to evacuation orders. Post et al. (1990) report evacuation rates as high as 96 percent on some of the barrier islands which received mandatory evacuation orders. Our data support these reports. Table 3-16 reveals that 88.6 percent of those in mandatory evacuation areas evacuated. Indeed, there is probably no better predictor of evacuation than whether or not one lived in a mandatory or at least strongly suggested evacuation area.

It has already been suggested that there was very little difference between the workshop and general samples in evacuation response (39.4 percent for workshop; 46.6 percent for general). The higher rate of evacuation for the general sample, however, could be due to the possibility that workshop respondents were not as likely to live in a mandatory evacuation area. Table 3-17 examines this possibility by comparing the workshop and general samples while controlling for whether or not evacuation was mandatory, strongly recommended or not recommended at all.

Table 3-16: Evacuation Response by Evacuation Recommendation

Evacuate?	No Evacuation Recommended N	%	Evacuation Strongly Recommended N	%	Evacuation Mandatory N	%
Yes	72	19.7	142	63.7	93	88.6
No	294	80.3	81	36.3	12	11.4
			X^2=207.36 p <.001			

Table 3-17: Evacuation Response by Sample Controlling for Evacuation Response

Sample	No Evacuation Recommended N	%	Evacuation Strongly Recommended N	%	Evacuation Mandatory N	%
Workshop	22	17.7	40	70.2	12	100.0
General	50	20.7	102	61.4	81	87.1
	X^2=0.44 p >.05		X^2=1.40 p >.05		X^2=1.75 p >.05	

Table 3-17 reveals that when controlling for official designation of evacuation areas, there were no significant differences between the control sample and the workshop samples. These data thus strongly suggest that evacuation behavior is not particularly responsive to education efforts. Rather, situational variables, primarily whether or not evacuation was mandatory or strongly suggested, are the most important factors in evacuation.

The situational character of the decision to evacuate is further highlighted when we examine why respondents who lived in mandatory or strongly suggested evacuation areas didn't evacuate. This question was not addressed by the initial interview, but was added for the follow-up interviews. Statistical analysis is quite meaningless because of the 143 respondents called for a follow-up interview, 119 had either evacuated or did not live in a strongly suggested or mandatory evacuation area. Among those living in recommended evacuation areas who did not evacuate, however, several reasons were given for not evacuating, including some of the recurring themes such as not wanting to leave pets, or believing that they could successfully challenge the forces of nature. More commonly, however, respondents failed to evacuate because of more practical reasons. Some didn't have automobiles or other ready means of transportation. Some had sick or otherwise non-ambulatory family members which made evacuation extremely difficult. Still others possessed emergency relevant skills or worked in emergency relevant positions and felt their presence was needed in the area. These are all reasons which are situational in character and will be little affected by greater levels of disaster education or knowledge.

Discussion

We began this chapter by seeking to examine (1) the impact of disaster education on household planning and response more specifically, (2) the effect of earthquake education on planning and response. These are empirical questions which have not received much investigation and have great practical as well as theoretical significance. Insofar as disaster education does impact positively on behavior, the case can be made for greater commitments to quality educational programs in local communities. These findings also have relevance to the broader theoretical issue of the relationship between attitudes (knowledge) and behavior. If ever there is a situation where we would expect there to be a disjunction between knowledge and behavior it would be in a disaster situation. This is a time when normal social life is disrupted, and when normal behavioral patterns are at least temporarily abandoned. Individuals respond to situational demands. Moreover, the relationship between earthquake education and household planning and response to hurricanes has important implications for how readily knowledge acquired in one context (earthquake education workshops) can be applied to other situations (a hurricane).

The data presented in this chapter clearly demonstrates a relationship between disaster education and appropriate planning and response behavior. There are, however, certain conditions under which this relationship is enhanced, which themselves raise some interesting theoretical issues. First, education has a particularly strong effect on planning behavior, where it results in an increase of over 15 percent (in the workshop sample). This contrasts with its effect on adaptive response behavior which is enhanced by only about 6 percent (although this is significant as well). Adaptive response behaviors are those activities which are carried out much closer to the time of a hurricane. Residents receive information from a number of sources regarding appropriate response actions, including television, radio, friends,

co-workers and neighbors. Most people, however, rely on television, which typically provides practical response information. Indeed, more than 86 percent of the sample reported that they received most of their information about Hugo from television. We would expect, therefore, that response will not be as affected by prior disaster education, and particularly not by earthquake education as will the more long-term planning activities, most of which are on-going or take place long before the actual threat of a hurricane. Having participated in disaster education programs was the most powerful predictor of appropriate household planning activities, even when controlling for such important variables as hurricane experience, race, marital status and so on.

The impact of the earthquake education programs specifically is less clear. When controlling for prior disaster education and hurricane experience in the tabular analysis, the workshop sample scored significantly better than the general sample, but under different conditions for adaptive response behaviors than for household planning. The workshops significantly contribute to household planning only where there has been prior disaster education or hurricane experience. The impact of these programs on adaptive response, however, is significant only among those individuals who have never been in a hurricane. In all other instances, the workshops did not make a significant impact on adaptive response activities. On an even more dismal note, any differences between the workshop and general samples reduces to non-significance when controlling for additional variables in the regression model.

The data provided by the tabular analysis does reveal a pattern which suggests that there may be a "threshold effect" of disaster education as it affects household planning activities. Disaster education seems to be most effective in enhancing household planning when it has been reinforced by other educational experiences. This effect does not appear to be operating with adaptive response, however. Here, while there is a direct relationship between the breadth of

educational experience, there is no evidence to suggest that there is a threshold level which maximizes the effectiveness of additional educational efforts.

These findings raise some direct implications for future educational efforts. First, the data suggest that disaster education is an important factor in appropriate preparedness behavior, particularly (but not limited to) household planning. Clearly, such programs should be continued and initiated in disaster prone areas where they do not currently exist. The data further reveal, however, that the earthquake education workshops do not significantly impact household planning or response when controlling for other pertinent variables. This does not mean that the workshops are not providing valuable information, but rather suggests that the workshops are reaching people who are already taking advantage of other educational opportunities (Table 3-3). The demographic data provided in Chapter 2, for example, reveals that the workshop sample is comprised of much more highly educated individuals from more wealthy households. Underrepresented in the workshops are minority households, as well as households with less income and education. These data thus confirm what has already been suggested in Chapter Two that the EEC and other disaster educational programs need to specifically target low-income, minority populations.

Furthermore, disaster education appears to affect household planning differently than it does adaptive response. First, both samples scored much more highly on the Adaptive Response Index than on the Household Planning Index, suggesting a need to focus disaster education programs more on planning issues than is currently being done. The EEC focuses strongly on this dimension, and the data suggest that this continued focus is important. Furthermore, while adaptive response activities seem to respond directly and incrementally to exposure to disaster education, household planning behaviors seem to increase significantly after a threshold of exposure to educational information is reached. Insofar as this is the case, these findings raise a direct policy implication. Frequently, disaster education programs are single time events,

consisting of a workshop, an in-service training program, or even something as basic as a presentation to a class or civic organization. These data suggest that this approach to disaster education is not the most effective, at least insofar as encouraging household planning. Rather, the data suggest that more protracted disaster education curricula should be developed which provide repeated exposure to this valuable information. This is admittedly difficult for voluntary workshops, for as we have seen in Chapter Two, the very individuals who needed the earthquake education programs the most (lower income, minority populations who do not participate in other disaster education programs) are not involved in these programs at all. It will be even more difficult to solicit their participation in longer term programs. Such an approach does have some possibilities for in-service training programs and even high school and college curricula, however. Other creative possibilities might include making correspondence courses available at no or nominal costs to disaster threatened populations. We shall discuss some of these practical implications more fully in the final chapter of this report.

FOOTNOTE

[1]These categories roughly approximate the three workshop clusters for the workshop sample.

CHAPTER FOUR:

DISASTER EDUCATION, PREPAREDNESS AND STRESS

There is a growing body of research which suggests that stress reactions occur in children and adults following a natural disaster. Generally termed "post-traumatic stress disorder" (Diagnostic & Statistical Manual of Mental Disorders, 3rd edition, Revised, 1987), such responses have been observed by McFarlane (1986, 1987, 1988) following an Australian bushfire and by Dufka (1988) following an earthquake. Stress reactions have also been observed following extensive flooding (Earls et al., 1988), tornadoes (Madakasira & O'Brien, 1987), and following a volcanic eruption (Murphy, 1984); Shore et al., 1986). We have also pointed out, however, that other research such as that by Mileti et al. (1984) has failed to find significant increases in stress levels following disastrous events.

Regardless of how much overall stress experienced by a community following a disaster, it would be expected that stress reactions should be considerably less among those who have had prior disaster experience and/or among those who have engaged in disaster education programs. Presumably, such experiences provide a basis for interpreting the events of the disaster as well as fostering greater preparedness on the part of individuals. Indeed, it was reported in Chapter Three that even when controlling for other pertinent variables, prior disaster education was the single most important predictor of preparedness among the households in our sample. Greater preparedness, in turn, should result in lower levels of stress. That is, engaging in household planning and adaptive response activities, individuals should have some sense of control over their environments, and an ability to engage in behaviors which might keep them out of harm's way.

Unfortunately, these hypotheses have remained in the realm of speculation as there has been very little research conducted on the effects of education and preparedness on stress reactions in disaster. This chapter empirically examines the impact of disaster education and hurricane experience on stress reactions among residents in the Charleston area. Furthermore, the effect of the two preparedness measures, household planning and adaptive response on stress will be examined. Finally, the independent effect of participation in the Earthquake Education Center programs on stress will be examined, after controlling for these and other pertinent variables.

A total of ten stress items were included for analysis. Respondents were asked to indicate whether or not they exhibited these symptoms, and if they did, to rank on a scale from 1 to 5 how intensely they experienced them. Possible scores, therefore, ranged from 0 to 5, with 0 indicating that they did not experience these symptoms at all, and 5 indicating that they experienced them with extreme intensity. (Respondents were also allowed to indicate that they did not know or remember if they had experienced a symptom. These cases were simply dropped from the analysis.)

The ten items used as stress measures were selected from a total of 13 items on the questionnaire by using a factor analysis procedure. As with the preparedness indices, principal axis factoring techniques were employed in order to examine the inter-relationships among these variables. Items with factor loadings failing to exceed .30 for any given factor were dropped from the analysis (Kim and Meuller, 1978b). The lowest factor loading for any of the final ten items was .46. This procedure yielded two factors with five items in each. For both factors, scores for each item were summated. Summing the five items, with scores on each ranging from 0 to 5, resulted in an index with potential scores ranging from 0 to 25. These scores were then multiplied by their factor loadings (which ranged from .46 to .85) so as to give greater weight to those items which most strongly contributed to the factor. The first

index, Physiological stress (alpha =.781) is made up of five items which reflect a physiological stress response. These items include experiencing shortness of breath, dizziness, nausea, numbness in one's hands or feet and chest pain. After weighting each item, scores on the physiological stress index ranged from 0 to 15. Psychological stress, the second index (alpha =.817) consists of five items which reflect psychological distress, and include restlessness, a fear of going crazy, difficulty concentrating, irritability and feeling keyed up or on edge. Scores on this index after weighting ranged from 0 to 17.82.

Table 4-1 compares, first, the weighted mean scores of the workshop and general samples for each of the stress items. T-tests were performed on each item to determine whether they were statistically significant. Table 4-1 reveals that on only three of the ten items are there any significant differences between the two samples. These items are: difficulty concentrating, irritability, and feeling keyed up or on edge. Importantly, however, workshop participants scored higher than did the general sample on these stress items. These preliminary comparisons suggest that stress may, in fact, be increased by participation in disaster education programs, a finding which runs directly counter to the expected findings. This issue will be taken up below when the relationship between disaster education generally and the stress indices is examined.

Examining the two indices (also reported in Table 4-1), there are clear differences between the two samples in their reported psychological stress, but no significant differences for physiological stress. Again, however, it is the workshop sample which reports significantly higher levels of psychological symptoms than the general sample. There are also noteworthy differences between the two indices. While the level ofstress reported by residents is relatively low for both indices, respondents report virtually no physiological stress whatsoever! The adjusted mean (after multiplying the score by its factor loading) is .790 and .653 for the general and workshop samples respectively. Indeed, the overwhelming majority of the

Table 4-1: Comparison of General and Workshop Samples on Specific Stress Items

Stress Item	General Sample (Mean)	Workshop Sample (Mean)	t Value
Shortness of breath	.358	.313	0.54
Dizziness	.208	.193	0.25
Nausea	.271	.168	1.64
Numbness in hands or feet	.133	.168	-0.57
Chest pain	.163	.126	0.72
Restlessness	2.279	2.460	-1.18
Fear of going crazy	.578	.566	0.10
Difficulty concentrating	1.328	1.690	-2.51[b]
Irritability	1.969	2.460	-3.18[a]
Keyed up or on edge	2.498	2.842	-2.37[b]
Physiological Stress Index+	.790	.653	0.81
Psychological Stress Index+	6.563	7.672	-2.78[a]

+Indices were constructed using factor weighted scores

a: $p < .01$
b: $p < .05$

respondents (78.8%) reported that they did not experience any of the physiological stress items at all. These data thus confirm Mileti et al's (1984) findings which suggest that the stress experienced by Middletown, Pennsylvania residents after the nuclear release at Three Mile Island was minimal as measured by physiological and behavioral indicators.

Similar to the reporting procedure in Chapter Three, two types of analyses were conducted on the two indices of stress. First, a tabular analysis was conducted, providing broad comparisons between the workshop and general samples. For purposes of the tabular analysis, the two indices were defined as "low" and "high" stress. Because of the relatively greater amount of psychological stress reported, the designations "high" and "low" are separately operationalized for the two indices in order to maximize the variation on each index. Psychological stress is defined as "low" for those respondents whose weighted mean score for the index is less than 6.90, which is the median score for the combined samples. (This is equivalent to a 9 out of a possible of 25 for the unweighted scale). "High" scores are those who score above the median. Because the majority of respondents reported no physiological stress, the operational definition of "low stress" is, in fact, no stress at all for this index. Respondents reporting any physiological stress, regardless of how slight, are categorized as "high" on this dimension. This distinction is problematic, and caution must be exercised when interpreting these data. A respondent who reports only a 1 (on a scale from 1 to 5) on a single item is operationalized here as high on physiological stress. Clearly this is not the case substantively. This division is used, however, so as to maximize any possible variation there may be and is, in fact, methodologically the most appropriate point at which to divide the scale. Furthermore, the more rigorous multiple regression analyses do not require the data to be collapsed in this way, thus correcting any distortions that may occur as a result of the highly skewed categories. It is also recognized that the nomenclature "low" and "high" is technically incorrect as we are, in

fact, distinguishing between no stress and any stress. This nomenclature is retained, however, for purposes of consistency across the indices.

Table 4-2 reveals, first, that psychological stress is much more likely to be affected by preparedness and educational experiences than is physiological stress. Physiological stress is significantly related to household planning only. It is not related to adaptive response, hurricane experience or prior disaster education. Psychological stress, on the other hand, is significantly related to adaptive response and prior disaster education as well as household planning. These differences are due, at least in part, to the greater variability in psychological stress reported. As has been pointed out, respondents reported very little physiological stress, with most reporting that they did not experience any of the physiological symptoms on the scale. Psychological stress, by contrast, is more broadly distributed across the sample, thus allowing for greater differences across the preparedness and educational variables.

Importantly, the relationship between the stress indices and measures of preparedness and education is opposite the expected direction. The higher the number of planning activities in which a household engaged, the higher the level of stress, as measured by both physiological and psychological symptoms. Similarly, the greater the number of adaptive response activities reported, the higher the level of psychological stress indicated. Finally, higher levels of psychological stress were reported by those individuals who had participated in prior disaster education programs than by those who had not. These data, preliminary though they are, clearly suggest that disaster education and preparedness had a negative impact with regard to lowering the level of stress among these respondents.

It would appear, therefore, that disaster education and preparedness activities do not lower stress by providing individuals with a greater sense of control over their environment as hypothesized. On the contrary, it seems that education and preparedness activities may actually serve to heighten individual awareness of the potential devastation that they may experience in a

Table 4-2: Physiological and Psychological Stress by Household Planning, Adaptive Response, Prior Disaster Education and Hurricane Experience

	Physiological Stress		
	Low	High	Sig.
Household Planning			
Low (N=260)	82.3%	17.7%	X^2=11.74
Medium (N=199)	84.9%	15.1%	p <.01
High (N=242)	72.7%	27.3%	
Adaptive Response			
Low (N=213)	76.1%	23.9%	X^2=3.82
Medium (N=173)	78.6%	21.4%	p >.05
High (N=315)	82.9%	17.1%	
Hurricane Experience			
Yes (N=472)	80.9%	19.1%	X^2=1.26
No (N=229)	77.3%	22.7%	p >.05
Prior Disaster Education			
Yes (N=418)	78.9%	21.1%	X^2=0.41
No (N=283)	80.9%	19.1%	p >.05
	Psychological Stress		
Household Planning			
Low (N=260)	58.1%	41.9%	X^2=12.32
Medium (N=198)	48.5%	51.5%	p <.01
High (N=242)	42.6%	57.4%	
Adaptive Response			
Low (N=212)	58.0%	42.0%	X^2=10.43
Medium (N=173)	51.4%	48.6%	p <.01
High (N=315)	43.8%	56.2%	
Hurricane Experience			
Yes (N=471)	48.8%	51.2%	X^2=0.79
No (N=229)	52.4%	47.6%	p >.05
Prior Disaster Education			
Yes (N=415)	45.5%	54.5%	X^2=8.10
No (N=285)	56.5%	43.5%	p <.01

disaster. Rather than feeling more adequately prepared and able to respond to the demands imposed by the disaster, this awareness of what one is supposed to do would seem to only increase the tension that an individual experiences. That is, greater knowledge may, in fact, result in a greater sense of responsibility for taking appropriate actions. This is certainly functional, and as has already been demonstrated, it results in higher levels of preparedness activity. This same heightened sense of reponsibility, however, places demands on individuals that those with less knowledge and awareness do not experience. Ironically, it may be that the lack of awareness of what to expect in a disaster, and the lack of knowledge about appropriate behaviors to take, while increasing one's vulnerability to the effects of the hurricane, actually reduce the level of stress that is experienced during these times.

The sections which follow examine each of the indices of stress respectively. Levels of stress experienced by the workshop and general samples are first compared, controlling for household planning, adaptive response, prior disaster education and hurricane experience respectively. These tabular analyses are followed by a more rigorous multiple regression analysis, which controls not only for these key variables, but also for other relevant demographic variables.

Physiological Stress

This section examines the impact of the earthquake education workshops on physiological stress. The items making up this index include: shortness of breath, dizziness, nausea, numbness in hands or feet, and chest pain. Again, it is important to point out that less that 25 percent of the sample indicated that they experienced any of these symptoms at all. Hence, a great deal of caution must be exercised in the interpretation of these data. This caveat is particularly relevant to the tabular analysis where some of the categories contain as few as

three cases. Furthermore, Table 4-1 reveals that there were no significant differences between the workshop and general samples on any of the items comprising the physiological stress scale. Nevertheless, this relationship is examined here to determine whether workshop participation has any impact on physiological stress when controlling for the preparedness and education variables.

The Impact of Earthquake Education on Physiological Stress Controlling for Household Planning, Adaptive Response, Prior Disaster Education and Hurricane Experience

Tables 4-3 and 4-4 report the relationship between physiological stress and the preparedness measures, household planning and adaptive response respectively. Table 4-3 reveals that participation in the earthquake education workshops does affect the likelihood of physiological stress, but only among those who scored in the intermediate range for household planning activities. Among those scoring at the extremes of preparedness, both low and high, the earthquake education workshop did not significantly affect physiological stress. It is interesting to note that when controlling for household planning, participation in the earthquake education programs actually mitigated physiological stress somewhat. While this difference is only significant among those in the intermediate category for household planning, this pattern is also found, albeit more weakly, among those scoring low on the planning index. As we shall see in the next section, this pattern is reversed for psychological stress. Table 4-4 reveals no significant relationships between participation in the earthquake education workshops and physiological stress, regardless of the level of adaptive response.

Controlling for prior disaster education and hurricane experience (Tables 4-5 and 4-6) there are no significant differences between the workshop and general samples on physiological stress. Regardless if one has participated in disaster education programs in the

Table 4-3: Physiological Stress by Sample Controlling for Household Planning

	Level of Household Planning					
	Low		Medium		High	
Stress	General	Workshop	General	Workshop	General	Workshop
Low	81.2% (164)	86.2% (50)	81.6% (120)	94.2% (27)	73.2% (115)	71.8% (61)
High	18.8% (38)	13.8% (8)	18.4% (27)	5.8% (3)	26.8% (42)	28.2% (24)
	$\bar{X}^2$=0.78 p >.05		$\bar{X}^2$=4.76 p <.05		$\bar{X}^2$=0.06 p >.05	

Table 4-4: Physiological Stress by Sample Controlling for Adaptive Response

	Level of Adaptive Response					
	Low		Medium		High	
Stress	General	Workshop	General	Workshop	General	Workshop
Low	75.4% (138)	80.0% (24)	79.3% (96)	76.9% (40)	81.7% (165)	85.0% (96)
High	24.6% (45)	20.0% (6)	20.7% (25)	23.1% (12)	18.3% (37)	15.0% (17)
	$\bar{X}^2$=0.30 p >.05		$\bar{X}^2$=0.13 p >.05		$\bar{X}^2$=0.54 p >.05	

Table 4-5: Physiological Stress by Sample Controlling for Prior Disaster Education

	Sample			
	No Prior Disaster Education		Prior Disaster Education	
Stress	General	Workshop	General	Workshop
Low	79.3% (184)	88.2% (45)	78.5% (215)	79.9% (115)
High	20.7% (48)	11.8% (6)	21.5% (59)	20.1% (29)
	X^2=2.16 p >.05		X^2=0.11 p >.05	

Table 4-6: Physiological Stress by Sample Controlling for Prior Hurricane Experience

	Sample			
	No Prior Hurricane Experience		Prior Hurricane Experience	
Stress	General	Workshop	General	Workshop
Low	76.3% (145)	82.1% (32)	80.4% (254)	82.1% (128)
High	23.7% (45)	17.9% (7)	19.6% (62)	17.9% (28)
	X^2=0.61 p >.05		X^2=0.19 p >.05	

past, or has experienced a hurricane, the earthquake education programs did not seem to increase or decrease the likelihood of experiencing physiological symptoms of stress.

Regression Analysis of the Impact of Preparedness, Education and Control Variables on Physiological Stress

In addition to the preparedness and education variables, there are several variables which may affect the relationship between workshop participation and household planning (e.g., see Bolin and Klenow, 1982; Flynn and Chambers, 1980; Friedsam, 1961; Glenn, 1979; Strumpfer, 1970). Variables such as race, home ownership, household income and marital status may all contribute to the likelihood that one will experience stress symptoms. Moreover, because stress symptoms are individual level reactions to disaster conditions, the highest level of education in the household (used in Chapter Three) was replaced with respondent's own level of education in the analyses of the stress indices. For the same reason respondents' age and sex were included as variables which may potentially contribute to stress reactions. Then, as in Chapter Three, all of these variables were examined in a single regression model for each of the samples respectively using an ordinary least squares technique. This procedure allows us to determine what effect, if any, that these variables have on stress reactions when controlling for all other variables simultaneously. Comparisons between the two samples are then made using a test for parallelism of slopes (Kleinbaum et al., 1988). This test allows us to determine whether or not there are any significant differences between the two samples after controlling for all other variables.

For purposes of the regression analysis, the physiological stress index (PHYSTRESS), the dependent variable, was not collapsed as it was in the tabular analyses. Similarly, household planning (PLANNING) and adaptive response (RESPONSE) were left intact and not

collapsed into the three categories used in the tabular analysis. Prior disaster education and hurricane experience were dummy coded (1=yes; 0=no). Age is coded directly, and sex is coded so that 1 = male and 2 = female. The remaining control variables used here are the same ones used in Chapter Three and include whether or not respondents owned their own home (OWNHOME), race (WHITE), marital status (MARRIED), income (INCOME), education (EDUCATION) and the number of dependents living in the respondent's household (DEPENDENTS). The coding of these variables is also identical to that used in Chapter Three.

The correlation matrices in Tables 4-7 and 4-8 are combined matrices comprising all of the variables that will be used in the models in this chapter for the workshop and general samples respectively. Again, there appears to be no basis for assuming a problem with multi-collinearity between the variables in this analysis with either the workshop or general sample. The highest correlation between any two variables appearing in any single model is .430 (between home ownership and marital status for the workshop sample). This falls well within acceptable limits for regression procedures.

The results of the regression analysis (Table 4-9) reveal that among the workshop sample, only marital status is significantly related to physiological stress ($b=-1.613$; $\beta=-.287$; $p<.01$). These data suggest that, controlling for other variables, not being married results in nearly a one and two-thirds unit, (about 9 percent) increase in physiological stress symptoms. This is consistent with the findings of Glenn (1979) that fear and anxiety is reduced if one is with other persons at the time of a disaster. None of the other variables, including the preparedness and education variables approached statistical significance. Among the general sample, marital status is not a significant predictor of physiological stress, however. Among these respondents, sex is the only variable that attains significance ($b=.326$; $\beta=.155$; $p<.01$). The regression analysis suggests that women are significantly more likely to report physiological symptoms than men, a finding which has been reported by other researchers as

Table 4-7: Correlation Matrix of Variables Used in the Analysis of the Workshop Sample

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	X	SD
1. PHYSTRESS	1.000	.330	.165	-.040	.102	.003	-.220	-.027	-.137	-.040	.058	-.290	-.056	.094	.671	1.971
2. PSYSTRESS		1.000	.145	.040	.035	-.115	-.077	.050	.046	.012	.171	-.088	-.227	.250	7.617	4.636
3. PREPARE			1.000	.213	.200	.090	-.005	.138	.003	-.120	-.025	-.128	-.075	.040	2.314	1.231
4. RESPONSE				1.000	.244	-.040	.110	.091	.086	.024	.048	-.016	.007	.084	7.469	.772
5 OTHER EDUC					1.000	-.011	.075	.125	.088	.037	-.096	.004	.034	.037	.754	.432
6. HURRRICANE EXP						1.000	.032	-.034	-.070	-.079	-.123	-.009	.225	-.089	.783	.413
7. INCOME							1.000	.228	.112	.267	.040	.371	.014	.024	4.137	1.403
8. EDUCATION								1.000	.021	-.067	-.040	-.130	-.283	.288	7.017	1.358
9. WHITE									1.000	.002	-.051	.188	-.060	-.017	.943	.233
10. OWNHOME										1.000	.155	.430	.001	-.133	.903	.297
11. DEPENDENTS											1.000	.185	-.256	.014	1.434	1.298
12. MARRIED												1.000	.128	-.217	.863	.345
13. AGE													1.000	-.402	44.211	11.434
14. SEX														1.000	1.771	.421

Table 4-8: Correlation Matrix of Variables Used in the Analysis of the General Sample

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	X	SD
1. PHYSTRESS	1.000	.388	.099	.012	.043	-.026	-.054	-.021	-.090	-.056	-.019	-.037	.029	.151	.631	1.719
2. PSYSTRESS		1.000	.097	.169	.103	.061	-.021	.037	.160	.058	.012	.043	-.175	.238	6.747	5.016
3. PREPARE			1.000	.265	.203	-.029	-.044	.047	-.045	-.181	.178	-.027	-.047	-.021	2.093	1.172
4. RESPONSE				1.000	.235	.168	.160	.164	.224	.151	.054	.170	.079	.036	6.969	1.350
5 OTHER EDUC					1.000	.041	.080	.203	.030	.039	.070	.141	-.070	.028	.587	.493
6. HURRRICANE EXP						1.000	.105	.044	.162	.098	-.013	.140	.226	-.007	.629	.484
7. INCOME							1.000	.323	.198	.294	.008	.214	.038	-.045	3.480	1.682
8. EDUCATION								1.000	.035	.121	-.009	.073	-.116	-.008	5.188	1.845
9. WHITE									1.000	.133	-.174	.161	.109	-.049	.823	.382
10. OWNHOME										1.000	.013	.345	.237	.057	.688	.464
11. DEPENDENTS											1.000	.262	-.268	.021	1.506	1.407
12. MARRIED												1.000	.061	.034	.753	.432
13. AGE													1.000	-.087	41.028	13.736
14. SEX														1.000	1.674	.833

TABLE 4-9 : Regression Analysis of Physiological Stress Index on Disaster Education, Hurricane Experience, Household Planning, Adaptive Response and Control Variables

	WORKSHOP SAMPLE			GENERAL SAMPLE		
Variable	b	ß	SE	b	ß	SE
Other Disaster Educ.	.559	.122	.346	.156	.044	.198
Hurricane Experience	.034	.007	.356	.014	.004	.200
Household Planning	.238	.148	.121	.156	.104	.084
Adaptive Response	-.244	-.095	.194	.004	.003	.077
Marital Status	-1.613[b]	-.287	.497	-.088	-.022	.242
Race	-.525	-.062	.630	-.501	-.110	.259
Education	-.087	-.060	.117	-.044	-.047	.054
Number of Dependents	.179	.118	.118	-.061	-.049	.074
Income	-.185	-.132	.116	.044	.042	.060
Home Ownership	.802	.121	.537	-.166	-.044	.225
Age	.005	.029	.015	.004	.035	.007
Sex	.357	.076	.382	.326[b]	.155	.112
	R^2= .171	F= 2.810[b]		R^2= .055	F=1.672	

a: p<.001
b: p<.01
c: p<.05

well (Flynn and Chalmers, 1980; Strumpfer, 1970). While significant, the actual difference between men and women is only about one-third unit (less than 2 percent) increase in stress.

In addition to examining the effects of these variables within each sample, the unique impact of the earthquake education programs on physiological stress after controlling for the possible effects of all other relevant variables was also of interest. As explained above, this is accomplished by comparing the slopes of the physiological stress index for the workshop and general samples respectively. As noted earlier the differences between these two samples were not significantly different prior to introducing the controls ($\overline{X}_{workshop}$=.653; $\overline{X}_{general}$=.790; t=0.81; p >.05). The differences between the samples do achieve significance when controlling for other variables, however ($\overline{X}_{workshop}$=2.922; $\overline{X}_{general}$=.242; t=-2.237; p <.05). Interestingly, however, the direction of association reverses when the controls are introduced, with the workshop sample scoring higher on physiological stress than the general sample.

While the preparedness and education variables are not significantly related to physiological stress, it should be pointed out that, with the exception of the adaptive response index in the workshop sample, the direction of association of these variables to the stress index is positive. That is, as with the contingency tables which used collapsed categories, the regression analysis does suggest that engaging in disaster education programs or having experienced a hurricane does, if anything, contribute to the level of stress that an individual experiences. Similarly engaging in household planning activities seems to increase physiological stress. Hence, while these relationships are not significant, and Table 4-9 should not be interpreted to suggest that these variables make a meaningful impact on physiological stress, the positive relationships found do tend to confirm the tabular analysis and assuage the concern with the biasing influence of the heavily skewed categorical analysis.

Psychological Stress

The second stress index includes symptoms of a psychological nature and includes restlessness, fear of going crazy, difficulty concentrating, irritability and being keyed up or on edge. Respondents in both samples indicated that they experienced considerably more of these symptoms than they did physiological symptoms, and there was considerably more variation in the levels of psychological stress experienced. Moreover, three of the stress items--difficulty concentrating, irritability and feeling keyed up or on edge--were significantly related to participation in the earthquake education workshops, with workshop participants scoring significantly higher on these items than non-participants (Table 4-1). Moreover, Table 4-2 has revealed that the psychological stress index is significantly related to the education and preparedness indices. These psychological symptoms of stress are significantly higher among those who have engaged in household planning and adaptive response activities, and among those who have participated in prior disaster education programs. Hence, the following section examines the relationship between psychological stress and participation in the earthquake education workshops controlling for these preparedness and education variables.

The Impact of Earthquake Education on Psychological Stress Controlling for Household Planning, Adaptive Response, Prior Disaster Education and Hurricane Experience

The relationship between psychological stress and participation in the earthquake education workshops is more likely to be affected by the preparedness and education variables than was the case with physiological stress. Table 4-10 reveals that when controlling for household planning, the workshop sample is significantly more likely to experience these

Table 4-10: Psychological Stress by Sample Controlling for Household Planning

	Level of Household Planning					
	Low		Medium		High	
Stress	General	Workshop	General	Workshop	General	Workshop
Low	61.6% (125)	45.6% (26)	50.7% (74)	42.3% (22)	44.9% (70)	38.4% (33)
High	38.4% (78)	54.4% (31)	49.3% (27)	57.7% (30)	55.1% (86)	61.6% (53)
	X^2=4.66 p <.05		X^2=1.08 p >.05		X^2=0.96 p >.05	

Table 4-11: Psychological Stress by Sample Controlling for Adaptive Response

	Level of Adaptive Response					
	Low		Medium		High	
Stress	General	Workshop	General	Workshop	General	Workshop
Low	59.0% (108)	51.7% (15)	57.5% (69)	37.7% (20)	45.5% (92)	40.7% (46)
High	41.0% (75)	48.3% (14)	42.5% (51)	62.3% (33)	54.5% (110)	59.3% (67)
	X^2=0.55 p >.05		X^2=5.75 p <.05		X^2=0.69 p >.05	

psychological symptoms where levels of household planning are low. This pattern may plausibly be explained in terms of the felt discrepency between what respondents knew they should have done versus the actual level of planning which took place in their household. That is, part of the training which takes place in the earthquake education workshops addresses the need for household planning activities. Hence, among those households that did not participate in these planning activities, it is more likely the workshop sample which experiences the discrepancy between what actions they took and their knowledge of what they should do. It is worthy of note, however, that while only significant where household planning was minimal, workshop participants also reported more psychological stress for all levels of household planning. Hence, it would appear that engaging in these planning activities does not necessarily mitigate the dissonance experienced by workshop participants. Indeed, respondents who scored high on household planning experienced substantially more psychological stress than did those who did not engage in household planning (see also Table 4-2). Hence, as suggested earlier, it would seem that the lack of knowledge and preparedness activities, while certainly not a recipe for reducing risks to life and property, does lower the level of stress experienced by hurricane victims.

Controlling for the second preparedness measure, adaptive response (Table 4-11), the earthquake education programs affect psychological stress in a significant manner, but only among those who participated in intermediate levels of adaptive response activities. Again, among these respondents, considerably more workshop participants reported high levels of psychological distress than did non-participants. While this finding is anomalous, a close examination of Table 4-11 reveals that there were only a small number of workshop participants who scored low on adaptive response in the first place, which may account for the lack of statistical significance. Furthermore, regardless of level of adaptive response, the workshop sample scored higher on the stress index. The direction of association, while not

significant in the low and high adaptive response categories, suggests at least that engaging in appropriate response activities does not greatly reduce the level of dissonance that might be created by workshop participation.

Table 4-12 reveals that the workshop sample was also more likely to report high levels of psychological stress, but only when respondents had not participated in any prior disaster education programs. The same pattern occurs in Table 4-13, where among those who have never experienced a hurricane prior to Hugo, the workshop sample reacted with higher levels of stress than did the general sample. These patterns, while contrary to what was hypothesized, are consistent with the explanation suggested earlier in this chapter. Respondents who have had no prior disaster education, or who have never experienced a hurricane before, are probably not as aware of appropriate responses that they can be taking to mitigate injuries and property damage as are those who have had such educational experiences. Hence, contrary to the hypothesis that disaster education should reduce stress levels in a natural disaster, it appears that stress is actually increased as a result of these experiences.

Regression Analysis of the Impact of Education, Preparedness and Control Variables on Psychological Stress

The regression analysis reveals that, similar to physiological stress, the education variables (prior disaster education and hurricane experience) were not significantly related to psychological stress in either the general or workshop samples (Table 4-14). Household planning, however, was significantly related to this stress index. Among the respondents in the workshop sample, having engaged in household planning activities was positively related to psychological stress ($b=.586$; $\beta=.156$; $p<.05$). Stated differently, each unit increase in household planning activities resulted in a .586 unit (or slightly over 3 percent) increase in

Table 4-12: Psychological Stress by Sample Controlling for Prior Disaster Education

	Sample			
	No Prior Disaster Education		Prior Disaster Education	
Stress	General	Workshop	General	Workshop
Low	59.7% (139)	42.3% (22)	47.8% (130)	41.3% (59)
High	40.3% (94)	57.7% (30)	52.2% (142)	58.7% (84)
	X^2=5.21 p <.05		X^2=1.61 p >.05	

Table 4-13: Psychological Stress by Sample Controlling for Prior Hurricane Experience

	Sample			
	No Prior Hurricane Experience		Prior Hurricane Experience	
Stress	General	Workshop	General	Workshop
Low	57.4% (109)	28.2% (11)	50.8% (160)	44.9% (70)
High	42.6% (81)	71.8% (28)	49.2% (155)	55.1% (86)
	X^2=11.03 p <.001		X^2=1.46 p >.05	

TABLE 4-14: Regression Analysis of Psychological Stress Index on Disaster Education, Hurricane Experience, Household Planning, Adaptive Response and Control Variables

	WORKSHOP SAMPLE			GENERAL SAMPLE		
Variable	b	ß	SE	b	ß	SE
Other Disaster Educ.	.085	.008	.824	.371	.036	.538
Hurricane Experience	-.694	-.062	.855	.780	.075	.542
Household Planning	.586[c]	.156	.292	.366	.086	.229
Adaptive Response	-.113	-.019	.468	.407	.109	.208
Marital Status	-.795	-.059	1.226	-.043	-.004	.662
Race	1.464	.073	1.519	2.089[b]	.158	.708
Education	-.046	-.013	.278	-.035	-.013	.148
Number of Dependents	.529	.148	.284	-.177	.050	.199
Income	-.292	-.088	.278	-.242	-.081	.167
Home Ownership	1.273	.081	1.302	.974	.090	.613
Age	-.022	-.055	.035	-.084[a]	-.230	.020
Sex	2.176[c]	.201	.909	1.262[a]	.208	.303
	R^2= .128	F= 2.013[c]		R^2= .156	F=5.337[a]	

a: $p<.001$
b: $p<.01$
c: $p<.05$

psychological stress. The adaptive response index was not significantly related to stress among the workshop participants. Morever, neither household planning nor adaptive response was significantly related to psychological stress for the general sample.

Table 4-14 reveals a number of other variables which are also significantly related to the psychological stress index. Among the workshop participants, females reported significantly more stress symptoms than males (b=2.176; ß=.201; p <.05). Women scored more than two points higher on the stress scale than men, representing over 12 percent more stress for women than for men among the workshop participants.

Women in the general sample also report higher levels of psychological stress than their male counterparts (b=1.262; ß=.208; p <.001). Here, women scored nearly 1 1/3 units higher (about 7 1/2 percent) on the stress scale than men. These data thus confirm the findings of earlier studies which suggest that reports of stress are higher among women during times of crisis (Flynn and Chalmers, 1980; Strumpfer, 1970).

In addition to sex, race was also significantly related to stress, with whites in the general sample scoring more than 2 units higher (about 12 percent) than were non-whites (b=2.089; ß=.158; p <.01). Finally, Table 4-14 also reveals that age is negatively related to psychological stress for the general sample with younger persons reporting slightly greater stress than older victims (b-.084; ß=-.230; p <.001). This finding contrasts with previous literature which generally reports that older persons have a more difficult time coping with the consequences of disaster (Bolin and Klenow, 1982; Friedsam, 1961). It may be, however, that this is a curvilinear relationship, with respondents at either end of the age continuum experiencing greater stress than those in the middle age categories.

Finally, as with physiological stress, this research seeks to examine the unique effect of participation in the earthquake education programs on psychological stress. Unlike physiological stress, there were significant differences between the two samples before the

control variables were introduced ($\bar{X}_{workshop}$=7.672; $\bar{X}_{general}$=6.563; t=-2.78; p <.01--See Table 4-1). Furthermore, the difference between the two samples remains significant even after controlling for relevant education, preparedness and demographic variables ($\bar{X}_{workshop}$=4.843; $\bar{X}_{general}$=1.764; t=-2.679; p <.05). These results thus provide strong evidence that the earthquake education workshops did have a significant impact on psychological stress. Again, however, the impact of these programs was opposite the expected direction. Program participants experienced significantly more intense levels of psychological stress than did non-participants, even after controlling for the effects of other variables which might have otherwise contributed to the differences between the two samples.

Discussion

The data presented throughout this chapter reveal several interesting patterns related to stress symptoms experienced by residents in the Charleston area following Hurricane Hugo. Two patterns are especially apparent and merit further discussion here: (1) the relatively greater levels of psychological stress as compared with physiological stress symptoms; and (2) the positive relationship between the preparedness and education variables (including participation in the earthquake education workshops) and levels of stress. The section will conclude with a brief discussion of the limitations of these data.

Physiological and Psychological Stress

Perhaps the most substantial finding of this chapter is the profound difference between levels of physiological and psychological stress experienced by the respondents in both the general and workshop samples. Nearly 80 percent of both samples indicated that they

experienced none of the physiological symptoms of stress measured here--not even with the slightest of intensity. Moreover, most of those who did report any physiological symptoms reported only very minor levels. Indeed, only 10 respondents (1.3 percent of the sample) reported moderate levels of physiological stress or greater. Hence, while it was methodologically necessary to divide the sample in categories of low and high for the tabular analysis, it is, in fact, quite inappropriate to even suggest that these Hugo victims experienced intense physiological symptoms at all. This contrasts with reported symptoms of psychological stress, where only 15 percent of the sample reported none of the psychological symptoms in the index and 19 percent reported their symptoms of moderate to very strong intensity. Despite the higher levels of psychological stress symptoms reported, it might also be noted that only 6.1 percent of the combined sample reported strong or very strong psychological stress reactions.

This pattern has both substantive and methodological implications which will be addressed more fully in the next chapter. First these data suggest that stress reactions are not as problematic as is commonly assumed during disaster. These data generally support the findings by Mileti et al. (1984), who using behavioral and physiological measures of stress, found that while stress did increase somewhat as a result of the accident at Three Mile Island, these increases were minimal. These increases were short-lived and well within normal levels during seasonal highs in a typical year, about what a normal population would experience during a major holiday. While we do not have baseline data with which to compare our data, the low levels of stress reported, particularly physiological stress, suggest that Charleston area residents were not severely stressed as a result of Hurricane Hugo.

It is difficult to interpret the meaning of the higher intensity levels reported for psychological stress symptoms. While restlessness, sleeplessness, and feeling keyed up or on edge are certainly not comfortable emotional states, and most of us would wish to avoid these states during normal times, these very symptoms may be quite functional in a disaster. Indeed,

it could be argued that these psychological responses actually help victims focus their energies for tackling the difficult problems associated with emergency response and even recovery phases of a disaster. Hence, unlike physiological symptoms of stress, which are more clearly dysfunctional in a disaster situation, the psychological indicators, at moderate levels such as reported here, may play a positive role in surviving a disaster such as Hugo.

Effect of Preparedness and Education on Stress

Contrary to what was expected, these data reveal that, generally, educational experiences and preparedness activities actually increased the intensity of stress experienced by the respondents in the samples. Furthermore, when controlling for other variables in the regression analysis, the workshop samples reported significantly higher levels of both physiological and psychological symptoms of stress. While these results challenge much of the existing knowledge, further reflection suggests that these patterns are not necessarily anomalous.

A major function of disaster education is to heighten cognitive awareness of the potential dangers of natural hazards and to foster an awareness of what sorts of activities might mitigate such damages. These educational experiences, in effect, raise one's expectations for their own behavior in a disaster as they present ideal models for preparedness and response activities. If one does not respond in these ideal ways, the individual may well experience a level of cognitive dissonance which might be manifest in certain stress symptoms, particularly psychological ones.

For the same reason, workshop participants who had not participated in other disaster education programs or who had not experienced a hurricane were significantly more likely to experience psychological stress than the general sample. There were no significant differences between the two samples, however, among those individuals who had been in a hurricane before

or had participated in other disaster education programs. These patterns support the notion that disaster education and/or experience may have a dissonance producing effect. Respondents who have been in a disaster or who have participated in other disaster education programs should be aware of appropriate preparedness and responsive action regardless of whether or not they participated in the earthquake education programs. Hence, respondents in both the workshop and general samples should experience a higher level of stress if they have participated in prior disaster education programs. The data in Table 4-2 suggest that this is, in fact the case, particularly with regard to psychological stress symptoms. Among those who have had no exposure to other disaster education opportunities, however, the workshop sample alone has had this consciousness-raising experience. Hence, under these conditions we would expect the workshop sample to score significantly higher than the general sample. The contingency tables generally support this explanation. More importantly, the regression analyses, which control not only for these variables, but for a variety of demographic variables as well, also reveal significantly more intense levels of stress among the workshop sample.

It was also found that stress levels were higher among respondents who did, in fact, engage in proper household planning activities (and less substantially so among those who engaged in adaptive response activities). Clearly, the level of dissonance should be less among these individuals than among those who failed to participate in these activities. This is not necessarily the case, however. We have demonstrated in Chapter Three that those scoring higher on the household planning and adaptive response activities were much more likely to have participated in disaster education programs and/or to have experienced a hurricane. Hence, most of these individuals scored higher on these preparedness measures presumably because of these educational experiences. Engaging in more household planning and/or adaptive response activities may not necessarily lower the dissonance, however. They could have always planned <u>better</u>; they could have had <u>more</u> family meetings, etc. Indeed, it could be argued that

those who are most conscientious about family planning and adaptive response are also the most likely to have higher standards for their own behavior.

It would be premature, however, to conclude that these educational programs are dysfunctional with regard to stress reactions. It has already been suggested that some stress is, in fact, likely to be functional in a disaster situation. The stress items included on these indices are, generally, quite minor. This is particularly true of those items included in the psychological stress index. Indicators of suicide attempts, alcoholism, cardiac arrest, or other behaviors/symptoms which are clearly dysfunctional are not included. Indeed, it is quite likely that the education and preparedness measures would lower the level of these sorts of stress symptoms. The stress items included here, however, are much more likely to facilitate appropriate responses in a disaster. Hence, far from having a dysfunctional effect, the stress induced by participating in disaster education programs and household planning activities probably functions to lower injury to life and property.

Limitations of the Data

This chapter is concluded by highlighting two limitations of these data which should be considered in their interpretation. First, these are "paper and pencil" responses to questions about stress reactions which were asked some three months after Hurricane Hugo struck the Charleston area. Actual behavioral and/or unobtrusive measures of physiological responses have been argued to provide a more realistic account of actual stress response (Mileti et al., 1984). Moreover, the fact that these interviews took place several months after the hurricane struck could result in rather unreliable information because of distortions in the memories of the respondents. These data are, in this sense, more properly considered accounts of stress.

A second source of caution with regard to the stress indices is the extremely low levels of physiological stress reported by these respondents. Because such an overwhelming majority of

the samples reported absolutely no stress, there is very little variability for which to account. Consequently, while variation on the physiological stress index is not reported, with some differences even attaining statistical significance, there is little substantive variation across the respondents with regard to physiological stress symptoms. Simply put, physiological stress symptoms were not widely manifest among the respondents in these samples and it is inappropriate to draw any broad conclusions regarding variation in physiological stress based on these data. The most meaningful analyses are those of psychological stress reactions.

CHAPTER FIVE:

SUMMARY AND IMPLICATIONS

This study had as its primary objective the examination of the impact of disaster education, specifically earthquake education, on individual and household preparedness for and response to Hurricane Hugo among residents in the Charleston, South Carolina area. Second, it was sought to determine whether these educational programs had any effect on levels of stress experienced by Charleston area residents. Beyond the specific effects of the earthquake education workshops, however, the study sought to examine what effect disaster education generally has on these individual and household responses to emergency situations. Hence, in addition to the earthquake education workshops the impact of disaster education was examined generally as well as hurricane experience (itself a type of disaster education) on these preparedness and response variables.

Preparedness was broadly defined in this study to include both household planning and adaptive response activities. Household planning refers to those activities in which residents engage substantially prior to the threat of a hurricane and includes such things as having family planning meetings for what to do in the event of a disaster, planning an evacuation route, etc. Adaptive response, by contrast refers to those activities performed in direct response to the hurricane threat. These activities include picking up loose items in one's yard, securing one's pets, filling one's automobile with gasoline, etc. In addition evacuation as a special type of adaptive response was examined. Stress symptoms measured include both those of a physiological nature (chest pains, nausea, dizziness, numbness in one's hands or feet, and shortness of breath) and those of a psychological nature (restlessness, a fear of going crazy, feeling keyed up or on edge, irritability and difficulty concentrating).

There has been a profound paucity of literature addressing the impact of disaster education on either preparedness activities or on stress reaction. While there has been a fairly extensive literature on the impact of disaster experience as an educational medium, literature addressing the effectiveness of formal disaster education programs is quite limited. Much of the literature which does exist tends to be based on convenience samples and even impressionistic data which, while helpful in providing an oriention to some of the issues and problems involved, does not allow any firm conclusions to be drawn. Hence, the data presented here are important in that they represent an attempt to more rigorously and systematically guage the effectiveness of formal disaster education programs.

The issues addressed in this study have great practical as well as theoretical significance. Insofar as disaster education does have a positive impact in the way of increased preparedness and reduced stress, there is a strong case for increasing local, state and federal commitments to quality disaster education programs. These findings, particularly those in Chapter Three, also have relevance to the broader theoretical issue of the relationship between attitudes (knowledge) and behavior. Disasters are times when normal social life is temporarily disrupted, when normative queues are ambivalent and when normal behavioral patterns are altered as individuals respond to situational demands imposed by the disaster. Hence, if there ever is a situation where one might expect there to be a disjunction between knowledge and behavior it would be in a disaster situation. Moreover, the relationship between earthquake education and household planning and response to hurricanes has important implications for how readily knowledge acquired in one context (earthquake education workshops) can be applied to other situations (a hurricane).

Summary of Findings

Disaster Education and Hurricane Preparedness

The data presented in this chapter clearly demonstrate a relationship between disaster education and preparedness behavior. There are, however, certain conditions under which this relationship is enhanced, which themselves raise some interesting substantive and theoretical questions. First, household planning is more substantially affected by disaster education than is adaptive response. Having participated in disaster education programs was the most powerful predictor of appropriate household planning, contributing to a 15 percent increase in these activities, even when controlling for such important variables as hurricane experience, race, marital status, etc. Adaptive response activities, by contrast, increase by only about 6 percent as a result of disaster education experience. Residents are informed of appropriate adaptive response actions from a number of sources including radio, friends, co-workers, neighbors, and especially television. We would expect, therefore, that response will not be as affected by formal disaster education programs as will the more long-term planning activities, most of which are on-going or take place long before the actual threat of a hurricane.

The impact of the earthquake education programs specifically is less clear. The regression analyses, which control for all relevant variables simultaneously, suggest that there are no significant differences between the two samples in levels of household planning or adaptive response. When controlling only for prior disaster education and hurricane experience in the tabular analyses, however, the workshop sample scored significantly better than the general sample, but under different conditions for adaptive response behaviors than for household planning. The workshops significantly contribute to household planning only where there has been prior disaster education or hurricane experience. Adaptive response, by

contrast, is significantly affected by workshop participation only where there has been no prior hurricane experience.

These findings raise an interesting theoretical question. It was expected that the earthquake education programs would be more likely to significantly impact household planning where there was no prior disaster education. It was hypothesized that under these conditions, the workshops represent one's only formal disaster education experience, hence representing a qualitatively greater exposure to disaster information. Among those who have participated in other disaster education programs, however, participation in the earthquake education workshops represents only incrementally more educational exposure. Hence, it was expected that the earthquake education programs have their greatest impact among those devoid of any other disaster education participation. The fact that the workshop participants scored higher where respondents have participated in prior disaster education programs or have had prior hurricane experience suggests that there may be a "threshold effect" whereby disaster relevant information becomes salient and effectively internalized only after repeated educational exposure. That is, disaster education seems to be most effective in enhancing household planning when it has been reinforced by other educational experiences. This hypothesis was further supported when the specific type of program in which the workshop sample participated was examined. It was only those who participated in the more intensive one and two day workshops that scored significantly higher on household planning when controlling for prior disaster education and hurricane experience. Community workshops alone, apart from other disaster education or hurricane experience, however, did not result in higher levels of household planning. Similarly, in-service training and classroom presentation sessions were not sufficiently intensive to encourage significantly higher levels of household planning activity.

In contrast to household planning, the impact of the earthquake education programs on adaptive response is significant only among those individuals who have never been in a

hurricane. The workshops did not make a significant impact on adaptive response activities when controlling for prior disaster education participation. Hence, the threshold effect which seemingly characterizes household planning does not appear to be operating with adaptive response. While participation in disaster education programs increases the likelihood of adaptive response activities generally (Tables 3-2 and 3-15), there is no evidence to suggest that there is a threshold level which maximizes the effectiveness of additional educational efforts.

Evacuation is a special form of disaster response which has received widespread attention in the literature. Indeed, for many residents of the Charleston area, evacuation was the most appropriate form of adaptive response to Hurricane Hugo. Post et al. (1990) report that some 96 percent of residents on some of the barrier islands evacuated their homes. Our data reveals that 46.6 percent of the general sample in the three-county area evacuated their homes. The evacuation rate varied greatly by geographical area, however, with 88.6 percent of the respondents who lived in mandatory evacuation areas evacuating their homes. Indeed, there was no better predictor of evacuation than whether or not one lived in a mandatory or strongly suggested evacuation area. When controlling for geographical location, there were no significant differences between the workshop and general samples as to their likelihood of evacuation.

Disaster Education, Preparedness and Stress Reactions

Stress reactions reported by the respondents in this study were quite minimal, particularly as measured by physiological symptoms. Only about 20 percent of both samples reported any physiological stress symptoms at all, and of those who did, only 10 (1.3 percent of the combined sample) reported levels of moderate intensity or higher. Respondents reported greater levels of psychological stress, although even here, only about 6 percent of the samples reported reactions which were strong or very strong. While we do not have baseline data to

compare these data with stress levels prior to Hurricane Hugo, the low levels of stress indicated here, particularly physiological symptoms, would suggest that Hugo did not dramatically increase the stress levels experienced by Charleston area residents.

It was expected that participation in disaster education programs should also contribute to a lowering of stress symptoms during and after the hurricane. It was hypothesized that participation in disaster education programs should provide a broader basis for interpreting the events of a disaster, allowing individuals to make more rational decisions and responses to a disaster. Furthermore, as demonstrated in Chapter Three, educational experiences tend to result in greater levels of household planning for a disaster on the part of individuals and households. Greater preparedness, in turn, should mitigate the vulnerability of individuals and households to a disaster. It was expected, therefore, that disaster education participation and higher levels of preparedness should result in lower levels of stress symptoms.

Contrary to expectation, the data revealed that educational experiences and preparedness activities generally increased stress levels. Furthermore, when controlling for other variables in the regression analysis, the workshop samples reported significantly higher levels of both physiological and psychological symptoms of stress. While these results challenge the conventional wisdom guiding our expectations, these results are broadly consistent with social psychological principles of cognitive dissonance.

A major goal of disaster education is to heighten cognitive awareness of the potential dangers of natural hazards and to foster an awareness of what sorts of activities might mitigate such damages. It is assumed that this greater knowledge will then result in appropriate behaviors that will reduce vulnerability to a disaster. Beyond this, however, these educational experiences are likely to raise one's expectations for their own behavior in a disaster. If one does not engage in the optimum manner suggested by these educational programs, one may well experience a level of dissonance which could result in stress symptoms.

It was also found that stress levels were higher among respondents who did, in fact, engage in proper household planning activities (and less substantially so among those who engaged in adaptive response activities). Again, it was expected that the level of stress should be less among these individuals than among those who failed to participate in these activities. Indeed, it would seem that those individuals who have been more diligent in engaging in preparedness and response activities should experience less dissonance than those who have not. This is not necessarily the case, however. Presumably, the higher scores on the preparedness indices were at least partially a result of broader educational experiences, either in formal disaster programs or through direct hurricane experience. If these educational experiences are successful they will challenge even the most diligent to stronger preparedness efforts. Indeed, it is likely to be the most conscientious who most experience the dissonance between what they have done in the way of preparedness efforts and what they could have done. Hence, higher levels of preparedness activities, could in this way, correlate with higher levels of stress symptoms experienced.

Implications of Findings

The findings presented throughout this report have important policy implications as well as theoretical and other research implications. This report is concluded by highlighting these implications and suggesting some possible areas for research and policy activities.

Policy Implications

These findings raise some direct implications for future educational efforts. First, the data demonstrate that disaster education is an important factor in appropriate preparedness behavior, particularly (but not limited to) household planning. There is no other single

variable that as strongly and consistently predicts preparedness behavior. Clearly, such programs should be continued, and initiated in disaster prone areas where they do not currently exist. According to these data, there is every reason to believe that if disaster education programs are widely made available to residents in areas threatened by disasters, the level of household preparedness in those communities should increase appreciably. Contrasting with these general findings suggesting that disaster education positively impacts household preparedness, the data further suggest that overall, the earthquake education workshops, specifically, did not significantly impact household planning or adaptive response.

These data thus suggest that there are problematic areas in the delivery of disaster education that need to be addressed in future efforts. First, and perhaps most obviously, disaster education programs need to specially target low income and minority population groups, as well as other segments of the population which are not likely to have access to disaster education information. While the earthquake education workshops offer valuable information for households and special interest groups on how to prepare for a disaster, these programs are reaching people who are already taking advantage of other educational opportunities. Furthermore, the data reveal that the workshops attract primarily those who are highly educated and comparably wealthy. Underrepresented in the workshops are minority households, as well as households with less income and education. This does not mean that populations which take advantage of other educational opportunities do not benefit from further exposure to this information. Indeed, our own data make a strong case for the need for repeated exposure to disaster information for it to be most effective.

Additionally, what is needed are strategies for targeting and recruiting those populations which are not in the traditional "loop" for receiving these kinds of information. Beyond targeting teachers, nurses, fire fighters, and other professional and special interest groups who generally have access to informational materials, disaster education programs might be

promoted and conducted under the auspices of neighborhood organizations as a means of attracting hard-to-reach populations. Alternatively, working through local churches where possible will reach many individuals who are not as likely to be involved in many of the traditional civic organizations. Also, organizations such as Habitat for Humanity, for which housing is a special focus, can provide a very effective forum for reaching populations not reached through more traditional strategies.

The finding that both samples scored substantially higher on the adaptive response index than on the household planning index suggests that future disaster education efforts should place greater emphasis on the importance of these long term planning activities. The Earthquake Education Center focuses strongly on this dimension, and the data suggest that this continued focus is important.

The findings also raise questions as to the effectiveness of earthquake specific education for hurricane preparedness. The regression analyses suggested that the EEC workshops did not make a significant impact on hurricane preparedness when controlling for other variables. Certainly, much of the information conveyed in these workshops is sufficiently generic that they can be applied to multiple disaster situations. Household planning activities tend to be of a more general nature than are adaptive response activities, most of which are uniquely appropriate to hurricanes. The tabular analyses do suggest that the workshops may have some positive impact on household planning where there has been prior exposure to disaster education information. Interestingly, the workshops significantly contributed to adaptive response only in the absence of prior hurricane experience, suggesting that specific hurricane experience is a more important predictor of adaptive response activities than are the workshops. This interpretation is corroborated in the regression analysis in Table 3-15. This suggests, therefore, that while there may be some knowledge transfer, disaster education programs need to be agent specific in their focus. In areas like Charleston, which are

threatened by more than one type of disaster agent, programs should be developing a multiple-agent approach.

It is also significant from a policy standpoint that household planning behaviors seem to increase significantly after a threshold of exposure to educational information is reached. Insofar as this is the case, we would not expect disaster education programs to have a substantial impact unless one received repeated exposure to this information. Yet, most typically, these programs are single time events, consisting of a one-day workshop, an in-service training program, or even something as basic as a presentation to a class or civic organization. It would appear that this approach to disaster education is not the most effective, at least insofar as encouraging household planning. Rather, the data suggest that more protracted disaster education curricula should be developed which provide repeated exposure to this valuable information. This approach to disaster education has an additional advantage in that it facilitates a multi-agent approach to disaster education. It is difficult to address two or three or more agent types in a single session; however, with a program curriculum that extends over a two or more week period, disaster education programs are more able to address agent-specific responses for several types of agents. An extended curriculum approach is admittedly difficult for voluntary workshops, for as has been shown the very individuals who needed the earthquake education programs most (lower income, minority populations who do not participate in other disaster education programs) are not involved in these programs at all. It will be even more difficult to solicit their participation in longer term programs. Such an approach does have some possibilities for in-service training programs and even high school and college curricula, however. Another strategy might involve making correspondence courses available at no or nominal costs to disaster threatened populations. Incentives for participating in these types of programs will certainly facilitate this kind of involvement. Lowered property insurance rates for households taking part in disaster education programs is one such incentive that may be

effective in promoting this kind of involvement. Insofar as participation in these kinds of programs are effective in mitigating property damage, it seems that it would also be in the best interests of insurance companies to make such rate reductions available.

The findings which suggest that stress levels increase as a result of participation in disaster education programs seems, ostensibly, to be counter-productive to the goals of disaster education. These findings are not interpreted to mean that these educational programs are dysfunctional with regard to stress reactions, however. It has been pointed out that some stress is likely to be functional in a disaster situation. The stress items included on these indices are, generally, quite minor. This is particularly true of those items included in the psychological stress index. Being keyed up or on edge, irritable, and restless should be expected in a disaster; indeed, failure to experience these symptoms might well be dysfunctional in a disaster situation. Hence, far from having a dysfunctional effect, the stress induced by participating in disaster education programs and household planning activities probably functions to lower injury to life and property. More serious symptoms of stress such as suicide attempts, alcoholism, cardiac arrest, etc. are not included in this analysis. These symptoms are clearly more dysfunctional, and would, hopefully, be reduced by participation in disaster education programs.

Research Implications

These findings have addressed a number of theoretical issues which have relevance to the study of disaster and to the social sciences generally. The impact of disaster education on preparedness is certainly a question which has been begging for evidence for some time. These data provide evidence that education programs do have a positive impact, although as has been suggested, there are a number of ways in which these programs may be improved. Beyond this substantive question, however, is the broader theoretical issue of "attitude-behavior consistency." It is commonly believed that behavior is a natural extension of one's attitudes.

Decades of social science research, however, have failed to provide strong support for this contention, finding instead that behavior tends to be much more situationally determined (Warner and DeFleur, 1969; Schuman and Johnson, 1976).

The subject of this study is a variant of this decades old theoretical question, addressing instead the extent to which knowledge of appropriate behavior for a given situation is manifest behaviorally when such a situation occurs. Our data suggests that, to some extent at least, disaster knowledge does take behavioral expression in a disaster situation. There are at least two possible reasons for why this is so, in contrast to much of the attitude-behavior consistency literature. First, disaster education programs specify appropriate behavior for specific situations. Unlike studies which measure general attitudes toward racial prejudice, for example, where situational circumstances may negate any behavioral tendencies that these more general attitudes may promote, disaster education programs are oriented to what an individual should do in a specific situational context. These findings are consistent with those of Ajzen and Fishbein (1977) and others (Crespi, 1971; Heberlein and Black, 1976) which suggest that as the specificity of attitudes increase, they are a much stronger predictor of behavior. Hence, we should expect greater consistency between cognitive and behavioral realities in this instance. A corollary explanation is that disaster education provides instrumental knowledge for behaviors appropriate for reducing loss of life and property in contrast to the more expressive or valuative nature of attitudes and associated behaviors examined by most studies of attitude-behavior consistency. Again, the cognitive nature of instrumental knowledge is more focused than is the case with more general attitudes, orienting the individual toward appropriate behavior in a specific situation.

This research, unfortunately, lacks a critical piece of information necessary to adequately test for attitude-behavior consistency: a measure of disaster knowledge. This study infers a greater level of knowledge on the part of individuals participating in disaster education

programs. This is a reasonable inference, but remains an empirical question. Future research addressing this issue should proceed in two stages. First, baseline data should be established with cohorts of residents in a disaster prone community who have and have not participated in disaster education programs. This research phase should include a battery of questions which would establish one's level of knowledge regarding appropriate preparedness and response behavior in a disaster. Only in this way is it possible to empirically establish the relationship between disaster education and instrumental knowledge. Long term household planning behavior can also be measured during this first phase of the research. Adaptive response behavior, however, can only be measured with follow-up interviews with the same cohort of individuals after a disaster strikes. Such a research design should provide a clearer picture of the nature of the impact of disaster education on preparedness behavior than we are able to do here, and will provide for a direct assessment of the impact of knowledge on behavior.

These data do not find strong evidence that the earthquake education programs had an impact on preparedness behavior, although among those who had participated in other disaster education programs, the workshop sample did seem to engage in more household planning activities. These data thus suggest that for agent-specific responses such as those included in the adaptive response index, there is minimal knowledge transfer across agent types. Future research comparing appropriate responses which are common across disaster agents with agent specific responses should provide more precise answers to this question.

Related to the above issue, this research compiled relatively extensive information regarding respondents' experience with the earthquake education workshops. These data did suggest that it was the intensive one and two day workshops which had the greatest impact on household planning behavior. However, no information was collected on other disaster education experiences which may have been more directly oriented to hurricane response, or even if these other disaster education experiences were hurricane or other agent-specific in nature. Because

disaster education programs vary greatly in the nature and amount of information they provide as well as the medium in which it is communicated, future research should examine how these variables affect disaster knowledge and behavior. Furthermore, given that the specificity of knowledge is generally more predictive of behavior, further research assessing the specific nature of disaster education should be helpful in understanding how disaster education programs impact on adaptive behavior.

The findings reported here also suggest that there may be a threshold effect, whereby educational experiences are most effective only after a critical level of exposure to disaster information has been achieved. Unfortunately, these findings allow only the inference of such an effect. Respondents were asked only whether or not they had participated in any prior disaster education programs, not how many programs or how much time they spent in these programs. Future research efforts should more directly test this hypothesis by soliciting data on the number of prior educational programs respondents have participated in, their intensity, and even the amount of time involved in these programs. These more detailed data will allow us to more directly determine at what point a threshold is reached, when additional disaster education begins to substantially impact preparedness and response activities.

Finally, this study raises some very interesting questions regarding the impact of disaster education on stress reactions, as well as the relationship between preparedness and stress. Reports of higher levels of stress by those who have participated in disaster education programs (including the EEC programs) and by those engaging higher levels of preparedness activities beg for further investigation. Further research in this area might proceed in two directions. First, it would be helpful to establish baseline stress information prior to a disaster which could later be compared with follow-up reports using identical items at some given point in time following a disaster. Combined with information on participation in disaster education programs, levels of knowledge and preparedness activities, this comparison of pre-

and post-disaster stress levels will allow us to more accurately measure the impact of these programs and activities on stress. That is, it may be that individuals who participate in disaster education programs and/or engage in high levels of preparedness activities experience higher levels of stress in the first place. Examining any differences in the levels of stress experienced before and after a disaster will provide a stronger basis from which to assess what effect, if any, that disaster education and preparedness activities may have on stress reactions.

Because of the potential problems of interpretation with psychological stress measures, it is also suggested that future research employ more unobtrusive behavioral and physiological measures of stress which can be more unambigously interpreted as dysfunctional in a disaster. Increases in levels of alcohol consumption, cardiac symptoms, marital conflicts, stomach ulcers, and the like are all more readily interpreted as dysfunctional and undesirable, even in a disaster situation. The occurrence of these symptoms at higher rates among participants in disaster education programs, were this to be the case, would clearly call for a re-examination of our approach to disaster education.

References

Ajzen, I. & Fishbein, M. (1977). Attitude-behavior relations: A theoretical analysis and review of empirical research. Psychological Bulletin, 84, 888-918.

Bolin, R.C. & Klenow, D.J. (1982). Response of the elderly to disaster: An age stratified analysis. International Journal of Aging and Human Development, 16, 283-296.

Bourque, L.B., Reeder, L.G., Cherlin, A., Raven, H. & Walton, M. (1973). The unpredictable disaster in a metropolitus: Public response to the Los Angeles earthquake of February, 1971. Los Angeles, CA: Survey Research Center, University of California, Los Angeles.

Charleston Trident Chamber of Commerce (1989). We're making history: Trident Area South Carolina Executive Summary. Trident Development Board.

Crespi, I. (1971). What kinds of attitude measures are predictive of behavior? Public Opinion Quarterly, 35, 327-334.

Demerath, N.J. (1957). Some general propositions: An interpretive summary. Human Organization, 16 , 28-29.

Deutscher, I. (1966). Words and deeds: Social science and social policy. Social Problems, 13, 225-254.

Drabek, T. (1983). Shall we leave? A study on family reactions when disaster strikes. Emergency Management Review, 1, 25-29.

Drabek, T. (1986). Human system responses to disaster: An inventory of sociological findings. New York: Springer-Verlag.

Drabek, T. & Boggs, K. (1968). Families in disaster: Reactions and relatives. Journal of Marriage and the Family, 30, 443-451.

Drabek, T. & Stephenson, J.S. (1971). When disaster strikes. Journal of Applied Social Psychology, 1, 187-203.

Dufka, C.L. (1988). The Mexico City earthquake disaster. The Journal of Contemporary Social Work, 69, 162-170.

Earls, F., Smith, E., Reich, W & Jung, K.G. (1988). Investigating psychopathological consequences of a disaster in children: A pilot study incorporating a structured diagnostic interview. Journal of the American Academy of Child and Adolescent Psychiatry, 27, 90-95.

Federal Emergency Management Agency (1989). Interagency hazard mitigation team report: In response to the September 22, 1989 disaster declaration State of South Carolina. FEMA-843-DR-SC.

Flynn, C.B. & Chalmers, J.A. (1980). The social and economic effects of the accident at Three Mile Island. Tempe, AZ: Mountain West Research, Inc. with Social Impact Research, Inc.

Freeman, L.C. & Ataov, T. (1960). Invalidity of indirect and direct measures toward cheating. Journal of Personality, 28, 443-447.

Friedsam, H.J. (1961). Reactions of older persons to disaster-caused losses: An hypothesis of relative deprivation. The Gerontologist, 1, 34-37.

Friedsman, H.J. (1962). Older persons in disaster. In G.W. Baker & D.W. Chapman (Eds.), Man and society in disaster (pp. 151-184). New York: Basic Books.

Fritz, C.E. (1961). Disaster. In R. Merton & R. Nisbet (Eds.), Contemporary social problems (pp. 651-694). New York: Harcourt.

Glenn, C. (1979). Natural disasters and human behavior: Explanation, research and models. Psychology: A Quarterly Journal of Human Behavior, 16, 23-36.

Graham, F. (1990). Matchsticks. Audobon, (January), 44-51.

Graham, M.R. (1990). The economic impact of Hurricane Hugo on the Trident Area. Economic Subcommittee of the Mayor's Recovery Task Force.

Haas, J. & Trainer, P. (1974). Effectiveness of tsunami warning systems in selected coastal towns in Alaska. Rome: Proceedings of the Fifth World Conference on Earthquake Engineering.

Heberlein, T.A. & Black, J.S. (1976). Attitudinal specificity and the prediction of behavior in a field setting. Journal of Personality and Social Psychology, 33, 474-479.

Hocking, F. (1965). Human reactions to extreme environmental stress. The Medical Journal of Australia, 2, 477-483.

Hodler, T.W. (1982). Residents' preparedness and response to the Kalamazoo tornado. Disaster, 6, 44-49.

Hutton, J.R. (1976). The differential distribution of death in disaster: A test of theoretical propositions. Mass Emergencies, 1, 261-266.

Jae-On, K. & Mueller, C.W. (1978a). Introduction to factor analysis: What it is and how to do it. Beverly Hills, CA: Sage Publications.

Jae-On, K. & Mueller, C.W. (1978b). Factor analysis: Statistical methods and practical issues. Beverly Hills, CA: Sage Publications.

Kleinbaum, D.G., Kupper, L.L. & Muller, K.E. (1988). Applied regression analysis and other multivariable methods (2nd edition). Boston: PWS-Kent.

Landon, E.L. & Banks, S.K. (1977). Relative efficiency and bias of plus one telephone sampling. Journal of Marketing Research, 14, 294-299.

LaPierre, R.T. (1934). Attitudes versus actions. Social Forces, 13, 230-237.

Mack, R. & Baker, G.W. (1961). The Occasion Instant. National Academy of Sciences/National Research Council Disaster Study #15. Washington, D.C.: National Academy of Sciences.

Madakasira, S. & O'Brien, K.F. (1987). Acute posttraumatic stress disorder in victims of a natural disaster. The Journal of Nervous and Mental Disease, 175, 286-290.

Maida, C.A., Gordon, N.S., Steinberg, A. & Gordon, G. (1989). Psychosocial impact of disasters: Victims of the Baldwin Hills fire. Journal of Traumatic Stress, 2, 37-48.

McFarlane, A.C. (1989). The aetiology of post-traumatic morbidity: Predisposing, precipitating and perpetuation factors. British Journal of Psychiatry, 154, 221-228.

McFarlane, A.C. (1989). The prevention and management of the psychiatric morbidity of natural disasters: An Australian experience. Stress Medicine, 5, 29-36.

McFarlane, A.C. (1988). The aetiology of post-traumatic stress disorders following a natural disaster. British Journal of Psychiatry, 152, 116-121.

McFarlane, A.C. (1988). The longitudinal course of posttraumatic morbidity: The range of outcomes and their predictors. The Journal of Nervous and Mental Disease, 176, 30-39.

McFarlane, A.C. (1988). The phenomenology of posttraumatic stress disorders following a natural disaster. The Journal of Nervous and Mental Disease, 176, 22-29.

McFarlane, A.C. (1987). Posttraumatic phenomenon in a longitudinal study of children following a natural disaster. Journal of the American Academy of Child and Adolescent Psychiatry, 26, 764-769.

McFarlane, A.C. (1986). Posttraumatic morbidity of a disaster: A study of cases presenting for psychiatric treatment. The Journal of Nervous and Mental Disease, 174, 4-13.

McKay, J. (1984). Community response to hazard information. Disasters, 8, 118-123.

Mileti, D.S. (1975). Natural Hazard Warning Systems in the United States: A Research Assessment. Boulder, CO: Institute of Behavioral Science, University of Colorado.

Mileti, D.S., Hartsough, D.M., Madson, P. & Hufnagel, R. (1984). The Three Mile Island incident: A study of behavioral indicators of human stress. International Journal of Emergencies and Disasters, 2, 89-113.

Moore, H.E. (1964). And the winds blew. Austin, TX: The Hogg Foundation for Mental Health, University of Texas.

Moore, H.E., Bates, F.L., Layman, M.V. & Parenton, V.J. (1963). Before the wind: A study of response to Hurricane Carla. National Academy of Sciences/National Research Council Disaster Study #19. Washington, D.C.: National Academy of Sciences.

Murphy, S.A. (1984). After Mount St. Helens: Disaster stress research. Journal of Psychosocial Nursing, 22, 9-18.

Nigg, J. (1982). Awareness and behavior: Public response to prediction awareness. In T.F. Saarinen (Ed.), Perspectives on increasing hazard awareness (pp. 71-96). Boulder, CO: Institute of Behavioral Science, University of Colorado.

Okabe, K. et al. (1979). Survey research on the attitude of Tokyo residents toward the prospective earthquake and the prediction warning. In Institute of Journalism (Ed.)(pp. 137-303). The Earthquake Prediction Warning and the the Social Responses. Tokyo, Japan: University of Tokyo.

O'Riordan, T. (1976). Attitudes, behavior and environmental policy issues. In I. Altman & J. Joachim (Eds.). Human behavior and environment: Advances in theory and research. New York: Plenum Press.

Pedhazur, E.J. (1982). Multiple regression in behavioral research (2nd edition). New York: Holt, Rinehart & Winston.

Perry, R.W. (1979). Evacuation decision-making in natural disasters. Mass Emergencies, 4, 25-38.

Perry, R.W. & Greene, M. (1982). The role of ethnicity in the emergency decision-making process. Sociological Inquiry, 52, 306-334.

Perry, R.W. & Greene, M. (1983). Citizen response to volcanic eruptions: The case of Mt. St. Helens. New York: Irvington Publishers.

Perry, R.W. & Lindell, M.K. (1986). Twentieth century volcanicity at Mt. St. Helens: The routiniuzation of life near an active volcano. Final report to the National Science Foundation. Tempe, AZ: Arizona State University.

Perry, R.W., Lindell, M.K. & Greene, M. (1981). Evacuation planning in emergency management. Lexington, MA: Lexington Books.

Pindyck, R.S. & Rubinfeld, D.L. (1981). Economic models and economic forecasts. (2nd edition). New York: McGraw-Hill.

Post, Buckley, Schub & Jernigan, Inc. (1990). Hurricane Hugo assessment: Review of hurricane evacuation studies utilization and information dissemination. Report prepared for the U.S. Army Corps of Engineers and the Federal Emergency Management Agency.

Regulska, J. (1982). Public awareness programs for natural hazards. In T.F. Saarinen (Ed.), Perspectives in increasing hazard awareness (pp. 36-70). Boulder, CO: Institute for Behavioral Science, University of Colorado.

Roder, W. (1961). Attitude and knowledge on the Topeka flood plain. In G.F. White (Ed.), Papers on flood problems (pp. 62-92). Chicago: Department of Geography, University of Chicago.

Ruch, C.E. (1978). Hurricane perception clues as related to response patterns. Paper presented at the Annual Hazards Workshop, Boulder, Colorado.

Ruch, C. & Christensen, L. (1980). Hurricane message enhancement. College Station, Texas: Sea Grant College Program, Texas A & M University.

Saarinen, T.F. (1982). The relation of hazard awareness to adoption of mitigation measures. In T.F. Saarinen (Ed.), Perspectives in increasing hazard awareness (pp. 1-35). Boulder, CO: Institute for Behavioral Science, University of Colorado.

Schuman, H. & Johnson, M.P. (1976). Attitudes and behaviors. Annual Review of Sociology, 2, 161-207.

Shore, J.H., Tatum, E.L. & Vollmer, W.M. (1986). Psychiatric reactions to disaster: The Mount St. Helens experience. American Journal of Psychiatry, 143, 590-595.

Sims, J.H. & Bauman, D.D. (1983). Educational programs and human response to natural hazards. Environment and Behavior, 15, 165-189.

Slovic, P., Fischoff, B., Lichtenstein, S., Korrigan, B. & Combs, B. (1977). Preference for insurance against small loss: Implications for theory and practice of insurance. Journal of Risk and Insurnace, 44, 237- 258.

Sorensen, J,H, (1983). Knowing how to behave under the threat of disaster: Can it be explained? Environment and Behavior, 15, 438-457.

Sorensen, J.H. & Mileti, D.S. (1987). Programs that encourage the adoption of precautions against natural hazards: Review and evaluation. In N.D. Weinstein (Ed.), Taking care:

Understanding and encouraging self-protective behavior (pp. 208-230). Cambridge: Cambridge University Press.

Sorensen, J.H. & Mileti, D.S. (1990). Risk communication in emergencies. In R.E. Kasperson & J.M. Stallen (Eds.), Communicating risk to the public (pp. 369-394). Dordrecht, The Netherlands: Klumer Academic Publishers.

Strumpfer, D.J.W. (1970). Fear and affiliation during a disaster. Journal of Social Psychology, 82, 263-268.

Visvanathan, T.R. (1980). Earthquakes in South Carolina, 1698 - 1975. Columbia, SC: South Carolina Geological Survey. Bulletin 40.

Wallace, A.F.C. (1956). Tornado in Worcester. National Academy of Sciences/National Research Council Disaster Study #3. Washington, D.C.: National Academy of Sciences.

Warheit, G.J. (1985). A propositional paradigm for estimating the impact of disasters on mental health. International Journal of Mass Emerencies and Disasters, 3, 29-48.

Warner, L.G. & DeFleur, M.L. (1969). Attitude as an interactional concept: Social constraint and social distance as intervening variables between attitudes and action. American Sociological Review, 34, 153-169.

Warriner, C.K. (1958). The nature and functions of official morality. American Journal of Sociology, 64, 165-168.

Waterstone, M. (1978). Hazard mitigation behavior of urban flood plain residents. Natural Hazards Research Working Paper #35. Boulder, CO: Institute of Behavioral Science, University of Colorado.

Weller, J.M. & Wenger, D.E. (1973). Disaster subcultures: The cultural residues of community disasters. Paper presented at the Annual Meeting of the North Central Sociological Society, Cincinnati, OH.

Wenger, D.E. (1978). Community response to disaster: Functional and structural alterations. In E.L. Quarantelli (Ed.), Disasters: Theory and research (pp. 27-47). Beverly Hills, CA: Sage Publications.

Wenger, D.E. , James, T.F. & Faupel, C.E. (1980). A few empirical observations concerning the relationship between the mass media and disaster knowledge: A research report. (pp. 241-253). In Committee on disasters and the mass media (Ed.). Disasters and the mass media: Proceedings of the committee on disasters and the mass media workshop, February, 1979. Washington, D.C.: National Academy of Sciences.

Wenger, D.E., James, T.F. & Faupel, C.E. (1985). Disaster beliefs and emergency planning. New York: Irvington Publishers.

Worth, M.F. & McLuckie, B.F. (1977). Get to high ground: The warning process in the Colorado floods, June, 1965. Disaster Research Center Historical and Comparative Disasters Series. Columbus, OH: Disaster Research Center, The Ohio State University.