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Disaster researchers have frequently argued that poor people are more vulnerable to hazard threats and disasters than are those with greater economic resources. In this sense, vulnerability can be defined as exposure to potential harm from the effects of the disaster agent on the built environment. Vulnerability, then, can be said to arise from spending large parts of one's everyday existence in older, substandard structures or in densely populated, often inner-city, areas.

It has also been argued that the same socio-economic factors that put some social groups at greater risk from disaster threats and events also make them more vulnerable to the negative and disruptive consequences of disaster events. That is, those with fewer economic resources will find it more difficult to recover from the losses incurred from disaster events. Although earlier research efforts have investigated and substantiated each of these claims, previous research efforts have not conceptually distinguished between these two types of vulnerability.

This paper develops the concepts of "event vulnerability" and "consequence vulnerability" and explores the relationships between them in order to better understand the recovery process for disaster victims, especially those who are economically disadvantaged. To date, there have been no efforts to disaggregate these two types of vulnerability or to predict what effects either has on victims' ability to recover from a disaster event.

An Overview of Disaster Recovery Research

In the last 15 years, researchers have begun to pay greater attention to the long-term effects of and the processes that affect the ability to recover from a disaster. The majority of these studies have used the individual as the unit of analysis and have focused either on one's ability to recover from the psychological or emotional impacts of catastrophic events (cf, Gilbert, 1958; Takuma, 1978; Flynn and Chalmers, 1980; Bartlett, 1983; Nigg and Mushkatel, 1985) or on the relationship between age and recovery (cf Bell, 1978; Huerta and Horton, 1978).

A smaller number of studies have focused on the abilities of collectivities to recover from disaster events. Those studies which used the community as the unit of analysis analyzed the long-term effects of disasters on the community (Friesma et al., 1979; Rubin, 1985; Erikson, 19 ; Couch and Kroll-Smith, 19), identified characteristics of communities that were important in successful recovery (Demerath and Wallace, 1957), or identified processes in the response and recovery phases that created problems for the community (Nigg and Tierney, forthcoming; Simile and Miller, 1992; Quarantelli and Dynes, 1976; Leivesley, 1977).

An even smaller number of studies have focused on the ability of families[1] to recover (Bolin, 1976; 1982; Bolton, 1979; Quarantelli, 1982). These family-oriented studies represent some of the most recent research efforts in the recovery field, and they generally utilize a more theoretically and methodologically sophisticated approach than do other types of studies. One reason for this tendency is their extension of earlier multivariate analyses of how families respond to disaster warnings and make evacuation decisions under conditions of uncertainty (cf, Perry, 1983; Drabek, 1969; Drabek and Key, 1976).

Vulnerability, Disaster Impacts, and Disaster Recovery

The concept of social location is central to a sociological understanding of patterns of inequality. Most recently, scholars have investigated inequality stemming from race, class and gender (e.g., Amott and Matthaei, 1991; Collins, 1990). Those who study social phenomena within disaster settings have argued that particular social forces associated with capitalism produce vulnerability to the effects of disasters (cf., Susman, O'Keefe and Wisner, 1983). Tierney (1992) argues that institutions that promote economic development and growth play an important role in heightening disaster vulnerability.

Groups that occupy particular social locations are differentially vulnerable to both impacts from disaster agents and consequences from disaster response. In this paper ***event vulnerability*** will refer to household vulnerability that is associated with the direct impacts from a disaster agent; and ***consequence vulnerability*** will refer to the household's vulnerability associated with the social and political processes of recovering from the disaster event.

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[1] The term "family" is used in most of these studies to connote a household; that is, a number of people who are residing together in one residential unit. Although we will continue to use this term in reference to past studies, the reader should not assume that kinship relationships are the basis for this unit of analysis.

Event Vulnerability Disaster researchers have frequently argued that lower income people are more vulnerable to disaster threats than are those with greater economic resources (Wisner, 1992; Bolin, forthcoming; Killian and Bates, 1982). Cochrane (1975) has shown that the effects of disasters are non-random, that the vulnerability of harm and damage is patterned by inequality. He writes:

> Hazards vary widely in their destructiveness and in their impact on different income groups. It appears, however, lower income groups consistently bear a disproportionate share of the losses (110).

In this sense, vulnerability arises from exposure to potential harm from the effects of the disaster agent on the built environment. Vulnerability arises from spending large parts of one's everyday existence in older, substandard structures (French et al., 1984) or from the location of one's residence in geologically unsafe areas (Wijkman and Timberlake, 1984).

Bolin and Bolton (1986) discuss race/ethnicity as an element of disaster vulnerability, suggesting that minorities are more at risk in disaster settings than are members of the majority population. Regarding damage to residential units, they write:

> Damage levels were directly related to ethnicity for two reasons: 1) residential patterns tend to be determined by ethnicity (segregation) and 2) different ethnic groups frequently live in differing sorts of houses (216).

When using the household as the unit of analysis, gender has never been specifically studied, ostensibly because households are most frequently considered to contain both males and females. Although we know that at some life cycle stages and within some minority groups in the United States female-headed households are the norm, this issue has never been directly addressed in the disaster literature. However, in his study of drought, Schroeder (1987) suggests that Hausan gender relations leave women more vulnerable than men to drought.

Consequence Vulnerability

Disaster researchers have also argued that the same factors that put some social groups at greater risk from disaster events, also make them more vulnerable to the negative and disruptive consequences of disaster events. Consequence vulnerability is also influenced by pre-event social locations, such as race, gender and class. For example, those with fewer economic resources will find it more difficult to recover from the losses incurred from disaster events. Indeed disaster researchers have increasingly focused on pre-existing social conditions in order to understand post-event impacts. Quarantelli (cited in Quarantelli and Dynes, 1977) argues that pre-disaster behavior is probably the best indicator of trans- and post-disaster behavior. Furthermore, Oliver-Smith (1991) notes that disasters tend to intensify pre-existing status differences and inequalities.

Bolin (forthcoming) notes that post-disaster behavior in securing shelter and housing is "influenced and constrained by social, cultural, ecological, historical and political-economic conditions" (1). For example, in situations where there is a shortage of low cost housing, temporary housing often becomes permanent housing if the victims are unable to relocate (Bates and Peacock, 1987; Bolin and Stanford, 1991). Moreover, Cochrane (1975) notes that a smaller percentage of lower income individuals seek aid from the Federal government than middle and upper income groups, ostensibly due to lower income residents' demonstrated inability to qualify for federally-insured disaster assistance loans.

Bolin (forthcoming) also suggests that certain household characteristics, themselves determined by social location, influence post-disaster household response and recovery. Those characteristics include: household social and monetary resources, degree of damage to shelter and property, housing needs, availability of help from social support networks, and demographic characteristics such as household size, age, and ethnicity (Bates, 1982; Bolin and Bolton, 1986; Oliver-Smith, 1990; Bolin, forthcoming).

Finally, the issue of relocation is directly tied to pre-event social location. Most research indicates that victims resist any type of relocation, even to temporary shelters, in order to stay as close to their homes as possible (Oliver-Smith, 1991).

Even when people who have been forced to leave their neighborhoods temporarily want to return, previously existing conditions prevent them from doing so, thus suggesting their vulnerability to consequences. For example, Bolton (1988), after studying the Whittier Narrows, California earthquake of 1987, found that Latino victims (who were often working class) had strong commitments to their neighborhoods and were reluctant to seek temporary or new permanent housing located away from their familiar neighborhood areas. Bolin (forthcoming), after a study of housing and the Loma Prieta earthquake, explains that lower socioeconomic status victims have fewer resources available to facilitate their return to permanent housing and thus take longer to do so. He concludes:

> "The variability in the speed at which victims are able to return to permanent housing reflects the underlying class structure and distribution of resources in the society." (6)

Additionally, Quarantelli (1985) found that renters take longer to reestablish permanent housing than homeowners and often do not reestablish their residences in the same neighborhood areas.

Event vs. Consequence Vulnerability

To date, there have been no efforts to disaggregate the effects of these two types of vulnerability or to predict the magnitude of the role that a victim's social location plays in the production of vulnerability. Disaggregation will provide a better understanding of how social locations affect vulnerability. For example, wealthy homeowners living on mountain property may be very vulnerable to event impacts such as landslides; yet, because they are likely to have insurance and other monetary resources, they are not as vulnerable to consequences. On the other hand, poor residents who live in public housing may be less vulnerable to event impacts because of government-enforced building codes; however, because they have few assets, they may be very vulnerable to the consequences of recovery (e.g., loss of minimum wage jobs, loss of locally available commercial services).

The purpose of this study is to begin to identify the factors that can be attributed to event vulnerability, consequence vulnerability, and the relationship between the two. For this investigation, we are using data collected from a sample of residents at two points in time following the 1983 Coalinga earthquake. The next two sections will briefly describe that disaster event and the methodology used to collect the data. Our models of event and consequence vulnerability are presented along with their respective analyses. A discussion of these findings concludes the paper.

The Disaster Event--The Coalinga Earthquake[2]

Coalinga, California is a small, rural community of about 6,500 people who live in western Fresno County. The one mile square community is relatively isolated from any major population center, with the county seat being about seventy miles east. Coalinga has a small community college, one high school, one hospital, and small fire and police departments. The central business district of the community is approximately three blocks long and consists of one-to-two story, unreinforced masonry structures, many of which had recently been given a face-lift as part of the city's redevelopment plan. The city prospered because

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[2] The data used in this paper were collected as part of a research project supported by a grant from the National Science Foundation (CEE 82-12799). Opinions, findings, conclusions, or recommendations are those of the authors and do not reflect the views of the Foundation.

it is located in the middle of a large farming area and oil fields which have been producing since the early 1900's. Most residences in the community are single-family wood or wood-and-stucco homes. A new residential complex for low-income and elderly people had also been recently constructed.

On Monday, May 2, 1983 at 4:43 p.m., a 6.5 magnitude earthquake struck the Coalinga area. The central business district was devastated; buildings collapsed or were destroyed in a resulting fire. Eventually, over half of the buildings in the downtown area were razed for safety reasons. About 60 percent of the residential units in the community had some type of earthquake-related damage; and eventually 350 families had to be relocated (at least temporarily) due to severely damaged or destroyed homes. All communication systems were out and utility systems unusable for at least one week after the quake. Remarkably, no deaths occurred; but approximately 110 people were eventually treated for injuries resulting from the earthquake event.

Methodology

Using the Red Cross' citywide damage assessment listing,[3] a proportionate, stratified random sample of households, based on extent of damage to the residential unit, was selected. The first survey was conducted with 271 randomly selected adult respondents in the selected households[4] one month after the earthquake. This sample represented about one in every seven households in the

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[3] In most disasters, the Red Cross conducts a structure-by-structure damage assessment to determine the types of assistance disaster victims may need. Individual addresses are listed and the damage is assessed on a four-point scale--no damage, non-structural damage, some structural damage, major structural damage or destroyed. This listing was used as the initial sampling frame for the study. In order to insure that all residential units were identified, the field director for the study visually verified each address on the listing by walking the community. A few blocks that had been omitted from the listing--ostensibly because very little damage had occurred--were manually added to the sampling frame in the appropriate damage category. In essence, the sampling frame for this study was actually the population of residential structures in the city of Coalinga.

[4] The Kish (19) method of selecting a random adult respondent in each household was used. The response rate for this study was 76% which was, unfortunately, below the 80% rate we had intended to achieve. However, a variety of methods--including FEMA locator records, utility company addresses, and post office changes of address--were used to attempt to locate community residents who had relocated within the month after the earthquake.

community. One year later, 247 of these same respondents were reinterviewed. Both surveys were conducted face-to-face using structured questionnaires and lasted between 40 minutes and two hours.[5]

Analysis of the Models of Event and Consequence Vulnerability

Table 1 presents and describes the variables included in the two vulnerability models. Means and standard deviations are also given for each variable. Figure 1 presents the path models for both event vulnerability and consequence vulnerability, including the hypothesized directions and signs of the paths. The path coefficients and significance levels are given in Tables 2 and 3; and Figure 2 is a graphic representation of the resulting models.

Event Vulnerability The event vulnerability model contains five variables--three exogenous and two endogenous--with damage to the household's residence as the dependent variable. Three social location variables--household income (INCOME), race or ethnicity of the household[6] (RACE), and female-headed household (FEMHEAD)--were the exogenous variables. All three were hypothesized to have direct effects on the structural stability[7] of the dwelling within which the household resided. Poorer, minority, female-headed households were expected to reside in those structures that were less structurally sound. The hazardousness of the structure, in turn, was hypothesized to be directly related to the extent of damage that the structure sustained.

[5] Interviewers for the first survey were trained through the Survey Research Laboratory at Arizona State University under the supervision of Joanne M. Nigg. Interviewers for the second survey were trained by the Survey Research Unit at California State University, Fresno; that survey was supervised by Kathleen J. Tierney.

[6] In this study, two ethnic groups predominated--white/Anglo and Hispanic/Mexican American/Latino. Although only the race/ethnicity of the respondent was requested, interviewers reported that other household members appeared to be of the same ethnic group as the respondent.

[7] In this case, "structural stability" was assessed on the basis of what was known about the damage patterns to dwellings in the community and the respondent's identification of the type of materials used in the construction of the residential structure. For example, those residential structures that were coded as "more hazardous" included: mobile homes (known to have twisted and fallen off supports), wood structures (that were often not anchored to their foundations), unreinforced masonry and adobe structures (known to have sustained the greatest amount of damage).

The results of Event Vulnerability Model were quite unexpected. Only one of the three social location variables had an effect on the model. Neither RACE nor FEMHEAD had a significant effect on the model: Income was the sole variable to have a significant effect on house construction. Consequently, the indirect effect on damage from income was also very strong. Therefore, in the event vulnerability model, income was the sole variable to affect damage.

Consequence Vulnerability The model of consequence vulnerability contains the entire event vulnerability model since the extent of damage to the residential structure has been demonstrated to have a major impact on the long-term disruption that a household endures. Two additional exogenous variables that demographically characterized the household--the size of the household (HHSIZE) and whether the residential structure is being occupied by its owner or it is being rented (HOUSOCPY)--and two endogamous variables--the extent to which the household undertook preparedness measures for an earthquake (PREPSC1) and the overall disruption experienced by the household (DISRUPT)--were added to the model.

The overall disruption of the household (that is, the disaster consequences experienced by the household) is what the total model is attempting to explain. It was hypothesized that all five exogenous variables would have direct effects on household disruption. Larger, poorer, minority, female-headed households that were renting were expected to experience greater disruption than did other types of households. Households with more income were expected to have taken a more preparedness actions; and, in turn, were expected to have been less disrupted. Households that had experienced greater damage to the home were also more likely to experience greater disruption.

The final consequence vulnerability model contains nine paths. Three of these are significant at the .05 level, one at the .01 level, and four at the .001 level (Table 2). The overall model has a goodness of fit index of .981; and an adjusted goodness of fit index of .949.

The strongest relationship is between DAMAGE and DISRUPT, implying that the more severe the damage to the residence the more disruption the household experienced. The next strongest relationship is between type of residential construction (RHOUSCONS) and extent of damage to the home (DAMAGE). As we saw in the event vulnerability model, older residential units or structures that are not as soundly built were more prone to damage. Event vulnerability, therefore, is a significant predictor of the extent to which a household is likely to sustain negative consequences during the recovery process.

Although amount of household preparedness for an earthquake (PREPSC1) was expected to have a significant negative effect on household disruption (DISRUPT), this was not the case ($t=-1.574$, $p>.05$). The path between PREPSC1 and DISRUPT was retained in the model for theoretical reasons even though it was non-significant.

Household demographics had interesting relationships to household disruption. The number of people, adults and children, living in the household (HHSIZE), for example, had a direct significant path to disruption (DISRUPT), but had no direct or indirect effects on damage to the residential structure (RCDAM2). Similarly, there were no effects, direct or indirect, of renter/owner status (HOUSOCPY) on damage to the dwelling (RCDAM2). Although some earlier literature might have suggested that larger families and families that rented would be more likely to be disrupted, no evidence for this was found.

Yet, there is a significant relationship between both renter/owner status (HOUSOCPY) and household size (HHSIZE) and household disruption (DISRUPT). Those households who rent and who have more members experience greater disruption.

The most interesting findings concern the social location variables--FEMHEAD, RACE and INCOME. Because female-headed households are less likely to prepare, this indirectly affects the amount of disruption they experience; however, the indirect effect on DISRUPT from FEMHEAD is very slight (ind. eff.=.009) and nonsignificant. There were no direct or indirect effects on DAMAGE from FEMHEAD.

The effects of RACE, however, produce significant and interesting results. There is a direct effect (dir. eff.=.106) on the disruption of a household (DISRUPT) from the race/ethnicity (RACE) of the household; but, as was found in analyzing the event vulnerability model, ethnicity of the household (RACE) had neither direct nor indirect effects on damage sustained by one's residence (RCDAM2). This indicates that race has an independent impact on disruption despite the amount of damage to the residential unit.

This is not the case for INCOME, however. The household's income has a significant effect on the amount of disruption experienced (DISRUPT), but only through type of residential construction (RHOUSCON) and damage on the dwelling (RCDAM2). The effects on household disruption are significant and indirect (ind. eff.=-.050). Income also has an effect on the amount of pre-disaster preparedness a household has undertaken (PREPSC1)--the higher the household's income, the greater the amount of preparedness that has been undertaken. This, in turn, has an effect, albeit a nonsignificant one, on the household's extent of disruption. The indirect relationship between INCOME and DISRUPT through the PREPSC1 variable is not as statistically strong as the indirect effect of INCOME through RCDAM2.

Conclusions

Several conclusions can be drawn. First, the most obvious is that vulnerability to a disaster must be conceived of in two ways-event and consequence. Second, both must be conceptualized in terms of social location. That is, social location and the attendent inequalities create both event and consequence vulnerabilty to disaster. Third, this model allows us to see that the individual social locations are separate structural systems that are not totally interwoven. Specifically, this study shows that race and class should not be subsumed into each other. Race impacts disruption in a way totally different than income. Income impacts disruption only through damage. Race impacts disruption directly. So there is something particular about the recovery process itself that makes people of differing race/ethnic groups more vulnerable. Future analysis will need to explore more fully what these processes are.

Table One

Coding Scheme for Variables Included in the Event and Consequence Models

VARIABLES	CODING SCHEME	MEAN	SD
Event Vulnerability Model:			
Income (INCOME)	1=< $4,999 2= $5,000-$9,999 3= $10,000-$19,999 4= $20,000-$29,999 5= $30,000-$39,999 6= $40,000-$49,999 7=> $50,000	4.023	1.653
Race/Ethnicity (RACE)	1= white 2= non-white	1.099	.300
Female-Headed Household (FEMHEAD)	0= not female-headed 1= female-headed	.218	.414
Hazardousness of Residential Construction (RHOUSCON)	1= less hazardous 2= more hazardous	1.640	.481
Extent of Damage to Residence (RCDAM2)	1= major structural damage 2= minor structural damage 3= non-structural damage 4= no damage	2.774	1.023

Table One (continued)

VARIABLES	CODING SCHEME	MEAN	SD
Consequence Vulnerability Model (additional variables):			
Household Size (HHSIZE)	1-12 persons	2.750	1.427
Owner-Occupied Residence (HOUSOCPY)	1= yes 2= no	1.306	.462
Level of Household Preparedness Taken for an Earthquake (PREPSC1)	1= done least 2= done less 3= done more 4= done most	2.502	1.090
Extent of Disruption to Household (DISRUPT2)	Composite Variable[1] 0 - 3 0= not disrupted	.878	.831

[1]Variable is created by summing whether answer is "Yes" to:

1). Used three or more services? (SERVICES)
2). Did injury occur in household? (HHINJURY)
3). Was resident displaced? (DISPLACE)

Table Two

Direct, Indirect, and Total Effects of Endogenous by Exogenous Variables

	INCOME	RACE	FEMHEAD	HHSIZE	HOUSOCPY	effects
DISRUPT	.000 -.050** -.050**	.106* .000 .106*	.000 .009 .009	.158** .000 .158**	.089* .000 .089*	direct indirect total
PREPARE	.222*** .000 .222***	.000 .000 .000	-.114* .000 -.114*	.000 .000 .000	.000 .000 .000	direct indirect total
DAMAGE	.000 .071** .071**	.000 .000 .000	.000 .000 .000	.000 .000 .000	.000 .000 .000	direct indirect total
CONSTRUCTION	-.298*** .000 -.298***	.000 .000 .000	.000 .000 .000	.000 .000 .000	.000 .000 .000	direct indirect total

Table Three

Direct, Indirect, and Total Effects of Endogenous by Endogenous Variables

	DISRUPT	PREPARE	DAMAGE	CONSTRUCTION	effects
DISRUPT	---- ---- ----	-.083 .000 -.083	-.449*** .000 -.449***	.000 .107*** .107***	direct indirect total
PREPARE	---- ---- ----	---- ---- ----	.000 .000 .000	.000 .000 .000	direct indirect total
DAMAGE	---- ---- ----	---- ---- ----	---- ---- ----	-.239*** .000 -.239***	direct indirect total
CONSTRUCTION	---- ---- ----	---- ---- ----	---- ---- ----	---- ---- ----	direct indirect total

* p<.05   **p<.01   ***p<.001

Figure One

Expected and Significant Direct Paths in Event and Consequence Vulnerability Models