
abstract Disaster studies address the social and behavioral aspects of sudden onset collective stress situations typically referred to as mass emergencies or disasters. These situations can be created by natural hazards, technological accidents, violent intergroup conflicts, shortages of vital resources, and other major hazards to life, health, property, well-being and everyday routines. Disaster studies address the impacts of these events on all social units ranging from individuals and households to nation-states. All aspects of the life history of such events, both actual and threatened, are examined in terms of the ways in which populations at risk conduct hazard and vulnerability analyses as well as plan and implement mitigation, preparedness, response and recovery actions.

keywords convergence ♦ crisis ♦ disaster ♦ emergence ♦ emergency ♦ improvisation ♦ mitigation ♦ preparedness ♦ recovery ♦ response ♦ vulnerability

Origins of disaster research

Although historical and literary accounts of disasters date back thousands of years, scientific analyses are more recent. Dynes (2000) contends that Rousseau provided the first social scientific insights into disaster with his observation that the impacts of the 1755 Lisbon earthquake would have been diminished if the city had been less densely populated and if people had evacuated promptly in response to the initial tremors. More than 150 years later, William James's (1983) observations in San Francisco immediately after the 1906 earthquake also anticipated important themes of later research by reporting improvisation ('the rapidity of the improvisation of order out of chaos', p. 336) and emergent organization ('within twenty four hours, rations, clothing, hospital, quarantine, disinfection, washing, police, military, quarters in camp and in houses, printed information, employment, all were provided for under the care of so many volunteer committees', p. 337). Nonetheless, the first systematic disaster research is generally acknowledged to be Samuel Prince's (1920) study of the 1917 Halifax explosion (Scanlon, 1988). This study documented the presence of convergence and emergence, as well as the absence of role abandonment. As Quarantelli

(2000) noted, little additional progress was made in disaster research until the National Opinion Research Center/National Academy of Sciences studies of the 1950s, whose findings were first summarized by Fritz and Marks (1954) and Fritz (1961), received more extensive treatment in Baker and Chapman (1962) and were the subject of a systematic analysis in Barton (1969). Other classic works of the 1950s are also reviewed in the *International Journal of Mass Emergencies and Disasters*, Vol. 6, No. 3, 1988. Drabek (1986) and Tierney et al. (2001) provided later summaries of this research. Tierney et al. (2001: 234–40) and CDRSS (2006: Ch. 8) describe the institutional context of disaster research.

Basic definitions

Definitions of disaster can be classified into three categories – classic, hazards/disasters and socially focused (Perry, 2006). According to Fritz (1961: 655), a disaster is 'an event concentrated in time and space, in which a society or one of its subdivisions undergoes physical harm and social disruption, such that all or

some essential functions of the society or subdivision are impaired'. Physical harm and social disruption (now more commonly labeled physical and social impacts) occur because the event exceeds normal protections (Kreps, 1984). The requirement that an event be concentrated in time and space is essential to distinguish between earthquake deaths that might number as few as 50 deaths in a matter of minutes from automobile fatalities that number approximately 40,000 per year in the US, for example.

A disaster's concentration in time obviously defines three temporal periods – pre-impact, trans-impact and post-impact. However, some disasters have multiple (e.g. earthquake aftershocks) or secondary (e.g. hazardous materials releases) impacts, so identifying the time at which impact occurs can be difficult. An alternative conception of disaster phases is defined in terms of hazard mitigation, disaster preparedness, emergency response and disaster recovery (National Governors Association, 1978). However, these terms are not accepted worldwide and, in any event, are functions rather than phases. Moreover, they are not mutually exclusive because mitigation and preparedness generally take place concurrently in the pre-impact period. There are also overlaps in the post-impact period, with some neighborhoods of a disaster-stricken community conducting emergency response operations while others are initiating disaster recovery. Finally, mitigation is frequently implemented during the disaster recovery period.

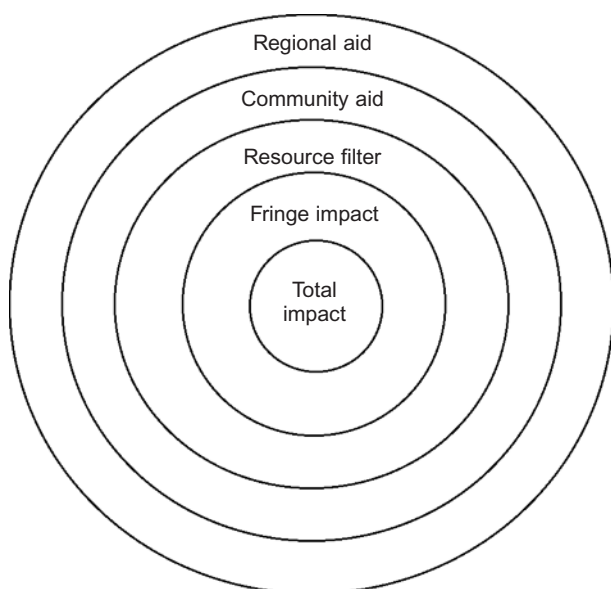


Figure 1. Disaster impact zones
Source: Dynes (1970).

A disaster's concentration in space defines a series of geographical areas that Figure 1 identifies as a series of (idealized) concentric zones that define impact and response (Wallace, 1956). In practice, these impact zones are more elusive than they appear. First, impact boundaries do not follow neat circles because the severity of building damage after an earthquake, for example, depends on the structural resilience of buildings and the intensity of earthquake shaking – neither of which is uniformly distributed so the boundaries of the damage area can be extremely irregular. Moreover, casualties are complexly determined, as are social impacts, which can extend far beyond the boundaries of the damage zone. For example, earthquake damage can cause a loss of electric power in areas where there is no physical damage. Thus, defining impact zone boundaries presents a significant problem for researchers studying response as well as practitioners trying to assess where disaster impacts have actually happened, let alone trying to predict where they will occur.

A society's subdivisions encompass a wide range of social units arrayed in overlapping social, economic and political sectors. Thus, individuals are included within households that are in neighborhoods within communities. Businesses are included within industries that are in economic sectors, and local jurisdictions are contained within states/provinces that are in nations (see Lindell et al., 2006: Ch. 2). A major challenge to understanding disaster impacts is that social units such as communities are not homogeneous, so subunits such as households and businesses vary in their vulnerability to disaster impacts. This has given rise to an expanding literature on differences in disaster vulnerability associated with demographic characteristics such as gender, ethnicity and poverty (Fothergill, 1996; Fothergill and Peek, 2004; Fothergill et al., 1999). Similarly, research into disaster impacts on business has examined variations by size and economic sector (Webb et al., 2000; Zhang et al., 2009).

Major methodological approaches

As Stallings (2006) noted, disaster research has been characterized by inductive field studies in which one or more researchers travel to the site of a reported disaster to observe behavior and conduct personal interviews (*The American Behavioral Scientist*, Vol. 13, No. 3, 1970 contains an early summary of such studies). Slow onset disasters such as hurricanes might allow researchers to observe pre-impact response activities but it has been more common to collect data after a disaster strikes. In either case,

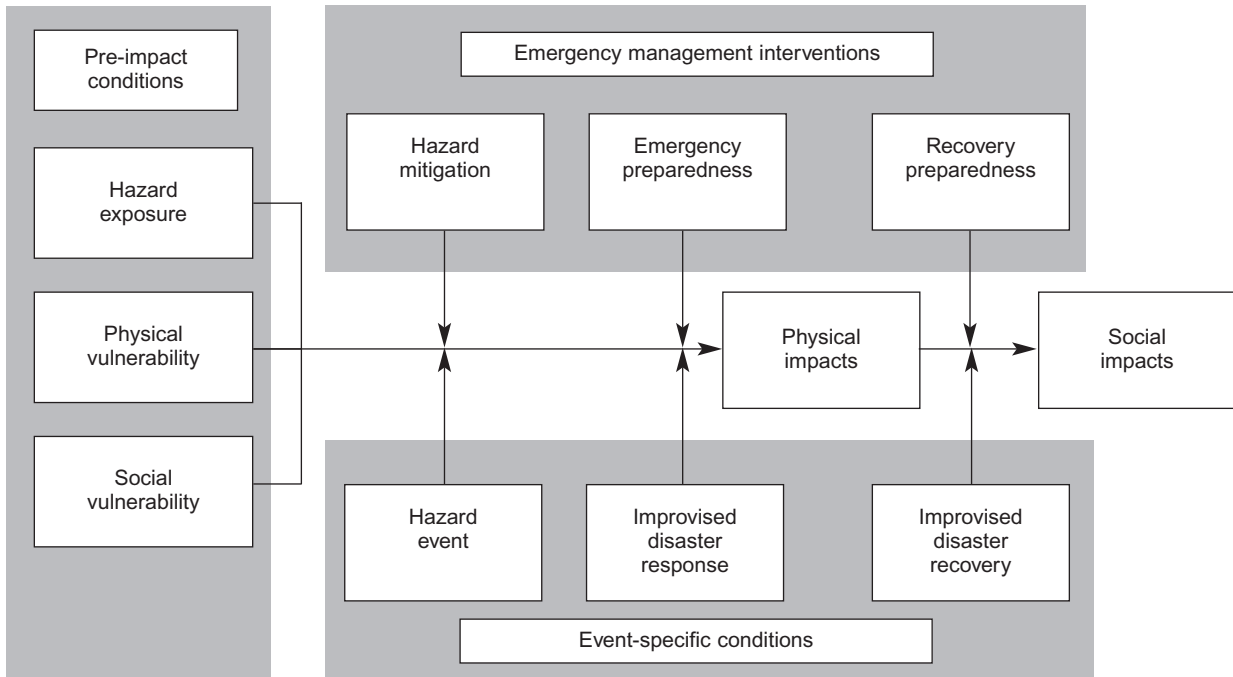


Figure 2. Disaster impact model

Source: Lindell, Prater and Perry (2006).

researchers collect important documents and interview key informants who are identified by organizational position or by snowball sampling. In recent decades, there has been an increasing reliance on survey research (Bourque et al., 1997). In most cases, surveys have been conducted to study households' warning response (Mileti and Beck, 1975; Perry et al., 1981) or perception and response to natural hazards (Turner et al., 1986). In both types of studies, the research objectives and methods of sociologists have overlapped significantly with those of geographers (White, 1974). In other cases, surveys have been conducted on businesses struck by disasters (Tierney et al., 1996) and emergency preparedness organizations (Lindell et al., 1996). Occasionally, disaster studies have analyzed archival data (Wright et al., 1979).

Disaster impacts model

The basic framework of disaster research can be summarized in Figure 2, which indicates that the effects of a disaster are determined by three pre-impact conditions – hazard exposure, physical vulnerability and social vulnerability. There also are three event-specific conditions – hazard event characteristics, improvised disaster responses and improvised disaster

recovery. Two of the event-specific conditions, hazard event characteristics and improvised disaster responses, combine with pre-impact conditions to produce a disaster's physical impacts. Physical impacts, in turn, combine with recovery actions to produce a disaster's social impacts. Communities can engage in three types of emergency management interventions to ameliorate disaster impacts. Physical impacts can be reduced by hazard mitigation practices and emergency preparedness practices, whereas social impacts can be reduced by recovery preparedness practices.

Of the three pre-impact conditions, hazard exposure arises from people's occupancy of geographical areas where they could be affected by specific types of events that threaten their lives or property. Physical vulnerability includes human vulnerability, agricultural vulnerability and structural vulnerability. Human vulnerability arises from humans' susceptibility to environmental extremes of temperature, pressure and chemical exposures that can cause death, injury and illness. Agricultural vulnerability exists because, like humans, plants and animals are also vulnerable to environmental extremes. Structural vulnerability arises when buildings are constructed using designs and materials that are incapable of resisting extreme stresses (e.g. high wind, hydraulic pressures of water, seismic shaking) or that allow hazardous materials to infiltrate into a

building where people are sheltering. The concept of social vulnerability (e.g. Wisner et al., 2004) represents an important extension of previous theories of hazard vulnerability (Burton et al., 1978). Whereas people's physical vulnerability refers to their susceptibility to biological changes (i.e. impacts on anatomical structures and physiological functioning), their social vulnerability refers to limitations in their physical assets (buildings, furnishings, vehicles) and psychological (knowledge, skills and abilities), social (community integration), economic (financial savings) and political (public policy influence) resources.

Of the three event-specific conditions, hazard event characteristics can be defined in terms of six attributes – speed of onset, availability of perceptual cues (such as wind, rain, or ground movement), the intensity, scope and duration of impact, and the probability of occurrence (CDRSS, 2006; Kreps, 1984). These characteristics determine people's ability to detect hazard onset, the amount of time they have to respond, the number of affected social units and – thus – the event's casualties, damage and socioeconomic disruption. The other two event-specific conditions, improvised disaster response and improvised disaster recovery, are addressed later on.

Physical impacts

Casualties. The number of casualties per event can be extremely high for some hazards. According to Noji (1997), hurricanes produced 16 of the 65 greatest disasters of the 20th century (in terms of deaths) and the greatest number of deaths from 1947 to 1980 (499,000). Earthquakes produced 28 of the greatest disasters and 450,000 deaths, whereas floods produced four of the greatest disasters and 194,000 deaths. There is significant variation by country, with developing countries in Asia, Africa and South America accounting for the top 20 positions in terms of number of deaths from 1966 to 1990. Low-income countries suffer approximately 3000 deaths per disaster, whereas the corresponding figure for high-income countries is approximately 500 deaths per disaster. Moreover, these disparities appear to be increasing because the average annual death toll in developed countries declined by at least 75 percent between 1960 and 1990, but the same time period saw increases of over 400 percent in developing countries (Berke, 1995).

Damage. Losses of structures, animals and crops also are important measures of physical impacts, and these are rising exponentially in the US (Mileti, 1999). However, the rate of increase is even greater in developing countries (Berke, 1995).

Social impacts

Psychosocial impacts. Disasters can cause a wide range of negative psychological responses (Bourque et al., 2006; Gerrity and Flynn, 1997). In most cases, the observed effects are mild and transitory and victims can experience positive impacts (e.g. strengthened family relationships) as well as negative ones (e.g. strained family relationships). Nonetheless, the fact that most effects are generally mild and transitory does not preclude the occurrence of some very negative long-term outcomes. Zahran et al. (2009) found that domestic crimes increased after disasters even though index, property and violent crimes decreased.

There also are psychological impacts with long-term adaptive consequences, such as changes in risk perception (beliefs in the likelihood of the occurrence of a disaster and its personal consequences for the individual) and increased hazard intrusiveness (frequency of thought and discussion about a hazard). In turn, these beliefs can affect risk area residents' adoption of household hazard adjustments that reduce their vulnerability to future disasters. However, the cognitive impacts of disaster experience do not appear to be large, resulting in modest effects on household hazard adjustment (see Lindell, in press; Lindell and Perry, 2000).

Demographic impacts. The demographic impact of a disaster can be assessed by adapting the *demographic balancing equation*, $P_a - P_b = B - D + IM - OM$, where P_a is the population size after the disaster, P_b is the population size before the disaster, B is the number of births, D is the number of deaths, IM is the number of immigrants, and OM is the number of emigrants (Smith et al., 2001). As noted earlier, the number of deaths from disasters can be large in developing countries, but the major demographic impacts of disasters in developed countries are likely to be the (temporary) post-impact immigration of construction workers and emigration of population segments that have lost housing. In many cases, housing-related emigration is also temporary, but the city of New Orleans lost thousands of households after Hurricane Katrina and had only returned to 300,000 (66 percent of its pre-impact population) four years after the disaster. Moreover, there are cases in which housing reconstruction has been delayed indefinitely – leading to 'ghost towns' (Comerio, 1998).

Economic impacts. The property damage caused by disaster impact creates losses in asset values that can be measured by the cost of repair or replacement (CACND, 1999). Disaster losses in the US are ini-

tially borne by the affected households, businesses and local government agencies whose property is damaged or destroyed. However, some of these losses are redistributed during disaster recovery. Unfortunately, the magnitude of these losses is difficult to determine because no organization tracks all of the relevant data and some data are not recorded at all (CACND, 1999; Charvériat, 2000).

In addition to direct economic losses, there are indirect losses that arise from the interdependence of community subunits. A business's operations can be interrupted because its workers are disaster casualties or are forced to move because they have nowhere to live within commuting distance. Alternatively, a business's operations can be interrupted by losses of its infrastructure or its normal customers (Rose and Limb, 2002; Tierney, 2006).

Disasters can have significant financial impacts on local government. Costs must be incurred for tasks such as debris removal, infrastructure restoration and replanning stricken areas. In addition, there are decreased revenues due to loss or deferral of sales, business, property and personal income taxes. However, most of the research in this area has been conducted by researchers in political science and public administration (e.g. Farazmand, 2001).

Political impacts. Disaster impacts can cause social activism resulting in political disruption. The disaster recovery period is a source of many victim grievances and this creates many opportunities for community conflict, both in the US (Bolin, 1982, 1993) and abroad (Albala-Bertrand, 1993). Attempts to change prevailing patterns of civil governance can arise when individuals sharing a grievance about the handling of the recovery process seek to redress that grievance through collective action. In some cases, new groups *emerge* to influence local, state, or federal government agencies and legislators to take actions that they support and to terminate actions that they disapprove of. Indeed, such was the case for Latinos in Watsonville, California following the Loma Prieta earthquake (Tierney et al., 2001). Usually, community action groups pressure government to provide additional resources for recovering from disaster impact, but might oppose candidates' re-elections or even seek to recall some politicians from office (Olson and Drury, 1997; Prater and Lindell, 2000).

Emergency management interventions

As Figure 2 indicates, there are three types of emergency management interventions, also known as *hazard adjustments* (Burton et al., 1978), that can

reduce disaster impacts. Hazard mitigation and emergency preparedness practices attempt to reduce a disaster's physical impacts (casualties and damage) and indirectly reduce its social impacts, whereas recovery preparedness practices attempt to reduce its social impacts.

Hazard mitigation

Hazard mitigation can be defined as pre-impact actions that protect passively against casualties and damage at the time of hazard impact (as opposed to an active emergency response to reduce those casualties and damage). Hazard mitigation includes hazard source control, community protection works, land use practices, building construction practices and building contents protection (see Lindell et al., 2006: Ch. 7). Hazard source control acts directly on the hazard agent to reduce its magnitude or duration. For example, patching a hole in a leaking tank truck terminates the release of a toxic gas. Community protection works, which limit the impact of a hazard agent on an entire community, include dams and levees that protect against floodwater. Land use practices reduce hazard vulnerability by avoiding construction in areas that are susceptible to hazard impact. Hazard mitigation can also be achieved through building construction practices that make individual structures less vulnerable to natural hazards – for example, using steel reinforced concrete rather than unreinforced masonry to construct apartment buildings. Finally, hazard mitigation can be achieved by contents protection strategies such as elevating appliances above the base flood elevation or bolting them to walls to resist seismic forces. Research on hazard mitigation has mostly been conducted by planners (e.g. Burby, 1998) and political scientists (e.g. Birkland, 1997) although there are exceptions such as Stallings' (1995) study that examined hazard mitigation from the perspective of social construction of risk.

Emergency preparedness

Emergency preparedness practices are pre-impact actions that provide the human and material resources needed to support active responses at the time of hazard impact. An important step in emergency preparedness is to use community hazard/vulnerability analysis (HVA) to identify the geographic areas and population segments at risk. In addition, communities should develop emergency operations plans, conduct emergency response training, acquire facilities and equipment, and perform emergency drills, exercises and critiques (Perry and Lindell, 2007).

Community and organizational disaster preparedness. Disaster research has identified many conditions influencing the effectiveness of local emergency management agencies (LEMAs) and local emergency management committees (LEMCs) in producing community hazard adjustments such as hazard/vulnerability analyses, hazard mitigation, emergency response preparedness and disaster recovery preparedness (see Figure 3). The figure indicates that LEMA effectiveness – measured by such organizational outcomes as the quality, timeliness and cost of hazard adjustments adopted and implemented by the community – is a direct result of individual outcomes and the planning process. Outcomes for the individual members of the LEMA and LEMC include job satisfaction, organizational commitment, attachment behaviors (effort, attendance and continued membership) and organizational citizenship behaviors (Lindell and Brandt, 2000). The planning process includes preparedness analysis, planning activities, resource development, organizational climate development and strategic choice. In turn, the planning process is determined by five factors, the first of which is community hazard experience and hazard analyses that reveal the likelihood and expected impacts of future disasters. Hazard exposure/vul-

nerability also has an indirect effect on the planning process via its effects on community support from public officials and the news media, as well as different demographic, economic and political segments of the local population. This community support draws upon community resources such as staff and budget to yield staffing and organization for the LEMA and the LEMC. In addition, communities draw upon extra-community resources such as professional associations, government agencies and regional organizations to supplement their own resources (see Lindell and Perry, 2007, for a more complete discussion).

Household disaster preparedness. Most research on natural hazards has reported significant correlations between hazard adjustment and perceived personal risk, where the latter refers to respondents' judgments of the likelihood that they will be personally affected by specific consequences such as death, injury, property damage, or disruption to daily activities (Mileti and Peek, 2000). There is mixed evidence that personal experience affects responses to hazards. Some studies indicate that this is due to its effect on risk perception but there is also evidence of an effect that is independent of risk per-

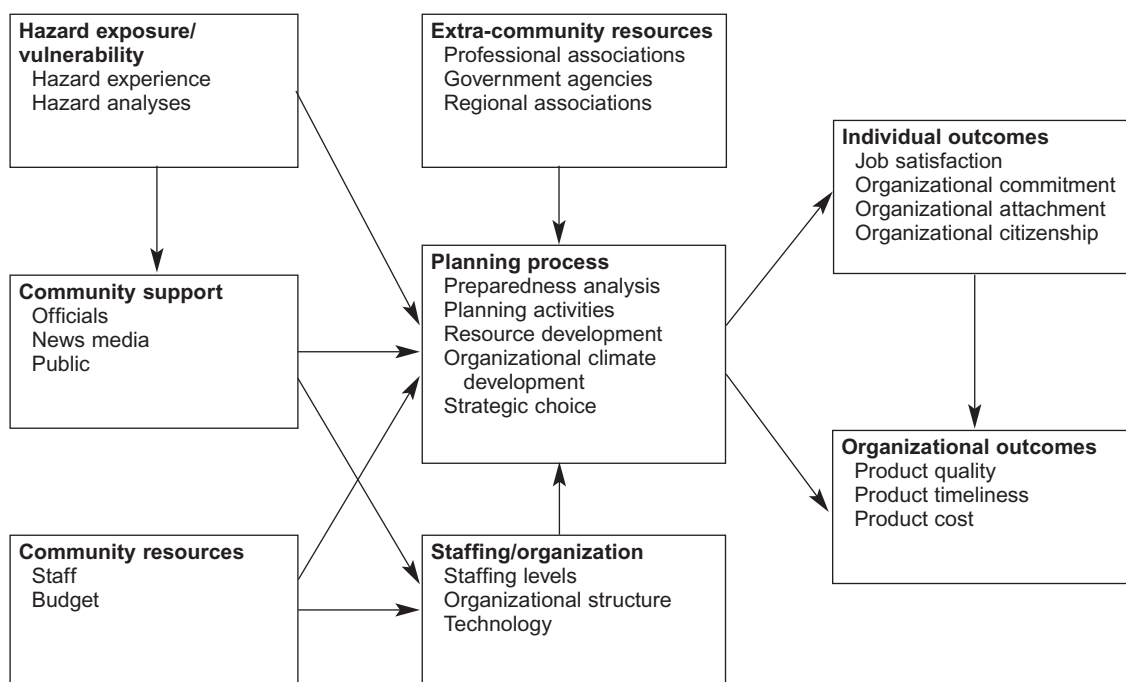


Figure 3. A model of local emergency management effectiveness

Source: Adapted from Lindell and Perry (2007)

ception. In addition, there is conflicting evidence regarding the correlations of hazard proximity with hazard adjustment. Here too, the conflicts might be explained by the mediating effects of other variables – in this case, the effect of proximity on experience, experience on risk perception, and risk perception on hazard adjustment. Finally, there is evidence that people's adoption of hazard adjustments is related to the perceived attributes of those adjustments such as efficacy, utility for other purposes, financial cost, knowledge and skill requirements, time and effort requirements and required social cooperation (Lindell et al., 2009).

Emergency response

As indicated by Figure 2, people try to reduce the physical impacts of a hazard agent by a combination of preparedness and improvisation (Kreps, 1991). The disaster response actions that take place at the individual and organizational levels differ significantly from most people's stereotypes. Although disaster myths commonly portray disaster victims as dazed, panicked, or disorganized (Fischer, 2008), people actually respond in a generally adaptive manner when disasters strike. Adaptive response is often delayed because *normalcy bias* delays people's realization that an improbable event is, in fact, occurring to them, so they seek confirmation of any initial indications of an emergency before initiating protective action. The vast majority of people respond in terms of their customary social units – especially their households and neighborhoods – which can consume time in developing organizations that can cope with the disaster's demands. Contrary to stereotypes of individual selfishness, disaster victims often devote considerable effort to protecting other people and their property. There is considerable social and material convergence on the disaster impact area and a decreased incidence of antisocial behaviors such as crime (Tierney et al., 2001). Finally, contrary to popular belief, emergency responders do not abandon their professional duties in favor of protecting their families. In fact, emergency responders are more likely to suffer burnout from working too many consecutive hours without relief (Quarantelli, 1988).

The actual performance of individuals and organizations in disasters can be characterized by four basic emergency response functions – emergency assessment, hazard operations and population protection and incident management (Lindell and Perry, 1992). *Emergency assessment* comprises diagnoses of past and present conditions and prognoses of future conditions that guide the emergency response. *Hazard operations* refers to expedient hazard mitigation actions that emergency personnel take to limit the magnitude or duration of disaster impact (e.g.

sandbagging a flooding river or patching a leaking railroad tank car). *Population protection* refers to actions – such as sheltering in-place, evacuation and mass immunization – that protect people from hazard agents. *Incident management* consists of the activities by which the human and physical resources used to respond to the emergency are mobilized and directed to accomplish the goals of the emergency response organization. These emergency response functions provide a useful framework for summarizing and evaluating existing research on disaster preparedness and response.

Emergency assessment and hazard operations.

Social scientists have conducted little research on topics such as threat detection/emergency classification and damage assessment and virtually none on hazard/environmental monitoring or population monitoring and assessment. What research has been done in these areas has conceptualized organizational response in more abstract terms such as continuity, contingency and improvisation. Specifically, Wachtendorf (2004; Kendra and Wachtendorf, 2006) proposed that there are different types of improvisation – reproductive, adaptive and creative – that differ from *organizational continuity* (continuation of normal organizational routines) and *organizational contingency* (implementation of the procedures specified in an Emergency Operations Plan). Mendonça and Wallace (2007) proposed a cognitive theory of improvisation in which procedural and declarative knowledge are used to process information about goals, functions, object groups, objects and properties to generate novel solutions to unanticipated problems. In contrast to this problem solving approach, Kreps and Bosworth (2006) focused on organizational roles. They characterized organizational adaptation to disaster demands in terms of role allocation (consistent or inconsistent), role relationships (continuous or discontinuous) and role behavior (conventional or improvised).

Population protection. Much of the research on disaster response has addressed population warning and, especially, evacuation. Warning research has provided a basis for assessing the degree to which 32 different variables are empirically related to warning response (Sorensen, 2000; Sorensen and Sorensen, 2006). The findings of this research can be summarized by the Protective Action Decision Model (Lindell and Perry, 1992, 2004), which proposes that sensory cues from the physical environment (especially sights and sounds, see Grunfest et al., 1978) or socially transmitted information (e.g. disaster warnings) can each elicit a perception of threat that

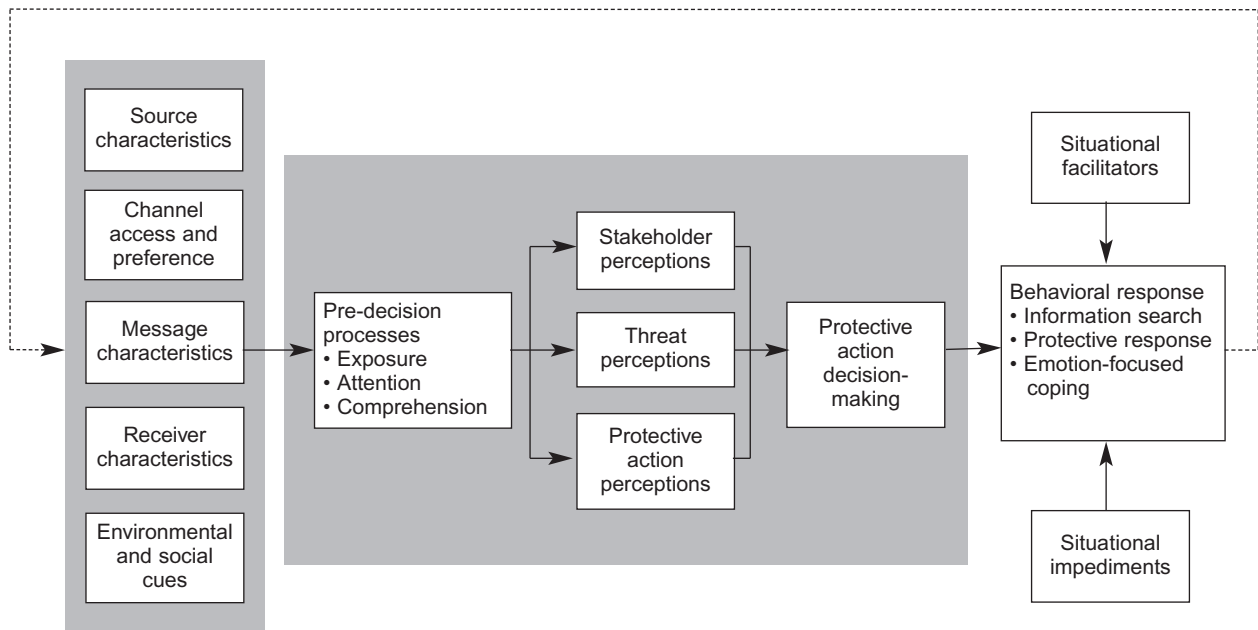


Figure 4. Protective action decision model

Source: Lindell and Perry (2004).

diverts the recipient's attention from normal activities (see Figure 4). In particular, disaster warnings are transmitted by social sources that use information channels to transmit warning messages. The principal warning sources – authorities, news media and peers – differ in their perceived expertise, trustworthiness and protection responsibility (Arlkatti et al., 2007). There are many different types of channels, which include print media, electronic media and face-to-face warnings. These differ in such characteristics as dissemination rate and precision, penetration of normal activities, message specificity/distortion, sender and receiver requirements and feedback/receipt verification (Lindell and Perry, 1987, 1992). Messages should contain information about the threat, especially the hazard agent (type, specific threats and potential impacts), and affected populations so people can form a perception of certain, severe and immediate personal risk. Warning messages should also contain recommended household response actions and describe official response actions such as agency/organizational response actions completed, in progress and planned. In addition, messages should list sources of official assistance and sources of further official information – especially rumor control hotlines (Lindell and Perry, 2004; Scanlon, 2006).

Most warning research has focused on compliance with authorities' evacuation recommendations and, to a lesser extent, evacuation shadow – people evacuating from outside officially designated evacuation zones (Sorensen and Sorensen, 2006). Traffic

analysts have developed models that require data on many other demographic and behavioral variables, but social scientists have studied only a few of these variables and traffic analysts have largely ignored the relevant social science data that are available (Lindell and Prater, 2007). Past evacuation research has focused substantially on 'typical' households (two parents and children evacuating in a personal vehicle) and is only now beginning to address transit dependent populations and special populations that have physical, sensory, or mental disabilities that hinder their evacuation. Although some of these population segments are located in facilities where evacuations can be planned by specialized staff (Vogt, 1991), others are dispersed throughout their communities. Research is also beginning to examine the problems associated with animals in evacuation (Heath et al., 2001).

Research on reception and care of victims has concluded that most evacuees in the US stay with friends and relatives, at least in the short term (Mileti et al., 1992). A smaller proportion stay in commercial facilities such as hotels and motels, and very few stay in public shelters – about 5–15 percent, depending on the weather, time of day and evacuees' financial resources. However, there are few studies that have begun to address the problems of re-entry (Siebeneck and Cova, 2008).

Search and rescue (SAR; Poteyeva et al., 2006) is an activity that is crucially important in disasters involving building collapses. In such incidents, primarily earthquakes and explosions, *crush syndrome*

will kill most of those who are injured within about 24 hours. Consequently, the prompt response of local volunteers – either singly, in emergent groups, or in previously organized and trained SAR teams – is far more significant than the response of heavily equipped urban search and rescue teams because the latter generally take days to arrive even in domestic incidents. The delays are even greater in international incidents, where mobilization delays, long flights and visa problems can cause even further delays (Prater and Wu, 2002). Such situations can require extensive coordination among a number of different organizations that do not normally work together (Drabek et al., 1981).

It is commonly assumed that authorities transport injured disaster victims in ambulances to the most appropriate hospitals. However, according to Quarantelli (1983), almost as many injured victims arrive at hospitals in their own vehicles or those of peers (46 percent of casualties) as in ambulances (54 percent of casualties). Moreover, the vast majority (75 percent) of victims are transported to the nearest hospital, which is usually overloaded at the same time as other competent facilities receive few or no patients (Auf der Heide, 1994).

Incident management. One of the major components of disaster response is emergent behavior, which arises when ‘individuals see needs that are not being met and therefore attempt to address them in an informal manner’ (McEntire, 2006: 175). Disaster demands that exceed the abilities of individuals acting independently lead to the emergence of coordinated responses – ‘the cooperation of independent units for the purpose of eliminating fragmentation, gaps in service delivery, and unnecessary (as opposed to strategic) duplication of services’ (Gillespie, 1991: 57). That is, according to Dynes (1970), *established organizations* perform their normal tasks within normal organizational structures, *extending organizations* perform novel tasks within normal organizational structures, *expanding organizations* perform their normal tasks within novel organizational structures, and *emergent organizations* perform novel tasks within novel organizational structures. Drabek et al. (1981) extended this typology by noting that organizations of all four types must often interact with each other in novel ways through structures they labeled *emergent multiorganizational networks* (EMONs). Because of their differences in organizational titles, organizational structures, training, experience and legal authority, EMONs frequently experience severe difficulties in communicating with each other and coordinating their responses to disasters. Indeed, such problems have led to the development of standardized systems,

the Incident Command System and Incident Management System. However, there have been challenges to the assumption that ICS and IMS can solve the problems that led to their development (Buck et al., 2006; Lutz and Lindell, 2008). Especially problematic is the role of volunteers and emergency-relevant organizations such as social service agencies that have little training in ICS/IMS and infrequent experience in emergency response.

Disaster researchers have also examined the dissemination of public information (which is intended for those who *are not* at risk, by contrast to warnings, which are directed to those who *are* at risk). One important goal of public information is to reassure people that they should *avoid* taking protective actions – especially if these might interfere with the protective actions of those who are at risk. Much of the research on public information has studied news media framing of disaster reports (Vultee, 2009).

There has been little research on topics such as mobilization of emergency facilities/equipment, incident communication/documentation, hazard analysis/planning, finance/administration and logistics. Such topics might seem to have little theoretical appeal for social and behavioral scientists but they have great practical importance for emergency managers. For example, Sorensen and Rogers (1988) conducted a survey of local agency procedures for notification and mobilization in toxic chemical emergencies. This research provided important background data for legislative and regulatory actions to improve safety around toxic chemical facilities in the aftermath of the Bhopal incident.

Disaster recovery

Disaster recovery begins with stabilization of an incident and ends when the community has re-established normal social, economic and political routines. It is now generally accepted that disaster recovery encompasses multiple activities, some implemented sequentially and others implemented simultaneously. At any one time, some households might be engaged in one set of recovery activities while other households are engaged in other recovery activities. Thus, attempts to define finely differentiated phases of disaster recovery are inherently limited in their validity so researchers have been less concerned about time phases (e.g. short-term recovery vs long-term recovery) than about the specific recovery functions that must be performed.

Household recovery. There are three basic components to household recovery – housing recovery, economic recovery and psychological recovery (Bolin and Trainer, 1978). All three components require resources to recover and households must frequently

invest significant amounts of time to obtain these resources. Households use four types of housing recovery following a disaster (Quarantelli, 1982). The first type, *emergency shelter*, consists of unplanned and spontaneously sought locations that are intended only to provide protection from the elements, typically open yards and cars after earthquakes (Bolin and Stanford, 1991, 1998). The second type is *temporary shelter*, which includes food preparation and sleeping facilities that usually are sought from friends and relatives or are found in commercial lodging, although mass care facilities in school gymnasiums or church auditoriums are acceptable as a last resort. The third type is *temporary housing*, which allows victims to re-establish household routines in non-preferred locations or structures. The last type is *permanent housing*, which re-establishes household routines in preferred locations and structures. There is no single pattern of progression through the stages of housing because households vary in the number and sequence of movements and the duration of their stays in each type of housing (Cole, 2003).

Sites for temporary housing include homes of friends and relatives, commercial facilities such as rental houses and apartments, and mass facilities such as trailer parks. Some of these sites are in or near the stricken community, but others are hundreds or even thousands of miles away. Lack of alternative housing within an acceptable distance of jobs or peers led some households to leave the Miami area after Hurricane Andrew. The population loss was 18 percent in South Dade County, 33 percent in Florida City and 31 percent in Homestead (Dash et al., 1997). Other households remained in severely damaged units – or even condemned units – without electric power or telephone service for months (Yelvington, 1997) or doubled up with relatives (Morrow, 1997).

There are significant variations among households in their housing recovery and these are correlated with households' demographic characteristics (Peacock et al., 2006). Because lower-income households have fewer resources on which to draw for recovery, they also take longer to return to permanent housing, sometimes remaining for extended periods of time in severely damaged homes (Girard and Peacock, 1997). Indeed, they sometimes are forced to accept as permanent what originally was intended as temporary housing (Peacock et al., 1987).

Some households' economic recovery takes place quickly, but others' takes much longer. For example, the percentage of households reporting complete

economic recovery after the Whittier earthquake was 50 percent at the end of the first year but 21 percent reported little or no recovery even at the end of four years (Bolin, 1993). Economic recovery was positively related to household income and negatively related to structural damage, household size and the total number of moves (Bolin, 1993). In some cases, this is due to the loss of permanent jobs that are replaced only by temporary jobs in shelter management, debris cleanup and construction – or are not replaced at all (Yelvington, 1997). There are also systematic differences in the rate of economic recovery among ethnic groups. For example, Bolin and Bolton (1986) found that Black households (30 percent) lagged behind Whites (51 percent) in their return to pre-impact economic conditions eight months after the 1982 Paris, Texas, tornado. However, the variables affecting economic recovery were relatively similar for Black and White families.

Household recovery is significantly determined by sources of assistance. Hazard insurance is a major source of the money needed to rebuild damaged structures and replace destroyed contents. However, risk area residents are particularly likely to forego hazard insurance because they consider premiums to be too high and deductibles too large (Palm et al., 1990), as well as inability to protect persons, and specificity to a given hazard (Lindell et al., 2009). Hazard insurance varies significantly in its availability and cost – flood, hurricane and earthquake insurance being particularly problematic (Kunreuther and Roth, 1998). Moreover, some ethnic groups cannot afford the rates of high-quality insurance companies or are denied coverage altogether (Peacock and Girard, 1997).

Kinship networks can also contribute to disaster recovery but the significance of this source depends on the physical proximity of other nuclear families in the kin network, the closeness of the psychological ties within the network, the assets of the other families and, of course, the extent to which those families also suffered losses. Friends, neighbors and co-workers can assist recovery through financial and in-kind contributions but these tend to be less important.

Institutional sources of recovery assistance include federal, state and local government as well as non-governmental organizations and community-based organizations (Phillips, 2009). Because the donor-victim relationship is defined by bureaucratic norms, the amount of assistance depends on whether victims meet the qualification standards, usually documented residence in the impact area and proof of loss. Institutional recovery provides assistance by means of loans (at below-market interest rates in the

case of the US Small Business Administration [SBA]), grants (that do not need to be repaid) and tax deductions or deferrals. SBA loans can be problematic because they involve long-term debt that takes many years to repay (Bolin, 1993).

Because few victims develop major psychological problems from disaster impacts, most benefit more from a *crisis counseling* orientation than from a *mental health treatment* orientation, especially if their normal social support networks of friends, relatives, neighbors and co-workers remain largely intact (Gerrity and Flynn, 1997). However, there are population segments requiring special attention and active outreach. These include children, frail elderly, people with pre-existing mental illness, racial and ethnic minorities and families of those who have died in the disaster. The appropriate strategy for psychological recovery by victims and emergency responders seems to be one of minimal intervention to provide information about sources of material support (for victims) and to facilitate optional involvement in social and emotional support groups (for victims and emergency responders).

Business recovery. Several studies have examined the ways in which individual businesses recover from disasters (Zhang et al., 2009). Whereas wholesale and retail businesses generally report experiencing significant sales losses, manufacturing and construction companies often show gains following a disaster (Kroll et al., 1990; Webb et al., 2000). Moreover, businesses that serve a large (e.g. regional or international) market tend to recover more rapidly than those that only serve local markets (Webb et al., 2002). Small businesses, in particular, have been found to experience more obstacles than large firms and chains in their attempts to regain their pre-disaster levels of operations. Compared to their large counterparts, small firms are more likely to depend primarily on neighborhood customers, lack the financial resources needed for recovery and lack access to governmental recovery programs (Alesch et al., 1993; Kroll et al., 1990).

New directions

Theoretical directions

Disaster studies need to maintain a balance between theoretical and practical significance. That is, researchers should seek to link practical problems that emerge in disasters with broader social science theories and other perspectives on disasters such as organizational crisis response (Bolin and 't Hart,

2006; Mitroff, 2005) and crisis communications (Seeger and Novak, 2010; Sellnow et al., 2009). The field will progress if research continues to be done both inductively, beginning with data and working toward theory, *and* deductively, beginning with theory and making predictions about data. In either case, significant progress in understanding disasters will require integration of theories from all of the disciplines that contribute to the field. In many cases, it will be necessary to work with researchers from other disciplines, including physical scientists and engineers, to ensure that the field as a whole identifies all of the variables that are needed for better hazard management. In this connection, it should be noted that Lindell and Prater (2007) identified 11 evacuation traffic model parameters for which behavioral research was the appropriate source. Unfortunately, social scientists have focused on only a few of these parameters and provided few or no data on the rest. Not only do disaster researchers need to develop more comprehensive models of critical outcomes such as evacuation, they also need to expand their visions of which human behaviors to study in disasters. To continue with the example of evacuation research, it is important to extend our understanding of evacuation logistics (the events that take place between a household's departure from its home and its arrival at its shelter destination), as well as the entire process of evacuation re-entry (e.g. Siebeneck and Cova, 2008).

One area that has become particularly active is social vulnerability (e.g. Bolin, 2006; Enarson et al., 2006; Phillips et al., 2010). Most, if not all, disaster researchers would agree with three basic premises of this approach. That is, there are systematic variations in people's hazard exposure attributable to the locations where they live and work. Moreover, there are also systematic variations in people's vulnerability based on the quality of the structures in which they live and work. Finally, there are systematic variations in the social impacts people are likely to experience even controlling for hazard exposure and structural vulnerability. However, disagreements emerge when one tries to examine what is meant by the widely accepted definition of vulnerability as 'the characteristics of a person or group and their situation that influence their capacity to anticipate, cope with, resist, and recover from the impact of a natural hazard' (Wisner et al., 2004: 11). People can be differentiated by many different characteristics, some of which *define* vulnerability and others of which are merely *correlated with* vulnerability. Are demographic characteristics such as gender, age or race/ethnicity defining characteristics of

vulnerability, or are they correlated with other variables (e.g. human, social, physical, financial and natural capital) that are the defining characteristics? A comprehensive theory of hazard vulnerability will need to identify which variables are *measures* of vulnerability, which are *proximal causes* of vulnerability, which are *distal causes* of vulnerability and which are merely *correlated with* these causes. To date, our ability to disentangle these theoretical issues has been hindered by the limited amount and uneven quality of the available research. In some cases there is a relatively strong research literature on which to base conclusions (Peek, 2010) whereas in others there is little more than anecdotes and highly aggregated statistics to work with (Clive et al., 2010).

Finally, there are many topics – such as popular culture of disaster (Webb, 2006) and community commemoration (Eyre, 2006) – that could not be addressed here. Though less likely to produce direct reductions in casualties, damage and disruption, research in these areas is needed to generate a comprehensive understanding of disasters.

Methodological directions

Future research needs to continue to use a variety of research methods involving a mix of qualitative and quantitative studies (see Stallings, 2002, 2006). Qualitative studies need to continue the practice of systematically sampling situations and informants, as well as conducting observations and interviews. Extending the four decades-long tradition of disaster research center teams, such data collection efforts can be followed by systematic analysis of interview archives (e.g. Kreps and Bosworth, 2006). Following such data collection, researchers should make more extensive use of qualitative analysis programs such as HyperRESEARCH, QSR NVivo and Atlas.ti to systematically code and analyze the data that are collected.

Disaster researchers can also take advantage of emergency response organizations' increased reliance on computer software to enter, distribute and store messages transmitted from one emergency responder to another. The accessibility of software systems such as E Team and WebEOC should make it easier for disaster researchers to retrieve the data needed to conduct sophisticated network analyses (e.g. Petrescu-Prahova and Butts, 2008).

Disaster researchers should also increase the use of experiments such as Drabek's (1970) elaborate simulation of a police dispatch center. Such simulations, which have become increasingly feasible because of the availability of inexpensive networked microcomputers, can be useful in disentangling causal mechanisms producing observed correlations in survey studies. Moreover, the advent of the

Internet provides researchers with opportunities to conduct web experiments in which representative population samples are contacted to log on to websites where they can be randomly assigned to different information conditions (Joinson et al., 2007). In addition to randomization, such web experiments can provide graphic materials (not available in telephone surveys) and control over the order of question completion (not available in mail surveys) at a cost that is far lower than personal interviews.

Field experiments and quasi-experiments have the potential for providing important complements to laboratory experiments and surveys. Mileti and his colleagues (Mileti and Darlington, 1995, 1997; Mileti and Fitzpatrick, 1993) conducted evaluations of earthquake hazard awareness programs and Perry (1990) conducted an evaluation of a volcano hazard awareness program. Systematic comparisons of communities that vary in their receipt of hazard information can provide valuable insights into the degree to which households have received, attended to, comprehended and processed information from authorities. Such designs allow researchers to test hypotheses about stages of information processing that cannot be tested rigorously in survey designs.

One recommended future direction for survey researchers is to increase the frequency with which they use the same measures as previous researchers so systematic comparisons can be made across studies. As Baker (1991) noted, disaster experience is routinely invoked as an explanation for why people do or do not evacuate but this variable has been measured in many different ways. It is true that part of the reason for changes in measurement procedures has been the limited success of existing measures. When a logically relevant variable fails to provide empirical prediction, the natural reaction is to assume that the measure is flawed. However, it is also possible that the measure predicted poorly only in that sample. Thus, researchers need to test measures over multiple samples before concluding that the measures are, in fact, flawed.

Finally, survey researchers need to increase the number of studies that test multivariate, multi-equation models. It is becoming increasingly obvious that theoretical progress will depend on researchers' ability to identify the mediating mechanisms through which the ultimate exogenous variables (independent variables that are not presumed to be caused by any other variables) exert their effects on the endogenous variables of interest (the ultimate dependent variables). It is only through the use of such models that it is possible to determine if hazard proximity, hazard experience, risk perception and hazard adjustment form a causal chain in which each variable completely determines the next variable in the chain

(e.g. Lindell and Hwang, 2008). Confirmation of the chain hypothesis would clarify the mechanisms by which each of the variables affects the others whereas disconfirmation of the chain suggests that there are either unexpected direct effects or unmeasured intervening variables. In either case, such analyses greatly enrich our theoretical understanding of the phenomenon being studied.

Annotated further reading

This section lists seven recent books that provide significant insights into disaster research. For summaries of a wider variety of hazards-related publications, see www.colorado.edu/hazards/library/.

Committee on Disaster Research in the Social Sciences. (2006) *Facing Hazards and Disasters: Understanding Human Dimensions*. Washington, DC: National Academy of Sciences.

This volume reports the results of a US National Research Council evaluation of social science research on disasters. In addition to discussing research in the areas of hazard/vulnerability analysis, hazard mitigation, disaster preparedness and response and disaster recovery, the report also addresses trends that will affect future disaster losses and the infrastructure needed to analyze these losses. The latter topics include interdisciplinary and international research, issues in data collection and management, knowledge dissemination to practitioners, and future staffing of the disaster research enterprise. The report includes recommendations for research areas that deserve funding by the US federal government and, especially, the National Science Foundation.

Mileti DS (1999) *Disasters by Design: A Reassessment of Natural Hazards in the United States*. Washington, DC: Joseph Henry Press.

This book is the capstone volume for the US National Science Foundation-funded Second Assessment of Research on Natural Hazards. Mileti summarizes the reports of the topical committees, some of which were published as separate volumes, and casts their findings in the framework of sustainable development. Although written primarily for national policy-makers, *Disasters by Design* provides a useful conceptual framework for non-specialists who are interested in hazards policy. It is also useful for researchers from other research areas who are interested in seeing their work inform governmental policy.

Peacock WG, Morrow BH and Gladwin H (eds) (1997) *Hurricane Andrew: Ethnicity, Gender and the Sociology of Disasters*. New York: Routledge.

This volume provides an in-depth examination of Hurricane Andrew's impacts and the Miami area's response to those impacts. The book is notable for its foundation in sociopolitical ecology. This framework guides a thorough examination of the conditions affecting vulnerable populations – racial/ethnic

minorities, women and the poor.

Rodríguez H, Quarantelli EL and Dynes RR (eds) (2006) *Handbook of Disaster Research*. New York: Springer.

This edited volume contains 32 chapters that address a wide range of topics addressed by sociologists and other social scientists who conduct research on rapid onset disasters involving natural and technological hazards. Many of the chapters (e.g. the chapter on warning and evacuation) emphasize the practical implications of disaster research for reducing casualties, damage and social disruption. However, others (e.g. the chapter on popular culture) are guided primarily by sociological theory. Overall, the volume provides a comprehensive overview of the entire field of disaster research.

Tierney KJ, Lindell MK and Perry RW (2001) *Facing the Unexpected: Disaster Preparedness and Response in the United States*. Washington, DC: Joseph Henry Press.

This volume is one of a series of books published as part of the US National Science Foundation-funded Second Assessment of Research on Natural Hazards. The authors summarize the findings of research on emergency preparedness and response at the individual, household and community levels.

Tierney KJ and Waugh WF Jr (eds) (2007) *Emergency Management: Principles and Practice for Local Government*, 2nd edn. Washington, DC:

International City/County Management Association. This edited volume addresses the range of disaster-related topics most relevant to local public administrators. The contents of this book overlap with those of the *Handbook of Disaster Research* (see above) – especially in the areas of disaster preparedness, response and recovery. However, there are some significant differences between the two books. For example, *Emergency Management* includes material on hazard/vulnerability analysis and hazard mitigation. These are topics that, to date, have been largely neglected by sociologists. However, given the book's intended audience, the chapters tend to focus on reporting established findings rather than identifying new research questions. Although the chapters generally provide excellent summaries of their topics, the reference lists are rather limited.

Wisner B, Blaikie P, Cannon T and Davis I (2004) *At Risk: Natural Hazards, People's Vulnerability and Disasters*, 2nd edn. London: Routledge.

This book extends the argument, articulated in its first edition, that people's vulnerability to environmental hazards is frequently produced by the limited choices that they over the locations and structures in which they live and work. The authors identify root causes of these constraints, among which are conditions created by conventional conceptions of economic development. Frequently, such development is dominated by projects whose short-term gains are offset by the expansion of geographic areas at risk and the creation of impediments to people's ability to cope effectively with those expanding hazards.

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résumé Les études de désastre abordent sociaux et comportementaux des situations de tension collectif généralement dénommés situations d'urgence ou de catastrophes. Ces situations peuvent être créés par les aléas naturelles ou technologiques, les conflits entre des groupes sociaux, les manques de ressources vitales, et d'autres risques majeurs pour la vie, la santé, les biens, le bien-être, e des routines quotidiennes. Les études de désastre abordent les effets de ces événements sur l'ensemble des unités sociales, allant des individus et de ménages aux nations. Tous les aspects de l'histoire de vie de ces événements, à la fois réelle et potentiels, sont examinés en fonction de la façon dont les populations à risques conduisent des évaluations des risques et de leur vulnérabilité ainsi qu'ils préparent e mettent en œuvre les mesures d'atténuation, de prévention, de préparation et de redressement.

mots-clés l'atténuation ♦ catastrophes ♦ la convergence ♦ les crises ♦ l'émergence ♦ l'improvisation ♦ intervention ♦ préparation ♦ les situations d'urgence ♦ la récupération ♦ la vulnérabilité

resumen Estudios de desastre aborda los aspectos sociales y del comportamiento de las situaciones de estrés colectiva repentina normalmente denominados de emergencias o desastres. Estas situaciones pueden ser creadas por las amenazas naturales o tecnológicas, los conflictos violentos entre los grupos sociales, la escasez de recursos vitales, y otros riesgos mayores a la vida, la salud, la propiedad, el bienestar y rutinas cotidianas. Estudios de desastre aborda los efectos de estos eventos en todas las unidades sociales, desde los individuos y las familias a los naciones. Todos los aspectos de la historia de vida de estos eventos, tanto reales como potenciales, son examinados por lo que se refiere a las formas en que las poblaciones amenazadas realizan los evaluaciones del riesgo y de la vulnerabilidad, así como planifican y ejecutan la prevención, preparación, la gestión de emergencias y la recuperación.

palabras clave la convergencia ♦ las crisis ♦ desastres ♦ emergencia ♦ emergencias ♦ la improvisación ♦ mitigación ♦ preparación ♦ recuperación ♦ respuesta ♦ vulnerabilidad