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Survey Research*

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We examine the kinds of information that can be obtained from well-designed, standardized, population-based surveys and demonstrate that some things which, in the past, have been considered barriers to the use of surveys following disasters provide insights into postdisaster behavior and may be advantageous. In specific, we examine: the use of standardized surveys to compare community behavior across time, events, and locations; the extent to which surveys represent the population of interest in the aftermath of a disaster; the receptivity of respondents to being interviewed after a disaster; the ability to utilize telephones for interviews after a disaster; the extent to which the data collected in a survey are perishable and subject to memory decay; the use of surveys as quasi-experimental designs for obtaining information on "control groups"; the use of surveys as a source of baseline or denominator data for ascertaining what other, more specialized datasets represent; the maintenance of verbal data collected within the context of a survey for later postcoding and analysis; and the storage of surveys in archives for use in secondary analyses by other researchers. Overall, we conclude that well-designed, standardized, population-based surveys can provide an accurate picture of a community's behaviors and attitudes with regard to disasters as well as describe the impact of a disaster on a population.

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Surveys provide a highly viable and excellent source of data about behavior during and after disasters, behavioral and attitudinal responses to disasters, and anticipatory behavior and attitudes about future disasters. Although surveys have increasingly been conducted by disaster researchers (e.g., Bolin and Bolton 1986; Mileti and O'Brien 1992; Palm et al. 1990; Tierney et al. 1996), the traditional approach to disaster research emphasized quick entry into a disaster site where selected informants were interviewed using semistructured interviews. Disaster researchers' reluctance to recognize the strengths and to advocate the use of well-designed, standardized, population-based surveys reflects both realistic and unrealistic barriers to their use. Some of these barriers are grounded in historical reality, but the availability of new, technologically sophisticated methods for conducting surveys makes many of these historical barriers obsolete.

This paper examines the kinds of information that can be obtained from well-designed, standardized, population-based surveys. In so doing, we will demonstrate that some of the issues, which in the past have been considered barriers to the use of surveys are, in fact, sources of important insights into community responses to disasters and are even among the advantages of surveys. The following aspects of surveys will be examined.

1. The use of standardized surveys to compare community behavior across time, events, and locations.
2. The extent to which surveys represent the population of interest in the aftermath of a disaster.
3. The receptivity of respondents to being interviewed after a disaster.
4. The ability to utilize telephones for interviews after a disaster.
5. The extent to which the data collected in a survey are perishable and subject to memory decay.
6. The use of surveys as quasi-experimental designs for obtaining information on "control groups."
7. The use of surveys as a source of baseline or denominator data for ascertaining what other, more specialized datasets represent.
8. The maintenance of verbal data collected within the context of a survey for later postcoding and analysis.
9. The storage of surveys in archives for use in secondary analyses by other researchers.

In examining the use of surveys as a source of information about disasters, we provide examples from five surveys that we have conducted following the Whittier Narrows, Loma Prieta, and Northridge earthquakes; from a survey that Gatz (1996) conducted following the Northridge earthquake; and from the surveys conducted by Ralph Turner and associates in the late 1970s (Turner et al. 1986).

Definition of Survey Research

Early disaster researchers differentiated between collecting data by questionnaire and by interview (Cisin and Clark 1962; Killian 1956). Questionnaires strictly referred to collecting data by having respondents fill out a structured questionnaire; the method by which the respondent obtained the questionnaire—whether by mail or distribution—was often unspecified. The use of questionnaires, as defined above, was largely discouraged. Interviews, in contrast, were a recommended way of collecting data, but the interview schedule was recommended to be (and often was) unstructured or semistructured, and the persons interviewed were as frequently selected to be key informants as to be representative of any larger population.

Over the years, the terms "survey research," "sample surveys," and "surveys" have been used interchangeably with the term "questionnaires." This interchangeable use of terms implies that, if a survey is being done, the data are being collected using a questionnaire. In fact, the interchangeable use of these terms is technically incorrect. "Surveys" refer to the units from whom data are collected and how those units are selected for study. The assumption is that the population or sample from which data are collected are heterogeneous in their characteristics, behaviors, experiences, and attitudes and that the task of the survey researcher is to adequately and accurately describe that diversity and how these diverse characteristics, behaviors, and attitudes of individuals, families, or groups may or may not be associated. Data in a survey are often collected with a questionnaire, but the questionnaire can be *administered* by mail, supervised self-administration, telephone interview, or face-to-face interview (Bourque and Clark 1992; Bourque and Fielder 1995).

The use of a questionnaire, however, is not necessary for a survey. Data can also be collected from records. We can, for example, take the population of all claims made to the Federal Emergency Management Agency (FEMA) and select a systematic or probabilistic sample of their records and, thereby, "survey" the characteristics of the applicants. In so doing, we never contact an applicant directly for information by mail, by telephone, or in person using a questionnaire.

For the remainder of this article we use the term "survey research" to refer to selecting a sample of respondents—whether individuals, families, businesses, or institutions—in such a way that the sample represents an underlying population. In some instances, all units in the population will be

targeted for study; in other instances—probably in most instances—a representative sample will be drawn of the population, generally using probabilistic sampling procedures. For purposes of this discussion, the data collection instrument will be a structured questionnaire, not a record. The questionnaire can be administered either through the mail (e.g., Mileti and O'Brien 1992), by telephone (e.g., Bourque et al. 1993), or by face-to-face interview (e.g., Bolin and Bolton 1986).

Contemporary Survey Methodology

Over the last twenty years, the methods of conducting surveys have been revolutionized. In the 1970s the majority of population surveys were administered using either face-to-face interviews or mail questionnaires, but by 1990, 95 percent of U.S. households had telephones (U.S. Census Bureau 1990). This close to universal saturation, combined with the reduced cost of telephone interviewing, respondents' reluctance to admit interviewers into their homes, reduced English literacy, and the increased availability of random digit dialing (RDD) and computer-assisted telephone interviewing (CATI) systems has resulted in telephone interviewing largely replacing face-to-face interviewing and mail questionnaires as the administrative procedure of choice. While telephones continue to be somewhat differentially distributed across the population with saturation being particularly high in moderate-sized, middle-class households in Metropolitan Statistical Areas (MSAs) outside the South, research conducted to date concludes that studies which utilize RDD procedures result in samples of the universe of households that are as representative as other methods (Aday 1996; Groves and Kahn 1979).

Over the last decade, computer-assisted telephone interviewing (CATI) procedures have increasingly replaced traditional paper-and-pencil methods for conducting telephone surveys. While only 3 of 30 academically based survey research centers (10 percent) had CATI systems in 1979 (Spaeth 1990), by 1993 21 of 25 such centers (84 percent) used CATI systems (Bourque and Becerra 1993) for some portion of the studies they conducted. While more expensive in initial setup, once a questionnaire is entered into a CATI system, a population-based survey can be fielded within a matter of days, sample parameters can be incorporated into the program, and error-free analytical files are available within days of the completion of the data collection. The result is better quality data collected closer in time to the index disaster when respondents are being interviewed about a past disaster.

There is one problem with CATI procedures that must be recognized and has yet to be overcome. Response rates in telephone interviews are determined by and highly correlated with the number and pattern of "callbacks" made (Aday 1996). "Callbacks" refer to the number of times that an interviewer attempts to call a number, first, to determine whether it is a household and thus eligible for inclusion, and, second, to complete an interview with the designated respondent within a household. It is well-known that callbacks result in completed interviews more quickly when the *pattern* of attempts is varied across time of day and day of the week. Unfortunately, to date, it is easier to vary callbacks productively when interviews are conducted using paper-and-pencil techniques rather than the computer. Setting up queues for callbacks on the computer takes substantial programming and thus increases the relative cost of a callback more on the computer than when data are collected using paper and pencil.

The Institute for Social Science Research at UCLA was among the first university-based survey research centers to have a CATI system (in 1977), and Turner's 1986 study of earthquake predictions was one of the first studies to be partially conducted on a CATI system. To our knowledge, since that time we are the only research group which has exploited the advantages of using CATI systems to collect data following a disaster. In collaboration with a consortium of researchers from UCLA and the County of Los Angeles, three waves of data were collected using random digit dialing (RDD) and CATI procedures following the Northridge earthquake of January 17, 1994. Earlier we combined traditional paper-and-pencil telephone interviewing data collection techniques with RDD sampling techniques following the Whittier Narrows and Loma Prieta earthquakes (Bourque et al. 1993; Goltz et al. 1992; Russell et al. 1995). Farley and others used a CATI system in interviewing Midwestern residents about the Iben Browning prediction that there would be an earthquake on the New Madrid fault (Farley et al. 1993).

Methodology

Datasets Referenced for Examples

The examples used in the remainder of this paper draw upon six datasets: a survey conducted after the Whittier Narrows earthquake of October 1, 1987; a survey conducted after the Loma Prieta earthquake of October 17, 1989; and four surveys conducted after the Northridge earthquake of January 17, 1994. All six surveys were conducted by telephone using a standardized questionnaire. Three of the six surveys (Whittier Narrows, Loma Prieta, and one Northridge survey) were conducted using traditional

paper-and-pencil procedures; the remaining three surveys, all following the Northridge earthquake, were conducted on a CATI system. Five of the six surveys were conducted by the Survey Research Center in the Institute for Social Science Research at UCLA, and samples for these same five studies were selected using random digit dialing procedures and were designed to represent households in the California counties from which they were drawn. The sixth survey was conducted by personnel at the Andrus Center for Gerontology at the University of Southern California (USC) and utilized an ongoing three-generational panel sample (Gatz 1996).

Questionnaires. As part of his study of community awareness and responses to earthquake predictions in the 1970s, Turner developed a questionnaire for administration in Los Angeles County should a substantial earthquake occur in the area during the course of the study (Turner et al. 1986). No earthquake of sufficient magnitude occurred, so the questionnaire was never used. However, we knew about it, and it was made available to us following the Whittier Narrows earthquake. Originally designed for use in an interview of 45 minutes to an hour, the questionnaire was modified for use following the Whittier Narrows earthquake to reduce the length of an interview to 30 minutes and to include the Brief Symptom Inventory, a measure of psychological symptomatology (Derogatis and Spencer 1982). With those two exceptions, however, the topics covered in the questionnaire and the format of the questionnaire were left much as they had been designed by Turner (Bourque and Clark 1992).

Utilizing information gained following the Whittier Narrows survey, the questionnaire was somewhat modified for use following the Loma Prieta earthquake, with the major change being the addition of the Civilian Version of the Mississippi Scale for Post-Traumatic Stress (Keane and Wolfe 1990) and the inclusion of questions suggested by Norris for measuring Post-Traumatic Stress Disorder (Norris 1990). Interviews following both the Whittier Narrows and Loma Prieta earthquakes averaged 30 minutes. Following the Northridge earthquake, the questionnaire was again modified but with the main modifications for the first wave being additions which resulted in an average interview of 48 minutes, and modifications in the questionnaires used in the other three postearthquake surveys being responses to the needs of other researchers in the Los Angeles area.

All six questionnaires contain some core information in common. Included in one or more questionnaires was information about: where the respondent was at the time of the earthquake, who they were with, and what they did during and immediately after the earthquake; whether or not the respondent or other members of the household were injured; damage to homes and neighborhoods; the extent to which utilities went out; use of media to obtain information; contact with officials and agencies after the quakes; adoption of preparedness and mitigation activities before and after the index quake; and standard demographic data about the respondent and the household. The existence of this common information across surveys asked in identical or highly comparable ways allows us to examine how California residents do or do not differ across geographic areas, time, and earthquake event. Following the Northridge earthquake, we were also able to ascertain the extent to which memory decay or enhancement occurs as the time following the earthquake increases and to compare findings from a specialized sample to a series of population-based samples.

Whittier Narrows Sample. Between October 1, 1988 and May 1, 1989, interviews were conducted in both English and Spanish with 690 residents of Los Angeles County. Random digit dialing (RDD) was used to obtain a representative sample, with intentional oversampling of predesignated communities in which the Modified Mercalli Intensity (MMI) isoseismals equaled 7 (Monterey Park, Rosemead, El Monte, and South El Monte) or 8 (Whittier). Within contacted residences, all persons over age 18 who resided in the household on the day of the earthquake were enumerated, and one resident was randomly selected for interview using the Kish method (Kish 1965).

As Table 1 shows, interviews were conducted within the high-impact area with 191 of the 254 useable telephone numbers identified. In the rest of the county, interviews were conducted with 499 of the 1,190 useable numbers. To complete an interview, up to 12 callbacks were made in the high-impact area and up to five callbacks in the rest of the county. Assuming alternately that all or none of the uncontacted numbers contained eligible respondents, a response rate of 75 to 80 percent was obtained within the high-impact area and 42 to 57 percent within the remainder of the county. In the high-impact area, interviews were conducted an average of 511 days after the earthquake, and 10 percent were conducted in Spanish. In the rest of the county, interviews were conducted an average of 504 days after the earthquake, and six percent were conducted in Spanish. Because disproportional sampling was intentionally done, the sample must be weighted when estimates of population parameters are desired.

Loma Prieta Sample. Between April 29, 1990 and August 1, 1990, interviews were conducted in both English and Spanish with 656 residents of San Francisco, Alameda, Santa Cruz, Santa Clara, and San Mateo counties. Modified RDD using a prescreened sample of numbers from Survey Sampling was used to obtain a representative sample, with inten-

tional oversampling of predesignated communities in which the Modified Mercalli Intensity (MMI) equaled 8 or 9 (the northwest edge of the San Francisco peninsula, Oakland, and the Boulder Creek-Santa Cruz-Watsonville area). Within contacted residences, all persons over age 18 who resided in the household on the day of the earthquake were enumerated, and one resident was randomly selected for interview using the Kish procedure (Kish 1965).

Within the high-impact areas, interviews were conducted with 83 of the 118 eligible households in the San Francisco-Oakland area and with 122 of the 164 eligible households in the Boulder Creek-Santa Cruz-Watsonville area. In the remainder of the five counties, interviews were conducted with 451 of the 655 eligible households. A minimum of seven callbacks were made when answering machines were obtained and nine callbacks when no answer was obtained. When a respondent within a household had been

Table 1. Comparison of Response Rates in Earthquake Studies to Response Rates in the Los Angeles County Social Surveys, 1993–1996*

	Telephone Numbers Generated	Total Screened and Ineligible	Total Usable	Refusals, Language Barriers, Incapable	Status Undetermined	Completed Interviews	Response Rates (%)
Los Angeles County Social Surveys							
1993	3,800	1,436	2,364	1,083	295	986	42–48
1994	3,300	1,459	1,841	597	387	857	47–59
1995	2,500	1,167	1,333	512	226	595	45–54
1996	3,100	1,423	1,677	633	316	706	42–52
Earthquake Studies							
Whittier Narrows							
High-impact area	639	385	254	48	15	191	78–80
Low-impact area	3,790	2,600	1,190	378	313	499	42–57
Loma Prieta							
5-county area	1,100	445	655	154	50	451	69–74
San Francisco	270	152	118	20	15	83	70–81
Santa Cruz	270	106	164	31	11	122	74–80
Northridge							
Wave 1	2,100	1,005	1,095	336	253	506	46–60
Wave 2	500	257	243	59	88	96	40–59
Wave 3	6,400	3,270	3,130	1,101	782	1,247	40–53

* All of the Los Angeles County Social Surveys (LACSS) were conducted on Computer-Assisted Telephone Interviewing (CATI). The Northridge survey was conducted on CATI; Whittier Narrows and Loma Prieta were conducted using pencil and paper.

designated for interview, as many as 12 callbacks occurred to obtain the interview. Response rates were between 70 and 81 percent in San Francisco-Oakland, between 74 and 80 percent in Boulder Creek-Santa Cruz-Watsonville, and between 69 and 74 percent in the rest of the five-county area. In San Francisco-Oakland, interviews were conducted an average of 217 days after the earthquake, and five percent were conducted in Spanish. In Boulder Creek-Santa Cruz-Watsonville, the figures were 223 days and two percent, and, in the rest of the five-county area, they were 226 days and one percent. Because disproportional sampling was intentionally done, the sample is weighted in these analyses for purposes of making population comparisons.

Northridge samples. After the Northridge earthquake on January 17, 1994, telephone interviews were conducted with three different probability samples of respondents and with three generations of an ongoing, systematic, panel sample of families first studied in 1971.

Wave 1, Probability Sample. Between August 10 and December 6, 1994, interviews were conducted in both English and Spanish with 487 residents of Los Angeles County and 19 residents of eleven zip codes in Ventura County. Only residents of Los Angeles County are included in these analyses. Modified RDD using a prescreened, list-assisted sample of numbers from Genesys was used to obtain a representative sample of Los Angeles and the designated areas of Ventura county. Strata were not created, and no areas were oversampled. Thus, no weights are used with this sample. Within contacted residences, all persons over age 18 who resided in the household on the day of the earthquake were enumerated, and one resident was selected for interview using either the next-birthday method or the Kish procedure within a split-ballot experiment.

Interviews were conducted with 506 of the 842 eligible households identified. No-contact cases or those where no one ever answered the phone were called a minimum of twelve times; callback cases, those determined to be households and in which a respondent was designated, were called back up to three times. Assuming alternately that all or none of the 253 numbers of unknown status contained eligible respondents, a response rate of from 46 to 60 percent was obtained. Interviews averaged 48 minutes in length, were conducted an average of 245 days after the earthquake, and 18 percent were conducted in Spanish.

Wave 2. Between August 2, 1995 and October 22, 1995, interviews were conducted in both English and Spanish with 96 residents of Los Angeles County. The process by which households and respondents within households were selected was identical to that used in collecting Wave 1 data.

Interviews were conducted with 96 of the 155 eligible households identified. Assuming alternately that all or none of the 88 numbers of unknown status contained eligible respondents, a response rate of 40 to 59 percent was obtained. Since the questionnaire used in this interview was reduced to focus primarily on injuries experienced by respondents, interviews averaged 25 minutes in length. Interviews were conducted an average of 577 days after the earthquake, and 17 percent were conducted in Spanish.

Wave 3. Between August 22, 1995 and May 29, 1996, interviews were conducted in both English and Spanish with 1,247 residents of Los Angeles County. The process by which households and respondents within households were selected was identical to that used in collecting Wave 1 data. Interviews were conducted with 1,247 of the 2,029 eligible households identified. Assuming alternately that all or none of the 782 numbers of unknown status contained eligible respondents, a response rate of between 40 and 53 percent was obtained. Since the questionnaire used in this interview was again expanded to include much of the information contained in Wave 1 as well as data on the use of services after the earthquake (which was of particular interest to the Los Angeles County Department of Health Services), interviews averaged 49 minutes in length. Interviews were conducted an average of 712 days after the earthquake, and 23 percent were conducted in Spanish.

Three-generational Panel Sample. Margaret Gatz and colleagues at the University of Southern California (USC) administered a modified version of the Wave 1 questionnaire to a three-generational longitudinal panel. The objectives were to assess how earthquake preparedness and psychosocial responses to earthquakes differ with age, to ascertain the extent to which earthquake preparedness is diffused through family networks, and to assess the extent to which differences can be attributed to intensity of the earthquake and to experiences in past earthquakes (Gatz 1996).

Families in which at least one member lived within the area affected by the Northridge earthquake with an MMI value of six or greater were identified from the USC Longitudinal Study of Generations (LSOG). A total of 115 families of 127 eligible LSOG families were included in the study. Those lost were due to refusal (n = 1), inability to complete the interview due to physical incapacity of the targeted respondent (n = 3) or to scheduling incompatibilities (n = 3), inability to locate the targeted respondent (n = 2), or death of the targeted respondents (n = 3). Excluding those in which the targeted respondent had died, 93 percent of eligible families participated in the study. Within the 115 participating families, 207 of the 244 potential respondents participated. The final sample contains 38

members of the oldest generation with a mean age of 85.5 years, 99 members of the middle generation with an average age of 66.0 years, and 70 members of the youngest generation with an average age of 42.0 years. Included in these analyses are the 166 persons, regardless of generation, who resided in southern California at the time of the Northridge earthquake.

Results

Earlier we listed a number of issues that have either been raised in the past about the ability to conduct valid surveys in the wake of a disaster or about the advantages and disadvantages of survey data as a source of information about disasters. Here we will address each of these issues utilizing, when possible, examples from the datasets described above.

Comparisons Across Time, Events, and Locations

Probably the single greatest advantage of collecting data with standardized questionnaires from population-based samples is that it allows researchers to compare community behavior across time, events, and locations. In an earlier analysis, we compared reports of the preparedness activities that respondents reported completing before the Whittier Narrows and Loma Prieta earthquakes with those reported by Turner, Nigg, and Heller Paz (1986) in the late 1970s (see Russell, Goltz, and Bourque 1995, p. 756, Table 1). In Table 2 we extend that analysis to look at preparedness activities prior to the Northridge earthquake. (Data on preparedness activities before and after the Northridge earthquake were not collected from the 96 respondents in the Wave 2 sample.)

Prior to the Northridge earthquake, we found that rates of survival activities (having a flashlight, a radio, a first-aid kit, and stored food and water) were dramatically higher in both northern and southern California before the Whittier Narrows and Loma Prieta earthquakes than they were in the late 1970s in the wake of the Palmdale bulge announcement (see Russell, Goltz, and Bourque 1995, pp. 755–756). In contrast, planning activities—particularly providing family members with instructions for what to do during and after an earthquake—had dropped or stayed approximately the same while hazard mitigation activities (rearranging cupboards, putting latches on cupboard doors, and reinforcing structures) had stayed consistently low.

When we examine similar data prior to the Northridge earthquake from the population-based samples, it is interesting to note that three of the four survival measures (having a flashlight, radio, and first-aid kit) had declined since the Whittier Narrows and Loma Prieta earthquakes. Providing

families with instruction had continued to decline, but investments in earthquake insurance and mitigation activities had risen slightly in the Los Angeles area. The panel study, however, shows levels of preparedness that are consistently higher than any of the other studies, across all types of preparedness. Possible explanations for this discrepancy will be discussed in a later section.

On the face of it, the downward trends look discouraging for practitioners. If anything, it would appear that investments in the simplest and most publicized kinds of activities actually dropped in the Los Angeles area between 1987 and 1994. There are, however, two potentially confounding pieces of information that practitioners should consider investigating in these datasets before concluding that their activities have been for naught. In these surveys, respondents are first asked whether or not they have done the activity. Second, they are asked whether they did the activity *before* or *after* the index earthquake. And third, respondents are asked whether they did the activity *specifically because of earthquakes, for some other reason, or for both earthquakes and other reasons.*

Table 2. Earthquake Preparedness in California: 1976-1994 (in percentages)

				Pre-Northridge		
Actions	Post-Palmdale[a]	Pre-Whittier	Pre-Loma Prieta	Wave 1	Wave 3	Gatz
Survival						
Have flashlight	11	58	60	48	49	87
Have radio	11	50	48	42	40	78
Have first-aid kit	8	48	42	36	39	77
Stored food	8	38	43	39	39	79
Stored water	8	37	40	42	40	68
Preparedness planning						
Family instruction	48	23	28	11	13	N/A
Earthquake insurance	13	12	17	22	19	46
Neighborhood plan	4	4	4	5	6	N/A
Hazard mitigation						
Rearranged cupboards	10	6	5	8	9	36
Latched cupboards	5	5	6	9	10	18
Reinforced structures	5	4	14	7	7	34
Total N	1,432	583[b,c]	550[b,c]	487[b,d]	1,247[b,d]	166[e]

a. From Turner, Nigg, and Heller Paz (1986)

b. Activities done for earthquakes or for both earthquakes and other reasons

c. Weighted sample

d. Unweighted sample

e. Sample of 166 people from Gatz multigenerational panel study (1996)

We suggest that people have increasingly bought flashlights, radios, and first-aid kits not just for use in earthquakes but for use in a variety of situations. We expect that this is particularly true of recent investments in portable radios. Indeed, when we examine whether respondents report having these items, regardless of the reason for which they were purchased, we find that more than 80 percent of the Northridge respondents had working flashlights before the earthquake, 65 percent had working battery-operated radios, and 54 percent had a first-aid kit. Rates of having an item, regardless of reason given for having it, are similarly higher in the Whittier data set, but the differences are not as dramatic: 78 percent have a flashlight; 65 percent have a radio; 62 percent have a first-aid kit; 49 percent store food; and 44 percent store water. Thus, what seems to have changed in the seven-year period between the Whittier Narrows and Northridge earthquakes is respondents' tendency to state that they have the item *because of* earthquakes. By the time of the Northridge earthquake, respondents were more likely to say they had one of these five items for reasons other than earthquakes.

This finding could also be of concern to practitioners. The fact that such a high proportion of Los Angeles County residents have these items but that some proportion fail to associate them with earthquake preparations *may* mean that Los Angeles County residents would not remember that they had them should an earthquake occur and, thus, would not use them. This interpretation is not completely farfetched. Southern California has experienced a significant amount of immigration over the last decade. Immigrants may be less knowledgeable about what to do when an earthquake occurs.

In the Northridge surveys, we asked respondents whether they had immigrated into the United States, whether their parents had immigrated into the United States, and how long the respondent had lived in California. A third of the Northridge respondents (35 percent in Wave 1, 31 percent in Wave 2, 37 percent in Wave 3) stated that they were born outside the United States. Similar or higher proportions reported that both parents were born outside the United States (41 percent in Wave 1, 38 percent in Wave 2, and 43 percent in Wave 3). Immigrants were an average of seven years younger than nonimmigrants, regardless of data set (37 versus 44 years), and had lived in California only half as long on average (15 versus 33 years). We compared the preparedness activity of immigrants and nonimmigrants and found that immigrants were less likely to store water for earthquakes (47 percent versus 59 percent), less likely to have a first-aid kit (37 percent versus 48 percent), less likely to have done structural reinforcement (7 percent versus 11 percent), less likely to have earthquake insur

percent versus 30 percent), but more likely to have put latches on cupboards (26 percent versus 15 percent) and equally likely to have engaged in the other preparedness activities listed here.

By being able to look at reports of preparedness activities across time and earthquake events, we have increased our ability to identify who may be less aware of what needs to be done to prepare for an earthquake. These analyses suggest that immigrants should be targeted for such programs.

Sample Representativeness

One concern that has been raised about doing telephone surveys after a disaster is that the sample from which data are collected are not representative of the population affected by the disaster. Two general objections are raised in this regard. First, it is suggested that telephone surveys will "miss" substantial numbers of persons who do not have telephones or access to telephones *prior* to the index disaster. Second, it is suggested that telephone surveys "miss" those who are dislocated as a result of the index disaster and, therefore, fail to get information on those most affected by the disaster. In analyzing the data obtained from our surveys, we have examined the representativeness of our samples by comparing them to the 1990 Census (U.S. Census Bureau 1990). While we cannot definitely answer the two challenges posed, we can state with some confidence what our samples do and do not represent. We suggest that telephone coverage is so pervasive in the United States and so quickly reinstated following disasters in the United States that the representativeness of any RDD sample, particularly in urban areas, will be as good or better than any other method of data collection *provided* that the researcher:

- Faithfully draws an up-to-date random-digit dialing (RDD) sample;
- Utilizes substantial numbers of callbacks distributed across different time periods and days of the weeks to maximize all households in the sample being identified and represented in the sample;
- Accurately and completely lists all adult residents of the household;
- Utilizes a Kish table or other demonstrated method for randomly selecting the designated respondent from within the household for interview; and
- Insures that interviewers indeed interview the selected respondent.

The procedures adopted and the methods used for calculating response rates should follow those recommended by the Council of American Survey Research Organizations (CASRO 1982).

Following the Loma Prieta earthquake, a great deal of attention was paid to, and concern expressed about, the homeless and those who occupied

single-room-occupancy (SROs) hotels prior to the earthquake, particularly in the Oakland area. Using the 1990 Census, we examined the extent to which our sample underrepresented: (1) persons who were homeless or who did not reside in households before the earthquake; (2) people who resided in households without telephones before the earthquake and who remained without telephones after the earthquake; and (3) persons whose telephones were disconnected as a result of the earthquake or whose households were destroyed as a result of the earthquake and who either left the area or remained inaccessible by telephone at the time of the interview (Bourque and Russell 1994, pp. 19–22).

Clearly, persons in category 1 (above) are going to be missed in a telephone survey of any kind. If this is the group of interest for study, a researcher must develop other methods for identifying and contacting them. In terms of persons in category 2, we found that household telephone ownership was high in the Bay Area with 95 percent of households in San Francisco/Oakland having telephones and 98 percent of the households in the rest of the Bay Area having households. The unavailability of these households for selection means that we "missed" between 3.82 and 4.23 people in the San Francisco-Oakland area, from 1.59 to 2.44 people in the Santa Cruz area, and between 5.86 and 6.77 people in the rest of the five-county area for a possible maximum miss of thirteen people.

The other group missed, by definition, is those who reside in group quarters, similar to the SROs in Oakland. According to the 1990 U.S. Census, three percent of persons in San Francisco-Oakland, 0.4 percent in Santa Cruz, and 1.5 percent in the rest of the five counties live in group quarters. Had such persons been available for interview, we would have interviewed an additional three persons in San Francisco/Oakland, an additional 0.5 person in Santa Cruz, and seven additional persons in the rest of the area. Thus, had all of the above groups been accessible by telephone, we would have interviewed an additional seven people (8.4 percent) in San Francisco/Oakland, three (2.5 percent) in Santa Cruz, and 14 (3.1 percent) in the rest of the area. Clearly, the sample stratum which was most affected in this study by lack of telephones was San Francisco/Oakland.

Finally, we examined whether the rate of disconnected telephones was disproportionally higher in the Bay Area following the Loma Prieta earthquake in order to estimate the extent to which we might have "missed" persons who moved after the earthquake. The percent of usable telephone numbers (i.e., a number that was neither a business nor disconnected) ranged from 44 percent in San Francisco/Oakland to 61 percent in Santa Cruz. These percentages are comparable to national rates and are actually

higher than the rates obtained in Los Angeles County following the Whittier Narrows earthquake, where 40 percent of the telephone numbers in the high-impact area and 31 percent of those generated in the rest of the County were usable. Thus, we did not find an unusually high number of disconnected or out-of-service telephone numbers, and there is no reason to think that mobility either out of the area or within the area was unusually high in the wake of the Loma Prieta earthquake.

The question then becomes: Did this affect our results? Of course this loss affected our results. Certainly a small proportion of the population who were assumed to be highly vulnerable to the impact of the earthquake were missed in this study. On the other hand, we *know* that we missed these people, and we can estimate the extent to which they were missed. Using data available in the actual dataset in combination with 1990 Census data, we could attempt to interpolate information for this group and to assess the extent to which their experiences might change our findings. On the other hand, the size of the group missed is so small in a total sample of 656 that the actual impact these cases would have on findings—assuming that they all had the most extreme experiences represented in the sample—would probably not substantially change the overall picture that the study provides of the Bay Area following the Loma Prieta earthquake. As noted earlier, if groups of persons without telephones are the major focus of a study, then telephone interviews should not be the method of data collection. If, in contrast, the researcher wishes to get a dependable overall picture of what happened to an entire community during and after a disaster, we suggest telephone interviewing is a very good way to get data.

Responsiveness to Interviews Following a Disaster

Earlier we reported the response rates for our surveys and briefly discussed the importance in number and pattern of callbacks in obtaining completed interviews. We also want to ascertain how receptive people are to being interviewed following a disaster. One way of estimating that is to compare the response rates we obtained in the Whittier Narrows, Loma Prieta, and Northridge surveys with response rates obtained in other telephone surveys conducted by UCLA's Institute for Social Science Research in southern California during the same calendar periods.

Response rates from four annual administrations of the Los Angeles County Social Survey (LACSS) are reported in Table 1 (above). All of the LACSS studies were conducted using CATI. Using methods recommended by the Council of American Survey Research Organizations (CASRO 1982), we calculated response rates by subtracting telephone numbers contacted and screened as ineligible from the total number of telephone

numbers generated. To establish the lower boundary of the response rate, we divided the number of completed interviews by the total number of useable numbers. This calculation assumes that all numbers whose status it was not possible to determine are eligible households with an eligible respondent. Included in this category are numbers that are never answered, always busy, and always answered by a machine as well as all combinations of these possibilities. To establish the upper boundary of the response rate, this number is subtracted from the total useable on the assumption that none of these numbers represent a household with an eligible respondent.

We see in Table 1 that the estimated response rates for the LACSS studies from 1993 to 1996 range from a low of 42 percent to a high of 54 percent. At 46 to 60 percent, the response rate for the Northridge study, which was also conducted on CATI, is well within this range. Similarly, the response rates for the majority of the sample in the Whittier Narrows study are within this range *even though* the Whittier Narrows study was conducted using paper-and-pencil techniques rather than CATI and in spite of the fact that paper-and-pencil techniques allow for better queuing of callbacks and, thus, often yield higher response rates. This occurred because the budget for the Whittier Narrows earthquake was such that fewer callbacks were made outside the high-impact area. In contrast, within the high-impact area of the Whittier Narrows sample and in all strata of the Loma Prieta sample, where many more callbacks were made, the response rates are as much as 20 percent higher than in Northridge and in the low-impact strata of Whittier.

On the basis of these comparisons, we conclude that there is no evidence that persons in households with telephones are any more reluctant to participate in a study after a disaster than they would be at any other time. Clearly, the amount of resources available for locating respondents determines the number of callbacks attempted which, in turn, increases the response rates obtained.

Timeliness of Data Collection

The inability to collect data in a timely fashion is another argument that has been made against surveys. How true is that in this day and age? In fact, if a researcher had a questionnaire ready to go, a probability sample of housing units already drawn, and the resources to do it, face-to-face interviews with randomly selected residents of households could start immediately after a disaster. The biggest barrier is the high cost involved in moving large numbers of qualified interviewers into an area quickly.

But an additional question is, how imperative is it to enter the area immediately? Many questions of interest cannot be answered if we enter the area too quickly. For example, any information about recovery and

rehabilitation, of necessity, cannot be collected until well after the index disaster. It is not even clear that information about use of services, extent of damage, injury, and psychological distress is best collected immediately. For example, in Los Angeles County we are still finding buildings that were damaged by the Northridge earthquake, and there is no definitive information about when, or if, excessive psychological distress—to the level of diagnosable posttraumatic stress disorder—occurs.

Certainly, telephone services do go off or become overloaded in disasters. Table 3 shows the number of respondents who reported losing utilities following the Loma Prieta and Northridge earthquakes. A minimum of 14 percent and a maximum of 26 percent reported that their telephones went off. We did not ask respondents how long their telephones were off, but clearly all of them had telephone service by the time we had the resources to conduct the study.

Table 3. Loss of Utilities by Earthquake

		Northridge[b]	
Quake Caused Utility to Go Off	Loma Prieta[a]	Wave 1	Wave 3
% Phone off	21	26	14
% Gas off	10	4	2
% Water off	7	8	4
% Electricity off	68	52	41
Mean days postquake interview conducted	225	245	712
Total N	656	487	1,247

a. Sample is weighted; the weights are 0.96 for the San Francisco/Oakland strata, 0.16 for the Santa Cruz strata, and 1.0 for the rest of the sample.

b. Wave 2 did not contain these questions.

We suggest that in survey research the largest barrier to quick entry into an area after a disaster is lack of resources. At the time of the Northridge earthquake, for example, the questionnaire used in the Loma Prieta survey was on the computer-assisted telephone interviewing (CATI) facility at the Survey Research Center in UCLA's Institute for Social Science Research. Had the resources been available, we could have modified the questionnaire for use after the Northridge earthquake, drawn a sample, and fielded a survey probably within a month of the earthquake. Instead, the need to obtain funding kept us from entering the field until August 1994, a minimum of 196 days after the earthquake. To the extent that some research questions are better asked later rather than sooner, this delay is not a problem. On the other hand, to the extent that some data are "perishable" and subject either to memory decay or memory enhancement, this could pose a problem for the researcher.

What Constitutes Perishable Data?

The three waves of data collected after the Northridge earthquake give us one of the first opportunities to examine the extent to which data really are perishable and to identify which kinds of data are more subject to problems of retrospective memory. Since these data have only just become available to us, we cannot answer this question in any detail at the moment, but we will pick out some questions to examine here. Following the Northridge earthquake, the first wave of data was collected an average of 245 days after the earthquake, the second wave was collected an average of 577 days after the earthquake, and the third wave was collected an average of 712 days after the earthquake.

Data available in Tables 2 and 3 (above) provide the first evidence of how events may change as time passes. In Table 2, we see little evidence that with time respondents change their reports of what kinds of preparedness activities they had engaged in before the Northridge earthquake. In contrast, in Table 3 it looks like reports of utility outages decline by as much as half between 245 and 712 days after the earthquake. Whereas 26 percent of the respondents in the first wave reported that their phone was out, only 14 percent in the third wave so reported. Does this suggest that those in Wave 1 overreported outages or that those in Wave 3 underreported outages? We cannot definitely answer this question. Further analyses of these datasets might give us information as to whether reporting was different across the population and, thus, provide some insight into whether certain groups tend to underreport or overreport these kinds of data. On the face of it, we conclude for now that accurate memory of utility outages *does* decay with time.

To examine memory in more detail, we selected a variety of kinds of information that were collected in at least two of the post-Northridge waves of data collection. Included were a selection of factual questions about where respondents were during the earthquake and what happened to them, a series of questions about victimization *in the year prior to the interview*, and two opinion questions. The questions about victimization were included in the surveys because of people's speculation that victimization increases following an earthquake. As reported here, the victimization data are cued to the year prior to the interview, so some victimizations in the Wave 1 data set occurred prior to the earthquake. All the data are reported in Table 4.

What is striking about the data is the extent to which all the information tends to remain constant across the three waves of data collection. To the extent that reports differ, the differences are almost exclusively in Wave 2 data which, given the small size of that sam[illegible]

Table 4. Examination of Memory Decay Across Three Waves of Data Collection Following the Northridge Earthquake

Factual Information about Quake and Aftermath	Data Collection Wave 1 8/10/94–12/6/94	Wave 2 8/2/95–10/22/95	Wave 3 8/22/95–5/29/96
% who felt the earthquake on Jan. 17, 1994	94	95	92
Of those who felt the quake:			
% who were indoors at the time of the quake	98	96	96
% who were in their own home	95	92	87
% who physically changed locations after the quake was over	63	68	64
% who reported damage within 5 blocks of home	36	43	37
% who reported home damage	39	34	37
Of those with damaged homes:			
Mean dollar amount of damage	$14,364	$7,823	$19,553
% who reported home inspected	67	47	66
Of those inspected:			
Who inspected?			
FEMA	20	47	34
City	22	7	17
County	4	7	4
Private company	15	–	8
Other	17	20	18
Don't know	22	20	19
% tag types:			
Red tag	2	–	4
Yellow tag	8	13	9
Green tag	37	31	23
No tag	46	50	48
Don't know	8	6	16
% who applied for assistance	30	28	35
Of those who applied for assistance			
% who had difficulty in applying	14	22	18
% who evacuated their home for any reason	34	–	48
Injuries			
% who were physically injured	8	7	8
% who were emotionally injured	36	35	32
% who reported other members of household were physically or emotionally injured	22	25	22
% who knew agencies that worked after the quake	54	–	50
Victimization in the year prior to the interview			
% robbed	7	5	6
% say *not* related to quake	100	100	88
% raped	0.2	1.0	0.6
% say *not* related to quake	100	100	100

Table 4 (continued)

Factual Information about Quake and Aftermath	Data Collection Wave 1 8/10/94–12/6/94	Wave 2 8/2/95–10/22/95	Wave 3 8/22/95–5/29/96
% motor vehicle crash caused injury	3	5	4
% say *not* related to quake	100	100	94
% had loved one die of accident, homicide, or suicide	6	2	5
% say *not* related to quake	96	100	96
% say life changed for worse in an important way (residence, job, personal relationship)	13	13	10
% say *not* related to quake	84	67	90
% some other terrifying experience	6	7	8
% say *not* related to quake	80	86	94
Opinions related to the earthquake			
In general, on the day of the earthquake, would you say that the radio and television programs that you listened to:			
Overreported the sensational aspects of the earthquake	22	–	28
Balanced sensational and helpful ideas	40	–	48
Underreported the sensationalism	5	–	5
Presented just the facts (not read)	14	–	14
Don't know	3	–	5
Missing	16	–	–
In your opinion, who is most responsible for helping people after an earthquake?			
The government	57	–	55
The people affected	24	–	26
Someone else	14	–	17
Don't know	5	–	2
Total N	487	96	1,247

statistical variance in a sample that is really too small to stand on its own. In spite of the fact that estimates are most "different" in Wave 2, the differences are not significant across the three datasets, largely because of the different sample sizes.

Looking only at Wave 1 and Wave 3 data, there are some places where increases or decreases in the Wave 3 data probably either reflect actual changes in rates over time or deterioration in memory over time. For example, the percentage of persons who reported having their homes inspected stays constant at 66–67 percent of those who reported their homes damaged, but the identification of who conducted the inspection shifts over time, away from city inspectors to FEMA inspectors, while the percentage of persons who say they "don't know" who inspected their home remains remarkably constant. Another substantial shift is in those with damaged

homes who report that they evacuated their homes. Further analyses will allow us to investigate this in more detail, but for now we suggest that these later evacuations may well have occurred when repair work actually started on respondents' homes. In contrast, the slight decline in the percent who remembered agencies that were active after the earthquake may be evidence of memory decline over time, particularly among those for whom the agencies had little salience.

Victimization rates remain constant across the three waves of data collection, and the overwhelming majority of those victimized state that their victimization was not related to the earthquake. Opinions about media coverage during the earthquake and about who is responsible for helping victims of an earthquake similarly remain highly stable over time.

In summary, this quick review of data available across three datasets following the Northridge earthquake suggests that social information about disasters may not be as perishable as we sometimes think and that memories about a disaster remain quite stable for at least some substantial period after a disaster.

Dose-response as a Quasi-experimental Method for Setting Up a Control

There is no way that a researcher can establish randomized control groups in studying responses to disasters, but the existence of population-based samples does allow systematic examination of whether and how experiences and responses differ across groups within the same community who are differentially exposed to the disaster. In earthquakes, Modified Mercalli Intensities (MMI) provide an approximation of the extent to which an area experienced shaking. Using MMI as an indicator of the extent to which respondents and their homes were "exposed" to the earthquake or the "dose" that they received, we can examine whether reports of damage, injury, and emotional distress differed with MMI. We expect that these three variables do vary with exposure or the "dose" of the earthquake that the respondent experienced. In contrast, there are other things that might not vary with exposure dose. We selected exposures to other kinds of violent events (robbery, rape, serious car accident) within the year proceeding the interview and opinions about the media and who is responsible for helping victims after an earthquake as examples of variables that might not vary with exposure to an earthquake. These data are reported in Table 5. Note that not every variable is available in every data set.

The three types of data that we predicted *would* vary with exposure to the earthquake's intensity and shaking generally do have a dose-response relationship with Modified Mercalli Intensity in all the datasets, although the proportions reporting these events tend to vary across the datasets. (The

Table 5. Examining Dose Response by Modified Mercalli Intensity (MMI) and Earthquake

					Northridge					
	Whittier[a]		Loma Prieta[b]		Wave 1		Wave 2		Wave 3	
MMI and Variable	%	(Total N)[c]	%	(Total N)	%	(Total N)	%	(Total N)	%	(Total N)
% of respondents in MMI area reporting damage within 5 blocks of home										
V		N/A	0	(11)		–		–		–
VI		N/A	23	(219)	15	(106)	28	(19)	16	(252)
VII		N/A	41	(202)	26	(260)	42	(56)	29	(698)
VIII		N/A	50	(118)	75	(72)	70	(11)	73	(177)
IX		N/A		–	83	(48)	70	(10)	86	(115)
% of respondents in MMI area reporting damage to home										
V		–	27	(11)		–		–		–
VI	9	(609)	32	(219)	18	(106)	16	(19)	19	(252)
VII	23	(43)	30	(202)	28	(260)	32	(56)	28	(698)
VIII	50	(38)	42	(118)	76	(72)	46	(11)	69	(177)
IX		–		–	83	(48)	70	(10)	81	(115)
% of those with damaged homes who applied for disaster assistance by MMI										
V		–	0	(11)		–		–		–
VI	7	(609)	1	(219)	11	(106)	0	(19)	15	(252)
VII	11	(43)	15	(202)	22	(260)	22	(56)	26	(698)
VIII	15	(38)	12	(118)	31	(72)	20	(11)	37	(177)
IX		–		–	54	(48)	67	(10)	63	(115)
% of those with damaged homes who reported building inspected by MMI area										
V		N/A		N/A		–		–		–
VI		N/A		N/A	42	(106)	0	(19)	31	(252)
VII		N/A		N/A	53	(260)	35	(56)	53	(698)
VIII		N/A		N/A	83	(72)	80	(11)	82	(177)
IX		N/A		N/A	85	(48)	71	(10)	89	(115)
% of respondents in MMI area who reported being physically injured										
V		–	0	(11)		–		–		–
VI	1	(609)	1	(219)	1	(106)	0	(19)	2	(252)
VII	5	(43)	1	(202)	6	(260)	9	(56)	5	(698)
VIII	5	(38)	2	(118)	18	(72)	9	(11)	20	(177)
IX		–		–	23	(48)	10	(10)	24	(115)
% of respondents in MMI area who reported being emotionally injured										
V		N/A		N/A		–		–		–
VI		N/A		N/A	25	(106)	37	(19)	26	(252)
VII		N/A		N/A	34	(260)	32	(56)	29	(698)
VIII		N/A		N/A	49	(72)	46	(11)	40	(177)
IX		N/A		N/A	58	(48)	40	(10)	55	(115)

Table 5 (continued)

MMI and Variable	Whittier[a] %	Whittier[a] (Total N)[c]	Loma Prieta[b] %	Loma Prieta[b] (Total N)	Northridge Wave 1 %	Northridge Wave 1 (Total N)	Northridge Wave 2 %	Northridge Wave 2 (Total N)	Northridge Wave 3 %	Northridge Wave 3 (Total N)
% of respondents in MMI area reporting being robbed in year prior to interview										
V	N/A		0	(11)		–		–		–
VI	N/A		5	(219)	8	(106)	5	(19)	4	(252)
VII	N/A		2	(202)	8	(260)	5	(56)	6	(698)
VIII	N/A		4	(118)	8	(72)	0	(11)	7	(177)
IX	N/A			–	4	(48)	10	(10)	8	(115)
% of respondents in MMI area reporting being raped in year prior to interview										
V	N/A		0	(11)		–		–		–
VI	N/A		0	(219)	0	(106)	0	(19)	0.4	(252)
VII	N/A		0	(202)	0.4	(260)	2	(56)	1	(698)
VIII	N/A		1	(118)	0	(72)	0	(11)	1	(177)
IX	N/A			–	0	(48)	0	(10)	0	(115)
% of respondents in MMI area reporting being in a car accident that killed or injured someone in year prior to interview										
V	N/A		0	(11)		–		–		–
VI	N/A		6	(219)	3	(106)	0	(19)	2	(252)
VII	N/A		3	(202)	2	(260)	4	(56)	4	(698)
VIII	N/A		2	(118)	3	(72)	27	(11)	3	(177)
IX	N/A			–	6	(48)	0	(10)	9	(115)
% of respondents in MMI area who think the government is responsible for helping victims										
V	N/A		N/A			–	N/A			–
VI	N/A		N/A		55	(106)	N/A		50	(252)
VII	N/A		N/A		57	(260)	N/A		57	(698)
VIII	N/A		N/A		54	(72)	N/A		52	(177)
IX	N/A		N/A		63	(48)	N/A		60	(115)
% of respondents in MMI area who think media coverage of the quake was too sensational										
V	N/A		N/A			–	N/A			–
VI	N/A		N/A		30	(106)	N/A		34	(252)
VII	N/A		N/A		20	(260)	N/A		29	(698)
VIII	N/A		N/A		24	(72)	N/A		17	(177)
IX	N/A		N/A		12	(48)	N/A		18	(115)

a. Whittier sample is not weighted in this analysis. Persons in the high impact strata were assigned Modified Mercalli Intensities of 7 or 8; all other respondents were assigned an MMI of 6.

b. The Loma Prieta sample is not weighted in this analysis. Because exact zip code maps with Mercalli Intensities were not available at the time of this analysis, the MMIs of some proportion of the sample may be inaccurate.

c. (N) = the number of respondents within that cell of the table. This number is the denominator for purposes of calculating the percentage reported in the cell.

fact that the percentages reporting damage, applying for assistance and being injured are lower in the Whittier Narrows and Loma Prieta surveys, particularly in areas with an MMI of eight, may be due to one of two factors. First, as noted in the footnotes to Table 5, the MMI scores assigned to respondents in Whittier Narrows and Loma Prieta need to be more precise than we were able to do for this analysis. Second, there is a possibility that the fact that the Whittier Narrows and Loma Prieta surveys were administered using paper-and-pencil methods while the Northridge surveys were administered on a CATI system has an impact on callbacks and response rates [see our earlier discussion], may have had some impact on this data.) Respondents in areas where the MMIs were higher are, as expected, more likely to report that there was damage in their neighborhood (within five blocks of their home), that there was damage to their home, that they applied for assistance, and that they were physically injured. In the Northridge datasets, those in areas with higher MMIs are more likely to report emotional injury. In contrast, there is no relationship between proximity to the earthquake and being robbed, raped, or in a serious automobile accident within the year preceding the interview.

The opinions examined, which are available only in two waves of the Northridge surveys, show a very slight dose-response relationship. Persons in areas with an MMI of nine are somewhat more likely to think that the government (rather than the victims themselves) are responsible for helping victims after an earthquake, but, interestingly, respondents in areas with an MMI of seven rather than eight are next most likely to think the government is responsible. When respondents were asked about media coverage, persons in the highest impact areas with an MMI of eight or nine were *least likely* to think that media coverage was too sensational.

The availability of data from probability samples where exposure to the disaster varies enables the researcher to estimate the extent to which proximity to a disaster results in different experiences, behaviors, and attitudes. While not as powerful as an experimental design for examining the impact of a disaster on communities, the use of the concept of dose-response provides a viable proxy or surrogate for a controlled experiment and allows for inferences to be made about how the disaster has differentially affected households with, for example, similar household resources.

Population-based Samples as Denominator Data

Population-based samples are useful in determining what a nonprobability sample represents. Gatz and her colleagues (1996) examined how three-generational families were affected by and reacted to the Northridge earthquake. Since the sample was originally drawn from members of the

Kaiser Permanente Health Plan in 1971, it clearly is not representative of Los Angeles County residents in 1994. However, since Gatz included questions similar to ours in her questionnaire, we can make comparisons between our three waves of data and her data set. In Table 6, we first see that her sample is more likely to be female, to own their own house, and to be on average twenty years older than respondents in our sample. Those residing in the southern California area were slightly more likely to feel the earthquake and to be alone when the earthquake occurred. They were more likely to report that phones, gas, and water were unavailable after the earthquake and equally likely to report electricity off. Although respondents were *less* likely to state that there was damage in their neighborhoods or that they themselves or family members were physically or emotionally injured by the earthquake, they reported a higher average amount of damage to their homes. Lower reports of injury probably reflect the fact that households of these 166 respondents are smaller and, thus, contain fewer persons who the respondent can report were injured. Finally, we see that these 166 persons were *more* likely to live in areas that experienced Modified Mercalli Intensities of eight and less likely to live in areas with MMIs of seven.

Table 6. Comparison of Specialized Population to Probability Sample of Los Angeles County

		Northridge		
	Gatz Sample	Wave 1	Wave 2	Wave 3
% who felt the earthquake	96	94	95	92
% who were alone at the time of the earthquake	25	22	–	–
% phone off	33	26	–	14
% gas off	15	4	–	2
% water off	18	8	–	4
% electricity off	52	52	–	41
% who reported damage within 5 blocks of home	26	36	43	37
Mean $ damage to home	$22,069	$14,364	$7,823	$19,553
% with self or family physically/emotionally injured	35	46	41	43
Mean age	64	41	42	41
% own home	77	47	57	46
% female	65	53	58	54
Modified Mercalli Intensities				
VI	28	21	20	20
VII	42	54	58	56
VIII	22	15	12	14
IX	8	8	10	9
TOTAL N =	166	487	96	1,247

Judging from these preliminary analyses, it appears that the differences observed between Gatz' families and Los Angeles County residents as a whole are explained by the fact that Gatz' respondents are substantially older and of higher socioeconomic status but were differentially residing in areas of the county that were more affected by the earthquake. Therefore, Gatz' respondents may report higher levels of preparedness activities because of greater economic resources and a tendency to more stability in their lives.

Maintenance of Verbal Data

In the past, code frames for data collected in response to open-ended questions either had to be created at the time the data were coded and prepared for machine entry, or hard copies of either the questionnaires or the responses to open-ended questions had to be stored until the researcher was ready to analyze them. The availability of computerized data-entry programs now makes this completely unnecessary (Bourque and Clark 1992). Using data-entry programs such as those available from SPSS and other groups as well as the increasing reliance on CATI systems makes it possible to store verbal data in machine-readable files at the same time that precoded data are being entered. As a result, it is no longer necessary to create code frames under pressure without sufficient thought. Nor is it necessary to store bulky questionnaires in scarce space or in locations where they may be vulnerable to persons not involved in the research project.

Creating Archives

The availability of CATI systems and computerized data-entry programs means that clean datasets can quickly become available both to the researcher who initiated the study and to others. Increasingly, archives are being made available for storage where datasets and documentation can be put into the public domain and made available to other researchers for secondary data analysis. Both the Whittier Narrows and Loma Prieta datasets have been archived at the National Information Service for Earthquake Engineering (NISEE) housed in the Earthquake Engineering Research Center Library at University of California, Berkeley. These datasets are also being put into the Social Science Research Archive at UCLA's Institute for Social Science Research.

Conclusion

We have examined the kinds of information, useful to disaster researchers, that can be obtained from well-designed, standardized, population-based surveys. We have also examined a number of the perceived

barriers that have been used in the past to justify a reluctance to widely adopt the use of survey research in the disaster area and have demonstrated that most of these barriers either no longer exist or are of limited importance in disaster research. Indeed, the supposed barriers may actually be advantageous sources of important information.

The utilization of standardized population-based surveys is especially useful in comparing community behaviors across time, locations, and events. The use of similar instruments across three earthquakes in both northern and southern California has allowed us to examine changes in a number of behaviors relevant to earthquakes. As shown in this paper, we have been able to track the rate of preparedness within California since the 1970s. The use of a standardized instrument also allows us to compare injury rates across different magnitude events.

Concern over the ability to use surveys, especially through telephone interviewing, as well concern about the representativeness of community surveys appear to no longer be realistic barriers. Practically universal coverage of telephones in the United States (especially in urban areas) and increasing use of new technologically sophisticated methodology such as computer-generated list-assisted random-digit dialing (RDD) procedures and computer-assisted telephone interviewing (CATI) have reduced the perceived barriers to accessing the population after a disaster. Additionally, the belief that respondents are reluctant to participate in a survey after a disaster has been shown to be unfounded. These methods, however, need to be implemented appropriately and only if the target is either the general population or one with access to telephones. Certainly a survey utilizing telephone interviewing would not be appropriate to identify the impact of a disaster on the homeless.

The timing of surveys is also an important factor to consider in conducting disaster research. As shown here, while some data may be subject to memory decay, other data appear to be quite stable over time. Still other data, such as estimates of damage and utilization of disaster services, may be unavailable until sufficient time has past after the disaster.

We have also shown that well-conducted population-based surveys may provide some estimates of a "dose-response" and may serve as denominator data for other specialized datasets. The ability to explore how rates of injuries, damage, and other earthquake-induced problems differ by distance from the epicenter or some estimate of the shaking such as MMI is an advantage of population-based surveys. Again, the explosion of technology is increasing the ability to compare survey data to other available data such as peak ground velocity or acceleration. The combination of survey results

with such datasets through the use of geographic information systems (GIS) is just now beginning to be explored and will allow for greater accuracy in using survey research in a quasi-experimental design. Likewise, the ability to use survey data as a denominator to compare specialized datasets is increasing. In this paper we explored one such use where our population-based studies allowed us to identify differences between the general population and a three-generational panel study using a similar questionnaire.

Lastly, we have shown how advances in computer technology have increased both the ease of storage of precoded and verbal data as well as the ability to share data with other researchers. Having verbal data stored in a database at the time of data collection or at the time that precoded data are entered increases both the usefulness of the data as well as their ability to be quickly shared with other researchers.

Overall, we have shown that well-designed, standardized, population-based surveys can provide an accurate look at a population's behaviors and attitudes regarding disasters as well as describe the impact of a disaster on a population. Many of the previously held notions of barriers to the use of survey research have become obsolete in this era of technological advances. Indeed, the future of survey research in conjunction with new technological advances may allow us to answer many of the important questions facing disaster researchers today.

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