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FINAL REPORT OF PRELIMINARY ANALYSES
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IMPACT OF THE MAGNITUDE 4.5 AFTERSHOCK OF DECEMBER 5, 1994, ON SAN FERNANDO RESIDENTS' LEVELS OF EARTHQUAKE PREPAREDNESS AND SELECTED PSYCHOSOCIAL VARIABLES

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The 4.5 magnitude earthquake that occurred Monday, December 5, 1994, approximately 3 miles east of the city of San Fernando, was considered an aftershock of the 6.6 magnitude Northridge earthquake of January 17, 1994. In this paper we report data obtained from a survey of individuals following the aftershock. This survey was designed to gather information regarding one primary issue: What was the effect of a magnitude 4.5 aftershock on the earthquake preparedness levels of individuals who had recently suffered substantial damage due to the occurrence of a

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[1]We would like to thank Paul Silvia for his able assistance in the data collection and analyses phase of the research.

major earthquake? The general research strategy was straightforward. First, we identified a population likely to have experienced substantial damage in their households because of the Northridge earthquake's occurrence. Second, we assessed levels of earthquake preparedness and related variables within this population on 2 separate occasions (Time 1 and Time 2) using survey items previously demonstrated to have acceptable psychometric properties. In the following section, we discuss the particular methods used in this regard.

POPULATIONS, SAMPLES, AND DATA COLLECTION

A population located approximately 4.5 miles from the epicenter of the magnitude 6.6 Northridge earthquake of January 17, 1994, was chosen for sampling. This population resides in Los Angeles County approximately 3 miles west of the city of San Fernando bounded by Sesnon Blvd. on the north, Lassen St. on the south, Hayvenhurst Ave. on the east, and Lelzah Ave. on the west. This population was selected because reports (e.g., The Northridge Earthquake, 1994) indicated substantial damage in this general area due to the Northridge earthquake.

The target population was to be assessed on two separate occasions designated as Time 1 and Time 2. The following method was used to generate lists of individuals to be sampled from the total target population for Time 1 and 2 assessment.

A list of city streets within the boundaries of the target population was obtained. For the Time 1 group, a set of streets was randomly selected from this list. A set of addresses was

randomly selected from this list of streets. For the Time 2 group, a second set of streets was selected from the target population without replacement regarding the Time 1 list of streets. A set of addresses was randomly selected from this list.

On December 10 and 11, 1994, 125 questionnaires were distributed to residents of addresses in the Time 1 subpopulation. On December 17, 18, and 19, 1994, 125 questionnaires were distributed to residents of addresses in the Time 2 subpopulation. Distribution of questionnaires was done using the following procedures.

1. The researcher went to a particular address on the list of addresses on a designated street and rang the doorbell or knocked on the door.

2. The researcher identified himself to the first adult who answered the door and asked the person if he or she would be willing to participate in a research survey on earthquake preparedness. If no one responded to the doorbell or knock, the researcher continued the investigation at the next listed address on that street.

3. If the person agreed to participate and was willing to have his or her name and residential address recorded, the researcher left a questionnaire to be completed along with a stamped envelope addressed to "EARTHQUAKE PROJECT, UNIVERSITY OF SOUTHERN CALIFORNIA". If the person declined to participate in the survey, the researcher thanked the person for their time,

moved to the next address on the list and continued the investigation in a similar manner.

A total of 34% (84) of the total number of questionnaires (250) were returned: 40% (50) for Time 1 and 27% (34) for Time 2. While these response rates are somewhat lower than the 50-55% rate obtained in previous research (Duval & Mulilis, 1995; Mulilis & Duval, 1993; Mulilis & Lippa, 1990), it should be noted that the survey took place during the Holiday Season approximately 2 weeks (Time 1) and 1 week (Time 2) prior to the Christmas Holiday weekend.

Based on previous investigations regarding earthquake preparedness (e.g., Mulilis & Duval, in press; Mulilis & Duval, 1993; Mulilis, Duval & Lippa, 1990), it was decided to assess earthquake preparedness using a written questionnaire. This questionnaire included the following items: (1) A cover page explaining the purpose of the questionnaire, (2) the MLEPS (Mulilis-Lippa Earthquake Preparedness Scale), (3) a 16 item list of preparedness suggestions (Turner, et al., 1986), (4) questions designed to obtain demographic information (e.g., level of damage suffered from the Northridge earthquake, age, education, gender, marital status, income), (5) questions concerning psychosocial factors thought to correlate with attempts to manage threatening events such as preparing for the possible occurrence of an earthquake (Mulilis & Duval, in press), and (6) measures of intention to become prepared, intention to learn more about earthquakes, and so forth.

The survey was intended to assess a population of individuals who had experienced substantial damage due to the occurrence of the Northridge earthquake of January 17, 1994. Determination of the extent to which individuals within the total sample (Time 1 plus Time 2) had actually experienced damage was based on responses to an item included in the survey questionnaire. This item read, "How much damage did you have in your entire household as a result of the January 17, 1994 Northridge earthquake?" Response choices to this question were "None", "A little", "Mild", "Moderate", "A lot", and "Extreme". Of the individuals who returned the questionnaire, 0% selected "None", 3.6% selected "A little", 9.6% selected "Mild", 27% selected "Moderate", 55.4% selected "A lot", and 3.6% selected "Extreme". From these data, it is clear that respondents to the questionnaire had, in fact, experienced substantial damage in their households due to the Northridge earthquake.

In the following section information concerning the demographics of the Time 1 and Time 2 samples are presented. In this case, interest is focused on possible differences between the two samples. Consequently, means and standard deviations for the Time 1 and Time 2 samples' non-categorical demographic information are presented in conjunction with *t*-tests on each variable.

Damage. Damage in the household was assessed using data from the item discussed above. No difference in level of damage between Time 1 (M = 4.49, SD = .82) and Time 2 (M = 4.41, SD = .93) was

evident, *t*(81) < 1.

Income. Level of income was assessed with the following item: "What is the annual income of your household?" on a 6 point scale anchored by "less than $10,000" and "more than $100,000". Time 1 (*M* = 4.52, *SD* = 1.24) and Time 2 (*M* = 4.39, *SD* = 1.28) respondents' levels of income did not differ, *t*(71) < 1.

Education. Level of education was measured on a 6 point scale asking "What is your highest education level completed?" anchored by "grade school" and "graduate school." Time 1 respondents' levels of education (*M* = 4.50, *SD* = 1.11) did not differ significantly from levels of education (*M* = 4.73, *SD* = .94) in the Time 2 sample, *t*(79) = 1.00, *ns*.

Age. The mean age of respondents in Time 1 (*M* = 49.02, *SD* = 13.68) and Time 2 (*M* 50.14, *SD* = 11.77) did not differ, *t* < 1.

In the following section, additional information about categorical features of the sample are presented.

	Time 1	Time 2
Gender		
Males	43%	45%
Females	57%	55%
Residence		
Own	94%	89%
Rent	6%	11%

Marital Status		
Married	80%	75%
Single	20%	25%
Household Size		
One	9%	11%
Two	29%	30%
Three	29%	33%
Four	17%	20%
Five	14%	6%
Six or more	2%	0%
Race		
Asian	4%	9%
Black	0%	3%
Caucasian	86%	82%
Hispanic	4%	0%
Other Ethnic Groups	6%	6%

COMPARISONS BETWEEN TIME 1 AND TIME 2 GROUPS

The absence of significant differences between the Time 1 and Time 2 samples regarding selected demographics suggests that the two groups are comparable. The following section presents analyses of variance (ANOVAS) for Time 1 versus Time 2 respondents when time from point of aftershock was implicated in any outcome. In the following data presentation, the magnitude of the particular dependent variable under consideration (e.g., earthquake preparedness) increases as the magnitude of the reported mean increases.

Earthquake Preparedness as Measured by the Mulilis-Lippa Earthquake Preparedness Scale (MLEPS). Total # yeses = total number of preparedness items for which respondent indicated that he or she was prepared. Total # no's = total number of items for which respondent indicated that he or she was not prepared.

	Time 1	Time 2	
1. Total # yeses			
M	18.54	20.21	$F(1,82) = 4.11$ $p = .046$
2. Total # noes			
M	8.02	5.91	$F(1,82) = 3.03$ $p = .083$

Summary: Levels of earthquake preparedness increased as time from point of the aftershock increased.

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3. Total Difficulty = summed difficulty of preparing for each item on MLEPS.

	Time 1	Time 2	
Gender			
Males			
M	45.46	57.25	
Females			
M	47.15	38.25	$F(1,34)^1 = 4.92$ $p = .033$

Summary: As time from point of aftershock increased, males' perceived level of difficulty of preparing for an earthquake increased whereas females perception of difficulty decreased.

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[1]Degrees of freedom may vary as a function of the total number of respondents who completed the particular scale item.

4. Imminence. (Item: "A major earthquake will occur soon in the Los Angeles area.")

	Time 1	Time 2		
M	3.71	4.21	F(1,79) = 3.18	p = .079

Summary: Perceived imminence of the occurrence of a major earthquake tended to increase as time from point of aftershock increased.

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5. Perceived amount of time needed to prepare for an earthquake. (Item: "Becoming prepared for a major earthquake takes a very long time.")

	Time 1	Time 2		
Gender				
Males				
M	3.63	4.18		
Females				
M	3.65	3.13	F(1,74) = 3.23	p = .077

Summary: As time from point of aftershock increased, length of perceived time needed to prepare for an earthquake increased among males but decreased for females.

6. External agents' responsibility for preparedness. (Item: "Indicate the extent to which you feel that the City, County, State, or Federal government is responsible for making sure that you are prepared for the occurrence of a major earthquake.")

	Time 1	Time 2		
Gender				
Males				
M	3.68	3.23		
Females				
M	3.29	4.38	$F(1,74) = 3.90$	$p = .052$

Summary: As time from point of aftershock increased, females tended to locate more responsibility for preparation in external agents whereas males' perception of external agent responsibility decreased.

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7. Presently have resources. ("How many resources do you feel you presently have that would enable you to deal with the effects of a major earthquake?")

	Time 1	Time 2		
M	4.27	4.68	$F(1,81) = 3.02$	$p = .086$

Summary: Perceived resources to manage effects of the occurrence of a major earthquake tended to increase as time from point of aftershock increased.

8. Presently have versus presently need resources. (Presently have resources [see #7] minus responses to "How many more resources than the ones you have do you feel you would need in order to deal with the effects of a major earthquake?")

	Time 1	Time 2	
M	.39	1.15	F(1,80) = 3.15 p = .080

Summary: Perceived present resources relative to needed resources increased as time from point of aftershock increased.

In the following section analyses are reported in which the Time 1 versus Time 2 variable had no direct or interactive effect on level of earthquake preparedness but other variables (e.g., marital status, gender) did.

9. Total # yeses (MLEPS)

	Marital Status	
	Married	Single
M	19.62	17.76

F(1,78) = 3.195 p = .078

10. Total # noes (MLEPS)

	Marital Status	
	Married	Single
M	7.10	7.38

F(1,78) = 2.91 p = .092

Summary: Married persons tended to be more prepared than single individuals.

11. Important to prepare. (Item: "Preparing for a major earthquake is very important.")

	Marital Status	
	Married	Single
M	5.57	5.24

$F(1,78) = 3.00$ $p = .087$

Summary: Married persons tended believe that preparing for an earthquake was more important than did single individuals.

12. Intention to become more involved. (Item: "I intend to become much more involved in preparing for a major earthquake.")

	Gender	
	Males	Females
M	4.47	4.81

$F(1,74) = 2.83$ $p = .097$

Summary: Females tended to indicate a greater intention to become more involved in preparing for an earthquake than did males.

13.

	Marital Status	
	Married	Single
M	4.77	4.33

$F(1,78) = 4.12$ $p = .046$

Summary: Married persons indicated a greater intention to become more involved in preparing for an earthquake than did single

individuals.

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14. Need resources. (Item: "How many more resources than the ones you have do you feel you would need in order to deal with the effects of a major earthquake?")

	Gender	
	Males	Females
M	3.28	4.05

$F(1,74) = 5.78$ $p = .019$

Summary: Females indicated a greater need for resources to manage the effects of a major earthquake than did males.

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15. Can make adequate progress. (Item: "Indicate the extent to which you believe you can make adequate progress toward preparing for a major earthquake.")

	Gender	
	Males	Females
M	4.61	5.14

$F(1,74) = 2.77$ $p = .100$

Summary: Females tended to believe that the progress they could make toward preparing for an earthquake was greater than did males.

16. Own responsibility for preparing for earthquakes. (Item: "Indicate the extent you feel responsible for preparing for the occurrence of a major earthquake." minus responsibility attributed to external agents [see #6])

	Marital Status	
	Married	Single
M	2.36	1.29

$F(1,78) = 3.36$ $p = .071$

Summary: Married persons tended to see themselves as more responsible for preparing for the occurrence of a major earthquake than did single individuals.

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17. Total # yeses on MLEPS.

	Residence	
	Own	Rent
M	19.42	16.00

$F(1,77) = 4.52$ $p = .037$

Summary: Persons who owned their residences were more prepared than persons who rented.

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18. Imminence. (Item: see #4)

	Own	Rent
M	3.85	4.57

$F(1,76) = 3.25$ $p = .076$

Summary: Persons who owned their residences tended to perceive the possible occurrence of another earthquake as less imminent

than did persons who rented.

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19. Intend to prepare. (Item: "I intend to become much more prepared for the occurrence of a major earthquake.")

	Own	Rent
M	4.79	4.14

$F(1,76) = 3.10$ $p = .082$

Summary: People who owned their residences tended to indicate a greater intention to prepare for the possible occurrence of another earthquake than did persons who rented.

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20. Need resources. (Item: see #8)

	Own	Rent
M	3.84	2.86

$F(1,76) = 3.70$ $p = .058$

Summary: Persons who owned their residences tended to indicate a greater need for additional resources to prepare for the possible occurrence of an earthquake than did persons who rented.

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21. Can prepare. (Item: "Indicate the extent to which you believe you can prepare for a major earthquake so that the damage and injuries resulting from such an event would be reduced.")

	Own	Rent
M	5.00	3.86

$F(1,76) = 3.44$ $p = .067$

Summary: Persons who owned their residences tended to believe

they could prepare for the possible occurrence of an earthquake to a greater extent than did persons who rented.

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22. Self causality for preparing. (Item: "To what extent are factors associated with yourself (e.g., your efforts, abilities) causing your present level of earthquake preparedness?")

	Damage				
	A Little	Mild	Moderate	A Lot	Extreme
M	4.40	5.50	4.88	4.32	4.33

$F(4,71) = 2.14$ $p = .084$

Summary: As level of household damage increased, extent to which the person located the causal reason for preparing in self increased and then decreased.

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23. Self cause relative to minus external cause. (Items: [see #22] minus responses to "To what extent are factors in the external environment (e.g., location, task difficulty) causing your present level of earthquake preparedness?")

	Damage				
	A little	Mild	Moderate	A lot	Extreme
M	.60	2.00	1.38	0.17	0.67

$F(4,71) = 2.51$ $p = .050$

Summary: As level of household damage increased, extent to which the person located the causal reason for preparing in self as opposed to external agents increased and then decreased.

24. Education. Level of education had no significant effect on levels of preparedness as measured by MLEPS or on other variables assessed.

25. Income. Level of income had no significant effect on levels of preparedness as measured by MLEPS or on other variables assessed.

26. Race. Race had no significant effect on levels of preparedness as measured by MLEPS or on other variables assessed.

27. Age. Age level had no significant effects on levels of preparedness as measured by MLEPS or on other variables assessed.

CORRELATIONAL ANALYSES

In this section, the results of correlational analyses between psychosocial variables and levels of earthquake preparedness for all respondents are reported.

Correlates of levels of earthquake preparedness as measured by the MLEPS.

Total yeses (MLEPS) with...

Total difficulty (see #3) $r = -.3524^*$

(Level of preparedness decreased as perceived difficulty of preparing for the possible occurrence of an earthquake (as measured by the MLEPS) increased.)

Important to prepare (see #11) r = .4166**
(Level of preparedness increased as perceived importance of preparing for the possible occurrence of an earthquake increased.)

Presently have resources.(see #7) r = .4618**
(Level of preparedness increased as perceived level of resources relevant to preparation for the possible occurrence of an earthquake increased.

Can prepare. (see #21) r = .3154*
(Level of preparedness increased as perceived ability to prepare for the possible occurrence of an earthquake increased.

Can make adequate progress.(see #15) r = .3695**
(Level of preparedness increased as perceived ability to make adequate progress toward preparing for the possible occurrence of an earthquake increased.

No other psychosocial or demographic variables were correlated

with levels of earthquake preparedness above a .01 level of significance. Note: *p < .01; **p < .001

Discussion

The present study's primary purpose was to assess the impact of a magnitude 4.5 aftershock on the earthquake preparedness levels of persons who had recently experienced substantial property damage due to an earthquake. We believe the information obtained has implications for understanding the effects of seismic activity on earthquake preparedness. In this section we briefly discuss these implications.

Participants in this study evidenced an increase over time in earthquake preparedness following the occurrence of a low magnitude seismic event. Previous research (Duval & Mulilis, 1995; Mulilis & Duval, 1993) assessing levels of earthquake preparedness both prior to and after the occurrences of six different earthquakes also found increases in preparedness behavior following significant seismic activity. However, in those cases earthquake preparedness increased only after the occurrence of earthquakes with magnitudes of 5.8 or greater (i.e., the magnitude 8.1 Mexico City earthquake of 1985; the magnitude 5.9 Whittier Narrows earthquake of 1987; the magnitude 7.1 Loma Prieta earthquake of 1989; the magnitude 5.8 Sierra Madre earthquake of 1991). When the magnitude of the earthquake was 5.5 or less (i.e., the magnitude 4.8 Whittier Narrows earthquake of 1988; the magnitude 5.5 Upland earthquake of 1990) no change in level of preparedness was observed. Consequently, individuals in the present study appear to have responded to the occurrence of a low magnitude seismic event as previously

surveyed persons did to earth movements of considerably larger magnitudes.

The most obvious explanation for the observed response to the low magnitude aftershock has to do with actual damage in participants' households caused by the Northridge earthquake. For example, people become more sensitive to cues associated with the previous occurrence of a harmful event (e.g., Lazarus & Folkman, 1984). Persons in the present study had recently experienced substantial damage to personal property due to the violent ground motion accompanying the Northridge earthquake. As a consequence they may have been sensitized to any unexpected ground movement and, thus, motivated to prepare following the aftershock even though the magnitude of that seismic event was relatively small.

On the other hand, it may be the case that actual damage to one's own household is sufficient but not necessary to sensitize people to respond to noticeable seismic activity. For instance, in previous research (Duval & Mulilis, 1995; Mulilis & Duval, 1993), individuals living in Los Angeles and Orange Counties increased levels of preparedness following the occurrence of physically distant earthquakes (i.e., the Mexico City earthquake; the Loma Prieta earthquake). These findings suggest that awareness of the damaging consequences of major earthquakes whether resulting in damage to one's own property or not may be sufficient to sensitize people. In this case, many individuals who did not actually experience damage from the Northridge

earthquake may have also been motivated by the aftershock to restock supplies, check batteries and so forth given that they noticed the event when it occurred.

Will the increased levels of preparedness found in the present study be maintained? Previous research (Mulilis & Duval, 1993) suggests the answer may depend on the time frame used. For example, the impact of particular earthquakes (e.g., Whittier Narrows, 1987; Loma Prieta, 1989) on levels of earthquake preparedness appeared to be short-lived. Even though individuals increased preparedness levels immediately following the occurrence of those earthquakes, level of preparation declined to pre-earthquake levels within 4-6 weeks (Mulilis & Duval, 1993). However, over longer periods of time the outlook appears more favorable (Duval & Mulilis, 1995). In 1985, respondents' (Placentia, California) mean level of preparedness as measured by the MLEPS was 55.1 on a scale with a maximum preparedness score of 81. In 1991, mean preparedness levels (Long Beach, California) had risen to 66.4 on the same scale. In the present study (Northridge, California), the overall (Time 1 + Time 2) preparedness levels of respondents was 69. Consequently, it appears that the actual occurrences of numerous earthquakes and the resulting damage, the general increase in awareness of the possibility of earthquakes and their potential to cause damage coupled with information regarding ways to prepare for earthquakes have resulted in increased levels of preparedness in the region since 1985.

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