Gender and earthquake preparedness

A research study of gender issues in disaster management: differences in earthquake preparedness due to traditional stereotyping or cognitive appraisal of threat?

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Abstract

Despite the fact that males and females appear to differ in their hazard preparedness and mitigation attitudes and behaviours, emergency managers typically have not focused their efforts on this area. Psychological explanations of differences in gender preparations have traditionally revolved around gender stereotyping. PrE theory suggests that differing attitudes and behaviors result from differences in appraisal of resources relative to threat. The present study was conducted to investigate masculine and feminine differences in earthquake preparedness and to explore reasons for these differences.

Results suggest that males and females may engage in different types of earthquake preparedness and mitigation activities, and that these differences may be the result of the way that males and females cognitively appraise the threat of an earthquake, an explanation that would be consistent with PrE theory.

Disaster preparedness and mitigation is a topic of much concern, especially in earthquake-prone areas such as California (e.g. Bourque, Shoaf, & Russell, 1995; Duval & Mulilis, in press; Mulilis & Duval, 1995a, 1995b, 1995c, 1996, 1997; Russell, Goltz, & Bourque, 1995). Furthermore, this same body of literature reveals that males and females appear to differ in their efforts along these lines. Examples of such differences include (1) that due to the structure of many societies, females may be more at risk in a general way to the consequences of hazards and disasters than males (e.g. Morrow, 1995a; Valdes, 1995), (2) both formal and informal personal post-disaster community response services are more likely to be performed by females than males (e.g. Morrow, 1995a; Neal & Phillips, 1990; Reskin & Padavic, 1994; Valdes, 1995), (3) males tend to be more active in early post-disaster recovery efforts, while females tend to be more active in later post-disaster recovery efforts (Morrow, 1995a), and (4) the family unit which has specific gender-related functions in the preparedness, mitigation, response, and recovery aspects of the disaster cycle (e.g. Abel & Nelson, 1990; Drabek, 1986; Finch & Groves, 1983; Fitzpatrick & Mileti, 1991; Fogelman & Parenton, 1956; Hill & Hanson, 1962; Nigg & Perry, 1988; Perry, 1987; Quarantelli, 1960; Shelton, 1992).

The above behavioral differences between males and females seem to point to the existence of a gendered dimension in disaster-related activities. Such a dimension would be consistent with the findings of Morrow (1995b) who notes that women are generally involved in more mitigation and preparedness activities than men, particularly for activities centered inside the house. Furthermore, mitigation and preparedness activities that men do perform, usually revolve around behaviors related to the outside of the residence (e.g. structural reinforcement of walls).

Sociotropic[1] versus egocentric perspective

A possible reason for these gender differences may be due to psychological differences that exist between males and females. For example, the gender literature in the field of psychology reveals that, in general, females tend to adopt a more sociotropic or connectedness focus compared to the more egocentric or autonomous perspective of males (Baumeister & Sommer, 1997; Brown & Gilligan, 1990; Carlson, Cooper, & Hsu, 1990; Chodorow, 1978, 1989; Cooper & Carlson, 1991; Cooper & Grotevant, 1989; Cross & Madson, 1997a, 1997b; Gilligan, 1982, 1990, 1991; Gilligan, Brown, & Rogers, 1990; Grotevant & Cooper, 1985; Martin & Ruble, 1997).

According to this perspective, differences in disaster-related activities might be behaviorally expressed differently in males and females, with females tending to be concerned more with gender stereotypical activities that focus on the perspective of others and males tending to be concerned more with gender stereotypical activities that focus on their own perspective.

Division of labor perspective

Another possible reason for gender differences in disaster-related preparedness activities may be due more to a difference in the socialized roles of males and females rather than differences in the personality structures of males and females. Such an approach has been used to suggest that a division of labor between genders has emerged over time due to a combination of biological and social factors. A review of the appropriate psychology literature indicates that traditional gender-stereotype attitudes and ideologies are linked to sex-typing in the division of labor between men and women both in the work force and at home (e.g., Atkinson & Huston, 1984; Baruch & Barnett, 1981; Eagly, 1987; Hochschild, 1989; Johnson, Huston, Gaines, & Levinger, 1992; Kibria, Barnett, Baruch, Marshall, & Pleck, 1990; Kroska, 1997).

Cognitive appraisal perspective

Still another possible reason for gender differences in hazard-related preparedness activities may arise from differences in the way that males and females cognitively appraise the threat of the hazard (i.e. think about the consequences of the threat), or from beliefs about household resources available to combat such a threat. Such an explanation for gender related preparedness differences is based in Lazarus' (Lazarus, 1966, 1991; Lazarus & Folkman, 1984) cognitive appraisal theory of coping (see below), and as such, would be consistent with PrE theory (Duval & Mulilis, in press; Mulilis & Duval, 1995a, 1995b, 1995c, 1996, 1997, 1998) and the research of Lindell (Lindell & Perry, 1997; Lindell & Whitney, 1998).

According to Lindell and Perry's (1997) review of 25 years of research regarding the adoption of actions that reduce personal injury and damage in the event of an earthquake, there are four different classes of factors that affect the extent to which households and individuals engage in preparedness activities. Lindell and Perry (1997) refer to these factors as 'household characteristics' (i.e., demographics such as gender, age, education, etc.), 'direct hazard experience' (e.g. damage and injuries sustained in previous hazards), 'household resources' (e.g. knowledge, skills, finances, as well as appraisals of a number of beliefs about preparedness activities), and 'perceptions of the hazard' (e.g. judgements or appraisals about the personal impact of the hazard). Furthermore, the effect of these factors on both preparedness activities as well as intentions to engage in such activities has been recently documented by Duval, Mulilis, and Lalwani (1998). Thus, according to this research, differences in preparedness activities between genders could arise from any one of these four factors. Furthermore, recent research by Lindell and Whitney (1998) indicating that females tend to appraise the risk of a major earthquake as greater than males would be consistent with this approach as would the growing body of disaster literature (e.g. Bord & O'Conner, 1990; Cutter, Tiefenbacher, & Solecki, 1992; Flynn, Slovic, & Mertz, 1994; Fothergill, 1996; Howe, 1990; Leik, Leik, Ekker, & Gifford, 1982; Turner, Nigg, & Paz, 1986) that indicates females tend to appraise disasters as more threatening, more serious, and more riskier than males for a variety of natural and man-made hazards (e.g. earthquakes, tornados, volcanoes, nuclear power issues, chemical pollutant issues, etc.).

The effects of gender differences in preparedness arising from differences in hazard appraisal and/or appraisals of beliefs about hazard resources are also consistent with PrE (person-relative-to-event) theory (Duval & Mulilis, 1998; Mulilis & Duval, 1995a, 1995b, 1995c, 1996, 1997, 1998). PrE theory is based in Lazarus' coping theory (Lazarus, 1966, 1991; Lazarus & Folkman, 1984) which proposes that coping efforts to deal with a harmful event such as an earthquake are based in two processes. On one hand, a person seeks to determine the seriousness of the threatening event, while on the other hand they simultaneously appraise their personal resources available to deal with the event.

Applying this approach to negative threat appeals, PrE theory maintains that behaviours such as changes in earthquake preparedness are a function of a person's appraised personal resources (i.e. the 'person') *relative to* their appraisal of the threatening event (i.e. the 'event'). As such, PrE theory maintains that behavioral change (e.g. as related to preparedness and mitigation activities) is not so much a function of either person variables (i.e. variables similar to Lindell & Perry's, 1997, 'household resources') or event variables (i.e. variables similar to Lindell & Perry's, 1997, 'perception of the hazard'), but rather due to appraisals of person variables *relative to* event variables. That is, PrE theory holds that such behaviors will or will not be engaged in based on the appraised value of person *relative to* event variables.

Extending the above research to the present topic, PrE theory would predict that observed gender differences in earthquake preparedness behavior would be accompanied by differences in the relative values of levels of appraised hazard resources (i.e. person variables) and levels of appraisals of the threat of the hazard in question (i.e. event variables). Mathematically, relative differences in these levels could only occur from either differences in levels of appraisals of preparedness resources or from differences in levels of appraisals of the threat of the event. Thus, as with the research of Lindell (Lindell & Perry, 1997; Lindell & Whitney, 1998), PrE theory would also predict that differences in the appraisal of a threatening hazard and/or differences in appraisals of beliefs about hazard resources between genders could also lead to differences in the behavioral preparedness activities of males and females.

In summary then, and in light of the recent emphasis on determining precisely why males and females differ in disaster-related preparedness activities (e.g., Scanlon, 1997), the present study was conducted to investigate the existence of differences in levels of masculine and feminine earthquake preparedness activities, hypothesising that (1) females would tend to exhibit higher levels of preparedness on disaster-related activities that reflect a more traditional feminine gender-stereotypic focus, and that (2) males would tend to exhibit higher levels of preparedness on disaster-related activities that reflect a more traditional masculine gender-stereotypic focus. Furthermore, based on both PrE theory (Duval & Mulilis, 1998; Mulilis & Duval, 1995a, 1995b, 1995c, 1996, 1997, 1998) and the research of Lindell (Lindell & Perry, 1997; Lindell & Whitney, 1998), it was also hypothesized that males and females would differ in either their appraised levels of the threat of an earthquake or in appraised levels of their beliefs about their preparedness resources.

Study 1 Method

Participants

Participants consisted of 2833 University of Southern California undergraduate students (1314 males and 1519 females) who took part in this research to earn extra course credit.

Procedure

As a matter of routine, earthquake preparedness and psychosocial data were obtained from participant populations on a semi-annual basis during the years 1986 to 1992 (i.e. each semester). The size of these 12 groups ranged from 151 to 443 participants per group, leading to 2833 undergraduates participating in this study over the six year period. It may be noted that this data set has not been previously analyzed in the hypothesized manner.

The earthquake preparedness data were collected using the MLEPS (i.e. the Mulilis-Lippa-Preparedness-Scale—Mulilis, Duval & Lippa, 1990; Mulilis & Lippa, 1985, 1990), which is a 27-item multi-act earthquake preparedness scale to which participants are asked to indicate if they have or do each of the 27 preparedness items *(see Tables 1 and 5 for examples of items)*. This scale has been shown to have reasonably good psychometric properties (e.g. validity, internal consistency, internal reliabilities and test-retest reliability — see Mulilis, Duval, & Lippa, 1990), and has been used in a number of investigations (e.g. Duval & Mulilis, 1995, in press; Duval, Mulilis & Lalwani, 1995, 1998; Mulilis, Boyde & Dewhirst, 1996; Mulilis & Dewhirst, 1997; Mulilis & Duval, 1990a, 1990b, 1991a, 1991b, 1993, 1995a, 1995b, 1995c; Mulilis, Duval & Lippa, 1990; Mulilis & Lippa, 1985, 1990). It may be noted, however, that due to the nature of these investigations, all of the above studies used the total score of the 27 items of the MLEPS (ranging from 27 to 81). That is, these investigations did not address the issue of subscales within the MLEPS.

The psychosocial data collected included participants' responses to questions concerning demographics (e.g. age, gender, ethnicity, religion, primary residence etc.), perceptions of the earthquake hazard, and beliefs about earthquake preparedness resources. Questions on demographics focused on variables such as age, gender, number of years lived in California, and present household living quarters.

Participants' perceptions of the earthquake hazard were measured by responses to the following items: (1) 'I worry that my property and/or living quarters would be destroyed should a great earthquake occur', and (2) 'I worry that I would suffer personal injury and/or die should a great earthquake occur'. Participants were asked to agree/disagree with each of these items by circling a number on scale following each item that was anchored by 1 ('disagree strongly') and 6 ('agree strongly'). Additionally, perceptions of the earthquake hazard were measured by having participants rate a great earthquake from 0 to 100, with 0 representing 'no problem', 50 representing 'a moderate problem', and 100 representing 'the worst possible problem'.

Lastly, earthquake preparedness resources were measured by a number of beliefs that Duval and Mulilis (Duval & Mulilis, in press; Duval, Mulilis & Lalwani, 1998; Mulilis & Duval, 1995a, 1997, 1998) argue should be treated as hazard resources. Thus, for example, participants' beliefs about their personal responsibility assumed for earthquake preparedness were assessed by their responses to the following items: (1) 'I am responsibility for my being prepared for a great earthquake', and (2) 'The city, state, or federal government is responsible for my being prepared for a great earthquake'. As before, participants were asked to agree/disagree with each item by circling a number on a scale following each item that was anchored by 1 ('disagree strongly') and 6 ('agree strongly'). Following Duval and Mulilis (Duval & Mulilis, in press; Duval, Mulilis & Lalwani, 1998; Mulilis & Duval, 1995a, 1997, 1998), level of personal responsibility assumed for earthquake preparedness was calculated by subtracting each person's level of responsibility attributed to external agents (i.e. city, state, and federal government) from his or her level of indicated personal responsibility.

Results

Preliminary analyses indicated no significant differences in male and female responses to the demographic questions (except, of course, the question on gender) *t's=ns*. Consequently, all subsequent analyses were collapsed across these variables.

Factor analysis was conducted on the 27 preparedness items of the MLEPS from the combined data for all 12 groups. Examination of the scree plot (Cattell, 1966) resulting from the analysis suggested a three-factor solution. Using principal components analysis and varimax rotated axis extractions, the preparedness items were forced into three factors. The results of this analysis revealed that all 27 preparedness items of the MLEPS loaded primarily on one of these three factors. The individual items that loaded on each factor are indicated in *Table 1*.

An examination of the factor items in *Table 1* reveals that conceptually these factors encompass similar dimensions of survival, planning/preparation, and hazard mitigation obtained by Russell, Goltz, and Bourque (1995), who used similar items in assessing the earthquake preparedness of Southern California household residents, and also obtained a three factor solution for the data collected from these residents. In this respect, factor 3 of the present study is similar to their survival factor (e.g. collecting food and other supplies, knowledge of an emergency broadcast radio station), while factor 2 of the present study is similar to their planning and mitigation factors (e.g. cognitive preparation, securing the contents of a home). Factor 1 of the present study focuses exclusively on the location and operation of household utilities (e.g. water, gas, electricity). The internal reliabilities (Cronbach's alpha—Cronbach, 1970) for the three factors in the present study were calculated to be .87, .65, and .71, for factors 1, 2, and 3, respectively, which are similar to the values obtained by Russell, Goltz, and Bourque (1995) for their three factors.

Factor 1 — Cronbach's alpha = 0.87

- location of water valve
- location of gas valve
- location of electric power switch
- operation of water valve
- operation of gas valve
- operation of electric power switch.

Factor 2 — Cronbach's alpha = 0.65

- cabinets fastened with latches
- water heater fastened to wall
- tall furniture (e.g. bookcases) fastened to wall
- heavy objects (e.g. mirrors, paintings, plants) fastened to wall
- household earthquake plan
- neighborhood medical emergency center
- read earthquake preparedness material
- listen/watch radio/television earthquake preparedness messages
- earthquake insurance
- school meetings on earthquake preparedness
- vote on earthquake-resistant buildings.

Factor 3 — Cronbach's alpha = 0.71

- flashlight
- batteries for flashlight
- transistor radio
- batteries for transistor radio
- emergency broadcast station
- first-aid kit
- 4 gallons of water in plastic containers
- 4 days supply of dehydrated or canned food
- fire extinguisher
- wrenches to operate utility shut-off valves and switches.

Table 1: MLEPS items for the Three Factors.

To investigate gender differences in these factors, t-tests were conducted on the mean male and female preparedness levels for each of the three factors. The results indicated that males were significantly more prepared than females on items in factor 1 (*M*'s = 11.5 and 9.2, respectively), however, females were significantly more prepared than males in items in factor 2 (*M*'s = 20.1 and 19.8, respectively), while males and females did not significantly differ on items in factor 3 (*M*'s = 18.0 and 17.8, respectively), $t(2831) = 15.14$, $p < .001$, $t(2831) = 1.92$, $p = .05$, and $t(2831) = 0.79$, *ns*, respectively. Thus, the results appear supportive of the proposed hypotheses, and seem supportive of the existence of gender differences in hazard preparedness activities.

To determine if the observed gender differences were stable over the 6 year data collection period, t-tests were also conducted on the mean male and female preparedness levels in each of the 12 groups of participants for each of these three factors. The results of these analyses, as well as the results of the t-tests conducted on the combined levels of preparedness for all 12 groups, are indicated in *Tables 2, 3*, and *4*, for factors 1, 2, and 3, respectively.

As indicated in these tables, the results of analyses on the 12 individual groups tend to be supportive of the results of the analyses conducted on the combined groups. That is, males tended to be more prepared for earthquakes than females on factor 1 for all 12 data groups, however, females tended to be more prepared for earthquakes than males on factor 2 for these groups, while males and females tended to be equally prepared for earthquakes on factor 3 for the 12 groups.

Discussion

The purpose of Study 1 was to investigate whether there were significant differences in masculine and feminine earthquake preparedness activities, and to determine the stability of these differences over the 6 year data collection period. Factor analyses performed on the combined data revealed the existence of three factors of an earthquake preparedness scale (i.e. the MLEPS) that were suggestive of corresponding gender differences in earthquake preparedness activities. While the results of analyses on the 12 individual groups tended to be supportive of the results obtained on the combined sample, there were some notable exceptions. Thus, as indicated in *Table 2*, while males were significantly more prepared than females on factor 1 for all 12 groups, the reverse gender trends were not obtained for factor 2 *(see Table 3)*. That is, on factor 2 females were more prepared than males for only 9 or the 12 groups, and none of these differences reached conventional levels of significance. Furthermore, female and male preparedness levels were very similar for many of these nine groups. Taken together with the fact that gender differences for the combined sample barely reached statistical significance (i.e. $t(2{,}831) = 1.92$, $p = .05$) may lead one to conclude that there were no clear gender differences for the preparedness items comprising factor 2, just as there were no differences observed in factor 3 (see *Table 4*). On the other hand, as suggested by Neal (1997), it may be that real gender differ-

		Males		Females		
	Group	Mean	No.	Mean	No.	T value
1	Fall, 1986	10.9	233	8.9	210	5.44**
2	Spring, 1987	12.0	92	9.4	110	4.69**
3	Fall, 1987	12.0	131	9.1	160	6.12**
4	Spring, 1988	11.7	98	9.3	80	3.85**
5	Fall, 1988	11.5	83	8.9	124	4.60**
6	Spring, 1989	11.4	109	9.3	120	4.15**
7	Fall, 1989	11.1	128	8.9	164	4.67**
8	Spring, 1990	11.2	110	9.3	102	3.27**
9	Fall, 1990	12.1	128	9.6	148	4.83**
10	Spring, 1991	11.7	76	9.4	117	3.74**
11	Fall, 1991	11.7	61	9.2	98	3.60**
12	Spring, 1992	11.2	65	9.0	86	2.99*
	All 12 groups	**11.5**	**1314**	**9.2**	**1519**	**15.14****

*** significance of t-test ≤ .001* ** significance of t-test = .003*

Note: As means increase, levels of preparedness increase.

Table 2: Cell means for male and female earthquake preparedness behavior on Factor 1.

		Males		Females		
	Group	Mean	No.	Mean	No.	T value
1	Fall, 1986	19.5	233	19.4	210	0.31
2	Spring, 1987	19.4	92	19.4	110	0.12
3	Fall, 1987	20.1	131	20.2	160	0.05
4	Spring, 1988	19.7	98	20.8	80	1.84*
5	Fall, 1988	20.1	83	19.9	124	0.20
6	Spring, 1989	20.3	109	20.6	120	0.53
7	Fall, 1989	19.6	128	19.9	164	0.65
8	Spring, 1990	19.6	110	20.2	102	0.93
9	Fall, 1990	19.7	128	20.0	148	0.62
10	Spring, 1991	19.9	76	20.3	117	0.80
11	Fall, 1991	20.0	61	20.8	98	1.24
12	Spring, 1992	19.6	65	20.1	86	0.65
	All 12 groups	**19.8**	**1314**	**20.1**	**1519**	**1.92****

*** significance of t-test = .05* ** significance of t-test = .07*

Note: As means increase, levels of preparedness increase.

Table 3: Cell means for male and female earthquake preparedness behavior on Factor 2.

ences in disaster preparedness may be obscured by the very nature of the factor analytic structure itself.

In discussing problems associated with the use of disaster phases (e.g. preparedness, response, recovery, and mitigation), Neal (1997) notes that factors associated with hazards are generated by statistical programs and then labeled using such terms as 'survival', 'planning', and 'mitigation' etc., that appear clear cut and obvious to the researcher. However, Neal (1997) points out that these categories may not reflect the potential victim's representation of what activities do and do not fall into distinct categories. Indeed, Neal (1997) suggests that no evidence exists indicating persons engage in the type of categorisation of activities that would yield the same factors in separate factor analyses across samples and time.

Clearly Neal's (1997) contentions are consistent with the discrepancies observed between results of the 12 individual groups and those of the total combined sample in the present investigation. Thus, using a factor analytic approach to answers questions concerning differences in male and female earthquake preparedness may be problematical. In view of this issue, it was decided to conduct Study 2 in order to explore the existence of gender differences in earthquake preparedness by relying more directly on the concept of traditional gender stereotyping (e.g. as contained in the notion of gender divisions of labor) rather than relying solely on the statistical procedure of factor analysis.

STUDY 2 Method

Participants

Participants consisted of the same 2833 University of Southern California undergraduate students (1314 males and 1519 females) described in Study 1. Likewise, the same data collected for Study 1 was also used in Study 2. In fact, the only differences in Study 2 involved the procedures used to form the gender subscales of the MLEPS as discussed below.

Procedure

Using the results of the factor analyses from Study 1 as more of a guideline rather than an inflexible rule, three subscales of the MLEPS were chosen which conceptually reflected the more traditional gender-stereotypic masculine and feminine aspects of earthquake preparedness activities. These three subscales are shown in *Table 5*, and were identified as a 'masculine subscale' (containing items associated more with a masculine stereotypic focus), a 'feminine subscale' (containing items associated more with a feminine stereotypic focus), and an 'androgynous subscale' (containing items associated more with either a masculine or feminine stereotypic focus). The internal reliabilities (Cronbach's Alpha—Cronbach, 1970) for these three subscales were calculated to be .82, .68, and .72, respectively, which again are similar to values obtained by Russell, Goltz, and Bourque (1995) for their 3 factors.

It may be noted that the masculine subscale contains the six utility-related items

		Males		Females		
	Group	Mean	No.	Mean	No.	T value
1	Fall, 1986	17.2	233	17.0	210	0.50
2	Spring, 1987	18.7	92	18.8	110	0.18
3	Fall, 1987	17.8	131	18.1	160	0.57
4	Spring, 1988	18.3	98	18.3	80	0.01
5	Fall, 1988	17.7	83	17.5	124	0.32
6	Spring, 1989	17.7	109	17.5	120	0.28
7	Fall, 1989	17.6	128	17.4	164	0.33
8	Spring, 1990	18.1	110	18.1	102	0.03
9	Fall, 1990	19.3	128	17.9	148	2.14*
10	Spring, 1991	18.7	76	18.5	117	0.17
11	Fall, 1991	17.7	61	18.6	98	1.10
12	Spring, 1992	17.9	65	17.2	86	0.75
	All 12 groups	**18.0**	**1314**	**17.8**	**1519**	**0.79**

** significance of t-test = .03*

Note: As means increase, levels of preparedness increase.

Table 4: Cell Means for Male and Female Earthquake Preparedness Behavior on Factor 3.

Masculine Subscale — Cronbach's alpha = 0.82
- fire extinguisher
- wrenches to operate utility shut-off valves and switches
- location of water valve
- location of gas valve
- location of electric power switch
- operation of water valve
- operation of gas valve
- operation of electric power switch
- water heater fastened to wall
- tall furniture *(e.g. bookcases)* fastened to wall
- heavy objects *(e.g. mirrors, paintings, plants)* fastened to wall
- vote on earthquake-resistant buildings.

Feminine Subscale — Cronbach's alpha = 0.68
- 4 gals of water in plastic containers
- 4 days supply of dehydrated or canned food
- household earthquake plan
- read earthquake preparedness material
- listen/watch radio/television earthquake preparedness messages
- school meetings on earthquake preparedness.

Androgynous Subscale — Cronbach's alpha = 0.72
- flashlight
- batteries for flashlight
- transistor radio
- batteries for transistor radio
- emergency broadcast station
- first-aid kit
- cabinets fastened with latches
- neighborhood medical emergency center earthquake insurance.

Table 5: MLEPS items for the Three Subscales.

of factor 1 plus the fire extinguisher and wrench items, as well as the three items involving fastening objects to the wall. Thus, the masculine subscale has a 'tool' orientation, which in general, tends to reflect a more traditional gender-stereotypic masculine focus. Additionally, the masculine subscale contains the item dealing with voting on earthquake-resistant buildings. The rationale for including this item on the masculine subscale is that historical voting was a privilege given to males and denied to females, and also since the topic of earthquake-resistant buildings implies a knowledge of engineering and construction, which historically has been a field dominated more by males.

On the other hand, the feminine subscale contains more items directly related to household preparedness activities, which would be consistent with Morrow's (1995b) findings that women are generally involved in these type of disaster-related activities than men. The androgynous subscale contains the remaining items and which tend to reflect either a tool, household, or medical orientation, and thus, may be assumed to have a focus that could be described as either masculine or feminine.

Results

To investigate gender differences in preparedness, 2 (gender) X 12 (group) ANOVAs were conducted on the preparedness data for the three subscales. These analyses were performed on the total combined sample of all 12 groups (1) since they were independent groups from the same population (i.e. University of Southern California undergraduates), and (2) to increase the power of the analysis.

The results of the ANOVA on the masculine subscale revealed a significant main effect of gender, with males being significantly more prepared on this subscale than females (*M*'s = 16.7 and 14.1, respectively), $F(1,2809) = 192.46$, $p < .001$. There were no other significant main effects or interactions for this analysis.

The results of the ANOVA on the feminine subscale also revealed a significant main effect of gender. On this subscale, however, females were significantly more prepared than males (*M*'s = 10.4 and 9.8, respectively), $F(1,2809) = 33.81$, $p < .001$. As was the case for the masculine subscale, there were no other significant main effects or interactions for this analysis.

Lastly, the results of the ANOVA on the androgynous subscale did not reveal any significant main effects of gender or sample, nor was the interaction between these two variables significant, *F*'s=*ns*.

To determine if the above gender differences on these subscales were stable over the 6 year data collection period, t-tests were conducted on the mean male and female preparedness levels in each of the 12 groups of participants, as well as on the combined preparedness levels for all 12 groups. The results of these analyses are indicated in *Tables 6, 7,* and *8*, for the masculine, feminine, and androgynous subscales respectively.

As indicated in *Table 6*, males were significantly more prepared for earthquakes than females on the masculine subscale for all 12 groups as well as for the combined data for the 12 groups. On the other hand, as indicated in *Table 7*, females were more prepared for earthquakes than males on the feminine subscale for all 12 samples. Furthermore, these differences were significant in five of these groups, as was the case for the combined data for the 12 groups, and approached significance in four other groups. Finally, as indicated in *Table 8*, males and females were more or less equally prepared for earthquakes on the androgynous subscale for 11 of the 12 samples as well as for the combined data for the 12 groups.

To determine if the above gender differences in earthquake preparedness corresponded to gender differences in either participants' perceptions of the earthquake hazard or in their beliefs about preparedness resources, as before, 2 (gender) X 12 (group) ANOVAs were conducted on the hazard perception and hazard resource data for the total combined sample.

The results of the ANOVA conducted on participants' ratings of a great earthquake as a problem revealed a significant main effect of gender, with females indicating a great earthquake to be a significantly greater problem than males (*M*'s = 73.8 and 70.2, respectively), $F(1,2809) = 20.01$, $p < .001$. This analysis did not reveal any other significant main effects or interactions. Similarly, the results of the ANOVAs conducted on participants' responses to the items relative to their degree of concern about personal injury and property damage resulting from a great earthquake revealed significant main effects of gender, with females indicating significantly greater concern than males about personal injury (*M*'s = 4.9 and 4.4, respectively) and about property damage (*M*'s = 4.8 and 4.5, respectively), $F(1,2809) = 45.03$, $p < .001$, and $F(1,2809) = 14.05$, $p < .001$, respectively. Again, neither of these analyses

		Males		Females		
	Group	Mean	No.	Mean	No.	T value
1	Fall, 1986	15.8	233	13.7	210	4.87****
2	Spring, 1987	17.7	92	14.6	110	4.78****
3	Fall, 1987	17.3	131	14.0	160	5.65****
4	Spring, 1988	16.8	98	14.2	80	3.49****
5	Fall, 1988	16.6	83	13.8	124	4.12****
6	Spring, 1989	16.4	109	14.2	120	3.56****
7	Fall, 1989	16.2	128	13.7	164	4.26****
8	Spring, 1990	16.5	110	14.3	102	3.11***
9	Fall, 1990	17.6	128	14.7	148	4.58****
10	Spring, 1991	16.9	76	14.7	117	2.96**
11	Fall, 1991	17.1	61	14.1	98	3.49****
12	Spring, 1992	16.5	65	14.0	86	2.80*
	All 12 groups	**16.7**	**1314**	**14.1**	**1519**	**13.78******

***** significance of t-test ≤ .001*
**** significance of t-test = .002*
*** significance of t-test = .003*
** significance of t-test = .006*

Note: As means increase, levels of preparedness increase.

Table 6: Cell means for male and female earthquake preparedness behavior on the Masculine Subscale.

		Males		Females		
	Group	Mean	No.	Mean	No.	T Value
1	Fall, 1986	9.5	233	9.6	210	0.02
2	Spring, 1987	9.5	92	10.0	110	1.40
3	Fall, 1987	9.5	131	10.3	160	2.32***
4	Spring, 1988	10.3	98	11.7	80	3.35*****
5	Fall, 1988	9.9	83	10.3	124	1.11
6	Spring, 1989	9.8	109	10.8	120	2.72****
7	Fall, 1989	9.7	128	10.1	164	1.55
8	Spring, 1990	9.8	110	10.8	102	2.34***
9	Fall, 1990	10.2	128	11.0	148	1.97**
10	Spring, 1991	9.9	76	10.5	117	1.57
11	Fall, 1991	10.1	61	11.0	98	1.88*
12	Spring, 1992	10.2	65	10.4	86	0.36
	All 12 Groups	**9.8**	**1314**	**10.4**	**1519**	**5.84*******

****** significance of t-test ≤ .001*
*** significance of t-test = .050*
***** significance of t-test = .007*
**** significance of t-test = .020*

Note: As means increase, levels of preparedness increase.

Table 7: Cell means for male and female earthquake preparedness behavior on the Feminine Subscale.

	Group	Males Mean	Males No.	Females Mean	Females No.	T Value
1	Fall, 1986	22.3	233	22.1	210	0.57
2	Spring, 1987	22.9	92	23.0	110	0.12
3	Fall, 1987	23.2	131	23.1	160	0.17
4	Spring, 1988	22.6	98	22.6	80	0.04
5	Fall, 1988	22.7	83	22.2	124	0.74
6	Spring, 1989	22.1	109	22.3	120	1.35
7	Fall, 1989	22.4	128	23.3	164	0.10
8	Spring, 1990	22.6	110	22.6	102	0.01
9	Fall, 1990	23.1	128	21.9	148	2.12*
10	Spring, 1991	23.5	76	23.1	117	0.59
11	Fall, 1991	22.2	61	23.5	98	1.69
12	Spring, 1992	22.0	65	22.0	86	0.05
	All 12 groups	**22.7**	**1314**	**22.5**	**1519**	**1.15**

** significance of t-test = .03*

Note: As means increase, levels of preparedness increase.

Table 8: Cell means for male and female earthquake preparedness behavior on the Androgynous Subscale.

	Group	Males Mean	Males No.	Females Mean	Females No.	T Value	P
1	Fall, 1986	69.5	233	71.2	210	0.77	0.443
2	Spring, 1987	70.0	92	74.9	110	1.53	0.127
3	Fall, 1987	67.1	131	73.0	160	2.26	0.024
4	Spring, 1988	69.8	98	75.6	80	1.83	0.070
5	Fall, 1988	67.3	83	72.2	124	1.55	0.124
6	Spring, 1989	69.7	109	74.6	120	1.68	0.094
7	Fall, 1989	68.2	128	74.0	164	2.27	0.024
8	Spring, 1990	75.8	110	77.1	102	0.45	0.651
9	Fall, 1990	74.4	128	77.3	148	1.04	0.300
10	Spring, 1991	68.4	76	74.5	117	1.81	0.073
11	Fall, 1991	65.7	61	71.7	98	1.63	0.105
12	Spring, 1992	72.9	65	74.5	86	0.44	0.658
	All 12 groups	**70.2**	**1314**	**73.8**	**1519**	**4.32**	**<.001**

Note: As means increase, ratings increase.

Table 9: Cell means for male and female ratings of a great earthquake as a problem.

revealed any other significant main effects or interactions.

To determine if the above gender differences were stable over the 6 year data collection period, t-tests were conducted on male and female perceptions of the earthquake hazard in each of the 12 groups as well as in the total combined sample. Results of these analyses are presented in *Tables 9, 10,* and *11,* for participants' ratings of a great earthquake as problematic, and their responses to the statements relating their degree of concern about the destruction of their property and personal injury, respectively.

As indicated in *Table 9*, females rated a great earthquake as a greater problem than males for all 12 groups. Furthermore, these differences either achieved or approached conventional levels of significance in 8 of these groups. Consistent with these results is the fact that females worried more than males about the destruction of personal property *(Table 10)* and about experiencing personal injury and/or dying *(Table 11)* during such an event, for all 12 groups. Again, these differences either achieved or approached conventional levels of significance in 10 *(Table 10)* and 9 *(Table 11)* of these groups, respectively. Taken together, these results suggest that females appraised the earthquake hazard as more severe than did males.

Lastly, in order to determine in similar gender differences existed in participants' beliefs about their earthquake preparedness resources, 2 (gender) X 12 (groups) ANOVAs were conducted on participants' appraised personal responsibility assumed for earthquake preparedness activities. The results of these analyses revealed that males and females assumed similar degrees of responsibility as indicated by their responses to the statements indicating that (1) they are responsible for being prepared for a great earthquake (*M*'s = 4.75 and 4.85, respectively), and (2) the city, state, or federal government is responsible for their being prepared for a great earthquake (*M*'s = 3.02 and 3.05 respectively), $F(1,2809) = 2.24$, *ns*, and $F(1,2809) = 0.69$, *ns*, respectively. Similarly, results of analyses conducted on the degree of responsibility for preparedness attributed to self minus the degree of responsibility attributed to the government for such actions (i.e. an 'absolute' level of responsibility attributed to self—see Duval & Mulilis, in press; Mulilis & Duval, 1995a, 1997, 1998) again revealed no significant differences in the level of personal responsibility assumed for preparedness actions (*M*'s = 1.73 and 1.80, respectively), $F(1,2809) = 0.30$, *ns*.

Discussion

The purpose of Study 2 was to investigate whether there were differences in masculine and feminine earthquake preparedness activities, and to explore possible reasons for these differences. Using the results of the three factors obtained in Study 1 as a guideline, three subscales of an earthquake preparedness scale (i.e. the MLEPS) were derived which were conceptually reflective of traditional stereotypic gender activities. Results of analyses on the total combined sample, as well as on the

	Group	Males Mean	Males No.	Females Mean	Females No.	T Value	P
1	Fall, 1986	4.2	233	5.0	210	3.28	0.001
2	Spring, 1987	4.5	92	5.0	110	2.59	0.010
3	Fall, 1987	4.4	131	4.8	160	1.97	0.050
4	Spring, 1988	4.2	98	5.0	80	3.99	<0.001
5	Fall, 1988	4.1	83	4.7	124	2.34	0.020
6	Spring, 1989	4.6	109	4.9	120	1.48	0.140
7	Fall, 1989	4.1	128	4.9	164	3.61	<0.001
8	Spring, 1990	4.2	110	5.0	102	3.28	0.001
9	Fall, 1990	4.2	128	4.9	148	2.95	<0.002
10	Spring, 1991	4.4	76	4.9	117	1.89	0.060
11	Fall, 1991	4.4	61	4.8	98	1.72	0.087
12	Spring, 1992	4.6	65	4.8	86	0.75	0.456
	All 12 groups	**4.4**	**1314**	**4.9**	**1519**	**6.58**	**<0.001**

Note: As means increase, agreement with statement increases.

Table 10: Cell means for male and female agreement with statements concerning worry about personal injury during an earthquake.

	Group	Males Mean	Males No.	Females Mean	Females No.	T Value	P
1	Fall, 1986	4.6	233	4.8	210	1.50	0.136
2	Spring, 1987	4.6	92	5.0	110	2.81	0.006
3	Fall, 1987	4.6	131	4.9	160	1.88	0.061
4	Spring, 1988	4.4	98	4.9	80	2.91	0.004
5	Fall, 1988	4.3	83	4.7	124	2.14	0.033
6	Spring, 1989	4.6	109	4.6	120	0.27	0.789
7	Fall, 1989	4.4	128	4.9	164	2.91	0.004
8	Spring, 1990	4.3	110	5.0	102	3.28	0.001
9	Fall, 1990	4.1	128	4.9	148	3.61	<0.001
10	Spring, 1991	4.5	76	4.9	117	1.67	0.097
11	Fall, 1991	4.5	61	4.9	98	1.79	0.076
12	Spring, 1992	4.6	65	4.8	86	0.52	0.600
	All 12 groups	**4.5**	**1314**	**4.8**	**1519**	**3.27**	**<0.001**

Note: As means increase, agreement with statement increases.

Table 11: Cell means for male and female agreement with statements concerning worry about property damage during an earthquake.

12 individual data groups, consistently suggested that males and females tended to engage in different types of earthquake preparedness activities, and that these differences appeared to be somewhat stable over the 6 year data collection period.

Since the activities involved in the items of the preparedness subscales were derived utilizing traditional gender stereotyping as a guideline, one explanation for the observed gender differences might be that males and females differ in gender identity either due to more dispositional factors such as personality characteristics (e.g. sociotropic or connectedness versus egocentric or autonomous) or due to more situational factors such as the socialization processes involved in the division of labor. Such an explanation would be consistent with the body of psychological literature on gender that supports such differences.

However, since Study 2 also revealed that males and females consistently differed in their appraisals of the earthquake hazard, and that these differences were also stable over the 6 year collection period, an alternative explanation for these differences might involve cognitive appraisals considerations. Such an explanation would not only be consistent with the work of Lindell (Lindell & Perry, 1997; Lindell & Whitney, 1998) and PrE theory, but also with the body of developmental literature that indicates gender differences in cognitive development (e.g. differences in the rate of development of verbal and quantitative skills between males and females).

Summary discussion and conclusions

In the present studies the existence of gender differences in earthquake preparedness was explored, as well as the stability of such differences over time, and reasons for such differences were postulated. Results of these studies seemed to indicate that Southern California undergraduate males were more prepared for earthquakes on certain items of the MLEPS while females were more prepared for earthquakes on other items of the MLEPS, and on still other items of the MLEPS, males and females appeared to be equally prepared for earthquakes. Furthermore, these gender differences in preparedness appeared consistent over the 6 year period in which the data was collected.

On one hand, these gender differences appear to reflect traditional stereotypic differences in males and females. That is, taken in conjunction with the psychology literature on gender, the results of the present study may suggest the existence of particular gendered dimensions in earthquake preparedness. Thus, it may be that these gender differences are motivated by basic differences in the focus of males and females (i.e. sociotropic or connectedness versus egocentric or autonomous focus), or to more traditional gender-stereotypic roles with respect to division of labor. That is, it may be that the gender differences in earthquake preparedness observed in the present investigation arise from socialized differences between males and females in the divisions of labor tasks they typically perform, which results in differences in gender idealogies between the genders. Such an interpretation of the results would be consistent with the views of Kroska (1997) who interprets such ideological differences as a difference in gender identity rather than a difference in a set of beliefs between males and females. However, not everyone views gender differences in these terms.

Others, for example, have directed their focus on the differing values, beliefs, attitudes, and perceptions of males and females, with we might add, somewhat mixed results. With respect to differing values, for example, Prince-Gibson & Schwartz (1998) found that males and females gave similar meanings to 10 different types of values (e.g. power, achievement, hedonism, benevolence, and conformity). On the other hand, Burger, Sanchez, Gibbons, and Gochfeld (1998) found that males and females had distinctly different attitudes and perceptions toward environmental problems and issues, topics that are more closely related to that of the present study. Thus, at least with respect to the results of the present investigation, it may be that the observed gender differences in earthquake preparedness reflect more fundamental issues underlying processes involved in behavior change as depicted, for example, by PrE theory (Duval & Mulilis, in press; Mulilis & Duval, 1995a, 1995b, 1995c, 1996, 1997, 1998).

According to PrE theory, behaviors such as those involved in earthquake preparedness activities are a function of appraised person variables (i.e. similar to what Lindell & Perry, 1997 call 'household resources') *relative to* appraisal of event variables (i.e. similar to what Lindell & Perry, 1997 call 'perception of the hazard'). Mathematically, Duval and Mulilis (in press) have shown that this can translate into the *ratio* of person to event variables. According to this view, PrE theory predicts that the magnitude of earthquake preparedness behaviors is dictated by the ratio of an appraisal of person *relative to* event variables. In the present investigation, person variables focused on beliefs about personal responsibility assumed for earthquake preparedness activities while event variables focused on the perception of the earthquake hazard, both of which are consistent with the conclusions of Lindell and Perry (1997) and Duval, Mulilis, and Lalwani (1998).

Applying the above to the gender differences in earthquake preparedness observed in the present study, PrE theory predicts that such differences would occur in conjunction with differences in appraised personal responsibility assumed for earthquake preparedness actions *relative to* appraisal of the threatening earthquake. In fact, these results were precisely what the present investigation indicated. That is, observed gender differences in earthquake preparedness were accompanied by corresponding gender differences in appraisals of the threatening earthquake, which is consistent with the research of Lindell and Whitney (1998), while appraisals of personal responsibility assumed for preparedness actions were similar for males and females, a finding consistent with the research of Mikula, Freudenthaler, Brennacher-Kroll, and Brunschko (1997). More specifically, differences between males and females in the *ratio* of appraised personal responsibility *relative to* appraisals of the threatening earthquake were due to differences in appraisals of the threat, rather than differences in appraised responsibility, and that these differences in appraised threat corresponded to observed differences in male and female preparedness behavior. Thus, taken in conjunction with PrE theory, the results of the present investigation suggest that gender differences in earthquake preparedness may be the result of differing appraisals of the earthquake hazard by males and females.

Finally, it may be noted that several large earthquakes occurred in California during the years 1986 to 1992 when the data for the present study were collected (e.g. the 5.9 magnitude Palm Springs earthquake on July 8, 1986, the 5.9 magnitude Whittier Narrows earthquake on October 1, 1987, the 7.1 magnitude Loma Prieta earthquake on October 17, 1988, and the 5.8 magnitude Sierra Madre earthquake on June 28, 1991). However, it was assumed that these earthquakes did not affect the results of the present investigation for two reasons.

The first reason has to do with the points in time when the earthquakes occurred relative to the points in time when the data were collected. That is, either the earthquakes occurred after the data collection period (e.g. the Whittier Narrows earthquake occurred approx. three weeks after the Sept. 1987 data was collected, and the

Loma Prieta earthquake occurred approx. one month after the Sept. 1989 data was collected), or the earthquakes occurred long enough before the data collection period (e.g. the Palm Springs earthquake occurred approximately two months before the Sept. 1986 data was collected and the Sierra Madre earthquake occurred approximately two and one-half months before the Sept. 1991 data was collected) so that it might be assumed that any effects of the earthquakes on the preparedness measures had dissipated (Mulilis & Duval, 1990a, 1990b, 1991a, 1991b, 1993).

Secondly, it was assumed that any effects of these earthquakes on preparedness behavior affected both males and females in a similar manner, and thus, differences between male and female preparedness levels would not have been substantially affected relative to one another. As it turned out, the fact that peak preparedness values for the masculine and feminine subscales occurred at different time periods over the six year data collection period *(see Tables 6, 7, and 8)* was not directly supportive of this second assumption. However, the fact that the pattern of preparedness values for these two subscales was similar (i.e., somewhat random — see *Tables 6, 7, and 8*) is suggestive that the pattern of gender differences would not vary substantially with temporal proximity to an earthquake.

In conclusion, the present research takes an important step in determining precisely why gender makes a difference in earthquake preparedness activities, and as such, could aid emergency managers in increasing disaster preparation efforts. It is suggested that future research be directed toward verifying the existence of these differences in terms of different populations (e.g. non-students), different sex-role attitudes and ideologies (e.g. traditional versus non-traditional), and different types of disasters (e.g. tornados, floods, hurricanes). Furthermore, additional research is recommended in determining whether these differences arise from more traditional gender-stereotypic notions (e.g. differences in personality or differences due to division of labor) or are grounded more in the rationale of cognitive appraisal approaches (e.g. Lazarus' cognitive appraisal theory—Lazarus, 1966, 1991; Lazarus & Folkman, 1984; PrE theory—Duval & Mulilis, in press; Mulilis & Duval, 1995a, 1995b, 1995c, 1996, 1997, 1998).

Footnotes

[1] The terms sociotropic and autonomic were originally used by Beck (Beck, Epstein, & Harrison, 1983) in his work on depression to describe two dimensions of personality. Developmental theorists (e.g. Baumeister & Sommer, 1997; Carlson, Cooper, & Hsu, 1990; Chodorow, 1989; Cooper & Grotevant, 1989; Cross & Madison, 1997a, 1997b; Gilligan, 1990, 1991; Grotevant & Cooper, 1985; Martin & Ruble, 1997) have applied these and similar terms (e.g. individual versus connected, independent versus interdependent, and justice versus care perspective) to describe differences between males and females.

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Author's note

The PrE theory as outlined in this and other manuscripts is the joint and collaborative work of the author and T. Shelley Duval.

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The Katherine–Daly flood disaster 1998

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- The Katherine flood map (13/2/98) be immediately mandated as the interim land usage flood areas and levels benchmark.
- Government bureaucracies enabling acts need to accommodate expedited functioning during periods of emergencies and disasters—'administrative realism'.
- Regional, urban and remote communities should be planned and administered to standards in line with their natural environments.
- Northern Territory Emergency Service needs augmentation, so that their immediately available operational resources and capabilities are matched to their demanding tasks of ensuring the survival and well-being of all, anytime.
- Appropriate flood gauging and telemetry systems, non-vulnerable, 'dedicated' communications systems, robust, accessible local physical resources and necessary external resources, and secure, adequate emergency operations control centres are required.
- The NTES needs to audit all current counter disaster plans and actionable resources to accommodate realistically, extreme levels of environmental hazards.
- Key emergency leaders and workers need continuing state-of-the-art selection, training and experience of simulations to become expert in complex, uncertain, emergency situations.
- Innovative extreme hazard contingency management training programs should be developed and offered by Emergency Management Australia
- Katherine-Daly region flood 1998 experiences and lessons should be carefully studied and incorporated for similar future emergency capabilities elswhere.
- Australian and Northern Territory Governments need to 'contemporise' their emergency operations procedures taking into account the many glitches and uncertainties of the 1998 Katherine-Daly flood.
- *Status quo* disaster restoration policies should be given close scrutiny, with a view to improving and increasing individual and community restoration.
- The whole issue of flood and counter-disaster mitigation measures, appropriate land use planning and building standards needs to be taken up at the highest Government levels. A National Hazard Mitigation Program is vital.
- Research needs to be undertaken on human behaviour of people and communities facing and coping with hazards.
- Effective communications to diverse people and groups is required.
- Overall, the 'Precautionary Principle'—anticipating and preventing potential hazards of all kinds, should be taken seriously and become integrated into all aspects of Australian (and elsewhere) human settlement planning, design, administration and management.

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