MODELING HOUSEHOLD ADOPTION OF EARTHQUAKE HAZARD ADJUSTMENTS: A LONGITUDINAL PANEL STUDY OF SOUTHERN CALIFORNIA AND WESTERN WASHINGTON RESIDENTS

A Dissertation

by

SUDHA S. ARLIKATTI

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

August 2006

Major Subject: Urban and Regional Science

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ABSTRACT

Modeling Household Adoption of Earthquake Hazard Adjustments: A Longitudinal Panel Study of Southern California and Western Washington Residents. (August 2006)

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This research, aimed at advancing the theory of environmental hazard adjustment processes by contrasting households from three cities in a high seismic hazard area with households from three other cities in a moderate seismic hazard area. It identified seven types of stakeholders namely, the risk area residents and their families (primary group), the news media, employers, and friends (secondary group), and federal, state, and local governments (tertiary group), and explained why they are relevant to the adoption of seismic hazard adjustments. It also addressed three key attributes— knowledge, trustworthiness, and responsibility for protection—ascribed to these multiple stakeholders and the relationships of these stakeholder attributes with risk perception, hazard intrusiveness, hazard experience, gender, resource adequacy, fatalism and hazard adjustment adoption. It was specifically concerned with the effects of nested interactions due to trust and power differentials among the seven stakeholders, with the self reported adoption of 16 earthquake protective measures at two points in time (1997 and 1999).

Some of the key findings indicate that risk perception, gender, fatalism, city activity in earthquake management and demographic characteristics did not significantly predict hazard adjustment adoption. However, all stakeholder characteristics had significant positive

correlations with risk perception and hazard adjustment, implying a peripheral route for social influence. Hazard intrusiveness, hazard experience, and stakeholder knowledge, trustworthiness, and responsibility affected the increased adoption of hazard adjustments by households. Particularly important are the peer groups' (employers, friends and family) knowledge, trustworthiness and responsibility.

These findings suggest, hazard managers cannot count only on the federal, state, and local government advisories put out through the news media to affect community decisions and thereby households' decisions to take protective actions. Instead, hazard managers need to shift focus and work through peer group networks such as service organizations, industry groups, trade unions, neighborhood organizations, community emergency response teams, faith-based organizations, and educational institutions to increase the knowledge, trustworthiness and responsibility of all in the peer group. This will assure higher household hazard adjustment adoption levels, thus facilitating a reduction in post disaster losses and recovery time.

To Mummy and Daddy, my strength and inspiration

To Shweta and Siddhant, my pride and joy

To Gita and Anoop my support

To Avneesh my best friend

and

To the beloved memory of my late husband Sudhir

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CHAPTER I

INTRODUCTION

1.1. Background and Rationale

The national 'crisis atmosphere' in the wake of the 9/11, 2001 bombings, has led to increased federal and state funding and research initiatives towards homeland security and the fight against terrorism in the United States. In comparison, even though seismic risk has become an increasing concern since the 1971 San Fernando earthquake with all or parts of 38 states in the United States lying in regions classified as having moderate to very high earthquake hazards (Federal Emergency Management Agency 1992), the perception of a 'crisis atmosphere' for seismic risks is lacking. Traditional ways of minimizing losses in susceptible areas have primarily focused on three strategies: technological fixes, risk communications, and sanctions which have often led to repeated revisions in the building codes or conditions affecting eligibility for federal relief. After evaluating earthquake risks, the National Earthquake Hazard Reduction Act of 1977 encouraged states and local efforts to address earthquake hazards. Subsequently some 30 states in earthquake prone regions have established provisions governing earthquake-resistant new construction as part of state building codes (May & Birkland, 1994).

Wherever there is a long and well-known history of seismic activity, the states have mandated planning in terms of mitigating damage from seismic events through added safety elements of local comprehensive land use plans (Nelson & French 2002).

This dissertation follows the style and format of the *American Journal of Community Psychology*.

Yet the annual losses from seismic hazards have not declined appreciably over the past 35 years because of federal policies that favor growth-inducing over growth restricting disaster management measures (Burby & Dalton, 1994; Burby, Cigler, French, Kaiser, Kartez, Roenigk, Weist, & Wittington, 1991). Although there is a general understanding that natural hazards impact would become less of a problem for communities if households became proactive in hazard mitigation and preparedness actions (Burby, French, & Nelson, 1998; Kunreuther & Roth, 1998; Tierney, Lindell, & Perry, 2001), very little is actually done at the household level. Quite often communities are free to craft their own mitigation strategies but there are serious gaps in content and implementation from one community to another. In light of the limited federal and state role in seismic hazard mitigation, there is a growing need to target measures at the local government and household levels to help bridge these gaps. Such a focus would reduce loss to life and property and decrease problems for community agencies that bear the burden of response and recovery.

Environmental hazard managers and policy makers seek to prepare their communities for disasters by encouraging residents to adopt *hazard adjustments* (Burton, Kates, & White, 1978). These include hazard mitigation measures providing passive protection at the time of disaster impact (e.g., strapped water heaters, tall furniture, and heavy objects to the building walls, installed latches to keep cabinets securely closed) emergency preparedness measures supporting active response when a disaster strikes (e.g. joined a community organization dealing with earthquake emergency preparedness, learned the location of nearby medical emergency centers) and recovery preparedness measures (e.g. purchased hazard insurance) supporting physical reconstruction after disaster (Lindell & Perry, 2000).

Lindell et al. (1997) espoused that these household hazard adjustments are linked to extremes in the physical environment and societal stakeholders by three dyadic relationships as illustrated in Fig.1. Risk of disaster impact defines the relationship between environmental extremes and societal stakeholders; cost defines the relationship between these stakeholders and hazard adjustments; and efficacy (i.e. the degree to which adjustments reduce risks) defines the relationship between hazard adjustments and environmental extremes.

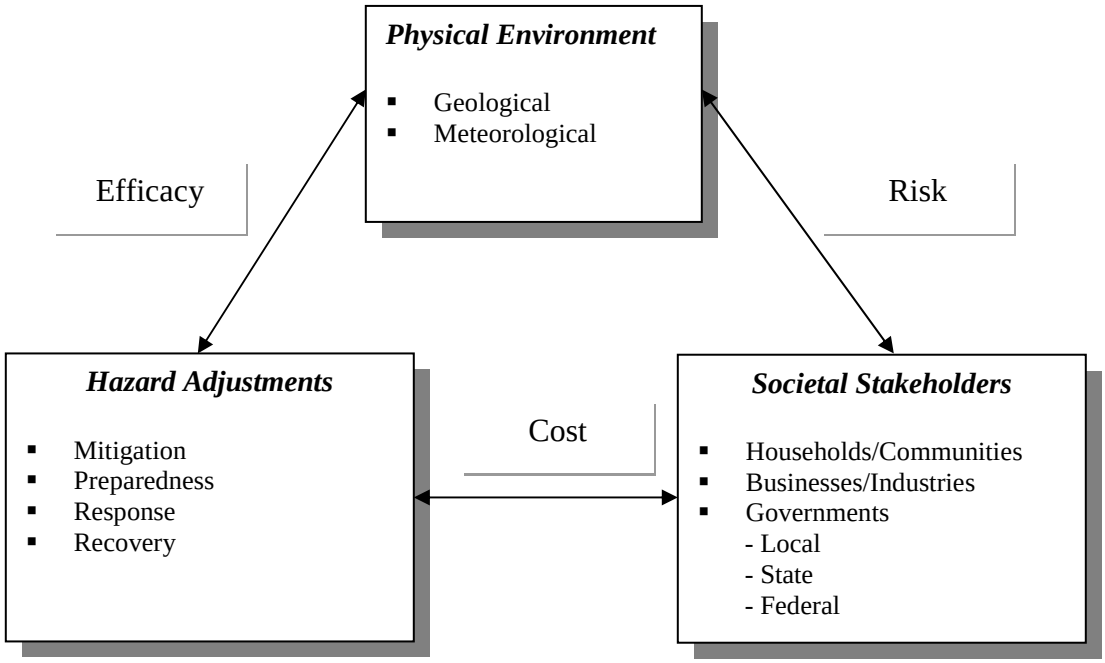

Fig. 1. Interrelationships among environmental extremes, societal stakeholders, and hazard adjustments.

Hazard theorists have accepted that the decision process by which households adopt and implement hazard adjustments occurs in stages, which include awareness of hazard, awareness of alternative adjustments, adoption of one or more adjustments, implementation of these adjustments, and evaluation (Burton, et al., 1978; Mileti, 1980; Lindell & Perry, 2004). At each

stage, variations in households' adoption of hazard adjustments result from many interrelated variables. Most research has focused on disaster experience, risk perceptions, hazard knowledge, hazard salience, personality characteristics, demographic characteristics, and economic resources (Lindell & Perry, 2000). But researchers have paid scant attention to the effects of interactions between societal stakeholders - households/communities, businesses/industries, and government agencies (see Fig.1.) - on risk communication, protective action intentions, and protective action adoption, even though much of a person's hazard knowledge, behavioral intentions, and actual behavior comes from social and governmental stakeholders (Fishbein & Ajzen, 1975; Slovic, 2000).

To overcome this gap the research identifies the risk area resident and his/her family and six additional stakeholders (federal government, state government, local government, news media, employers, and friends). It explains how social interactions between these stakeholders and perceptions of three key attributes— knowledge, trustworthiness, and responsibility for protection—ascribed to them, affect protective action decision-making. Additionally, the relationships of these attributes with risk perception, hazard intrusiveness, hazard experience, gender, resource adequacy, fatalism and a household's decisions to adopt 16 seismic protective actions are explained.

1.2 Problem Statement

The proposed research aims at comparing the extent to which households located in areas with different levels of seismic vulnerability vary in their adoption of earthquake protective measures. It also seeks to explain how perceptions of stakeholder interactions and attributes contribute to the stability of risk perceptions and hazard adjustment adoption behavior over time. Two previous studies have analyzed part of the data collected in 1997 (Lindell & Prater, 2000,

2002), but the follow up panel data collected during 1999 have not previously been analyzed. This study will thus examine the results of the two time periods to gauge the stability of respondents' perceptions and identify other variables that predict households' adoption of earthquake protective actions/ hazard adjustments.

1.3 Organization of this dissertation

Chapter II presents a review of hazards, public policy, psychology, and social sciences literature pertaining to the social amplification of risk, stakeholder inter-relationships and seismic hazard adjustment adoption. Chapter III presents hypotheses to be tested, describes the research methods, and elaborates on the measures adopted. Chapter IV presents the statistical analyses conducted on the two waves of data from 1997 and 1999. It includes examining the interitem correlations for California and Washington respondents to assess the homogeneity of correlations in the two states, comparing the stakeholders' mean ratings on perceived hazard knowledge, trustworthiness, and protection responsibility. These analyses compare ratings of stakeholder characteristics, risk perceptions, seismicity/location, fatalism, adequacy of resources, controllability, and city activity in hazard management, between states and examine the correlations of these variables with household adoption of seismic hazard adjustments. The final chapter of this dissertation presents a summary of the analyses and the conclusions drawn, describes the study limitations, and offers suggestions for future research in this area.

CHAPTER II

LITERATURE REVIEW AND CONCEPTUALIZATION

2.1 Framework of the Protective Action Decision Model (PADM)

Lindell and Perry (1992, 2004) conducted an extensive review of literatures in risk communication and protective action encompassing situations involving disaster response and long-term adoption of hazard adjustments. They examined a wide variety of theoretical perspectives and conceptual models dealing with social influence, behavioral evaluation and choice, attitude-behavior relationships and information seeking that guide people's actions and innovations in an environmental hazard situation and developed an integrated model labeled the *Protective Action Decision Model* (PADM). This model characterizes the way people typically make decisions about adopting adjustments to protect against environmental hazards.

The model (Fig.2) depicts a sequential process starting with the predecisional stage in which people first receive a warning message, pay attention to it, and comprehend its content. Once the predecisional processes have been successfully completed, cognitive processing is turned on and the five decision stages of risk identification, risk assessment, protective action search, protective action assessment, and protective action implementation are pursued. In addition, the process is also influenced by the interpretation of environmental and social context variables. The interpretation of the warning message is influenced by characteristics of the information sources and channels, message content, and receiver characteristics.

The present study uses the PADM as the basic theoretical framework to build upon, adopts some variables tested extensively in the hazard mitigation literature (risk perception, hazard intrusiveness, and earthquake experience, demographic characteristics and social context), and adds some other variables that have previously received limited attention (fatalism,

controllability, adequacy of resources, stakeholder characteristics, location, and city activity in earthquake hazard management) in the context of a household's intention to adopt hazard adjustments. These variables used to operationalize the household hazard adjustment adoption process are illustrated in a conceptual model (Fig.3) and discussed briefly in the following pages.

2.2. Risk Assessment

Risk Perception

Numerous studies have generally found significant correlations between risk perception and seismic hazard adjustments (Lindell & Perry, 2000). Specifically, people's perceptions of greater quake likelihood (Farley, Barlow, Finkelstein, & Riley, 1993), and beliefs that they are at risk of death, and injury (Showalter, 1993), property damage, or disruption of their daily activities motivates a search for actions they can take to prevent such personal consequences. Kunreuther and Roth (1998) found insurance purchase was associated with perceived likelihood of an earthquake and subsequent damage to one's property. However, some researchers have also found adjustment adoption was unrelated to expectations of future earthquake losses (Jackson, 1977, 1981), risk perception and hazard concern (Mileti & Darlington, 1995).

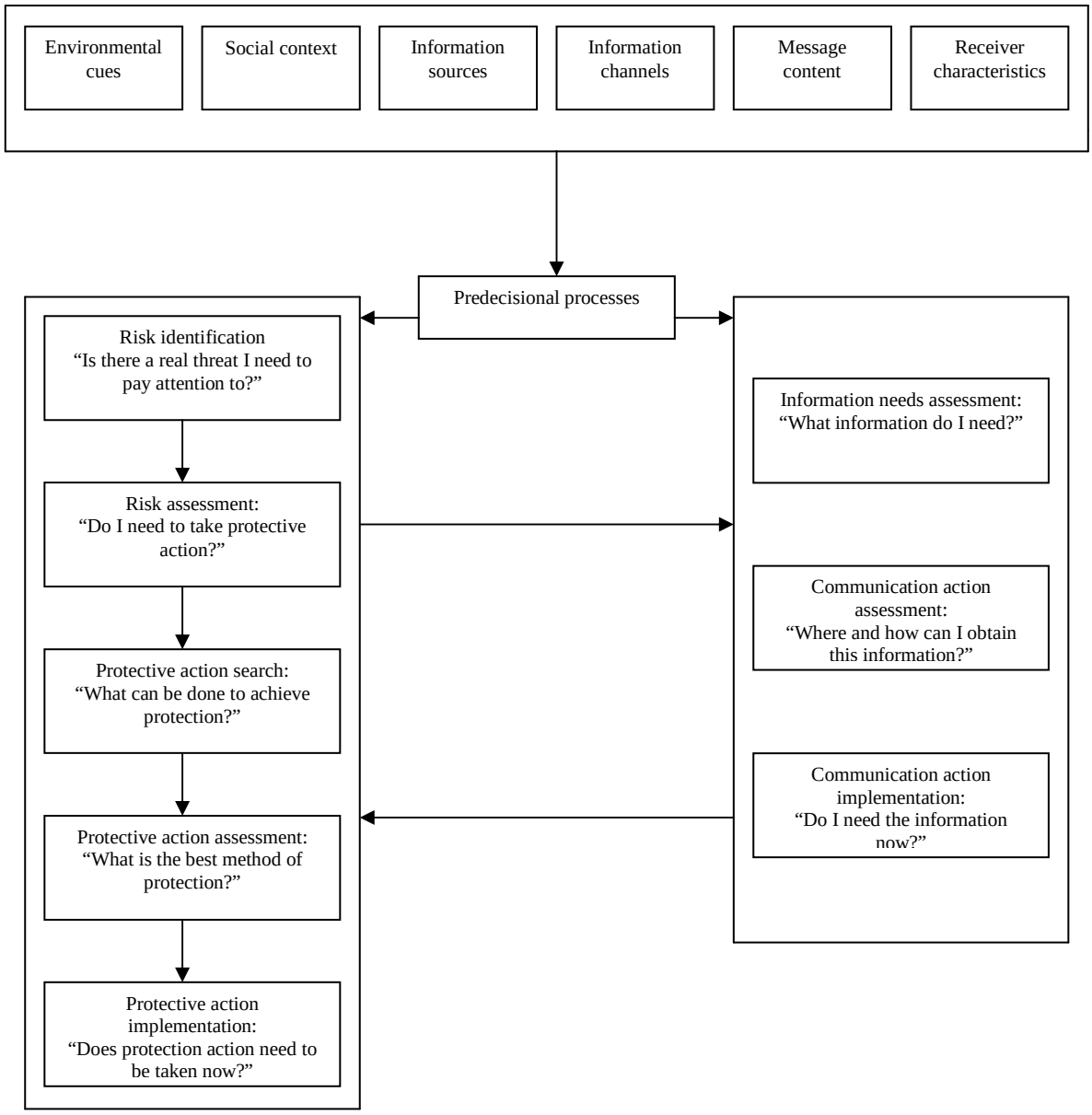

Fig.2. Information flow in the Protective Action Decision Model (PADM).

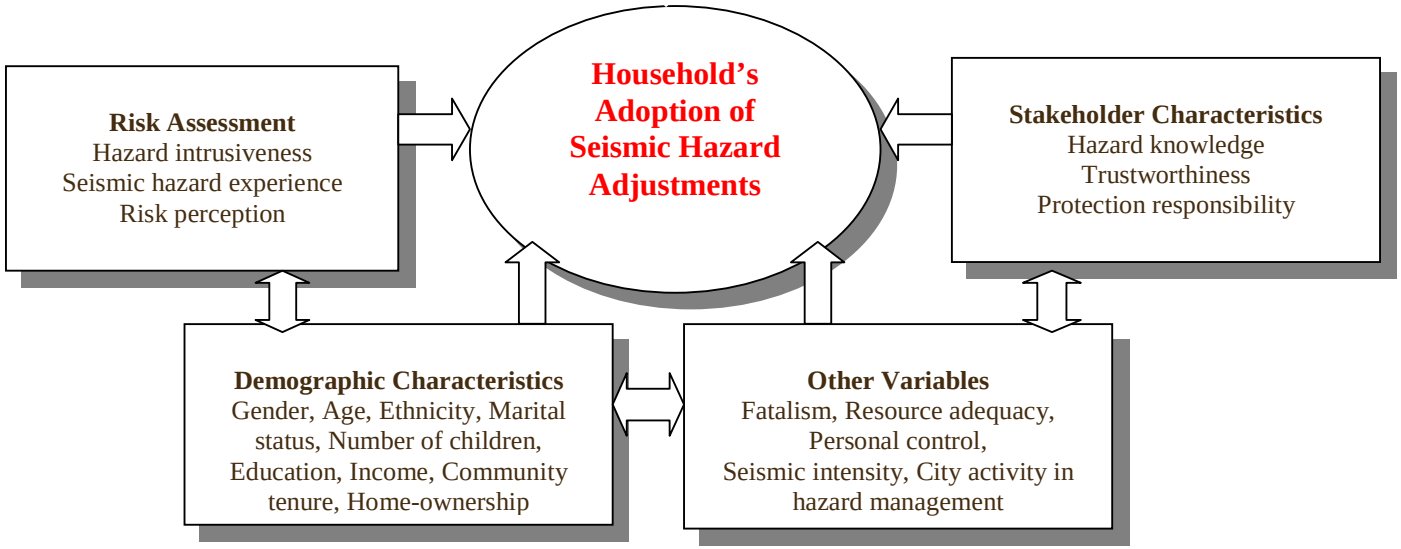

Fig.3. Conceptual model of measures to operationalize a household's adoption of seismic hazard adjustments.

Hazard Intrusiveness

Hazard intrusiveness, measured as the frequency of thought, discussion, and information receipt about earthquakes, is important to seismic adjustment (Turner, Nigg, & Heller-Paz, 1986; Mileti & Fitzpatrick, 1993). Mileti and Darlington's (1995) study of the response to hazard awareness brochure in the San Francisco Bay area, found that information seeking was the single best predictor of seismic adjustments. It indicates the degree to which spontaneous thoughts or messages from others cause local residents to stop thinking about other tasks and focus on their vulnerability to a hazard.

Seismic Hazard Experience

A person's prior seismic hazard experience is likely to influence his/her perception of the danger and, as such, is an important variable for study (Dooley, Catalano, Mishra, & Serxner, 1992; Turner et al., 1986; Russell, Goltz, & Bourque, 1995). Even when people are aware of a hazard, they are often lulled into a false sense of security because earthquakes are so rare and, in addition, the demands of daily life are more pressing, thus leading to little protection motivation and/or adoption of hazard adjustments (Lindell & Perry, 2004). Respondents who have not experienced any recent earthquakes tend to procrastinate in the adoption and implementation of seismic hazard adjustments. In such a scenario, risk communication by the various societal stakeholders such as the governmental influentials, economic influentials (e.g. insurance and mortgage companies), and social influentials (e.g. the media and peers) can become exceedingly important. However, conflicting interests, low prioritization of environmental hazards, and difficulties in information/scientific data sharing makes sustained adoption of protective actions difficult to achieve.

2.3. Demographic Characteristics

In their search for variables that can predict adoption of seismic hazard adjustments by households, some researchers have reported that adaptive action is correlated with demographic characteristics of the household such as gender, ethnicity, age, education level, income, occupation, place of residence, and presence of children in household (Turner et al., 1986; Russell et al., 1995; Mileti & Darlington, 1997; Lindell & Whitney, 2000; Peacock, 2003). Gender is a relevant variable because research has shown women tend to perceive a variety of risks to be greater than men do (Fothergill, 1996), but there is some evidence that they nonetheless adopt fewer seismic hazard adjustments (Lindell & Prater, 2000). One possible explanation for this result is that women might have lower levels of perceived protection responsibility but this possibility has not been addressed in previous research. More generally, it is unknown whether women differ from men in their perceptions of any stakeholder characteristics.

Several studies imply that hazard adjustment adoption may also depend on community bondedness (Russell et al., 1995) and proximity to hazard zones (Farley et al., 1993; Kunreuther & Roth, 1998; Peacock, 2003; Peacock, Brody, & Highfield, 2005). Schwab, Topping, Eadie, Deyle and Smith (1998) found disaster impacts vary across communities or sectors within those communities. Some low-income communities are likely to suffer disproportionate damage due to the relative age of their housing stock and the limited financial capacity of many residents to undertake effective mitigation measures. Also, in comparison to homeowners, renters are less prepared to survive disasters due to incentives, disincentives and the barriers they face (Tierney, Lindell, & Perry, 2001; Burby, Steinberg, & Basolo, 2003).

Although these correlations are useful in terms of their theoretical value, they have limited practical utility because none of them are “instrumental variables” that can be changed

by emergency managers. Their principal practical role would be to identify census tracts where additional risk communication or technical assistance might be needed (Lindell et al., 1997). Hence, in order to make use of these demographic predictors, there is a need to consider them in conjunction with other variables that can possibly be controlled by emergency planners.

2.4. Other Variables

Fatalism

Turner et al. (1986) found fatalistic attitudes regarding earthquake impacts to be inversely related to adjustment adoption. Less conclusively, Farley et al. (1993) reported that adjustment adoption was predicted by lower fatalism ratings in a survey conducted before the Browning earthquake prediction date but not in a survey conducted immediately after the prediction date. These inconsistent correlations cannot be dismissed as being due to variations in the nature of the instruments and samples used. Instead, respondents' judgments of fatalism may be considered as a lack of *self-efficacy*, which Mulilis, Duval and Lippa (1990) found to predict adjustment adoption.

Perceived Personal Control

Several studies have implied that receiver characteristics governed by cognitive and attitudinal processes are particularly important in increasing hazard awareness, thereby increasing hazard adjustments. Perceived *controllability* and level of *felt responsibility* (Mulilis & Duval, 1995), denoting to what extent one's personal safety is determined by the actions of oneself or other stakeholders are important variables to be considered.

Perceived Resource Adequacy

A person's perceived lack of self-efficacy in performing a task in Mulilis and Duval's (1995) person relative to event (PrE) model is equivalent to a perceived presence of implementation barriers such as lack of required information and skill or other resources such as tools and equipment and financial assets in Lindell and Perry's (1992, 2004) PADM. Thus perceived resource adequacy, which summarizes the above, is also expected to be an important variable predicting hazard adjustment.

Seismic Intensity

Some researchers have found locational and proximity to fault lines suggest positive impacts for hazard adjustments (Palm, Hodgson, Blanchard, & Lyons, 1990) and some others have found nonsignificant effects (Mileti & Darlington, 1997). Moreover, regions of the country differ in their hazard exposure, but most of the research on seismic hazard adjustment has focused on California where seismic experience is homogenously high and most of the remaining studies have taken place in the Midwest where seismic experience is homogenously low (Farley et al., 1993). This leaves out areas of moderate risks, making generalizability difficult. Hence there is a need to make comparisons to areas with moderate levels of seismic hazard, especially, to make comparisons between locations that differ in their levels of seismic hazard (Lindell & Perry, 2000). Thus, it is worthwhile to examine the extent to which location is a correlate of hazard adjustment.

City Activity in Earthquake Hazard Management

In addition, there are likely to be locational differences in stakeholder perceptions because local government knowledge and responsibility for seismic hazard would be expected to

be greater in areas where the risk is high. May and Birkland (1994) showed that city activity in earthquake hazard management was an important correlate to seismic hazard adjustments. Employing cluster analysis they identified unique groupings of cities in California and Washington with respect to the number of local earthquake risk reduction policies adopted and implemented. Their model included three sets of factors: (1) the commitment of communities to deal with earthquake risks, (2) local governmental capacity for addressing earthquake risks, and (3) the hazard context that establishes the tractability of addressing earthquake risks (May & Birkland, 1994). Consequently three distinct clusters namely, leading comprehensive cities, leading focused cities, and lagging cities were thereby labeled. *Leading cities* were relatively wealthy, rapidly growing jurisdictions that adopted greater number of measures to deal with earthquake hazards than the *lagging cities* and expended greater effort implementing them, than lagging cities. They concluded that within every region, be it the high risk regions such as California or the moderate and low risk regions such as Pacific Northwest and central United States, there are noteworthy differences among localities in levels of earthquake risk reduction that are not simply a function of variation in earthquake vulnerability. Hence, city activity in earthquake hazard management will be another variable considered for the present study.

2.5. Seismic Policy Stakeholders and Perceived Characteristics

Although there is a growing recognition that stakeholder participation is important to the hazards planning process (Godschalk, Beatley, Berke, Brower, Kaiser, 1999; Brody, 2003; Brody, Godschalk, & Burby, 2003), research on hazard adjustments adoption has failed to understand the ways in which these *stakeholder interactions* influence a household's decision-making process. Indeed, uncertainty about when (or if) environmental extremes will occur can cause deep division among stakeholders over the acceptability of a wide variety of risks. Hence,

environmental hazard managers must frequently determine what levels of perceived risk are acceptable to their communities and find ways to take collective actions against the unacceptable risks (Kasperson, Renn, Slovic, Brown, Emel, Goble, Kasperson, & Ratick, 1988; Slovic, 2000). In addition to collective actions that affect the entire community, environmental hazard managers also encourage households to take individual actions to protect themselves. An advantage of individual actions, such as bolting water heaters to the foundation or storing a three-day supply of food and water, is that each household can decide for itself what is a suitable level of protection from environmental extremes. Nonetheless, each household's decisions are made in a social context, so it is important to understand the ways in which other stakeholders in their communities influence households. Many researchers argue that increasing collaboration amongst the stakeholders will enable better understanding of information, help generate new ideas for dealing with problems, and produce a sense of ownership and support for policy recommendations in the long run (Brody et al., 2003).

Stakeholders Identified

Multiple stakeholders - including households, businesses, governmental influentials, economic influentials, social influentials, and hazard professionals - influence the adoption of seismic hazard adjustments (Lindell et al., 1997). For this research, seven types of stakeholders can be identified as falling into three broad groups—households (self and family), social influentials, and governmental influentials (this is explained below in more detail). Households are important because they affect the vulnerability of a substantial amount of financial assets (in aggregate) by living in hazard prone areas either by conscious choice or otherwise, and by whether they elect to adopt pre-impact hazard adjustments. Social influentials include peers such as friends, employers, and the news media. Friends are sources of information and social

comparison (Turner, 1991), whereas employers affect the seismic safety of household members through hazard adjustments adopted to protect employees in the workplace where much of their time is spent. The news media can put environmental hazards on the public agenda and educate those who do not have direct experiences with disasters (Prater & Lindell, 2000). Dash and Morrow's (2001) research on hurricanes in the Florida Keys found that there is a tendency for people to seek information primarily from radio and television to assess their personal risk, rather than automatically follow the advisories put out by public officials. Unfortunately, these information sources sometimes perpetuate disaster myths and thus impede the adoption of hazard adjustments (Whitney, Lindell & Nguyen, 2004). Government influentials include policymakers and administrators in federal, state, and local government who have extensive resources of knowledge and capital (although more so at the federal than at the state and local levels). In addition, government influentials have some legal responsibility for protecting public health and safety, property, and the environment within their jurisdictions.

Stakeholder Interrelationships

The interrelationships among the seven types of stakeholders can be understood in terms of the "onion model" (see Fig.4) adapted from Godschalk, Parham, Porter, Potapchuk and Schukraft's (1994) model, highlighting the nested levels of stakeholder interactions that are key to planning and development of consensus building. Risk area residents and their families (households) are located in the primary ring; peers (friends and employers) are in the secondary ring; news media is in the tertiary ring, and governmental influentials (federal, state, and local government) are in the outermost ring.

The interactions among stakeholders are defined by the power they wield over each other's decisions to take protective actions. French and Raven (1959; Raven, 1965) posited

power relationships can be defined in terms of six bases of power namely reward, coercive, legitimate, referent, expert, and information power. Reward and coercive power are the principal bases of regulatory approaches, but Raven (1993) noted these require continuing surveillance in order to assure rewards are provided only for compliance and punishment is certain to follow noncompliance. Unfortunately, research has revealed state mandates are hampered by a lack of formal reporting or review by state officials, and limited or no penalties for failing to enforce their provisions (Burby, French, & Nelson, 1998; Nelson & French, 2002). Consequently, there is a need to better understand the ways in which households can be influenced by bases of power other than reward and coercion.

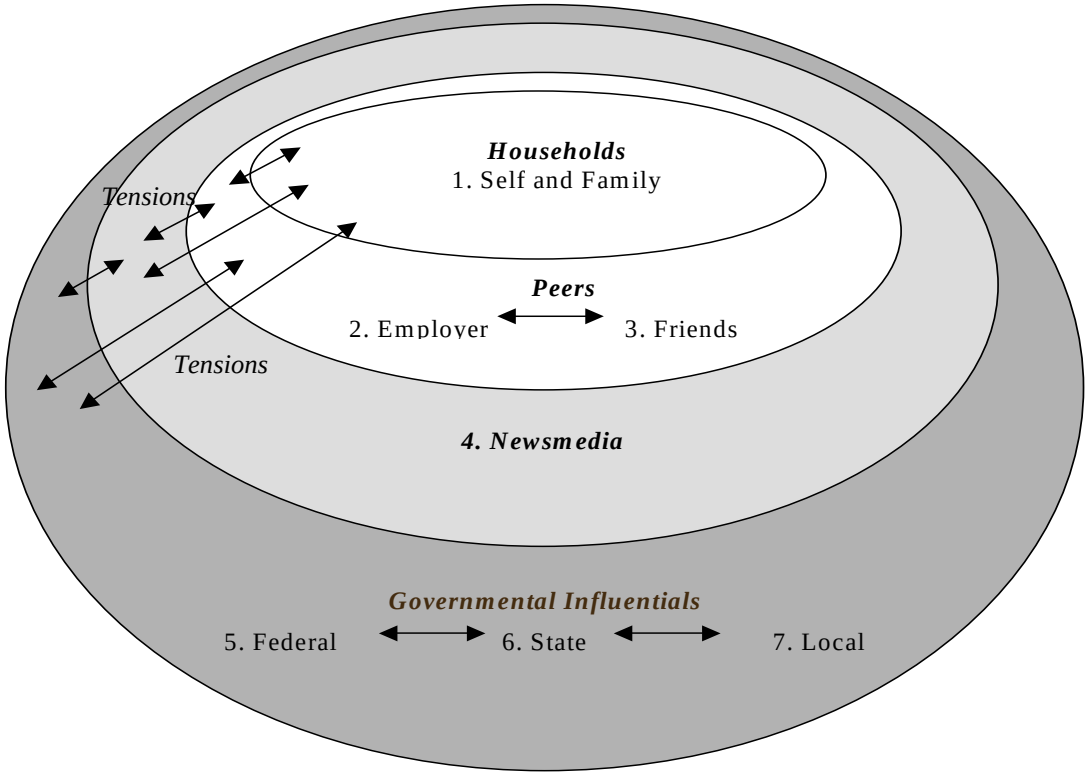

Fig. 4 Stakeholder interactions related to adoption of hazard adjustments.

Specifically, French and Raven's conception of expert (i.e., understanding of cause and effect relationships in the environment) and information (i.e., knowledge about states of the environment) power suggests assessing perceptions of other stakeholders' seismic hazard knowledge. However, research on this topic shows most people are unrealistically optimistic about their hazard vulnerability (Svensen, 1981). Weinstein (1980) made this clearer by pointing out people believe they are better than their "average" peers. However, this does not mean they think they are better than all other stakeholders. Indeed, Lindell and Perry (1992) reported that respondents rated their own hazard knowledge as higher than that of peers and family, but lower than authorities such as local, state and federal government.

Moreover, French and Raven's conception of referent power suggests addressing the trustworthiness of different stakeholders. This is reinforced by Kasperson, Renn, Slovic, Brown, Emel, Goble, Kasperson & Ratick's (1988; see also Kasperson, Kasperson, Pidgeon & Slovic, 2003) social amplification/attenuation of risk framework, which seeks to explain why "risk events with minor physical consequences often elicit strong public concern and produce extraordinarily severe social impacts" (Kasperson, et al., 1988, p. 177). A wide range of studies have attributed the failure of risk control efforts to lack of trust, transparency, and openness (Frewer, 2003) and have sought to add general requirements of a democratic society such as social trust (Cvetkovich & Lofstedt, 1999) to the amplification process. Further, increased trust between stakeholders and generates an increased probability of changing the attitudes of others (Maass & Clark, 1983).

In highlighting the importance of public trust levels Lofstedt (2004, p.337) states,

> First, past research indicates that it is much easier to destroy trust than to build it…. Second, research that Paul Slovic, myself, and others have done over recent years shows that public trust is one of the most important explanatory variables of the publics' perceptions of risk (Lofstedt 1996). That is, if the public trusts regulators they will perceive risks to be less than when they do not trust regulators, In fact, there is a correlation between low public-perceived risk and a high level and public trust and vice-versa. In sum, as the public becomes increasingly distrustful, the public is increasingly risk averse.

Although trustworthiness is clearly an important stakeholder attribute, it is difficult to make specific predictions about differences in stakeholders' perceived trustworthiness because the most relevant research—trust in institutions—has examined only a few of the stakeholders that are relevant to household hazard adjustment adoption. Thus, for seismic hazard mitigation actions at the household level, perceptions of trustworthiness of multiple societal stakeholders becomes a key variable. Specifically, increasing trust in these stakeholders will help to attenuate perceptions of risk, improve transparency and openness, and in turn increase hazard adjustment adoption.

Finally, French and Raven (1959) defined legitimate power in terms of the rights and responsibilities associated with each role in a social network, which raises questions about what households consider to be the responsibility different stakeholders have for protecting them from seismic hazard. This is reinforced by research on stakeholders' perceived protection responsibility from seismic hazard, which dates from Jackson's (1977, 1981) research that attributed low rates of seismic adjustment adoption to respondents' beliefs that the federal government (54%) was the stakeholder most responsible for coping with earthquakes. Much later, Garcia (1989) found respondents had come to believe earthquake preparedness was an individual's responsibility. Her conclusion that a higher level of seismic adjustment adoption in her sample was due to this perception of personal responsibility is supported by Mulilis and

Duval's (1997) research showing preparation for tornadoes reveals the moderating effects of felt responsibility.

Effects of Stakeholder Characteristics

Stakeholder characteristics could affect hazard adjustment adoption in one of two ways, indirect or direct. An indirect effect occurs if stakeholder characteristics influence a person's acceptance of information about a hazard and hazard adjustments and this information, in turn, changes their behavioral intentions and actual behavior. Fishbein and Ajzen (1975) describe this mechanism as the effect on the *attitude toward the act*, Petty and Cacioppo (1986) as the *central route to persuasion*, and Chaiken (1987) as *systematic processing*. A direct effect occurs if stakeholder characteristics influence a person's behavioral intentions and actual behavior without affecting their acceptance of information about the hazard and hazard adjustment. Fishbein and Ajzen (1975) describe this mechanism as the effect on the *subjective norm*, Petty and Cacioppo (1986) as the *peripheral route to persuasion*, and Chaiken (1987) as *heuristic processing*.

Lindell and Whitney (2000) found support for an indirect effect of stakeholder characteristics in their study of risk perceptions, perceptions of stakeholder knowledge and protection responsibility, and adoption of seismic hazard adjustments among students from a state university campus in Southern California. Their finding that two perceived stakeholder characteristics (hazard knowledge and protection responsibility) were significantly correlated with hazard adjustment intentions and actual adjustment adoption, but risk perception was not, supported an indirect effect. Moreover, consistent with the findings of Lindell and Perry (1992), these data showed mean ratings of hazard knowledge were highest for government agencies, next highest for self/family, and lowest for peers, but mean ratings of protection responsibility were highest for self/family, next highest for government, and lowest for peers. Although Lindell

and Whitney's (2000) study provided useful insights into perceptions of stakeholder characteristics, it was limited by a small sample of 168 students from a high seismic risk area, so there is a need to determine if these findings generalize to more demographically diverse samples of respondents from communities having both high and moderate levels of seismic risk. In addition to perceptions of hazard knowledge (i.e., *ability* to provide others with hazard information) and protection responsibility addressed by Lindell and Whitney (2000), the present study examines the role of trustworthiness (i.e., *willingness* to provide others with accurate hazard information, McGuire, 1985) as an important stakeholder characteristic.

2.6. Longitudinal Panel Study Design

In the social sciences, cross-sectional observations are the form of data most commonly used for assessing the determinants of behavior (Davies, 1994; Blossfeld & Rohwer, 1995). Primarily due to data constraints, scholars and practitioners rarely examine whether perceptions of seismic hazards are correlated with adoption of seismic adjustments over time. However, perceptions can change over time depending upon various factors, especially the knowledge base and experiences of the community. Cross-sectional data cannot support conclusive causal inferences (James, Mulaik, & Brett, 1982). This is because persuasive messages received by the respondents can yield a number of different types of temporal effects due to decay in induced change, delayed action effects, and resistance to later persuasion. Longitudinal designs are required to overcome the inherent limitations of previous cross-sectional designs and trace the flow of information over time and assess its effects. Panel designs are also useful in detecting pseudo-opinions (Lindell and Perry, 1990). *Pseudo-opinion* is the term coined by Bishop, Hamilton and McConahay (1980) to explain the answers that people offer when called upon to answer questions about issues on which they had no opinion prior to being asked the question.

The number of persons who answer with pseudo-opinions depends on the salience of the issue at hand. Fewer the people who have thought about an issue, or fewer the issues thought about by a person, more the pseudo-opinions offered. Converse (1970) calls a similar phenomenon *non-attitudes*, defined as lack of a stable affective disposition in answering survey questions, and pseudo-opinions as apparent expressions of opinion that do not reflect any relevant opinion. This is an important issue to be considered in seismic hazard adjustment processes because our research aims to better understand the will of households' to take these protective actions and pseudo-attitudes cannot motivate action (Graeff, 2003). A better understanding of households' hazard adjustment adoption process will also help to guide community actions, especially political legislation.

2.7. Research Hypotheses

Previous research on social influence and risk communication suggests Lindell and Whitney's (2000) findings of significant correlations between stakeholder hazard knowledge and protection responsibility will be replicated in a larger, more diverse sample of respondents. In addition, these correlations are expected to extend to stakeholder trustworthiness. Specifically, this leads to the following three closely related hypotheses.

H1a: Respondents' perceptions of all stakeholders' hazard knowledge will be positively correlated with perceptions of those stakeholders' trustworthiness.

H1b Respondents' perceptions of all stakeholders' hazard knowledge will be positively correlated with perceptions of those stakeholders' protection responsibility.

H1c: Respondents' perceptions of all stakeholders' trustworthiness will be positively correlated with perceptions of those stakeholders' protection responsibility.

In addition, Lindell and Whitney's (2000) findings regarding profiles (of mean ratings across stakeholders) for hazard knowledge and protection responsibility are expected to be replicated and extended to trustworthiness. Specifically, this leads to the following four closely related hypotheses.

H2a: Mean ratings of hazard knowledge will be highest for government agencies, next highest for self/family, and lowest for peers.

H2b: Mean ratings of trustworthiness will be highest for self/family, next highest for the government, and lowest for peers.

H2c: Mean ratings of protection responsibility will be highest for self/family, next highest for government, and lowest for peers.

H2d: Mean ratings of protection responsibility will be lower than ratings of hazard knowledge for all stakeholders except self/family, which will have higher ratings for protection responsibility than for hazard knowledge.

Previous research on social context, receiver characteristics and information sources suggests the following hypothesis.

H3a: Respondents' perceptions' of self/family hazard knowledge will be significantly correlated with their demographic characteristics (age, gender, ethnicity, marital status, number of children, education, income, community tenure, and home ownership) and their adoption of seismic hazard adjustments.

H3b: Respondents' perceptions' of federal, state and local government and media trustworthiness will be significantly correlated with their demographic characteristics and with their adoption of seismic hazard adjustments.

H3c: Respondents' perceptions' of self/family protection responsibility will be significantly correlated with their demographic characteristics and with their adoption of seismic hazard adjustments.

Previous research on locational differences in disaster experience related to location and hazard salience suggests the following hypothesis.

H4: Perceptions of stakeholder characteristics will be significantly higher for respondents in a high seismic risk area than in a moderate seismic risk area.

H5: Respondents in a high seismic risk area will have greater level of hazard intrusiveness, hazard experience, and risk perception than respondents in a moderate seismic risk area.

Previous research on gender differences in risk perception suggests the following hypothesis.

H6: Females will have significantly higher perceptions of seismic risk and stakeholder characteristics.

Lindell and Whitney's (2000) findings on seismic risk perception, together with those of Mileti and Darlington (1997) suggest the following hypothesis.

H7: Respondents' perceptions of stakeholder characteristics will be positively correlated with their hazard intrusiveness and earthquake experience and their adoption of seismic hazard adjustments.

H8: Respondents' risk perceptions will be positively correlated with their perceptions' of stakeholder characteristics, but not with their adoption of seismic hazard adjustments.

Previous research on the effects of individual belief systems, fatalism, control and choice on protective action behavior suggests the following hypotheses.

H9a: Respondents' perceptions of fatalism (luck or chance/God's will) will be significantly correlated with their risk perceptions and with their adoption of seismic hazard adjustments.

H9b: Respondents' perceptions of perceived personal control (whose actions govern their personal safety in an earthquake) would be positively correlated with their adoption of seismic hazard adjustments.

H9c: Respondents' perceptions of resource adequacy (implementation barriers such as lack of required information and skills, or other resources such as tools and equipment, and financial assets) will be negatively correlated with their adoption of seismic hazard adjustments.

Previous research on location and city activity in earthquake hazard management (May & Birkland, 1994) as important correlates to protective action behavior suggests the following hypotheses.

H10a: Households in leader communities in both regions will have greater levels of hazard intrusiveness, perceptions of seismic hazards, and hazard adjustment adoptions than those in laggard communities.

H10b: Ratings of stakeholder knowledge, trustworthiness and responsibility for protection will be significantly higher for respondents in leader communities than for those in laggard communities in both regions.

CHAPTER III

RESEARCH METHODS

3.1 Respondents

The panel data reported here are taken from a two-wave survey conducted in 1997 (whose results were partly reported by Lindell and Prater, 2000 & 2002) and 1999. In this survey, Southern California and Western Washington were identified as high and moderate seismic hazard areas, respectively. Three cities in Southern California (Inglewood, Norwalk and Santa Clarita) and three others in Western Washington (Bremerton, Edmonds and Renton) were selected because the *County and City Data Book* (U.S. Department of Commerce, 1994) showed they are diverse in household ethnicity, education, and income. Moreover, Inglewood and Renton were categorized as leaders in community hazard adjustment, whereas Norwalk and Bremerton were categorized as laggards (May & Birkland, 1994). Santa Clarita and Edmonds were not classified by May and Birkland (1994), but Santa Clarita was picked because it was stricken by the 1994 Northridge earthquake. Edmonds was selected because it had education and income levels that approximated those of Santa Clarita.

The mail-out questionnaire administration procedure was consistent with Dillman's (1978, 1983) *Total Design Method*. In 1997, the first wave of questionnaires were mailed to 300 randomly selected addresses in each city. Those who did not respond within 10 days were sent a second questionnaire and this process was repeated through four mailings. A total of 561 in the sample of 1800 responded, but four households' returned duplicate questionnaires that differed from each other, so all four pairs were deleted. This left 553 questionnaires—332 from Western Washington and 221 from Southern California. A total of 174 households no longer at their original addresses, undeliverable, or who returned incomplete questionnaires, were deleted. This

yielded an adjusted response rate of 34% (California: 19% in Inglewood, 23% in Norwalk, 31% in Santa Clarita; Washington: 37% in Renton, 38% in Bremerton, 36% in Edmonds). In 1999, the respondents from 1997 were sent the second wave of questionnaires. A total of 235 in the sample responded but two were duplicates and one incomplete, so these were deleted. This left 232 questionnaires—141 from Western Washington and 91 from Southern California yielding a response rate of 41.95% for the panel (California: 31% in Inglewood, 40% in Norwalk, 47% in Santa Clarita; Washington: 44% in Renton, 37% in Bremerton, 45% in Edmonds). The adjusted percentage of female respondents in 1997 (panel respondents) was 39% = 88 and in 1999 (panel respondents) was 36% = 82 (after adjusting for missing values).

The response rates are lower than desired, but lie within the 31-52% range obtained by Mileti and Fitzpatrick (1993). The low response rate might raise questions about sample representativeness and indeed, comparison of the respondents from each city to the 1994 *County and City Data Book* showed the sample slightly over-represented males, homeowners, and older residents, and had higher levels of education than the populations from which they were drawn (see Lindell & Prater, 2000, for further details). However, over-representation of some demographic categories will produce bias in psychological variables such as perceived stakeholder characteristics only to the degree the latter are correlated with demographic variables, but such correlations are generally low (Lindell & Perry, 2000). Moreover, reports by Curtin, Presser and Singer (2000), Keeter, Miller, Groves and Presser (2000), and Lindell and Perry (2000) indicate low response rates do not appear to bias central tendency estimates such as means and proportions. Lindell and Perry (2000) argued that low response rates would affect correlations only if the item variances were severely restricted by severe over representation of respondents at one end of the response distribution. This study will analyze residents' self reported adoption of 16 hazard adjustments collected from this longitudinal panel data pool (N =

232) to assess the stability and predictive validity of variables associated with seismic hazard adjustment adoption.

There were few significant demographic differences in the characteristics of the two geographic groups of respondents. As indicated in Table I, there were significant differences in ethnicity, with Californians more likely than Washingtonians to be Black or Hispanic and less likely to be White. Tables II and III show the demographic characteristics of the study sites for the whole sample in 1997 (N=553) and the panel respondents in 1999 (N=232) respectively. Finally, Table IV summarizes the comparisons between the demographic characteristics of the study sites for respondents in the two periods.

Table I. Differences Between States in Demographic Characteristics in 1999 Panel (N=232) Data Set

	Southern California	Western Washington %	Significance
Demographic Characteristics			χ^2
1. Sex (female)	34.48%	37.41%	0.09
2. Hispanic ethnicity	12.09%	1.42%	9.97**
3. Asian ethnicity	5.49%	7.80%	0.17
4. Black ethnicity	8.79%	1.42%	5.61**
5. White ethnicity	58.24%	83.69%	17.19**
6. Other ethnicity	10.99%	4.26%	2.9
7. Married	75.82%	72.34%	0.19
8. Widowed	4.40%	7.09%	0.31
9. With children	37.36%	37.59%	0
10. Ownership (renter)	5.56%	7.97%	0.19

Table II. Demographic Characteristics of the Study Sites for the Whole Sample of Respondents in 1997 (N=553)

Variables	% Washington 1997				% California 1997			
	Renton	Bremerton	Edmonds	Average	Inglewood	Norwalk	Santa Clarita	Average
1. Average age	52	50	51	51	49	50	47	49
2. Avg. community tenure	13	13	13	13	15	16	10	14
Gender								
3. Female	46.2	36.7	35.5	39.5	45.5	50.7	39.1	45.1
4. Male	53.8	63.3	64.5	60.5	54.5	49.3	60.9	54.9
Ethnicity								
5. Hispanic	0.0	1.9	1.9	1.3	22.2	35.3	6.7	21.4
6. Asian	10.4	2.8	1.9	5.0	0.0	11.8	4.5	5.4
7. Black	0.9	0.0	0.9	0.6	50.0	1.5	0.0	17.2
8. White	81.1	88.9	91.5	87.2	13.0	42.6	83.1	46.2
9. Other	7.5	6.5	3.8	5.9	14.8	8.8	5.6	9.7
Marital Status & Children								
10. Married	73.5	61.5	71.7	68.9	45.3	77.6	88.9	70.6
11. Widowed	6.7	7.3	2.8	5.6	7.5	9.0	1.1	9.2
12. With children	27.8	37.3	31.3	32.1	40.9	48.3	46.8	45.3
Education								
13. Less than high school	0.9	1.8	0.0	0.9	9.1	13.2	0.0	7.4
14. High school	17.8	26.6	12.0	18.8	16.4	16.2	8.9	13.8
15. Some college/vocational	36.4	42.2	35.2	37.9	30.9	41.2	34.4	35.5
16. Bachelors	32.7	16.5	31.5	26.9	23.6	23.5	37.8	28.3
17. Graduate school	12.1	12.8	21.3	15.4	20.0	5.9	18.9	14.9
Income								
18. < $15,000	4.4	8.9	2.3	5.2	15.4	8.8	2.4	8.9
19. $15,000-24,999	11.0	14.9	3.4	9.8	15.4	14.0	4.8	11.4
20. $25000-34999	14.3	26.7	13.6	18.2	25.0	19.3	7.2	17.2
21. $35,000-49,999	13.2	23.8	25.0	20.7	13.5	29.8	9.6	17.6
22. >than 50,000	57.1	25.7	55.7	46.2	30.8	28.1	75.9	44.9
Home ownership								
23. Renters	7.5	18.3	12.1	12.6	33.9	6.0	3.3	14.4
24. Owners	92.5	81.7	87.9	87.4	66.1	94.0	96.7	85.6

Table III. Demographic Characteristics of the Study Sites for Panel Respondents in 1999 (N=232)

Variables	% Washington 1999				% California 1999			
	Renton	Bremerton	Edmonds	Average	Inglewood	Norwalk	Santa Clarita	Average
1. Average age	56	53	55	55	53	56	52	54
2. Avg. community tenure	17	15	15	16	16	21	13	17
Gender								
3. Female	34.7	37.2	40.4	37.4	41.2	38.5	29.5	36.4
4. Male	65.3	62.8	59.6	62.6	58.8	61.5	70.5	63.6
Ethnicity								
5. Hispanic	2.0	0.0	2.0	1.3	22.2	17.9	4.4	14.8
6. Asian	10.2	4.7	8.2	7.7	0.0	7.1	6.7	4.6
7. Black	2.0	0.0	2.0	1.3	44.4	0.0	0.0	14.8
8. White	81.6	88.4	81.6	83.9	11.1	60.7	75.6	49.1
9. Other	2.0	7.0	4.1	4.4	22.2	3.6	11.1	12.3
Marital Status & Children								
10. Married	79.6	65.1	71.4	72.0	50.0	75.0	86.7	70.6
11. Widowed	6.1	11.6	4.1	7.3	0.0	10.7	2.2	4.3
12. With children	36.7	41.9	34.7	37.8	38.9	28.6	42.2	36.6
Education								
13. Less than high school	0.0	0.0	2.1	0.7	111.0	11.1	0.0	7.4
14. High school	16.3	23.8	10.6	16.9	16.7	18.5	4.7	13.3.
15. Some college/vocational	38.8	50.0	42.6	43.8	27.8	37.0	41.9	35.6
16. Bachelors	36.7	21.4	25.5	27.9	33.3	22.2	34.9	30.1
17. Graduate school	8.2	4.8	19.1	10.7	11.1	11.1	18.6	13.6
Income								
18. < $15,000	4.4	7.7	7.3	6.5	5.6	4.2	0.0	3.3
19. $15,000-24,999	4.4	15.4	9.8	9.9	22.2	12.5	9.5	14.7
20. $25000-34999	4.4	15.4	9.8	9.9	11.1	16.7	4.8	10.9
21. $35,000-49,999	28.9	25.6	19.5	24.7	33.3	45.8	2.4	27.2
22. >than 50,000	57.8	35.9	53.7	49.1	27.8	20.8	83.3	44.0
Home ownership								
23. Renters	4.1	14.6	8.2	9.0	11.1	3.7	4.4	6.4
24. Owners	95.9	85.4	91.8	91.0	88.9	96.3	95.6	93.6

Table IV. Comparison Between Demographic Characteristics of Respondents in 1997 (N=553) and in 1999 (N=232)

	Average in 1997		Average in 1999	
Variables	Washington	California	Washington	California
1. Average age	51	49	55	54
2. Avg. community tenure	13	14	16	17
Gender				
3. Female	39.5	45.1	37.4	36.4
4. Male	60.5	54.9	62.6	63.6
Ethnicity				
5. Hispanic	1.3	21.4	1.3	14.8
6. Asian	5.0	5.4	7.7	4.6
7. Black	0.6	17.2	1.3	14.8
8. White	87.2	46.2	83.9	49.1
9. Other	5.9	9.7	4.4	12.3
Marital Status & Children				
10. Married	68.9	70.6	72.0	70.6
11. Widowed	5.6	9.2	7.3	4.3
12. With children	32.1	45.3	37.8	36.6
Education				
13. Less than high school	0.9	7.4	0.7	7.4
14. High school	18.8	13.8	16.9	13.3
15. Some college/vocational	37.9	35.5	43.8	35.6
16. Bachelors	26.9	28.3	27.9	30.1
17. Graduate school	15.4	14.9	10.7	13.6
Income				
18. < $15,000	5.2	8.9	6.5	3.3
19. $15,000-24,999	9.8	11.4	9.9	14.7
20. $25000-34999	18.2	17.2	9.9	10.9
21. $35,000-49,999	20.7	17.6	24.7	27.2
22. >than 50,000	46.2	44.9	49.1	44.0
Home ownership				
23. Renters	12.6	14.4	9.0	6.4
24. Owners	87.4	85.6	91.0	93.6

The tables indicate that the panel respondents in 1999 were not significantly different from the whole sample of respondents in 1997. However, as previously reported by Lindell and Prater (2000) for the whole sample, families with children were over represented among the panel respondents. Additionally, the Californians were not significantly different from the Washingtonians in sex and marital status. Neither were there significant differences in age or education. However, both groups of respondents over-represented males and older residents and

had higher levels of education than the populations from which they were drawn. Specifically, 93% of the southern Californian respondents had at least a high school education, and 44% had a bachelor's degree or higher. Similarly, 99% of the western Washington respondents had at least a high school education and 38% had a bachelor's degree or higher. The two groups also had non-significant differences in income, home ownership, and community tenure. However, homeowners were over-represented amongst respondents in California (93.6%) and Washington (91%).

3.2. Instrument

The survey was composed of multiple measures used to operationalize a household's adoption of seismic hazard adjustments. These were classified into four broad categories as listed and elaborated below.

Risk Assessment

The three variables grouped in this category were risk perception, hazard intrusiveness and hazard experience.

Risk perception was measured in two ways. *Personal risk* was measured as a respondent's judgment that an earthquake occurring in the next 10 years will cause, a) major damage to property in her/his city, b) major damage to his/her home, c) injury to self or immediate family, d) disruption to his/her job that prevents them from working, and e) disruption to shopping and other daily activities. These five items were measured on 5-category Likert scale with anchors "Not at all likely" (= 1) and "Almost a certainty" (= 5). *Relative structural risk* was measured as structural vulnerability of the respondents' a) home and b) workplace, as compared to other buildings in his/her vicinity. These two items were measured on 5-category Likert scale

with anchors “Much less than average” (= 1) and “Much more than average” (= 5). Item responses for the seven questions were averaged and this seven-item scale had an acceptable reliability (1997 sample: *Cronbach’s* α = 0.84; 1999 sample: *Cronbach’s* α = 0.84).

Hazard intrusiveness items asked how often the respondent thought about, talked to others about, or received information about earthquakes and ways to prepare for them. These three items were rated on a 1-5 rating scale whose response categories were daily (=5), weekly, monthly, yearly, and never (=1). Item responses were averaged to compute an index with an acceptable reliability (1997 sample: *Cronbach’s* α = 0.85; 1999 sample: *Cronbach’s* α = 0.80).

Hazard experience was the respondents’ experience with earthquakes and addressed a) whether the respondent’s immediate family’s property had been damaged in an earthquake, b) whether the respondent or an immediate family member had been injured in an earthquake, c) whether the property of a friend, relative, neighbor or coworker known personally had been damaged in an earthquake and d) whether a friend, relative, neighbor, or coworker the respondent knew personally had been injured in an earthquake. Respondents’ No (= 0) or Yes (=1) responses were summed to compute an index ranging 0-4. The four-item scale had an acceptable reliability (1997 sample: *Cronbach’s* α *= 0.71*; 1999 sample: *Cronbach’s* α *= 0.68*).

Other Variables

The four variables grouped in this category were fatalism, perceived personal control, perceived resource adequacy and city activity in hazard management. *Fatalism* was the respondent’s perception of two measures namely, *luck or chance,* and *God’s will* as determinants of their personal safety in an earthquake. The variables were measured on 5-category Likert scales with anchors “Not at all” (= 1) and “Very great extent” (= 5), and responses to these two

items were treated separately as they did not have an acceptable reliability (1997 sample: *Cronbach's* α = 0.48; 1999 sample: *Cronbach's* α = 0.39).

Perceived *personal control* was the respondents' perceptions of the extent to which their personal safety in an earthquake was determined by the actions of, a) themselves/family, b) friends, relatives, neighbors and coworkers, c) local newsmedia, d) local government and e) federal and state agencies. The variables were measured on 5-category Likert scales with anchors "Not at all" (= 1) and "Very great extent" (= 5). (Note on coding: If a respondent answered "yourself and your immediate family" as responsible to a very great extent (=5), it was coded as is. However, if a respondent coded other stakeholders high, say local government (= 5), it meant they had little control. In such cases, the variable was reverse scored by subtracting from 6 to give a value of 1. Finally, respondents' answers to these five items were summed to compute an index ranging 5-25. This 5-item scale had an acceptable reliability (1997 sample: *Cronbach's* α = 0.65; 1999 sample: *Cronbach's* α = 0.69).

Perceived *resource adequacy* was measured by asking the respondents how certain they were that they had, a) all the information, b) tools and equipment, and c) financial assets (money, credit, insurance) needed to protect themselves against the earthquake. The variables were measured on 5-category Likert scales with anchors "Not at all" (= 1) and "Very great extent" (= 5). Responses to these three items were summed to compute an index ranging from 5-15 and had an acceptable reliability (1997 sample: *Cronbach's* α = 0.76; 1999 sample: *Cronbach's* α = 0.76).

City typology of leader or laggard was imputed to each respondent; according to the emergency management support provided by his or her city. This depended on the respondent's *city's activity in hazard management* initiatives. One dummy coded variable for the two leader

cities (Inglewood and Renton) and another dummy-coded variable for the two laggard cities (Norwalk and Bremerton) were created.

Demographic Characteristics

Nine *demographic characteristics* were considered. *Age w*as a continuous variable indicating the respondent's self-reported age in years. *Community tenure w*as a continuous variable representing the length of time (in years) that the respondent had lived in the home they were in. *Gender* was measured as 0 for males and 1 for females. Race/ethnicity was measured by dummy coded variables indicating membership in one of the ethnic categories – *Hispanic, Asian, Black, White*, and *Other* (American Indian, mixed ethnicity, and other ethnicity). For example, Hispanic was measured as 1 if household was of Hispanic ethnicity and 0 if not. *Married was* measured as 1 if the respondent was married and 0 if respondent was single or widowed. *Widowed was* measured as 1 if respondent was widowed and 0 if respondent was single or married. *With children was* measured as a 1 if the respondent had children below 18 years of age living in the household and 0 otherwise. *Education* measured the education level reported by the respondent from a set of 4 categories education level with response codes ranging from 1-4 for education less than high school (=1), high school (= 2), some college/ vocational school (= 3), college graduate (= 4), graduate school (= 5). *Income* measured the household income reported by the respondent from a set of 5 categories with codes ranging from 1-5 for income less than $15000 (= 1) , between $15,000-24,999 (= 2), between $25,000-34,999 (= 3), between $35,000-49,999 (= 4), and more than 50,000 (= 5). *Homeownership was* coded as 0 indicating homeowner and 1 representing renter.

Stakeholder Characteristics

The portion of the survey questionnaire not analyzed previously by Lindell and Prater (2000, 2002) included measures of the seven stakeholder types on three *stakeholder characteristics*. Respondents rated the federal government, their state government, their local government, the news media, their employer, their peers, and themselves and their families on hazard knowledge, trustworthiness, and protection responsibility. (Respondents were asked to rate only their families, not themselves and their families, on trustworthiness). The variables were measured on 5-category Likert scales with anchors "Not at all" (= 1) and "Very great extent" (= 5).

Adoption of Hazard Adjustments

Adoption of hazard adjustments was measured by asking the respondent whether he or she had adopted each of 16 different hazard mitigation and emergency preparedness measures. These items, drawn from previous research on hazard adjustments (Lindell, 1994; Mileti & Darlington, 1997; Mulilis et al., 1990; Russell et al., 1995; Turner et al., 1986), fell into one of three categories. Emergency preparedness actions were, a) stocked at least 4 gallons of water, b) had a 4 day supply of dehydrated or canned food, c) had a working transistor radio with spare batteries, d) had a complete first aid kit, e) had a fire extinguisher, and f) wrenches to operate utility shutoff valves and switches. Hazard mitigation actions were g) strapping water heaters, tall furniture, and heavy objects to building walls, h) installed latches to keep cabinets secured, i) purchased earthquake insurance. Planning activities were, j) developed a household earthquake emergency plan, k) learned where and how to turn off utility lines, l) learned the location of nearby medical emergency centers, m) contacted the Red Cross or government agencies for information about earthquake hazard, n) attended meetings to learn about earthquake hazard, o)

joined a community organization dealing with earthquake emergency preparedness, and p) written a letter to a newspaper or a governmental official supporting action about earthquake hazard. Respondents' No (= 0) or Yes (=1) answers to these items were summed to compute an index ranging 0-16. As reported by Lindell and Prater (2000, 2002), the 16 hazard adjustment items formed a scale with acceptable reliability (1997 sample: *Cronbach's* α = 0.73; 1999 sample: *Cronbach's* α = 0.65).

3.3. Analyses

Analyses were conducted on the panel of respondents for Time 1 (1997) and then repeated for Time 2 (1999) and compared. Mean ratings were computed for respondents' perceptions of stakeholder characteristics. To help gauge whether the responses across all the stakeholders were in agreement, followed a uniform distribution, or were polarized, interrater agreement on individual items was also assessed because mean ratings near the midpoint of a rating scale can be quite ambiguous (Lindell & Brandt, 1999, 2000). For example a mean rating of M = 3.0 can result if the responses are identical (i.e., all respondents give a rating of 3), uniformly distributed (i.e., an equal number of responses in each of the five categories), or bipolar (i.e., half of the responses are 1 and the remainder are 5). These three patterns have radically different implications about people's beliefs. Consequently, interrater agreement was assessed using $r^*_{wg,}$, which is +1.0 (its upper limit) when all the respondents give exactly the same rating, 0 when ratings are uniformly distributed over the categories, and -1.0 when the ratings are polarized (in rare circumstances, $r^*_{wg} < -1.0$, see Lindell, Brandt and Whitney, 1999). Tests were performed to check for pseudo-opinions that is, items having r^*_{wg} values that were non-significantly different from zero (i.e. are not significantly different from chance responding).

Locational differences were assessed in two ways. First, differences due to overall seismic vulnerability were measured by contrasting the two states, California and Washington. Hazard knowledge, trustworthiness, protection responsibility, hazard intrusiveness, seismic experience, risk perception, gender and hazard adjustment adoption scores were initially intercorrelated separately for respondents from California (N=91) and Washington (N=141) in 1997 and 1999. Following the graphical test proposed by Gnanadesikan (1977) and used by Lindell and Perry's (1990) study of perceptions of radiological hazards from the Trojan nuclear power plant in the interval from five months before to one month after the Chernobyl accident, the equivalence of the patterns of intercorrelations among various stakeholder characteristics in these two states was assessed by taking the obtained value of each correlation for respondents of California and plotting it against the corresponding value of that correlation for respondents in Washington. For example, one data point is defined by plotting the value of the correlation between federal government hazard knowledge and state government hazard knowledge for the Southern California sample on the x-axis and the corresponding value of the correlation between these same two variables for the Washington sample on y-axis. Thus, the total number of data points is equal to the distinct correlation coefficients in the correlation matrix, k (k-1)/2 = 21 (20)/2 =210. Additionally, t-tests were used to compare item means for respondents from California (higher seismic risk) and Washington (medium seismic risk).

Second, differences in emergency management support were measured by establishing one dummy coded variable for the two leader cities (Inglewood and Renton) and another dummy-coded variable for the two laggard cities (Norwalk and Bremerton). All these tests were conducted for Time 1 and Time 2 and comparisons made.

For assessing the stability of perceptions over the two time periods, the procedures for testing differences between states was used, specifically, the patterns of intercorrelations among all the variables at Time 1 were cross-plotted against the intercorrelations among the same variables at Time 2. This was done by taking the obtained value of each correlation for respondents' in Time1 and plotting it against the corresponding value of that correlation for respondents' in Time 2. The plot was used to indicate whether the variables had similar correlations in both time periods. If the variables had very different correlations in the two time periods, this would suggest the items were measuring pseudo opinions.

CHAPTER IV

RESULTS OF WAVE-I (1997) & WAVE-II (1999) DATA

4.1. Homogeneity of Intercorrelations

The cross-plots of interitem correlations for California and Washington respondents in 1997 and 1999 respectively, are approximately linear and have no obvious outliers, indicating a similar overall pattern of intercorrelations among perceptions of stakeholder characteristics in the two states (see Fig.5). Consequently, tests of the correlational hypotheses (H1, H3, H4, H5, H6, H7, H8, H9 and H10) were conducted by combining the two state subsamples to give N = 232.

The resulting correlation matrix for 1997 (see Table V) reveals high intercorrelations among perceptions of the three stakeholder characteristics with respect to each other (i.e., all correlations among Variables 1-7, 8-14, and 15-21 are statistically significant). In addition, 47 of the 49 correlations of stakeholder knowledge with stakeholder trustworthiness are significant, as are 32 of the 49 correlations of stakeholder knowledge with stakeholder responsibility are significant, and 38 of the 49 correlations of stakeholder trustworthiness with stakeholder responsibility. Finally, the other variables (hazard intrusiveness, hazard experience, risk perception, location, gender and adjustment adoption) have 27 of 42 significant correlations with knowledge, 17 of 42 significant correlations with trustworthiness, 20 of 42 significant correlations with responsibility, and 9 of 15 significant intercorrelations among themselves. Thus, the actual number of significant correlations (190) substantially exceeds chance expectations (1% of 288 = 3) among all of these groups of variables.

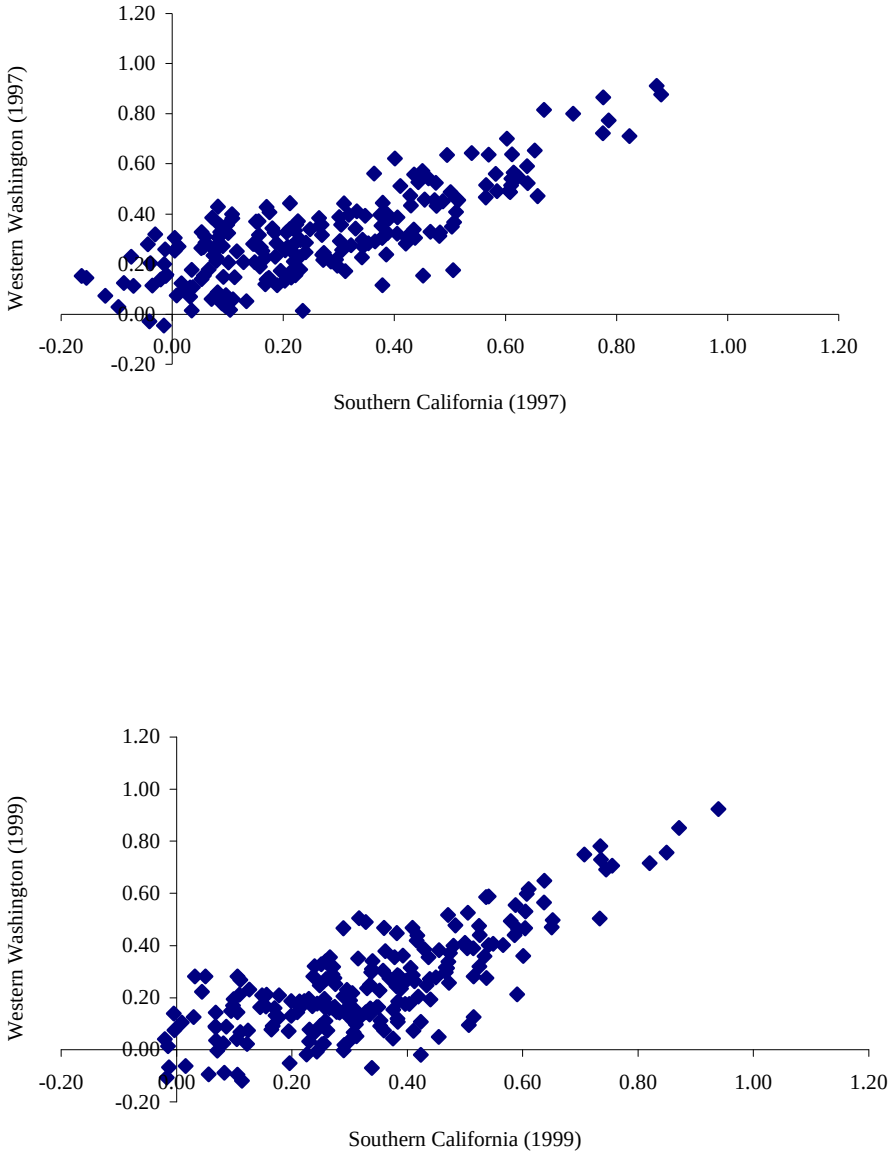

Fig. 5. Cross-plot of interitem correlations for California and Washington respondents in 1997 and 1999.

Table V. Means *(M)* , Standard Deviations *(SD),* Interrater Agreement Indices *(r* wg)* , and Intercorrelations (*r*) amongst Key Variables for Panel in 1997 (N=232)

Variable	*M*	*SD*	r^*_{wg}	1	2	3	4	5	6	7	8
Knowledge (Kn)											
1. FedKn	3.47	1.05	0.48	1.00							
2. StaKn	3.68	1.01	0.49	0.75	1.00						
3. LocKn	3.46	1.16	0.42	0.55	0.76	1.00					
4. MedKn	3.38	1.08	0.46	0.39	0.54	0.57	1.00				
5. EmpKn	3.21	1.23	0.39	0.31	0.37	0.48	0.37	1.00			
6. FrdKn	2.94	0.95	0.52	0.24	0.37	0.45	0.44	0.55	1.00		
7. SelKn	3.47	1.12	0.44	0.08	0.19	0.41	0.31	0.52	0.60	1.00	
Trustworthiness (Tr)											
8. FedTr	3.27	1.13	0.43	0.58	0.52	0.37	0.33	0.25	0.23	0.10	1.00
9. StaTr	3.56	1.10	0.45	0.49	0.62	0.52	0.47	0.31	0.33	0.24	0.82
10. LocTr	3.52	1.10	0.45	0.39	0.55	0.67	0.48	0.38	0.41	0.30	0.61
11. MedTr	3.51	1.14	0.43	0.34	0.45	0.40	0.60	0.28	0.36	0.24	0.48
12. EmpTr	3.20	1.28	0.36	0.22	0.27	0.33	0.30	0.67	0.50	0.34	0.30
13. FrdTr	3.00	1.17	0.41	0.19	0.29	0.28	0.28	0.32	0.59	0.40	0.27
14. SelTr	3.33	1.28	0.36	0.09	0.21	0.26	0.20	0.40	0.55	0.59	0.15
Responsiblility (Re)											
15. FedRe	3.02	1.30	0.35	0.32	0.26	0.17	0.19	0.09	0.05	-0.01	0.35
16. StaRe	3.28	1.32	0.34	0.28	0.30	0.20	0.21	0.08	0.07	0.04	0.31
17. LocRe	3.35	1.34	0.33	0.20	0.27	0.23	0.23	0.13	0.11	0.09	0.17
18. MedRe	2.69	1.29	0.36	0.10	0.11	0.09	0.29	0.03	0.04	0.00	0.05
19. EmpRe	2.91	1.37	0.31	0.16	0.16	0.18	0.15	0.33	0.15	0.18	0.02
20. FrdRe	2.45	1.16	0.42	0.06	0.10	0.14	0.19	0.19	0.28	0.22	-0.04
21. SelRe	4.15	1.16	0.42	0.07	0.15	0.26	0.18	0.21	0.26	0.39	0.08
Other variables											
22.Gender	0.39	0.49	-	0.03	0.10	0.11	0.18	0.05	0.04	0.06	0.09
23.Locat	0.61	0.49	-	-0.02	-0.26	-0.28	-0.12	-0.17	-0.24	-0.16	0.02
24.Leader	0.29	0.45	-	0.02	-0.04	0.00	0.08	0.00	0.03	-0.02	0.12
25.Laggard	0.31	0.46	-	0.02	0.07	0.06	0.02	0.07	-0.02	0.03	0.00
26.PerCo	16.30	4.23	-	-0.14	-0.15	-0.11	-0.31	-0.04	-0.13	-0.05	-0.16
27.ResAd	8.98	3.02	-	0.08	0.04	0.14	0.09	0.23	0.30	0.27	0.08
28.AcLu	2.79	1.41	-	-0.02	0.00	0.09	0.05	0.06	0.06	0.00	0.00
29.ActGod	2.75	1.67	-	-0.04	-0.16	-0.17	-0.16	-0.07	-0.08	-0.10	-0.06
30.HazIn	2.26	0.82	-	0.09	0.16	0.20	0.21	0.18	0.14	0.27	0.03
31.HazEx	1.01	1.16	-	-0.09	0.11	0.17	-0.04	0.16	0.17	0.25	-0.13
32.RiskPe	2.81	0.86	-	0.10	0.15	0.21	0.14	0.24	0.16	0.26	0.03
33.HazAd	8.24	2.88	-	-0.07	-0.03	0.14	0.06	0.30	0.25	0.39	-0.05

Notes: N's ranged from 198 to 232

r = 0.18 or greater, significant at the 0.01 level; between *r* = 0.13 and 0.17, significant at the 0.05 level.

Fed = Federal government, Sta = State government, Loc = Local government, Med = Media, Emp = Employer,

Sel = Self/family, Gender = Female (1), Locat = Washington (1), Leader = Leader City, Laggard = Laggard City,

PerCo = Personal Control, ResAd = Resource Adequacy, ActLu = Act of luck, ActGod = Act God,

HazIn = Hazard Intrusiveness, HazdEx = Hazard Experience, RiskPe = Risk Perception, HazAdj = Hazard Adjustment Adopti

Table V. Continued

9	10	11	12	13	14	15	16	17	18	19	20	21
1.00												
0.78	1.00											
0.61	0.57	1.00										
0.37	0.35	0.38	1.00									
0.34	0.33	0.37	0.56	1.00								
0.25	0.28	0.28	0.52	0.76	1.00							
0.25	0.18	0.23	0.20	0.17	0.13	1.00						
0.29	0.23	0.26	0.15	0.19	0.16	0.90	1.00					
0.25	0.28	0.25	0.15	0.19	0.16	0.77	0.88	1.00				
0.04	0.03	0.27	0.12	0.19	0.12	0.49	0.50	0.52	1.00			
0.08	0.08	0.18	0.42	0.31	0.29	0.46	0.43	0.45	0.47	1.00		
-0.02	0.00	0.06	0.22	0.40	0.29	0.33	0.30	0.30	0.53	0.48	1.00	
0.22	0.20	0.25	0.25	0.27	0.37	0.08	0.14	0.14	0.17	0.29	0.24	1.00
0.15	0.07	0.14	-0.03	0.06	-0.02	0.14	0.16	0.15	0.29	0.17	0.22	0.13
-0.11	-0.21	-0.08	-0.12	-0.20	-0.18	0.00	-0.04	-0.09	0.04	0.02	-0.10	-0.11
0.10	0.07	0.18	0.07	0.03	-0.01	0.05	-0.03	-0.04	-0.03	0.08	0.04	-0.04
0.07	0.07	0.02	0.02	-0.01	0.00	-0.09	-0.04	-0.03	-0.05	-0.06	-0.09	0.13
-0.14	-0.17	-0.24	-0.06	-0.11	-0.04	-0.41	-0.42	-0.45	-0.47	-0.24	-0.31	-0.04
0.14	0.18	0.03	0.24	0.19	0.27	-0.17	-0.16	-0.11	-0.17	0.09	0.00	0.21
0.00	0.07	-0.06	0.04	0.05	0.05	0.06	0.01	0.02	0.05	0.04	0.15	-0.03
-0.04	-0.12	-0.08	-0.13	-0.09	-0.04	-0.10	-0.09	-0.10	-0.08	0.05	-0.12	-0.08
0.06	0.12	0.10	0.16	0.15	0.18	0.00	0.01	0.05	0.04	0.07	0.17	0.21
-0.01	0.08	-0.03	0.10	0.19	0.30	-0.07	-0.06	-0.02	-0.13	0.05	-0.03	0.16
0.07	0.12	0.11	0.13	0.07	0.13	0.14	0.16	0.26	0.18	0.15	0.19	0.10
0.05	0.12	0.09	0.28	0.27	0.36	-0.04	-0.05	-0.04	-0.02	0.14	0.16	0.24

Table V. Continued

22	23	24	25	26	27	28	29	30	31	32	33
1.00											
-0.04	1.00										
0.00	0.16	1.00									
0.00	0.00	-0.42	1.00								
-0.13	-0.05	0.04	0.02	1.00							
-0.13	-0.06	-0.07	0.01	0.16	1.00						
0.13	-0.09	0.12	-0.02	0.06	-0.05	1.00					
-0.10	0.05	0.09	-0.03	0.06	-0.04	0.26	1.00				
0.09	-0.20	-0.03	0.00	-0.18	0.21	0.04	-0.08	1.00			
0.01	-0.56	-0.18	-0.16	0.10	0.19	0.01	0.00	0.32	1.00		
0.19	-0.09	-0.04	0.00	-0.16	-0.02	0.13	-0.01	0.35	0.16	1.00	
0.01	-0.23	-0.07	-0.08	0.03	0.52	0.07	0.00	0.39	0.41	0.10	1.00

Similarly the resulting correlation matrix for 1999 (see Table VI) reveals high intercorrelations among perceptions of the three stakeholder characteristics with respect to each other (i.e., all correlations among Variables 1-7, 8-14, and 15-21 are statistically significant). In addition, 47 of the 49 correlations of stakeholder knowledge with stakeholder trustworthiness are significant, as are 32 of the 49 correlations of stakeholder knowledge with stakeholder responsibility are significant, and 39 of the 49 correlations of stakeholder trustworthiness with stakeholder responsibility. Finally, the other variables (hazard intrusiveness, hazard experience, risk perception, location, gender and adjustment adoption) have 22 of 42 significant correlations with knowledge, 20 of 42 significant correlations with trustworthiness, 14 of 42 significant correlations with responsibility, and 9 of 15 significant intercorrelations among themselves. Thus, the actual number of significant correlations (183) substantially exceeds chance expectations (1% of 288 = 3) among all of these groups of variables. There is also a noticeable *simplex* pattern of decreasing correlations with increasing distance from the main diagonal, which suggests the psychological ordering of the stakeholders in terms of increasing distance from the respondents is the same as the order in which they are listed in the table for both 1997 and 1999.

Table VI. Means (M), Standard Deviations (SD), Interrater Agreement Indices (r* wg), and Intercorrelations (*r*) amongst Key Variables for Panel in 1999 (N=232)

Variable	*M*	*SD*	r^*_{wg}	1	2	3	4	5	6	7	8
Knowledge (Kn)											
1. FedKn	3.48	0.99	0.50	1.00							
2. StaKn	3.73	0.98	0.51	0.72	1.00						
3. LocKn	3.64	1.10	0.45	0.51	0.74	1.00					
4. MedKn	3.49	1.15	0.42	0.45	0.53	0.58	1.00				
5. EmpKn	3.21	1.18	0.41	0.40	0.48	0.39	0.41	1.00			
6. FrdKn	3.00	0.90	0.55	0.26	0.37	0.46	0.37	0.49	1.00		
7. SelKn	3.60	0.96	0.52	0.21	0.23	0.34	0.30	0.37	0.63	1.00	
Trustworthiness (Tr)											
8. FedTr	3.34	1.07	0.47	0.56	0.44	0.28	0.22	0.28	0.12	0.04	1.00
9. StaTr	3.67	0.97	0.51	0.46	0.62	0.46	0.37	0.44	0.25	0.13	0.72
10. LocTr	3.64	1.08	0.46	0.36	0.56	0.66	0.39	0.40	0.34	0.21	0.52
11. MedTr	3.61	1.17	0.42	0.37	0.41	0.42	0.52	0.39	0.24	0.15	0.44
12. EmpTr	3.13	1.29	0.36	0.31	0.34	0.33	0.25	0.72	0.36	0.23	0.44
13. FrdTr	3.01	1.15	0.42	0.18	0.26	0.29	0.19	0.32	0.44	0.30	0.26
14. SelTr	3.28	1.25	0.37	0.20	0.26	0.35	0.22	0.34	0.45	0.47	0.20
Responsiblility (Re)											
15. FedRe	2.89	1.29	0.36	0.20	0.24	0.22	0.27	0.12	0.03	-0.01	0.27
16. StaRe	3.22	1.27	0.36	0.12	0.24	0.21	0.22	0.11	0.05	0.02	0.15
17. LocRe	3.28	1.30	0.35	0.12	0.22	0.22	0.24	0.08	0.02	0.01	0.13
18. MedRe	2.70	1.35	0.33	0.05	0.19	0.21	0.33	0.15	0.11	-0.01	0.05
19. EmpRe	2.89	1.30	0.35	0.24	0.26	0.23	0.29	0.31	0.27	0.15	0.22
20. FrdRe	2.43	1.19	0.41	0.10	0.16	0.18	0.21	0.28	0.29	0.13	0.16
21. SelRe	4.17	1.11	0.45	0.16	0.22	0.22	0.13	0.15	0.30	0.35	0.05
Other variables											
22.Gender	0.36	0.48	-	0.00	0.07	0.11	0.09	0.07	0.06	0.03	0.04
23.Locat	0.61	0.49	-	-0.02	-0.21	-0.27	-0.16	-0.14	-0.33	-0.30	-0.05
24.Leader	0.29	0.45	-	-0.01	-0.05	0.03	0.03	-0.12	0.01	-0.04	0.02
25.Laggard	0.31	0.46	-	0.05	0.12	0.05	0.07	0.09	0.04	0.03	0.08
26.PerCo	17.09	4.13	-	-0.23	-0.23	-0.22	-0.27	-0.19	-0.11	-0.05	-0.17
27.ResAd	9.32	3.22	-	0.13	0.08	0.06	-0.03	0.27	0.31	0.37	0.03
28.AcLu	3.02	1.60	-	-0.04	0.00	0.05	0.03	-0.07	-0.11	-0.11	-0.02
29.ActGod	2.79	1.74	-	-0.04	-0.11	-0.15	-0.16	-0.09	-0.03	0.01	0.01
30.HazIn	2.29	0.88	-	-0.06	0.00	0.11	0.12	0.05	0.06	0.17	0.07
31.HazEx	0.98	1.12	-	0.01	0.13	0.20	0.08	0.23	0.34	0.37	-0.02
32.RiskPe	2.76	0.85	-	0.18	0.22	0.27	0.29	0.11	0.09	0.21	0.05
33.HazAd	8.56	2.73	-	0.02	0.05	0.13	0.09	0.20	0.23	0.41	-0.06

Notes: N's ranged from 198 to 232

r = 0.18 or greater, significant at the 0.01 level; between *r* = 0.13 and 0.17, significant at the 0.05 level.

Fed = Federal government, Sta = State government, Loc = Local government, Med = Media, Emp = Employer,

Sel = Self/family, Gender = Female (1), Locat = Washington (1), Leader = Leader City, Laggard = Laggard City,

PerCo = Personal Control, ResAd = Resource Adequacy, ActLu = Act of luck, ActGod = Act God,

HazIn = Hazard Intrusiveness, HazdEx = Hazard Experience, RiskPe = Risk Perception, HazAdj = Hazard Adjustment Adopti

Table VI. Continued

9	10	11	12	13	14	15	16	17	18	19	20	21
1.00												
0.77	1.00											
0.56	0.56	1.00										
0.52	0.49	0.47	1.00									
0.30	0.35	0.35	0.52	1.00								
0.22	0.29	0.28	0.44	0.77	1.00							
0.22	0.23	0.29	0.17	0.15	0.08	1.00						
0.22	0.22	0.30	0.11	0.17	0.05	0.86	1.00					
0.19	0.24	0.29	0.08	0.11	0.03	0.80	0.93	1.00				
0.17	0.22	0.32	0.09	0.21	0.10	0.57	0.62	0.61	1.00			
0.19	0.23	0.27	0.39	0.30	0.23	0.45	0.44	0.41	0.43	1.00		
0.18	0.21	0.22	0.33	0.52	0.41	0.39	0.36	0.32	0.48	0.36	1.00	
0.15	0.21	0.21	0.17	0.22	0.32	0.16	0.20	0.18	0.08	0.21	0.21	1.00
0.11	0.17	0.11	0.06	0.14	0.04	0.07	0.12	0.11	0.12	0.05	0.06	0.03
-0.20	-0.22	-0.05	-0.16	-0.23	-0.18	-0.20	-0.20	-0.16	-0.07	-0.15	-0.22	-0.08
-0.03	0.02	0.08	0.03	-0.06	-0.02	0.01	0.01	0.04	0.00	0.01	-0.04	0.01
0.15	0.05	0.03	0.07	0.12	0.07	-0.02	0.00	-0.02	-0.03	-0.05	-0.02	0.04
-0.22	-0.24	-0.30	-0.19	-0.28	-0.20	-0.37	-0.38	-0.35	-0.49	-0.25	-0.37	-0.09
0.10	0.11	0.07	0.24	0.17	0.23	-0.13	-0.09	-0.10	-0.06	0.06	0.04	0.20
-0.05	-0.07	-0.07	-0.02	-0.11	-0.09	-0.06	-0.11	-0.12	-0.16	-0.14	-0.09	-0.21
-0.09	-0.15	-0.05	-0.03	-0.07	-0.05	-0.22	-0.24	-0.24	-0.28	-0.08	-0.21	0.01
0.15	0.16	0.08	0.15	0.17	0.18	0.03	0.03	0.01	0.10	-0.02	0.07	0.03
0.08	0.14	0.01	0.16	0.17	0.24	0.07	0.09	0.07	0.04	0.15	0.18	0.13
0.09	0.13	0.11	0.06	0.12	0.16	0.21	0.20	0.23	0.23	0.12	0.10	0.20
0.06	0.09	0.06	0.20	0.09	0.21	-0.04	-0.02	0.01	-0.02	0.02	0.05	0.23

Table VI. Continued

22	23	24	25	26	27	28	29	30	31	32	33
1.00											
0.03	1.00										
0.00	0.16	1.00									
0.02	0.00	-0.42	1.00								
-0.18	0.01	0.03	-0.04	1.00							
-0.15	-0.05	-0.01	-0.05	0.00	1.00						
0.11	-0.07	-0.05	0.06	0.14	-0.01	1.00					
-0.06	0.02	-0.01	-0.01	0.23	0.11	0.24	1.00				
0.14	-0.23	-0.02	0.02	-0.11	-0.03	0.14	0.03	1.00			
-0.07	-0.56	-0.19	-0.15	-0.03	0.25	0.08	-0.03	0.20	1.00		
0.26	-0.08	0.01	0.02	-0.17	-0.16	0.03	-0.13	0.17	0.06	1.00	
-0.02	-0.15	-0.06	-0.04	-0.01	0.54	0.02	0.05	0.26	0.41	0.12	1.00

1997 Results

Consistent with Hypothesis 1a, respondents' ratings of hazard knowledge were positively correlated (average r = .62) with the corresponding ratings of trustworthiness. For example, federal knowledge had a correlation of r = .58 with federal trust, state knowledge had a correlation of r = .62 with state trust, and so on.

Consistent with Hypothesis 1b, respondents' ratings of hazard knowledge were positively correlated with the corresponding ratings of protection responsibility. Thus, federal knowledge had a correlation of r = .32 with federal responsibility, state knowledge had a correlation of r = .30 with state responsibility, and so on. However, the correlations of hazard knowledge with protection responsibility (average r = .30) were much lower than the corresponding correlations of hazard knowledge with trustworthiness (average r = .62).

Consistent with Hypothesis 1c, respondents' ratings of trustworthiness were positively correlated with the corresponding ratings of protection responsibility. Thus, federal trust had a correlation of r = .35 with federal responsibility, state trust had a correlation of r = .29 with state responsibility, and so on. As was the case for the correlations of hazard knowledge with protection responsibility, the correlations of trustworthiness with protection responsibility (average r = .34) were much lower than the corresponding correlations of hazard knowledge with trustworthiness (average r = .62).

1999 Results

Consistent with Hypothesis 1a, respondents' ratings of hazard knowledge were positively correlated (average r = .57) with the corresponding ratings of trustworthiness. For example, federal knowledge had a correlation of r = .56 with federal trust, state knowledge had a correlation of r = .62 with state trust, and so on.

Consistent with Hypothesis 1b, respondents' ratings of hazard knowledge were positively correlated with the corresponding ratings of protection responsibility. Thus, federal knowledge had a correlation of r = .20 with federal responsibility, state knowledge had a correlation of r = .24 with state responsibility, and so on. However, the correlations of hazard knowledge with protection responsibility (average r = .28) were much lower than the corresponding correlations of hazard knowledge with trustworthiness (average r = .57).

Consistent with Hypothesis 1c, respondents' ratings of trustworthiness were positively correlated with the corresponding ratings of protection responsibility. Thus, federal trust had a correlation of r = .27 with federal responsibility, state trust had a correlation of r = .22 with state responsibility, and so on. As was the case for the correlations of hazard knowledge with protection responsibility, the correlations of trustworthiness with protection responsibility (average r = .33) were much lower than the corresponding correlations of hazard knowledge with trustworthiness (average r = .57).

Comparison of Results in 1997 and 1999

The results presented above indicate that the patterns of statistically significant positive correlations confirmed H1a-H1c in both years. In addition, however, Tables V and VI show the absolute values of the correlations were quite similar from one year to the next. For example, the correlations of stakeholder knowledge in 1997 ranged from .58 to .67. The equivalent correlations in 1999 ranged from .44 to .67. Similar patterns can be seen for the other correlations, as well.

4.2. Mean Ratings of Stakeholder Characteristics

Fig. 6 depicts a plot of the mean ratings for stakeholder attributes - perceived hazard knowledge, trustworthiness, and protection responsibility- across the seven stakeholder types for 1997 and 1999.

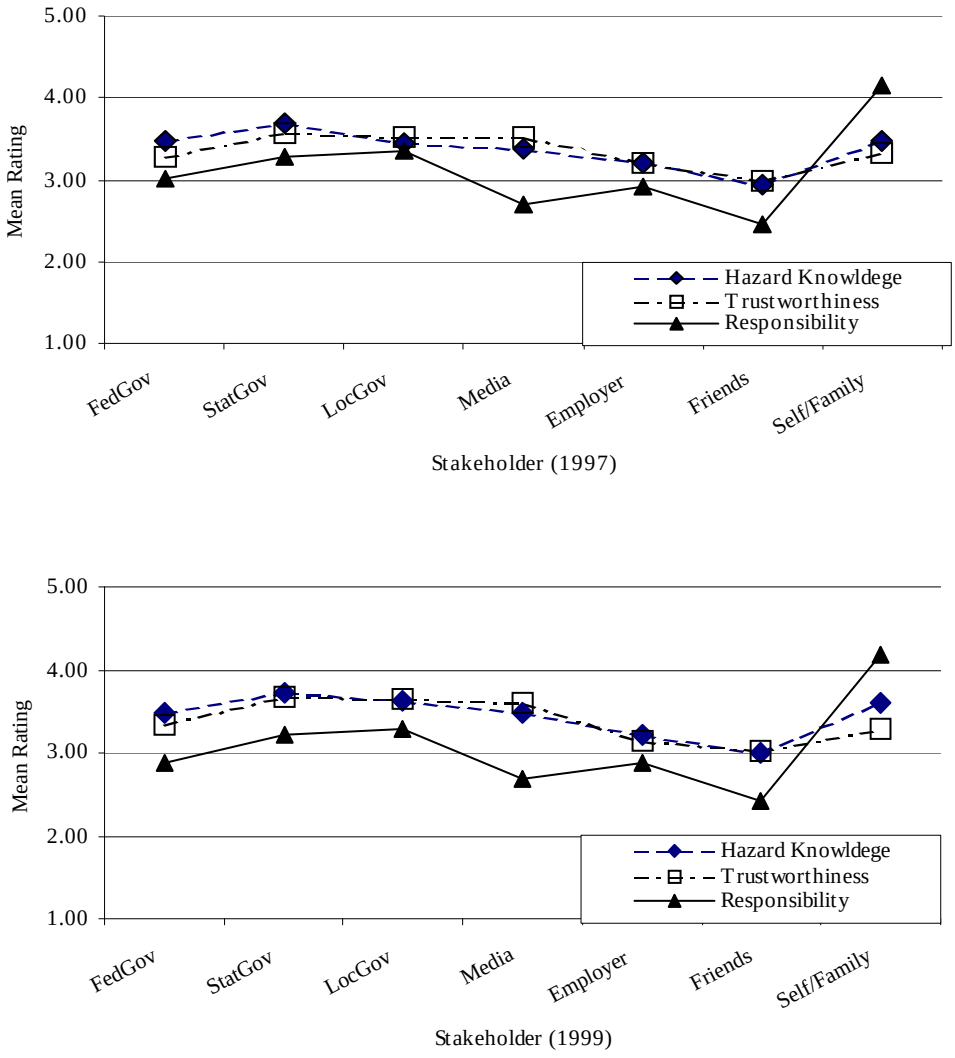

Fig.6. Mean ratings of perceived hazard knowledge, trustworthiness, and protection responsibility across seven stakeholders in 1997 and 1999.

1997 Results

Partially consistent with Hypothesis 2a, ratings of hazard knowledge are higher for state ($t_{224} = 2.52$, $p < .05$) government than for self/family; and higher for self/family than for employers ($t_{196} = -3.17$, $p < .05$), and friends ($t_{221} = -8.03$, $p < .05$). Contrary to the hypothesis, hazard knowledge was rated as high for the federal government ($t_{223} = 0.18$, *ns*), local government ($t_{224} = 2.52$, *ns*) and news media ($t_{222} = -0.85$, *ns*) as for self/family. The data reveal only slight variability among government influentials; state government was rated only slightly more knowledgeable than federal ($t_{225} = -4.26$, $p < .05$) and local ($t_{222} = 4.44$, $p < .05$) government. Amongst social influentials, the news media were rated as knowledgeable as employers ($t_{196} = 1.65$, *ns*) but higher than friends ($t_{221} = 5.96$, $p < .05$). Interrater agreement was moderately high across all items (average $r^*_{wg} = 0.46$) and there was slightly less agreement on employers' knowledge ($r^*_{wg} = 0.39$) than on other stakeholders.

Partially consistent with Hypothesis 2b, which predicted trustworthiness would be higher for family than for government, trustworthiness ratings for family were significantly different from those for state ($t_{219} = 2.35$, $p < .05$) and local ($t_{219} = 2.15$, $p < .05$) government but not for federal government ($t_{217} = -0.47$, *ns*). Ratings for family were significantly higher than friends ($t_{217} = -5.49$, $p < .05$) but not different from media ($t_{219} = 1.72$, *ns*) and employers ($t_{198} = -1.36$, *ns*). Interrater agreement across all items was similar to the levels for hazard knowledge (average $r^*_{wg} = 0.41$) with the lowest level of agreement on employer and family trustworthiness ($r^*_{wg} = 0.36$).

Consistent with Hypothesis 2c, ratings of protection responsibility are significantly higher for self/family than for federal ($t_{221} = -10.13$, $p < .05$), state ($t_{222} = -7.94$, $p < .05$), or local ($t_{222} = -7.15$, $p < .05$) government. In addition, ratings of protection responsibility are significantly lower for news media ($t_{220} = -13.49$, $p < .05$), employers ($t_{197} = -11.09$, $p < .05$), or

friends (t_{221} = -17.53, $p < .05$) than for the federal government level—which had significantly lower ratings than state (t_{221} = -6.07, $p < .05$) or local (t_{221} = -5.28, $p < .05$) government. Interestingly, although not hypothesized, employers had significantly higher ratings of protection responsibility than the news media (t_{196} = -2.54, $p < .05$) and friends (t_{197} = 4.55, $p < .05$). Unlike the previous two stakeholder characteristics, local government received the highest rating of any government level and respondents rated self/family as the most responsible of all stakeholders. Interrater agreement across all items was lower than that for knowledge and trustworthiness (average r^*_{wg} = 0.36). It was the highest for friends' and self/family responsibility (r^*_{wg} = 0.42).

In support of Hypothesis 2d, ratings of protection responsibility were significantly higher than ratings of hazard knowledge for self/family (t_{223} = -8.02, $p < .05$) and were significantly lower for news media (t_{219} = 7.12, $p < .05$) and friends (t_{219} = 5.70, $p < .05$). Smaller, but significant, differences were found for federal (t_{222} = 4.89, $p < .05$) and state (t_{223} = 4.34, $p < .05$) government, and for employers (t_{190} = 2.62, $p < .05$).

1999 Results

Partially consistent with Hypothesis 2a, ratings of hazard knowledge are higher for self/family than for employers (t_{197} = -4.93, $p < .05$), and friends (t_{221} = -10.89, $p < .05$). Contrary to the hypothesis, hazard knowledge was rated as high for the federal government (t_{222} = -1.32, *ns*), state government (t_{223} = 1.74, *ns*), local government (t_{222} = 0.28, *ns*) and news media (t_{224} = -1.27, *ns*) as for self/family. The data reveal only slight variability among government influentials; state government was rated only slightly more knowledgeable than federal (t_{221} = -4.78, $p < .05$) and local (t_{221} = 2.14, $p < .05$) government. Amongst social influentials the news media was rated higher than employers (t_{195} = 2.50, $p < .05$) and friends (t_{220} = 6.08, $p < .05$). Interrater agreement

was moderately high across all items (average $r^*_{wg} = 0.48$) and there was slightly less agreement on employers' knowledge ($r^*_{wg} = 0.41$) than on other stakeholders.

Partially consistent with Hypothesis 2b, which predicted trustworthiness would be higher for family than for government, trustworthiness ratings for family were significantly different from those for state ($t_{223} = 4.24$, $p < .05$) and local ($t_{224} = 3.91$, $p < .05$) government but not for federal government ($t_{223} = 0.68$, *ns*). Ratings for family were significantly higher than media ($t_{223} = 3.03$, $p < .05$) and friends ($t_{224} = -4.89$, $p < .05$) but not different from employers ($t_{194} = -1.60$, *ns*). Interrater agreement across all items was similar to the levels for hazard knowledge (average $r^*_{wg} = 0.41$) with the lowest level of agreement on employer and family trustworthiness ($r^*_{wg} = 0.36$).

Consistent with Hypothesis 2c, ratings of protection responsibility are significantly higher for self/family than for federal ($t_{220} = -12.19$, $p < .05$), state ($t_{223} = -9.51$, $p < .05$), or local ($t_{221} = -8.82$, $p < .05$) government. In addition, ratings of protection responsibility are significantly lower for news media ($t_{222} = -13.23$, $p < .05$), employers ($t_{192} = -12.24$, $p < .05$), or friends ($t_{221} = -17.96$, $p < .05$) than for the federal government level—which had significantly lower ratings than state ($t_{223} = -7.40$, $p < .05$) or local ($t_{221} = -7.11$, $p < .05$) government. Interestingly, although not hypothesized, employers had significantly higher ratings of protection responsibility than the news media ($t_{192} = -2.63$, $p < .05$) and friends ($t_{193} = 4.26$, $p < .05$). Unlike the previous two stakeholder characteristics, local government received the highest rating of any government level and respondents rated self/family as the most responsible of all stakeholders. Interrater agreement across all items was lower than that for knowledge and trustworthiness (average $r^*_{wg} = 0.37$). It was the highest for friends' and self/family responsibility ($r^*_{wg} = 0.45$).

In support of Hypothesis 2d, ratings of protection responsibility were significantly higher than ratings of hazard knowledge for self/family ($t_{223} = -7.26$, $p < .05$) and were

significantly lower for news media ($t_{221} = 8.11$, $p < .05$), employers ($t_{190} = 2.84$, $p < .05$) and friends ($t_{218} = 6.96$, $p < .05$). Similarly, significant differences were found for federal ($t_{219} = 6.11$, $p < .05$), state ($t_{223} = 5.71$, $p < .05$) and local ($t_{220} = 3.96$, $p < .05$) government.

Comparison of Results in 1997 and 1999

The profiles for 1997 and 1999 are very similar in appearance. In both years, mean ratings on hazard knowledge for self/family were as high as federal, and local government, and media knowledge. State government was rated slightly more knowledgeable than other governmental influentials. Newsmedia was rated most knowledgeable amongst the social influentials. Self/family was rated more knowledgeable than employers and friends. Interrater agreement was moderately high across all stakeholders, but slightly lower for employers' knowledge than for other stakeholders.

In addition, both years showed that mean ratings of trustworthiness for family were significantly lower than those for state and local government but not for the federal government. Trustworthiness ratings for family were significantly higher than friends. However, ratings for family were not different from employers. Interrater agreement was similar to knowledge and moderately high across all stakeholders but there was lowest level of agreement on employers and family trustworthiness.

Finally, both years showed that mean ratings of protection responsibility for self/family were significantly higher than all governmental influentials and they were most responsible of all stakeholders. Employers were rated the highest for protection responsibility amongst the social influentials, and local government had the highest ratings amongst governmental influentials. Interrater agreement across all items was much lower than for knowledge and trustworthiness. It was highest for friends and self/ family responsibility. Mean ratings of protection responsibility

for self/family were significantly higher than knowledge ratings. Protection responsibility ratings for self/family were much higher than for all other stakeholders. The one noticeable difference between the two years was that, in 1997, mean ratings on trustworthiness for family were not significantly different from the newsmedia but in 1999 they were significantly higher than the newsmedia.

4.3 Demographic Variables

1997 Results

There was no support at all for the Hypothesis 3a predictions that respondents' ratings of self/family hazard knowledge would be significantly correlated with respondents' demographic characteristics and their adoption of seismic hazard adjustments. Of the 98 correlations (Table VII) between the 7 stakeholders' hazard knowledge with 14 demographic variables, only 8 were statistically significant at 0.05 level. This small number of significant correlations does not exceed chance expectations (1% of 98 = 9) among these groups of variables.

There was no support for the Hypothesis 3b predictions that respondent ratings of federal, state and local government and media trustworthiness would be significantly correlated with their demographic characteristics. There were statistically significant correlations between females and state government trustworthiness (r = 0.15) and, females and media trustworthiness (r = 0.14) and, mixed ethnicity and state trustworthiness (r = -0.14) only. Of the 98 correlations (Table VII), between the 7 stakeholders' trustworthiness with 14 demographic variables, only 11 were statistically significant at 0.05 level. The actual number of significant correlations (11) does not exceed chance expectations (1% of 98 = 9) among these groups of variables by a reasonable margin.

Table VII. Intercorrelations Between Demographic Characteristics and Stakeholder Characteristics for 1997

Variables	Federal	State	Local	Media	Employer	Friend	Self/Fa	*Stakeholders' Hazard Knowledge*
	Kn	Kn	Kn	Kn	Kn	Kn	Kn	
1. Age	-0.07	-0.04	-0.03	0.02	-0.13	-0.14	-0.08	
2. Female	0.03	0.10	0.11	0.18	0.05	0.04	0.06	
3. Hispanic	0.12	0.09	0.09	0.12	0.11	0.08	0.06	
4. Asian	-0.07	-0.08	-0.03	0.04	-0.14	-0.06	-0.05	
5. Black	0.03	0.05	0.01	-0.04	-0.13	-0.05	-0.11	
6. White	0.01	0.04	0.01	-0.06	0.07	0.01	0.04	
7. Other	-0.04	-0.10	-0.11	-0.03	0.02	-0.04	-0.02	
8. Married	-0.08	-0.07	-0.03	0.00	0.11	0.12	0.04	
9. Widowed	-0.04	-0.02	0.03	0.04	-0.08	-0.01	0.10	
10. Children	0.04	0.00	-0.04	-0.03	0.05	0.06	0.05	
11. Education	-0.05	-0.06	-0.10	-0.13	0.07	0.01	0.00	
12. Income	-0.02	-0.06	-0.02	-0.08	0.16	0.16	0.00	
13. Renter	0.06	0.06	0.09	0.12	0.08	0.02	-0.01	
14. Tenure	-0.02	-0.03	-0.04	0.01	0.07	-0.02	-0.09	
	Tr	Tr	Tr	Tr	Tr	Tr	Tr	*Stakeholders' Trustworthiness*
1. Age	-0.05	-0.02	-0.04	0.02	-0.14	-0.12	-0.16	
2. Female	0.09	0.15	0.07	0.14	-0.03	0.06	-0.02	
3. Hispanic	0.06	0.03	0.04	0.07	-0.02	0.02	-0.01	
4. Asian	-0.04	-0.05	-0.04	0.01	-0.03	0.03	-0.03	
5. Black	0.04	0.07	0.09	0.02	-0.07	0.02	-0.02	
6. White	0.03	0.05	-0.02	-0.02	0.07	-0.02	0.04	
7. Other	-0.10	-0.14	-0.08	-0.07	-0.06	-0.05	-0.01	
8. Married	0.01	-0.02	0.06	0.01	0.13	0.18	0.18	
9. Widowed	-0.02	0.09	-0.02	0.07	-0.09	0.02	-0.02	
10. Children	-0.02	-0.02	-0.04	-0.09	0.09	0.11	0.17	
11. Education	-0.07	-0.07	-0.02	-0.20	-0.12	-0.01	0.02	
12. Income	0.00	-0.02	0.03	-0.09	0.15	0.10	0.14	
13. Renter	0.04	0.02	0.08	0.11	0.11	0.03	0.04	
14. Tenure	0.07	0.05	0.00	0.05	0.02	-0.06	-0.01	
	Re	Re	Re	Re	Re	Re	Re	*Stakeholders' Protection Responsibility*
1. Age	-0.17	-0.13	-0.09	-0.05	-0.15	-0.11	-0.10	
2. Female	0.14	0.16	0.15	0.29	0.17	0.22	0.13	
3. Hispanic	0.14	0.15	0.14	0.05	0.03	0.14	0.02	
4. Asian	0.08	0.03	0.03	0.08	-0.03	0.07	-0.05	
5. Black	0.10	0.09	0.12	0.16	-0.04	0.14	0.01	
6. White	-0.12	-0.06	-0.09	-0.15	0.03	-0.20	0.06	
7. Other	-0.06	-0.11	-0.12	0.00	-0.08	0.00	-0.10	
8. Married	-0.07	-0.06	-0.08	-0.19	0.00	-0.08	0.03	
9. Widowed	0.00	-0.01	0.01	0.14	-0.04	0.10	0.03	
10. Children	0.08	0.04	0.02	-0.06	0.11	0.03	0.02	
11. Education	-0.16	-0.14	-0.16	-0.25	-0.09	-0.20	-0.02	
12. Income	-0.06	-0.02	0.00	-0.21	0.05	-0.10	0.08	
13. Renter	0.19	0.17	0.18	0.18	0.11	0.08	-0.05	
14. Tenure	-0.09	-0.09	-0.10	0.02	-0.02	-0.08	0.05	

Notes: Correlations r = 0.18 or greater are significant at the 0.01 level

Correlations between r = 0.13 to 0.17 are significant at the 0.05 level.

Kn = Hazard Knowledge, Tr = Trustworthiness, Re = Responsibility for Protection

There was very little support for the Hypothesis 3c predictions that respondents' ratings of self/family protection responsibility were significantly correlated with their demographic characteristics. The only statistically significant correlation was between gender and self/family responsibility (r = 0.13). Of the 98 correlations (Table VII) between the 7 stakeholders' responsibility for protection with 14 demographic variables, 30 were statistically significant at 0.05 level. The actual number of significant correlations does exceed chance expectations (1% of 98 = 9) among these groups of variables by a significant margin (21 more than expected by chance).

1999 Results

There was no support at all for the Hypothesis 3a predictions that respondents' ratings of self/ family hazard knowledge would be significantly correlated with their demographic characteristics and their adoption of seismic hazard adjustments. Of the 98 correlations (Table VIII) between the 7 stakeholders' hazard knowledge with 14 demographic variables, only 6 were statistically significant at 0.05 level. The actual number of significant correlations (6) does not exceed chance expectations (1% of 98 = 9) among these groups of variables.

There was no support for the Hypothesis 3b predictions that respondent ratings of federal, state and local government and media trustworthiness would be significantly correlated with their demographic characteristics. The only statistically significant correlations were between females and local government trustworthiness (r = 0.17), married respondents and federal government trustworthiness (r = -0.15), and widowed respondents and federal government (r = 0.14) and media (r = 0.15) trustworthiness only. Of the 98 correlations (Table VIII), between the 7 stakeholders' trustworthiness with 14 demographic variables, only 11 were statistically significant at 0.05 level. The actual number of significant correlations (11) does not

exceed chance expectations (1% of 98 = 9) among these groups of variables by a significant margin.

There was a little more support for Hypothesis 3c's predictions that respondent ratings of self/ family protection responsibility would be significantly correlated with their demographic characteristics. There were statistically significant correlations between age of respondents' (r = -0.17), married respondents' (r = 0.13), income (r = 0.18), and community tenure (r = -0.13) with family responsibility. Of the 98 correlations (Table VIII) between the 7 stakeholders' responsibility for protection with 14 demographic variables, 25 were statistically significant at 0.05 level. The actual number of significant correlations does exceed chance expectations (1% of 98 = 9) among these groups of variables by a significant margin (16 more than expected by chance).

Comparison of Results in 1997 and 1999

There were no significant correlations between respondents' ratings of self/family hazard knowledge and trustworthiness with their demographic characteristics and their adoption of seismic hazard adjustments. However, there were significant correlations of demographic characteristics with protection responsibility in both years, but the number of statistically significant correlations was smaller in 1999 than in 1997. Moreover, the pattern of correlations was quite inconsistent. Only nine correlations were statistically significant in both years. None of the demographic variables was significantly associated with ratings of protection responsibility for more than two stakeholders.

Table VIII. Intercorrelations Between Demographic Characteristics and Stakeholder Characteristics for 1999

Variables	Federal	State	Local	Media	Employer	Friend	Self/Fa	
	Kn	Kn	Kn	Kn	Kn	Kn	Kn	*Stakeholders' Hazard Knowledge*
1. Age	-0.11	-0.01	0.04	0.08	-0.13	-0.05	-0.07	
2. Female	0.00	0.07	0.11	0.09	0.07	0.06	0.03	
3. Hispanic	-0.03	-0.01	0.00	0.10	-0.08	-0.02	0.09	
4. Asian	0.06	0.08	0.06	0.02	-0.01	-0.02	-0.12	
5. Black	0.03	0.06	0.01	-0.05	-0.04	0.07	-0.04	
6. White	-0.04	-0.06	-0.03	-0.04	0.04	-0.06	-0.06	
7. Other	0.06	0.04	0.01	0.06	0.07	0.14	0.19	
8. Married	-0.15	-0.08	-0.08	0.01	0.00	0.02	0.03	
9. Widowed	-0.01	-0.02	0.02	0.00	0.02	-0.09	-0.04	
10. Children	-0.03	0.03	-0.03	-0.07	-0.02	-0.14	0.03	
11. Education	-0.04	-0.01	-0.06	-0.09	0.10	0.00	0.05	
12. Income	0.00	0.00	-0.07	-0.12	0.10	0.00	-0.01	
13. Renter	-0.04	0.06	0.10	0.02	0.03	-0.02	-0.01	
14. Tenure	-0.04	0.00	0.02	0.15	-0.06	0.05	-0.05	
	Tr	Tr	Tr	Tr	Tr	Tr	Tr	*Stakeholders' Trustworthiness*
1. Age	-0.04	0.04	0.03	0.09	-0.19	-0.14	-0.15	
2. Female	0.04	0.11	0.17	0.11	0.06	0.14	0.04	
3. Hispanic	-0.04	-0.03	-0.03	-0.02	-0.06	0.00	-0.01	
4. Asian	0.09	0.00	0.00	0.08	0.03	0.07	0.06	
5. Black	0.06	0.12	0.09	0.05	0.05	0.05	-0.01	
6. White	-0.05	0.02	0.01	0.02	-0.01	-0.09	-0.08	
7. Other	0.07	0.04	0.04	-0.07	0.06	0.10	0.19	
8. Married	-0.15	-0.06	-0.05	-0.04	0.01	0.03	0.13	
9. Widowed	0.14	0.12	0.06	0.15	0.05	0.05	-0.07	
10. Children	-0.05	-0.06	-0.03	0.03	0.00	0.11	0.13	
11. Education	-0.09	-0.09	-0.01	-0.08	-0.03	-0.05	0.08	
12. Income	0.00	-0.03	-0.03	-0.09	0.07	0.01	0.11	
13. Renter	0.00	0.04	0.02	0.03	0.06	0.08	0.01	
14. Tenure	-0.03	0.00	-0.05	0.03	-0.13	-0.06	-0.07	
	Re	Re	Re	Re	Re	Re	Re	*Stakeholders' Protection Responsibility*
1. Age	-0.04	0.01	0.01	0.24	-0.14	-0.03	-0.17	
2. Female	0.07	0.12	0.11	0.12	0.05	0.06	0.03	
3. Hispanic	0.14	0.13	0.11	0.06	-0.06	0.08	0.00	
4. Asian	0.12	0.18	0.17	0.13	0.01	0.13	0.05	
5. Black	0.14	0.13	0.14	0.08	0.11	0.11	0.08	
6. White	-0.18	-0.15	-0.13	-0.08	-0.07	-0.20	0.00	
7. Other	0.01	-0.07	-0.09	-0.04	0.04	0.11	-0.03	
8. Married	-0.09	-0.08	-0.04	-0.09	-0.14	0.01	0.13	
9. Widowed	0.07	0.11	0.07	0.23	0.06	0.01	-0.12	
10. Children	0.08	0.06	0.04	-0.07	0.07	0.00	0.04	
11. Education	-0.13	-0.10	-0.06	-0.15	-0.02	-0.03	0.11	
12. Income	-0.02	-0.02	0.00	-0.14	0.07	-0.04	0.18	
13. Renter	0.14	0.09	0.08	0.12	-0.05	0.12	-0.01	
14. Tenure	-0.04	-0.05	-0.06	0.12	-0.04	-0.01	-0.13	

Notes: Correlations r = 0.18 or greater are significant at the 0.01 level

Correlations between r = 0.13 to 0.17 are significant at the 0.05 level.

Kn = Hazard Knowledge, Tr = Trustworthiness, Re = Responsibility for Protection

4.4. Seismicity, Location, and Hazard Salience

1997 Results

Partially consistent with Hypothesis 4, (Table IX) Californians gave higher ratings than Washingtonians, to many, but not all stakeholders' hazard knowledge. Table 4.4b shows there were no significant differences between the respondents of the two states with respect to federal government knowledge ($t_{224} = 0.35$, *ns*) and news media ($t_{222} = 1.78$, *ns*). However, there were significant differences for state ($t_{225} = 3.98$, $p < .05$) and local government ($t_{222} = 4.37$, $p < .05$), employers ($t_{196} = 2.49$, $p < .05$), friends ($t_{221} = 3.71$, $p < .05$) and self/family ($t_{223} = 2.40$, $p < .05$) knowledge.

There was less support for Hypothesis 4's predictions on trustworthiness because there were no significant differences between the two states with respect to the federal government ($t_{224} = -0.35$, *ns*), state government ($t_{223} = 1.63$, *ns*), news media ($t_{222} = 1.19$, *ns*) and employer ($t_{197} = 1.65$, *ns*) trustworthiness. However, differences in trustworthiness ratings for local government ($t_{221} = 3.24$, $p < .05$), friends ($t_{218} = 3.07$, $p < .05$) and family ($t_{219} = 2.77$, $p < .05$) were significant, with California residents providing higher ratings than Washington residents.

Support for Hypothesis 4 was weakest on ratings of protection responsibility, because there were no significant differences between California residents and Washington residents with respect to any of the ratings for federal government ($t_{221} = 0.01$, *ns*), state government ($t_{223} = 0.65$, *ns*), local government ($t_{222} = 1.38$, *ns*), news media ($t_{220} = -0.56$, *ns*), employers ($t_{196} = -0.22$, *ns*), friends ($t_{220} = 1.46$, *ns*) and self/family ($t_{224} = 1.72$, *ns*) on responsibility for seismic protection.

Table IX. Means (M), Standard Deviations (SD) and Significant Differences (t-value) Between Stakeholder Characteristics in Southern California (N = 91) and Western Washington (N = 141) for 1997 and 1999

	1997			1999		
Variables	California	Washington		California	Washington	
	M (SD)	M (SD)	*t-value*	M (SD)	M (SD)	*t-value*
Knowledge (Kn)						
1. FedKn	3.50 (1.03)	3.45 (1.06)	0.35	3.51 (1.04)	3.47 (0.96)	0.25
2. StaKn	4.01 (0.91)	3.48 (1.02)	3.98***	3.99 (1.02)	3.57 (0.93)	3.16***
3. LocKn	3.87 (1.00)	3.20 (1.18)	4.37***	4.00 (1.07)	3.40 (1.06)	4.17***
4. MedKn	3.54 (1.09)	3.28 (1.07)	1.78	3.72 (1.25)	3.35 (1.07)	2.43**
5. EmpKn	3.48 (1.23)	3.04 (1.20)	2.49**	3.41 (1.22)	3.07 (1.13)	2.05**
6. FrdKn	3.24 (1.01)	2.76 (0.88)	3.71***	3.38 (0.93)	2.76 (0.81)	5.24***
7. SelKn	3.69 (1.15)	3.33 (1.08)	2.4**	3.96 (0.90)	3.37 (0.93)	4.72***
Trustworthiness (Tr)						
8. FedTr	3.23 (1.16)	3.29 (1.12)	-0.35	3.41 (1.12)	3.30 (1.04)	0.75
9. StaTr	3.72 (1.10)	3.47 (1.10)	1.63	3.92 (1.05)	3.52 (0.89)	3.03***
10. LocTr	3.82 (1.10)	3.34 (1.07)	3.24***	3.93 (1.08)	3.45 (1.04)	3.32***
11. MedTr	3.63 (1.17)	3.44 (1.12)	1.19	3.68 (1.26)	3.56 (1.10)	0.76
12. EmpTr	3.39 (1.34)	3.08 (1.24)	1.65	3.38 (1.28)	2.97 (1.26)	2.23**
13. FrdTr	3.30 (1.16)	2.81 (1.15)	3.07***	3.34 (1.10)	2.8 (1.14)	3.51***
14. SelTr	3.62 (1.26)	3.14 (1.27)	2.77**	3.56 (1.24)	3.11 (1.23)	2.67**
Responsibility (Re)						
15. FedRe	3.02 (1.32)	3.02 (1.29)	0.01	3.22 (1.27)	2.68 (1.26)	3.11***
16. StaRe	3.35 (1.34)	3.24 (1.30)	0.65	3.55 (1.25)	3.01 (1.25)	3.12***
17. LocRe	3.51 (1.39)	3.25 (1.31)	1.38	3.53 (1.28)	3.12 (1.28)	2.36**
18. MedRe	2.63 (1.24)	2.73 (1.32)	-0.56	2.83 (1.37)	2.62 (1.33)	1.12
19. EmpRe	2.88 (1.39)	2.93 (1.37)	-0.22	3.13 (1.26)	2.72 (1.31)	2.14**
20. FrdRe	2.60 (1.23)	2.36 (1.11)	1.46	2.76 (1.28)	2.22 (1.08)	3.36***
21. SelRe	4.32 (1.05)	4.05 (1.22)	1.72*	4.28 (1.11)	4.10 (1.11)	1.19
Other						
22.HazdInt	2.46 (0.79)	2.13 (0.82)	3.04***	2.55 (0.97)	2.13 (0.79)	3.64***
23.HazdEx	1.82 (1.14)	0.49 (0.83)	10.28***	1.76 (1.14)	0.48 (0.77)	10.24***
24.RiskPe	2.91 (0.81)	2.75 (0.89)	1.30	2.85 (0.93)	2.71 (0.80)	1.20
25.Gender	0.81 (3.87)	0.37 (0.48)	0.63	0.34 (0.48)	0.40 (0.55)	-0.44
26.HazAdj	9.04 (3.23)	7.72 (2.51)	3.51***	9.07 (3.00)	8.24 (2.50)	2.27**

Notes: *p < 0.10, **p < 0.05, ***p < 0.01

Fed = Federal government, Sta = State government, Loc = Local government, Med = Media, Emp = Employer, Sel = Self/family, HazdInt = Hazard intrusiveness, HazdEx = Hazard experience, RiskPe = Risk perception, Gender = Female (1), HazAdj = Hazard Adjustment Adoption

Partially consistent with Hypothesis 5 (Table IX), Californians reported higher levels than Washingtonians for hazard intrusiveness ($t_{230} = 3.04$, $p < .05$), hazard experience ($t_{220} = 10.28$, $p < .05$), and hazard adjustment adoption ($t_{230} = 3.51$, $p < .05$). Surprisingly, there were no

significant differences between the respondents of the two states with respect to risk perception ($t_{227} = 1.30$, *ns*).

1999 Results

Partially consistent with Hypothesis 4 (Table IX), Californians gave consistently higher ratings than Washingtonians to the hazard knowledge of all stakeholders except federal government ($t_{221} = 0.25$, *ns*). There were significant differences for state ($t_{223} = 3.16$, $p < .05$) and local government ($t_{223} = 4.17$, $p < .05$), news media ($t_{224} = 2.43$, $p < .05$), employers ($t_{196} = 2.05$, $p < .05$), friends ($t_{220} = 5.24$, $p < .05$), and self/family ($t_{226} = 4.72$, $p < .05$) knowledge.

There was slightly less support for Hypothesis 4's predictions on trustworthiness because there were no significant differences between the two states with respect to the federal government ($t_{222} = 0.75$, *ns*) and news media ($t_{225} = 0.76$, *ns*). However, differences in trustworthiness ratings for state government ($t_{224} = 3.03$, $p < .05$), local government ($t_{225} = 3.32$, $p < .05$), employer ($t_{192} = 2.14$, $p < .05$), friends ($t_{223} = 3.51$, $p < .05$) and family ($t_{225} = 2.67$, $p < .05$) were significant, with California residents providing higher ratings than Washington residents.

There was more support for Hypothesis 4's predictions on responsibility by the governmental influentials because there were significant differences between the two states with respect to the federal government ($t_{222} = 3.11$, $p < .05$), state government ($t_{225} = 3.12$, $p < .05$) and local government ($t_{222} = 2.36$, $p < .05$), employers ($t_{192} = 2.14$, $p < .05$), and friends ($t_{221} = 3.36$, $p < .05$) on responsibility for seismic protection. However, there were no significant differences between the two states with respect to the news media ($t_{223} = 1.12$, *ns*) and self/ family ($t_{225} = 1.19$, *ns*) responsibility for protection.

Partially consistent with Hypothesis 5 (Table IX), Californians reported higher levels than Washingtonians for hazard intrusiveness ($t_{230} = 3.64$, $p < .05$), hazard experience ($t_{220} = 10.24$, $p < .05$), and hazard adjustment adoption ($t_{230} = 2.27$, $p < .05$). In this year also, there were no significant differences between the respondents of the two states with respect to risk perception ($t_{230} = 1.20$, *ns*).

Comparison of Results in 1997 and 1999

Federal government knowledge ratings did not differ for California and Washington respondents in either year whereas perceptions of state government, local government, employer, friends and self-knowledge ratings were significantly higher for Californian respondents. In both years, only news media ratings had a mixed pattern of statistically significant differences.

Perceptions of federal government and media trustworthiness were not significantly different for California and Washington respondents in either year. By contrast, perceptions of local government, friends, and family trustworthiness ratings were significantly higher for Californian respondents. In both years, state and employer trustworthiness ratings had mixed patterns with higher trust levels for Californians than Washingtonians in 1999 but not in 1997.

New media and self/family ratings on responsibility for protection were not different for California and Washington respondents in either year but ratings for federal, state, local, employer, and friends had mixed patterns in 1997 and 1999. In both years, Californians had higher ratings of hazard intrusiveness, hazard experience, and hazard adjustment adoption, but not risk perception.

4.5. Gender Differences in Risk Perceptions

1997 Results

Partially consistent with Hypothesis 6, Table V shows female respondents had higher risk perceptions (r = 0.19), and higher ratings on a few stakeholder characteristics. Female gender showed significant correlations with news media knowledge (r = 0.18), news media trustworthiness (r = 0.14), and state government trustworthiness (r = 0.15). Additionally, female gender had significantly higher correlations with all other stakeholders' protection responsibility (average r = 0.18) than themselves (r = 0.13). Finally, although not hypothesized female gender showed significant correlations with personal control (r = -0.13), and resource adequacy (r = -0.13).

1999 Results

There was very little consistency with Hypothesis 6, as Table VI shows female respondents had higher risk perceptions (r = 0.26), but showed higher ratings for only two stakeholder characteristics namely, local government trustworthiness (r = 0.17), and friend trustworthiness (r = 0.14) ratings only. Finally, although not hypothesized, female gender showed significant correlations with personal control (r = -0.18), and resource adequacy (r = -0.15).

Comparison of Results in 1997 and 1999

In both years female respondents' had significantly higher levels of risk perception than male respondents. However, the pattern of correlations of gender with stakeholder characteristics was not consistent from one year to the next.

4.6. Hazard Intrusiveness and Hazard Experience

1997 Results

Consistent with Hypothesis 7, Table V shows that respondents' perceptions of stakeholder characteristics were positively correlated with their hazard intrusiveness, hazard experience and adoption of seismic hazard adjustments. Of the 21 correlations with hazard intrusiveness, 11 were statistically significant at 0.05 level. Of the 21 correlations with hazard experience, 9 were statistically significant at 0.05 level. In both cases, only one would be expected by chance. Consistent patterns were observed between hazard intrusiveness and hazard experience ratings with some stakeholder characteristics. There were statistically significant correlations of local government knowledge with hazard intrusiveness ($r = 0.20$) and hazard experience ($r = 0.17$); of employer knowledge with hazard intrusiveness ($r = 0.18$) and hazard experience ($r = 0.16$); of friend knowledge with hazard intrusiveness ($r = 0.14$) and hazard experience ($r = 0.17$); and of self/family knowledge with hazard intrusiveness ($r = 0.27$) and hazard experience ($r = 0.25$). Respondents' reports of their adoption of seismic hazard adjustments were positively correlated with hazard intrusiveness ($r = 0.39$) and hazard experience ($r = 0.41$).

1999 Results

Consistent with Hypothesis 7, Table VI shows that respondents' perceptions of stakeholder characteristics were positively correlated with their hazard intrusiveness, hazard experience, and adoption of seismic hazard adjustments. Of the 21 correlations with hazard intrusiveness, 6 were statistically significant at 0.05 level. Of the 21 correlations with hazard experience, 13 were statistically significant at 0.05 level. Both exceed the chance expectation of one significant correlation. Consistent patterns were observed between hazard intrusiveness and

hazard experience ratings with some stakeholder characteristics. There were statistically significant correlations of self/family knowledge with hazard intrusiveness (r = 0.17) and hazard experience (r = 0.37); of local government trustworthiness with hazard intrusiveness (r = 0.16) and hazard experience (r = 0.14); of employer trustworthiness with hazard intrusiveness (r = 0.14) and hazard experience (r = 0.17); of friend trustworthiness with hazard intrusiveness (r = 0.17) and hazard experience (r = 0.17); of self/family trustworthiness with hazard intrusiveness (r = 0.18) and hazard experience (r = 0.24). Respondents' reports of their adoption of seismic hazard adjustments were positively correlated with hazard intrusiveness (r = 0.26) and hazard experience (r = 0.41).

Comparison of Results in 1997 and 1999

Although the number of significant correlations of stakeholder characteristics exceeded chance in both years, only the correlation of self/ family knowledge with hazard intrusiveness and hazard experience was significant in both years. In addition, hazard intrusiveness and hazard experience had significantly high positive correlations in both years with the adoption of seismic hazard adjustments.

4.7. Stakeholder Characteristics with Risk Perceptions

1997 Results

Consistent with Hypothesis 8, Table V shows respondents' risk perceptions were positively correlated with their perceptions of stakeholder characteristics but not with their adoption of seismic hazard adjustments. Of the 21 correlations with risk perception, 14 were statistically significant at 0.05 level (only one would be expected by chance). There were statistically significant positive correlations between risk perception and six of the stakeholders'

knowledge ratings: state government knowledge (r = 0.15), local knowledge (r = 0.21), news media knowledge (r = 0.14), employer knowledge (r = 0.24), friend knowledge (r = 0.16), and self/family knowledge (r = 0.26). However, risk perception was positively correlated with only two stakeholders' trustworthiness ratings: employer trustworthiness (r = 0.13) and family trustworthiness (r = 0.13). But risk perception was positively correlated with all governmental and social influentials protection responsibility (average r = 0.18) except self/family. As hypothesized, risk perception did not show any positive correlations with seismic hazard adjustment adoption.

Of the 21 correlations with hazard adjustment adoption, 10 were statistically significant at 0.05 level (only one would be expected by chance). Of these, a common pattern emerged that there were statistically significant correlations between seismic hazard adjustment adoption and peer group (employer, friend, and self/family) knowledge (average r = 0.31), peer group trustworthiness (average r = 0.31), peer group responsibility (average r = 0.18), and local government knowledge (r = 0.14) ratings.

1999 Results

Consistent with Hypothesis 8, Table VI shows respondents' risk perceptions were positively correlated with their perceptions of stakeholder characteristics but not with their adoption of seismic hazard adjustments. Of the 21 correlations between stakeholder characteristics and risk perceptions, 12 were statistically significant at 0.05 level. There were statistically significant correlations between risk perception with governmental knowledge (average r = 0.22), news media knowledge (r = 0.29), and self/family knowledge (average r = 0.21). Risk perception was significantly correlated with only two stakeholders' trustworthiness ratings: local government trustworthiness (r = 0.13) and family trustworthiness (r = 0.13).

However, risk perception was significantly correlated with all stakeholders' protection responsibility (average $r = 0.17$) except employer and friend responsibility. Risk perception did not show any significant correlations with seismic hazard adjustment adoption.

Of the 21 correlations with hazard adjustments, 7 were statistically significant at 0.05 level. There were statistically significant correlations between seismic hazard adjustment adoptions and peer group (employer, friend, self/family) knowledge (average $r = 0.28$), local government knowledge ($r = 0.13$), employer trustworthiness ($r = 0.20$), self/family trustworthiness ($r = 0.21$), self/family responsibility ($r = 0.23$) ratings.

Comparison of Results in 1997 and 1999

The number of significant positive correlations of stakeholder characteristics with risk perceptions exceeded chance in both years. Risk perception was consistently correlated with state government, news media, and self/family knowledge; family trustworthiness; federal, state, and local government, news media, and employer responsibility. Similarly, the number of significant positive correlations of stakeholder characteristics with the adoption of seismic hazard adjustments exceeded chance in both years. Adjustment adoption was consistently correlated with peer group (employer, friend, and self/family) and local government knowledge; employer and family trustworthiness; and self/family responsibility. However, risk perception did not show any significant correlations with seismic hazard adjustment adoption in either year.

4.8. Fatalism, Personal Control, and Resource Adequacy

1997 & 1999 Results

Table X shows there was no support for the Hypothesis 9a predictions that respondents' fatalism (luck or chance/God's will) will be significantly correlated with their risk perceptions

and with their adoption of seismic hazard adjustments. The only significant correlation was between respondents' belief in luck/ chance and act of God in 1997 (r = 0.26) and 1999 (r = 0.24) respectively, but none with seismic hazard adjustment adoption.

Table X shows there was no support for the Hypothesis 9b predictions that respondents' perceptions of personal control (whose actions govern their personal safety in an earthquake) will be positively correlated with their adoption of seismic hazard adjustments. There were statistically significant negative correlations between personal control and risk perception in 1997 (r = -0.16) and 1999 (r = -0.17), respectively, but none with seismic hazard adjustment adoption.

Consistent with the Hypothesis 9c, Table X shows respondents' perceptions of implementation barriers such as lack of required information and skills or other resources such as tools and equipment and financial assets (i.e. perceived resource adequacy) was negatively correlated with their adoption of seismic hazard adjustments in 1997 (r = 0.52) and in 1999 (r = 0.54) respectively.

Comparison of Results in 1997 and 1999

In both years, there were statistically significant positive correlations between respondents' perceptions of the hazard being an act of God with it being an act of luck/chance and consistently nonsignificant correlations of these variables with hazard adjustment adoption. Perceived personal control had significant negative correlations with risk perceptions and consistently nonsignificant correlations with hazard adjustment adoption. There were statistically significant positive correlations between respondents' perceptions of resource adequacy with hazard adjustment adoption.

Table X. Means (M), Standard Deviations (SD) and Intercorrelations Between Personal Control, Resource Adequacy, Fatalism and Risk Perception with Hazard Adjustment Adoption

					1997			
Variables	M	SD	1	2	3	4	5	6
1. PerCo	16.3	4.23	1.00					
2. ResAd	8.98	3.02	0.16*	1.00				
3. ActLu	2.79	1.41	0.06	-0.05	1.00			
4. ActGod	2.75	1.67	0.06	-0.04	0.26**	1.00		
5. RiskPe	2.81	0.86	-0.16**	-0.02	0.12	-0.01	1.00	
6. HazAdj	8.24	2.88	0.03	0.52**	0.07	0.00	0.10	1.00
					1999			
Variables	M	SD	1	2	3	4	5	6
1. PerCo	17.09	4.13	1.00					
2. ResAd	9.32	3.22	0.00	1.00				
3. ActLu	3.02	1.6	0.14*	-0.01	1.00			
4. ActGod	2.79	1.74	0.23**	0.11	0.24**	1.00		
5. RiskPe	2.76	0.85	-0.17**	-0.16*	0.03	-0.12	1.00	
6. HazAdj	8.56	2.73	-0.01	0.54**	0.02	0.05	0.12	1.00

Notes: *Correlations between r = 0.14 to 0.16 are significant at the 0.05 level,
**Correlations r = 0.17 or greater are significant at the 0.01 level.
1. PerCo = Personal Control, 2. ResAd = Resource Adequacy, 3. ActLu = Act of luck, 4. ActGod = Act God, 5. RiskPe = Risk Perception, 6. HazAdj = Hazard Adjustment Adoption

4.9. City Activity in Hazard Management

1997 & 1999 Results

There was no support for the Hypothesis 10a predictions that households in leader communities in both regions will have greater levels of hazard intrusiveness, perceptions of seismic hazards, and hazard adjustment adoptions than those in laggard communities. There were no significant correlations observed.

There was no support for the Hypothesis 10b predictions that ratings of stakeholder knowledge, trustworthiness, and responsibility for protection, will be significantly higher for respondents in leader communities than for those in laggard communities in both regions. There were no significant correlations observed.

4.10. Stability of Perceptions from 1997 to 1999

The similarity in the pattern of correlations within 1997 and 1999 (see Tables V & VI) suggests there will be an approximately linear plot if these correlations are analyzed in the same way as they were for Fig. 5. This is indeed the case as indicated by Fig.7 .

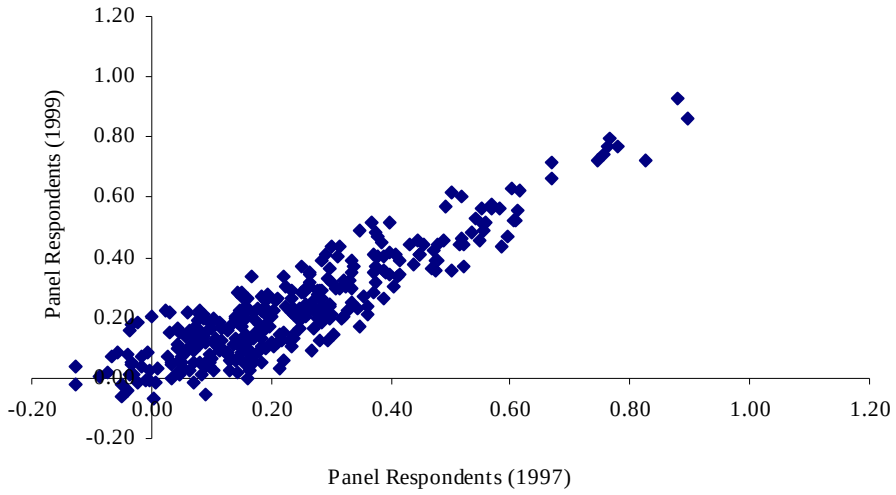

Fig. 7. Cross-plot of interitem correlations for respondents in Time 1 (1997) and Time 2 (1999).

On examination of the stability correlations, which are the correlations between the measures of each variable at Time 1 and Time 2, it is observed that the minimum stability correlation is .23 and the maximum is .73 (see Appendix A). All of these correlations are statistically significant. The absolute value of stability correlations for knowledge fell in the range of $.00 \leq r \leq .49$ and the resulting average correlation was $r = .37$. For trustworthiness, the stability correlations fell in the range of $.00 \leq r \leq .53$ and the resulting average correlation was $r. =$

.45. For responsibility, the stability correlations fell in the range of $.00 \leq r \leq .50$ and the resulting average correlation was $r = 0.41$. However, stability correlations for federal knowledge ($r = 0.23$), state government knowledge ($r = 0.24$), friend responsibility ($r = 0.26$), and self/family responsibility ($r = 0.31$) were relatively low.

There were only three statistically significant differences in means between Time 1 and Time 2 (Table XI). Firstly, respondents' perceptions of local government knowledge ($t_{217} = -2.19$, $p < .05$) ratings were higher in 1999 than in 1997. In addition, respondents' perceptions of federal government responsibility ($t_{217} = 5.17$, $p < .05$) ratings were lower in 1999 than in 1997. Finally, respondents' adoption of seismic hazard adjustments ($t_{231} = -2.40$, $p < .05$) was higher in 1999 than in 1997.

TableXI. Means (M), Standard Deviations (SD), t-value Gauging the Stability of Perceptions from Time1 to Time 2

Stakeholder Characteristics	Paired Differences		
Pairs	M	SD	t-value
Knowledge (Kn)			
1. 97FedKn - 99FedKn	-0.05	1.26	-0.54
2. 97StaKn - 99StaKn	-0.06	1.23	-0.77
3. 97LocKn - 99LocKn	-0.17	1.17	-2.19**
4. 97MedKn - 99MedKn	-0.11	1.23	-1.26
5. 97EmpKn - 99EmpKn	-0.01	1.33	-0.06
6. 97FrdKn - 99FrdKn	-0.05	1.02	-0.74
7. 97SelKn - 99SelKn	-0.14	1.07	-1.95
Trustworthiness (Tr)			
8. FedTr97 - FedTr99	-0.09	1.15	-1.12
9. StaTr97 - StaTr99	-0.11	1.00	-1.67
10. LocTr97 - LocTr99	-0.11	1.13	-1.49
11. MedTr97 - MedTr99	-0.12	1.25	-1.40
12. EmpTr97 - EmpTr99	0.07	1.30	0.68
13. FrdTr97 - FrdTr99	-0.01	1.28	-0.16
14. SelTr97 - SelTr99	0.01	1.31	0.16
Responsibility (Re)			
15. FedRe97 - FedRe99	0.56	1.60	5.17***
16. StaRe97 - StaRe99	0.05	1.29	0.63
17. LocRe97 - LocRe99	0.08	1.33	0.92
18. MedRe97 - MedRe99	0.03	1.35	0.35
19. EmpRe97 - EmpRe99	0.00	1.47	0.00
20. FrdRe97 - FrdRe99	0.03	1.43	0.33
21. SelRe97 - SelRe99	-0.03	1.35	-0.35
Other variables			
22. HazInt97 - HazInt99	-0.04	0.97	-0.56
23. HazEx97 - HazEx99	0.03	0.77	0.68
24. RisPe97 - RisPe99	0.05	0.82	0.88
25. Gender97 - Gender99	0.02	0.33	1.00
26. HazAd97 - HazAd99	-0.33	2.08	-2.4**

Notes: *p < 0.10, **p < 0.05, ***p < 0.01

Fed = Federal government, Sta = State government

Loc = Local government, Med = Media, Emp = Employer,

Sel = Self/family, HazIn = Hazard Intrusiveness,

HazdEx = Hazard Experience, RiskPe = Risk Perception,

HazAdj = Hazard Adjustment Adoption

CHAPTER V

DISCUSSION AND CONCLUSIONS

5.1 Discussion

The results of this study generally supported most, but not all, of the ten hypotheses. It extends the results of previous studies, especially those of Lindell and Whitney (2000), to a larger more diverse sample of respondents' at two different time frames in two different seismic regions. The cross plot of inter-item correlations for select variables (stakeholder knowledge, trustworthiness, and responsibility, controllability, resource adequacy, hazard intrusiveness, hazard experience, risk perception, gender, and hazard adjustment adoption) for California and Washington residents was approximately linear. This indicated that respondents in these two seismic regions were equivalent in their perceptions and hence respondents from both these regions were combined and treated as one dataset. The actual number of significant correlations —190 in 1997 (Table V) and 183 in 1999 (Table VI) — substantially exceeds chance expectations and is an indicator that there is indeed stability of perceptions from Time 1 to Time 2. This finding indicates that, in general, the ratings of the questionnaire items are stable overtime and reflect real beliefs rather than pseudo-attitudes. This is important for the study of households' seismic hazard adjustments because pseudo-attitudes cannot motivate adoption of protective actions. By contrast, real beliefs that reflect the salience of an issue in the minds of people can motivate personal action and help to guide community actions, especially political legislative ideas.

Data relevant to Hypothesis 1a revealed significant correlations (1997 average $r = 0.62$; 1999 average $r = 0.57$) of respondents' perceptions of stakeholders' hazard knowledge with the corresponding ratings of trustworthiness, whereas data relevant to Hypothesis 1b and Hypothesis

1c indicated protection responsibility had much lower correlations with hazard knowledge (1997 average $r = 0.30$; 1999 average $r = 0.28$) and trustworthiness (1997 average $r = 0.34$; 1999 average $r = 0.33$) than the latter had with each other. The differences in these correlations suggest knowledge and trustworthiness are perceived as being roughly equivalent because ratings of hazard knowledge and trustworthiness are quite similar in means and are highly correlated. Thus, it is difficult to determine if seismic hazard knowledge is inferred from trustworthiness, trustworthiness is inferred from seismic hazard knowledge, or both are inferred from some other source characteristic(s). However, protection responsibility is perceived as a distinctly different characteristic—at least for some stakeholders. As noted earlier, hazard knowledge and trustworthiness seem to imply protection responsibility must be assumed to a greater extent by local government than by employers and more by employers than by the news media and friends. Conversely, self and family have protection responsibility even when hazard knowledge and trustworthiness are low. The complexity of these findings indicates further research, possibly in different cultural settings of the world, is needed to replicate and explain them.

The profiles of mean ratings for both years were similar. Hazard knowledge ratings were highest for the state government and lowest for employer and friends. This partial support for Hypothesis 2a is important because it confirms government agencies are likely to be considered to be more credible information sources than peers (friends and employer). The higher level of governmental hazard knowledge is most likely to affect households when government claims about hazards conflict with those of peers, particularly when such peers attempt to pass on erroneous information about seismic hazard (Whitney, et al., 2004). However, lack of stability in whether government agencies are more knowledgeable than or only as knowledgeable as self/family is important because there is a need to understand whether households will accept

initiatives from these agencies without question if the agencies' claims strongly conflict with their own beliefs. The limitation of the present finding is that it refers to both government agencies in general and peers in general. It is unclear how a specific government agency (e.g., an emergency management agency vs. a police department) or a specific representative of an agency would compare to a specific peer considered to be knowledgeable about seismic hazard.

In addition, though not hypothesized, the present study found the news media were considered to be as knowledgeable as the government agencies and employers were judged little more knowledgeable than friends. Overall, the level of differentiation among the levels of government with respect to hazard knowledge found in this study was less than that reported by Lindell and Whitney (2000). Indeed, the level of differentiation in hazard knowledge among all stakeholders was smaller—2.9-3.7 (1997) and 3.00-3.70 (1999) in this study versus 2.7-4.0 in Lindell and Whitney. This lower level of differentiation among stakeholders with respect to ratings of hazard knowledge is noteworthy because the profile for this stakeholder characteristic is virtually identical to that reported by Lindell and Perry (1992) for volcano hazard. Moreover, the latter data showed ratings of stakeholder knowledge of volcano hazards were quite different from those for chemical and radiological hazards (which were similar to each other).

The similarity of the hazard knowledge profiles for earthquake (Lindell & Whitney, 2000 and the present study) and volcano (Lindell & Perry, 1992) hazards versus the corresponding profiles for radiological and chemical hazards (Lindell & Perry, 1992) suggests profiles of stakeholder knowledge for (more familiar) *natural* hazards will be similar to each other and different from profiles of stakeholder knowledge for (less familiar) *technological* hazards. Future research should use a variety of other hazards to determine if this conjecture is correct. Such research should consider the findings of Slovic and his colleagues (1987, 1992) regarding the degree to which hazards are known to science and to those exposed. In the context

of the present research, hazard knowledge by the federal government is a reasonable proxy for *risks known to science*, whereas hazard knowledge by self/family is equivalent to *risks known to those exposed*. From this perspective, the present research extends Slovic's work in examining the level of knowledge by important societal stakeholders intermediate in knowledge between scientists and those exposed. It also extends Slovic's work by examining stakeholders' relative levels of trustworthiness and protection responsibility, neither of which dimensions is addressed within the framework described by Slovic (1987, 1992). These data on hazard knowledge support Lindell and Whitney's (2000) conclusion that research on optimistic bias is more informative if it includes a variety of stakeholders. This study also suggests optimistic bias is limited to peers and supports Rothman, Klein and Weinstein's (1996) conclusion that optimistic bias results from underestimating (some) others' abilities rather than overestimating one's own.

The partial support for Hypothesis 2b is consistent with the partial support for Hypothesis 2a in suggesting government sources are considered to be more trustworthy, as well as more knowledgeable, than peers. It was surprising to find the family (recall that the family only, not self and family, was rated with respect to trustworthiness) was considered to be no more trustworthy than the federal government and less trustworthy than the state and local government. Trust in news media was also higher than employer, friends and family. Given the findings of public opinion polls revealing a pervasive lack of trust in institutions (Slovic, 1997) this needs to be pursued in future research.

The finding that mean ratings of protection responsibility were highest for self/family, next highest for government, and lowest for peers confirms Hypothesis 2c. This is a theoretically significant result because it suggests people are taking more responsibility for seismic safety than was found in earlier studies (e.g., Jackson, 1977, 1981). This evidence of a major shift in public thinking over the past 30 years means that official statements that earthquake victims

must be prepared to survive without help for at least 72 hours, are being heeded by the risk area population (Lindell & Whitney, 2000). Interestingly, the nonsignificant differences between California and Washington residents suggest this assumption of personal responsibility results from something broader than messages from local seismic safety officials, which would presumably have been limited to the California sample before Washington's 2001 Nisqually earthquake. The source(s) of this pervasive increase in personal responsibility should be addressed in future research.

In addition, though not hypothesized, the present study found news media and employers were considered to be slightly less responsible than governmental agencies and slightly more responsible than friends. This is important because, even though governmental agencies continue to be thought of as most responsible, they can widen their influence through concentrated efforts in conjunction with the news media, as well as with service organizations, trade unions, industry groups, educational institutions, and neighborhood organizations that essentially form the employers' pool. As was the case with hazard knowledge, the level of differentiation among the government agencies found with respect to protection responsibility in this study was less than that reported by Lindell and Whitney (2000). Indeed, the level of differentiation in protection responsibility among all stakeholders was smaller, ranging 2.5–4.1 in this study versus 2.2–4.4 in Lindell and Whitney (2000). Thus, the heuristics a respondent uses to judge protection responsibility seem to be different from the ones they use to judge hazard knowledge and trustworthiness. This is especially clear for perceptions of federal responsibility because the r^*_{wg} values for this variable were lower than for any others and Table V & VI indicates this was due primarily to the ratings of Washington residents. However, it is unclear why there would be a difference on only this variable.

The confirmation of Hypothesis 2d (mean ratings of protection responsibility were lower than ratings of hazard knowledge and trustworthiness for all stakeholders except self/family, which had higher ratings for protection responsibility than for hazard knowledge) is important because knowledge and trust seem to form an upper bound for protection responsibility by stakeholders other than self/family. In this regard, government and employers are seen as having a role relationship that is different from that of news media and friends. This difference raises questions about perceived role expectations of other stakeholders in other hazards, especially the role expectations of facility operators in connection with radiological or toxic chemical hazards.

Data relevant to Hypothesis 3a did not find any support, as there were no meaningful correlations between hazard knowledge of the seven stakeholders and the 14 demographic variables. The few that were reported were not consistent over both years. Hence, as the results are not replicated using the same respondents, they probably are chance fluctuations in the data. Data relevant to Hypothesis 3b found very little support in that females' perception of trust was positively correlated with the state government and newsmedia in 1997 but not in 1999. This might be because the number of female household respondents' declined in 1999 (the household member answering the questionnaire for the second wave in 1999 was not necessarily the same as who answered it in 1997).

The finding that demographic characteristics were not good predictors of seismic hazard adjustment adoption in this study is consistent with Lindell & Perry's (2000) review of the literature. In one sense, this is a helpful finding because demographic variables like ethnicity, income, community tenure, homeownership, etc. are not instrumental variables that emergency managers can change. Although demographic variables were not good predictors in both years, future researchers should not ignore them because it is important to assess the degree to which study samples are demographically representative of the populations from which they are drawn.

Data relevant to Hypothesis 4 revealed partial support by finding perceptions of some stakeholder characteristics were significantly higher for respondents in higher seismic risk area (Southern California) than those in a moderate seismic risk area (Western Washington). Mean ratings on hazard knowledge found respondents from California and Washington rated the federal government's knowledge equally but Californians generally rated the other six stakeholders' (state, local, news media, employer, peers, self/family) knowledge higher than Washingtonians did. This corresponds with our expectations that Californians have interpreted the numerous earthquakes and advisories as increasing their hazard knowledge. Mean ratings on trustworthiness found respondents from both the states rated the federal government and news media equally. By contrast, perceptions of local government, friends, and family trustworthiness ratings were significantly higher for Californian respondents. Differences in mean ratings on protection responsibility were not stable over time, as Californians gave governmental influentials, employer, and friends higher ratings in 1999 but not in 1997. Only news media and self-responsibility ratings were stable for both regions. The differences in the findings across stakeholder characteristics raise questions about why they occurred. The pattern of differences with respect to hazard knowledge can be interpreted as indicating California residents were more confident than Washington residents (and reasonably so) that all stakeholders *within* their state were relatively knowledgeable about seismic hazard. However, it is unclear why both years' data indicated Californians have more confidence in the trustworthiness of local government, friends, and family than do Washingtonians. It might be that decades of earthquake advisories, confirmed by numerous earthquakes, have created a generalized sense of confidence in the trustworthiness of some sources of seismic hazard information. It is similarly unclear why Californians consider all government agencies and employers and friends as more responsible for their safety only in

1999. An explanation of these findings is most likely to emerge from further research that includes other environmental hazards, such as toxic chemicals release.

There was partial support for Hypothesis 5 in 1997 & 1999 – which posited respondents from a higher seismic risk area (California) would have greater hazard intrusiveness, hazard experience, and risk perception than respondents in a moderate seismic risk area (Washington). Although, Californians did show significantly higher hazard intrusiveness and hazard experience ratings, these did not produce heightened risk perceptions. There were no significant differences between respondents in the two states with respect to their risk perceptions. This supports the notion that having seismic hazard experience and increased hazard intrusiveness alone are not the deciding variables for increased risk perceptions. There must be other antecedent variables that increase risk perceptions, but none of them were identified in this study.

The weak support for Hypothesis 6—which posited female respondents would have higher stakeholders' hazard knowledge, trustworthiness, and protection responsibility as well as perceptions of seismic risk—is interesting because, although females showed higher risk perceptions in both years than male respondents, they did not show consistently high ratings on all stakeholder characteristics. The 1997 data showed females actually had greater confidence in the news media than in authorities and also were more likely to believe stakeholders other than self/family were responsible for their safety. The reason for this broader assignment of protection responsibility should be pursued in future research because it might be related to gender effects in the broader political arena. For example, women tend to be more supportive than men for government initiatives for family programs (Atkeson & Rapaport, 2003; Shapiro & Mahajan, 1986). Thus the explanation might be that they are more supportive than men of collective (rather than individualistic) actions. Alternatively, women may perceive a greater need for protection in general, or their lower level of adoption of hazard adjustments may be related to

(lack of) control over enough financial resources to achieve protection from seismic hazard (Lindell & Prater, 2000). Although not hypothesized, both years' results showed that female gender had significant negative correlations with perceived personal control (personal safety in an earthquake being determined by the actions of themselves/family, friends, relatives, neighbors and coworkers, local news media, local government and federal, and state agencies) and resource adequacy (having all the information, tools and equipment, and financial assets: money, credit, and insurance, needed to protect themselves against the earthquake). Thus, future research should more carefully examine gender differences in perceptions of individual hazard adjustments. This could reveal if, for example, gender differences are limited to the most expensive hazard adjustments, those requiring special tools and equipment, or other gender-relevant hazard adjustment attributes. Additionally, it could inform us whether these differences arise due to a gender-blind analysis in which women's perspectives are marginalized in the dominant institutional practices. Women often manage the household budget and, if they are not privy to important information, they cannot budget expenses differently to prepare for the event. Consequently, they may continue to spend money without regard to future situations. There are also problems that arise from male-dominated information networks. There is an increasing need to encourage women's participation in community outreach programs both as community educators and receivers. By making them responsible for developing public education and awareness programs, we can increase the likelihood the needs and roles of women will be taken into consideration. It might be worthwhile for future research on long-range sustainable risk reduction programs to be more quantitative, using gender equality indicators to disaggregate data and findings that allow us to target female population segments and inform them better.

Data relevant to Hypothesis 7 revealed partial support by finding a number of significant correlations of stakeholder characteristics with hazard intrusiveness, hazard experience, and

hazard adjustment adoption that exceeded chance in both years. The correlation of self/family knowledge with hazard intrusiveness and hazard experience was significant in both years. In addition, both years' data showed hazard intrusiveness and hazard experience had significantly high positive correlations with the adoption of seismic hazard adjustments. These findings are consistent with Lindell & Whitney's (2000) study, suggesting that increasing people's experience with a hazard will in turn encourage them to think, speak and receive information, about the hazard, thus increasing hazard adjustment adoption. However, further analyses are needed to assess the direction of causality among these variables.

Hypothesis 8 revealed partial support by finding a number of significant correlations of stakeholder characteristics with risk perception that exceeded chance in both years. Risk perception was consistently correlated with state government, news media, and self/family knowledge; family trustworthiness; federal, state, and local government, news media, and employer responsibility. It was surprising that trustworthiness ratings for stakeholders other than family did not affect risk perception. This conflicts with the findings for the 1997 sample as a whole (N=532) and could be the result of a small biased panel sample data set. In recent years, numerous articles and surveys have shown the negative effects of extreme distrust in individuals, industries, and institutions responsible for risk management and linked it to risk perception (Slovic, 2000). Studies have further shown that initial trust influences interpretations of events, thus reinforcing people's prior beliefs. An explanation of these differences is most likely to emerge from further research. In any event, Hypothesis 8 was supported by the nonsignificant correlation of risk perception with hazard adjustment adoption. This suggests stakeholder characteristics affect hazard adjustment via the peripheral route rather than the central route (Petty & Cacioppo, 1986). Weinstein and Nicolich (1993) have demonstrated that correlations between risk perception and hazard adjustment adoption could be spuriously low when tested

with cross-sectional data. However, this longitudinal panel study suggests similar findings indicating that risk perceptions alone do not predict household hazard adjustments adoption.

There was no support in either year for Hypotheses 9a & 9b. There were no significant correlations between respondents' perception of the hazard being an act of God, or an act of luck/chance with hazard adjustment adoption; or between perceived personal control and hazard adjustment adoption, respectively. This coincides with Farley et al.'s (1993) *fatalism* studies, which showed inconsistent correlations with hazard adjustments. This is a contradictory to previous research that suggests receiver characteristics governed by cognitive and attitudinal processes are particularly important in increasing hazard awareness, thereby increasing hazard adjustment adoption (Mulilis & Duval, 1995). Future research needs to look into the reasons for these differences.

Data relevant to Hypothesis 9c found support in that respondents' perception of perceived resource adequacy was positively correlated with hazard adjustment adoption. This correlation confirms the theorizing of previous researchers (Mulilis et al., 1990; Mulilis & Duval, 1995; Lindell & Perry, 2004) that perceived presence of implementation barriers—such as lack of required information and skill, tools and equipment, and financial assets—predicts adoption of seismic hazard adjustments.

Data relevant to Hypothesis 10 found no support because households in leader communities in both regions did not show greater levels of stakeholder knowledge, trustworthiness, and responsibility for protection, hazard intrusiveness, risk perception, and hazard adjustment adoption than those in laggard communities. Hence, these findings did not support previous research, which showed that *City activity in earthquake hazard management* was an important correlate to seismic hazard adjustments (May & Birkland, 1994). This shows that the commitment of communities to deal with earthquake risks, local governmental capacity

for addressing earthquake risks, and the hazard context that establishes the tractability of addressing earthquake risks, the three sets of factors based on which May and Birkland (1994) classified the cities, did not influence the households' perceptions of hazard adjustments as expected. There seems to be a gap between local government initiatives and communication with the citizenry that needs to be examined in future research.

5.2 Stability of Perceptions over Time

The similarity in the pattern of correlations within 1997 and 1999 translated into an approximately linear plot of interitem correlations as seen in Figure 7. The correlations between the measures of each variable at Time 1 and Time 2 reveals consistent stabilities, with a minimum stability correlation of .23 and a maximum of .73 (see appendix). Stability correlations for federal knowledge ($r = 0.23$), state government knowledge ($r = 0.24$), friend responsibility ($r = 0.26$), and self/family responsibility ($r = 0.31$) were relatively the lowest and these inconsistent patterns of low correlations needs to be looked into.

There were only three statistically significant differences in means between Time 1 and Time 2 as seen in Table XI. Respondents' perceptions of local government knowledge ($t_{217} = -2.19$, $p < .05$) ratings were higher in 1999 than in 1997. This difference could be due to special earthquake management efforts carried out in a particular city or in a particular seismic region. Research looking into these differences will inform us of possible best practices in those areas which can be translated to others.

In addition, respondents' perceptions of federal government responsibility ($t_{217} = 5.17$, $p < .05$) ratings were lower in 1999 than in 1997. This finding is theoretically significant because it supports the argument that people's perceptions of governmental protection responsibility have been declining since Jackson's (1977, 1981) and Garcia's (1989) research. Significantly, only

perceptions of federal protection responsibility changed, while perceptions of state or local government responsibility remained the same. Further research is needed to replicate this finding and explain why it occurred. Finally, respondents' adoption of seismic hazard adjustments (t_{231} = -2.40, $p < .05$) was higher in 1999 than in 1997. This could have been because of improved city activity or management initiatives that increased hazard knowledge. Alternatively the increase could have resulted from being part of the respondent pool, which might have heightened their hazard intrusiveness and thereby increased adoption of hazard adjustments.

The variables predicting hazard adjustment over time seemed to follow a very interesting pattern. Despite many significant stability correlations between Time 1 and Time 2, the ones that seem to really matter in protective action decision-making were: employer knowledge, friend knowledge, and self/family knowledge (peer group knowledge average $r = 0.31$); employer trustworthiness, friend trustworthiness, and family trustworthiness (peer group trustworthiness average $r = 0.31$); self/family responsibility ($r = 0.21$); hazard intrusiveness ($r = 0.36$); hazard experience ($r = 0.35$) and location Washington ($r = -0.15$). Female gender, risk perception and other stakeholder characteristics did not predict hazard adjustment adoption over time.

These are very interesting findings that suggest stakeholder characteristics could affect hazard adjustment adoption in one of two ways, indirect or direct. In this case, an indirect effect on hazard adjustment might have occurred through the respondent's perception of peer group knowledge and trustworthiness, which influence him/her to accept information about a hazard and hazard adjustments and this information, in turn, changes their behavioral intentions and actual behavior. This indirect effect corresponds to changes in Fishbein and Ajzen's (1975) *attitude toward the act*, Petty & Cacioppo's, (1986) *central route to persuasion*, and Chaiken's (1987) *systematic processing*. An alternative direct effect is also possible as employers, friends, and family are very close to oneself as seen in the 'onion model' and thereby influence a

person's behavioral intentions and actual behavior without affecting their acceptance of information about the hazard and hazard adjustment. Clearly, increased trust between peer group and oneself leads to positive interactions (Slovic, 2000) and generates an increased probability of changing the attitudes of others (Maass & Clark, 1983). This direct effect corresponds, to Fishbein and Ajzen's (1975) *subjective norm*, Petty and Cacioppo's (1986) *peripheral route*, and Chaiken's (1987) *heuristic processing*.

5.3 Research Limitations

It is important to acknowledge that this study has its limitations. First, the response rate for this panel was low (42%) and this raises questions about the generalizability of the results. Despite the representation of both sexes, a wide range of ages, education, income, ethnicities, and home ownership arrangements, the respondents' demographic characteristics did not exactly mirror the population from which they were drawn (compared with 1990 census data for the study communities). However, biases were found in only a few variables and even those were not large (Lindell & Prater, 2000). The biases tended to be similar in the two states suggesting that there is no net effect on differences in means between states (i.e. the tests of H4 & H5). Moreover, as noted earlier, correlation coefficients are resistant to mean bias so tests of the other hypotheses (H1, H2, H3, H6, H7, H8, H9 and H10 can be taken at face value).

Second, this study was a longitudinal panel study aimed at overcoming the limitations of cross-sectional designs related to causal inferences; the data was collected only at two points in time 1997 and 1999. Although the data made it possible to test the stability of different measures including, risk perception, stakeholder characteristics, and adoption of seismic hazard adjustment, it would have been richer had it been collected from multiple points in time. This may not always be possible from a random sample of the population because of reduction in

panel sample size due to migration of an inherently transient population and funding limitations, but may need to be looked into for future research.

Third, the questionnaires were administered during years when no earthquake hit either region, possibly reducing the salience of the issue in the minds of the respondents. The same questionnaires could be administered to populations in these regions immediately following a major earthquake to test for differences in perceptions and adoption of seismic hazard adjustments.

Fourth, the federal, state, and local government influentials were not separated by agency name (e.g. FEMA, California/ Washington Governor's Division of Emergency Management, local planning commissions, police department etc.) leading to possible unintentional generalizations of perceptions of these stakeholders' knowledge, trustworthiness and responsibility. The same was the case with news media (paper, TV, radio) being generalized as one. Future research might want to identify these agencies by name and as individual stakeholders and ask specific questions about them.

5.4 Practical Implications

In addition to its contributions to theory, this study also has practical implications. Respondents agreed significantly in their perceptions about the government agencies, especially state government being most knowledgeable and trustworthy despite self/family having the most responsibility for personal safety. Self-reliance is an admirable trait, but is problematic if people are responsible for protecting themselves from hazards they don't understand. The obvious practical solution is for seismic hazard managers and non-governmental organization representatives, such as the American Red Cross, to address these needs by providing more hazard knowledge to those exposed. Moreover, the data revealed respondents' lack of confidence

about the hazard expertise of their employers, friends and family, so knowledgeable organizations should implement hazard education programs to inform employers about seismic hazard adjustments. Once this pool is educated and trained they can impart that knowledge to their employees. Furthermore, by increasing specific information of the various hazard adjustments and their applicability to multiple hazards, and developing a portfolio of incentive programs (tax breaks, % APR, loans, installment schemes) that reward adoption can help as well (Peacock, 2003).

The data also indicate that females differ from males in risk perceptions and protection responsibility but, nonetheless, have only small differences in hazard adjustment. A better understanding of these results will require a gendered perspective (Fothergill, 1996). Hazard managers can effect greater improvements in seismic hazard adjustments if they use gender mainstreaming—that is, targeting female population segments with specific messages about sustainable hazard reduction programs.

5.5 Conclusions

The findings indicate that risk perception, fatalism, personal control, demographic characteristics, and city activity in hazard management do not predict hazard adjustment processes. Both years' data showed hazard intrusiveness, hazard experience, and stakeholder knowledge, trustworthiness, and responsibility are significantly related to the increased adoption of hazard adjustments by households. Particularly important is the role of peer groups' (employers, friends and family) knowledge, trustworthiness and responsibility. These stakeholders, which are the closest to oneself in the 'onion model' (Godschalk et al., 1994), seem to influence households' actions to take protective actions. The news media, however, was perceived to be different from the government agencies and the peer groups and occupied their

own ring of influence. This suggests that emergency managers cannot count only on the federal, state, and local government advisories put out through the news media to affect households' decisions to adopt hazard adjustments. This would not inform the peer groups adequately. Emergency managers need to get to the various service organizations, industrial groups, trade unions, neighborhood organizations, and educational institutions to increase the knowledge and trustworthiness of all in the peer group. By so doing, they will assure higher household hazard adjustment adoption levels, thus facilitating a reduction in post disaster losses and recovery time.

5.6 Suggestions for Future Research

1. Apply structural equation modeling (LISREL) to the six city panel data by using the results from this study to specify the models of interest. This will enable the testing of the best model for the stability of perceptions over time that affects seismic hazard adjustment adoption behaviors.
2. Future research needs to address the connection between mass media and authority, and if these perceptions have changed after the recent hurricanes Katrina and Rita devastations.
3. Find out if there are differences between those communities that had Community Emergency Response Teams (CERTs) and those that didn't.
4. We have the household level data for the six cities and we need to do face-to-face interviews with local authorities to find out what they think of the hazard adjustment processes. This will facilitate the extension of household level data to the local government level, which is where the policies are made.
5. Most of the existing literature on gender and disasters focuses almost exclusively on impact and response and is mostly anecdotal. There is a dearth of research data

disaggregated by sex for different environmental disaster situations. This needs to be pursued.

6. It will be worthwhile to model the adoption of hazard adjustments by households' facing other natural disasters (e.g. cities along the Gulf Coast bearing the brunt of floods and catastrophic hurricanes). Comparing data from these hazards with the present data on earthquakes will allow us to find commonalities and differences that will better inform policies at the jurisdictional and household levels.

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APPENDIX A

Stability Correlations (*r)* Between Variables in 1997 and 1999

Variables	1	2	3	4	5	6	7	8	9	10	11
99Knowledge (Kn)											
1. FedKn	0.23	0.23	0.17	0.15	0.09	0.17	0.11	0.35	0.38	0.30	0.30
2. StaKn	0.12	0.24	0.31	0.26	0.14	0.17	0.14	0.23	0.40	0.44	0.29
3. LocKn	0.11	0.26	0.45	0.32	0.16	0.24	0.19	0.16	0.33	0.48	0.27
4. MedKn	0.15	0.24	0.24	0.40	0.12	0.27	0.17	0.16	0.26	0.33	0.40
5. EmpKn	0.12	0.22	0.23	0.22	0.39	0.29	0.15	0.17	0.23	0.24	0.21
6. FrdKn	0.10	0.17	0.27	0.19	0.28	0.40	0.26	0.09	0.23	0.27	0.22
7. SelKn	0.08	0.19	0.29	0.16	0.33	0.36	0.49	0.01	0.14	0.21	0.09
99Trustworthiness (Tr)											
8. FedTr	0.19	0.23	0.14	0.13	0.11	0.13	0.02	0.45	0.46	0.32	0.27
9. StaTr	0.17	0.31	0.29	0.21	0.13	0.18	0.09	0.39	0.53	0.47	0.35
10. LocTr	0.08	0.25	0.32	0.27	0.17	0.18	0.12	0.21	0.39	0.46	0.26
11. MedTr	0.16	0.26	0.17	0.34	0.09	0.17	0.14	0.30	0.42	0.31	0.42
12. EmpTr	0.13	0.18	0.21	0.20	0.37	0.26	0.17	0.28	0.29	0.32	0.25
13. FrdTr	0.10	0.18	0.21	0.17	0.18	0.29	0.20	0.14	0.22	0.25	0.18
14. SelTr	0.06	0.14	0.18	0.14	0.22	0.33	0.33	0.12	0.17	0.23	0.11
99Responsiblility (Re)											
15. FedRe	0.08	0.15	0.15	0.25	0.06	0.05	0.01	0.10	0.13	0.15	0.25
16. StaRe	0.08	0.16	0.18	0.26	0.05	0.08	0.09	0.08	0.15	0.19	0.26
17. LocRe	0.02	0.09	0.11	0.21	0.01	0.04	0.07	0.03	0.10	0.14	0.19
18. MedRe	0.00	0.08	0.16	0.28	0.08	0.09	0.10	-0.08	-0.01	0.06	0.24
19. EmpRe	0.03	0.11	0.16	0.18	0.22	0.20	0.15	0.03	0.10	0.15	0.19
20. FrdRe	-0.02	0.11	0.11	0.20	0.14	0.24	0.13	-0.03	-0.01	0.10	0.13
21. SelRe	0.15	0.19	0.22	0.12	0.18	0.24	0.26	0.19	0.26	0.21	0.20
99Other variables											
22.Gender	0.06	0.07	0.13	0.12	0.04	-0.02	0.06	0.09	0.09	0.06	0.08
23.Locat	-0.02	-0.26	-0.28	-0.12	-0.17	-0.24	-0.16	0.02	-0.11	-0.21	-0.08
24.Leader	0.02	-0.04	0.00	0.08	0.00	0.03	-0.02	0.12	0.10	0.07	0.18
25.Laggard	0.02	0.07	0.06	0.02	0.07	-0.02	0.03	0.00	0.07	0.07	0.02
26.PerCo	-0.03	-0.03	-0.04	-0.15	0.00	0.05	0.03	-0.10	-0.05	-0.09	-0.18
27.ResAd	-0.04	-0.05	0.03	-0.01	0.19	0.22	0.24	0.05	0.13	0.15	0.06
28.ActLu	-0.06	-0.05	0.03	0.01	0.03	-0.04	0.04	0.00	0.01	0.00	-0.03
29.ActGod	-0.02	-0.09	-0.10	-0.12	-0.02	-0.06	-0.06	0.02	0.09	-0.06	-0.10
30.HazIn	0.10	0.12	0.18	0.08	0.18	0.16	0.30	0.05	0.09	0.11	0.10
31.HazEx	-0.04	0.12	0.19	0.02	0.16	0.24	0.24	-0.13	0.01	0.09	-0.02
32.RiskPe	0.10	0.16	0.21	0.22	0.20	0.12	0.22	0.05	0.12	0.14	0.18
33.HazAd	-0.07	-0.07	0.10	0.04	0.30	0.24	0.39	-0.04	0.02	0.11	0.06

Notes: N's ranged from 198 to 232

r = 0.18 or greater, significant at the 0.01 level; between r = 0.13 and 0.17, significant at the 0.05 level.

Fed = Federal government, Sta = State government, Loc = Local government, Med = Media,

Emp = Employer, Sel = Self/family, Gender = Female (1), Locat = Washington (1), Leader = Leader City, Laggard = Laggard City,

PerCo = Personal Control, ResAd = Resource Adequacy, ActLu = Act of luck, ActGod = Act God,

HazIn = Hazard Intrusiveness, HazdEx = Hazard Experience, RiskPe = Risk Perception, HazAdj = Hazard Adjustment Adoption

12	13	14	15	16	17	18	19	20	21	22	23	24
0.16	0.05	0.06	0.25	0.21	0.24	0.08	-0.01	0.02	0.04	0.07	-0.02	-0.01
0.20	0.04	0.09	0.20	0.22	0.28	0.08	0.02	0.00	0.11	0.14	-0.21	-0.05
0.25	0.11	0.12	0.15	0.13	0.20	0.11	0.12	0.10	0.16	0.15	-0.27	0.03
0.17	0.07	0.10	0.23	0.22	0.26	0.30	0.19	0.15	0.10	0.17	-0.16	0.03
0.44	0.15	0.13	0.08	0.08	0.14	0.03	0.13	0.07	0.06	0.13	-0.14	-0.12
0.30	0.24	0.24	-0.09	-0.08	0.00	-0.04	0.05	0.05	0.17	0.10	-0.33	0.01
0.23	0.24	0.40	-0.06	-0.02	0.07	-0.06	0.08	0.08	0.25	0.06	-0.30	-0.04
0.15	0.09	0.01	0.16	0.12	0.08	0.08	0.05	-0.03	0.07	0.10	-0.05	0.02
0.18	0.16	0.11	0.12	0.18	0.21	0.10	0.06	0.00	0.19	0.15	-0.20	-0.03
0.18	0.12	0.10	0.06	0.10	0.18	0.08	0.11	0.02	0.19	0.21	-0.22	0.02
0.23	0.23	0.16	0.17	0.19	0.22	0.16	0.14	0.11	0.13	0.13	-0.05	0.08
0.48	0.29	0.21	0.07	0.08	0.13	0.05	0.22	0.10	0.16	0.08	-0.16	0.03
0.23	0.38	0.34	0.02	0.04	0.08	0.05	0.04	0.11	0.14	0.10	-0.23	-0.06
0.25	0.34	0.46	0.01	0.03	0.03	0.01	0.12	0.10	0.20	0.02	-0.18	-0.02
0.08	0.11	0.05	0.44	0.41	0.41	0.43	0.16	0.21	0.05	0.16	-0.20	0.01
0.09	0.16	0.09	0.45	0.50	0.51	0.46	0.15	0.21	0.10	0.19	-0.20	0.01
0.05	0.12	0.05	0.43	0.48	0.49	0.42	0.15	0.20	0.12	0.17	-0.16	0.04
0.05	0.10	0.06	0.25	0.29	0.34	0.48	0.16	0.22	0.01	0.16	-0.07	0.00
0.24	0.15	0.09	0.22	0.19	0.26	0.25	0.39	0.20	0.07	0.17	-0.15	0.01
0.15	0.21	0.15	0.17	0.14	0.16	0.22	0.14	0.26	0.06	0.13	-0.22	-0.04
0.24	0.23	0.27	0.17	0.24	0.23	0.02	0.14	0.12	0.31	0.03	-0.08	0.01
-0.03	0.02	-0.03	0.11	0.13	0.13	0.23	0.12	0.15	0.07	0.76	0.03	0.00
-0.12	-0.20	-0.18	0.00	-0.04	-0.09	0.04	0.02	-0.10	-0.11	-0.04	1.00	0.16
0.07	0.03	-0.01	0.05	-0.03	-0.04	-0.03	0.08	0.04	-0.04	0.00	0.16	1.00
0.02	-0.01	0.00	-0.09	-0.04	-0.03	-0.05	-0.06	-0.09	0.13	0.00	0.00	-0.42
0.05	-0.01	0.03	-0.28	-0.28	-0.33	-0.37	-0.15	-0.19	-0.05	-0.16	0.01	0.03
0.23	0.22	0.29	-0.10	-0.10	-0.06	-0.10	-0.03	0.03	0.17	-0.15	-0.05	-0.01
-0.03	-0.07	-0.04	0.01	-0.02	-0.01	0.00	0.01	0.00	-0.09	0.05	-0.07	-0.05
-0.02	-0.05	0.02	-0.13	-0.09	-0.11	-0.14	-0.01	-0.13	-0.10	-0.13	0.02	-0.01
0.13	0.13	0.19	0.10	0.11	0.09	0.07	0.17	0.06	0.21	0.06	-0.23	-0.02
0.12	0.20	0.28	-0.03	0.00	0.06	-0.06	0.06	0.07	0.18	0.03	-0.56	-0.19
0.13	0.06	0.15	0.23	0.25	0.30	0.23	0.15	0.16	0.10	0.25	-0.08	0.01
0.26	0.20	0.31	-0.04	-0.06	-0.01	-0.02	0.12	0.12	0.21	-0.09	-0.15	-0.06

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25	26	27	28	29	30	31	32	33
0.05	-0.20	0.03	-0.06	0.01	-0.03	-0.06	0.16	-0.04
0.12	-0.14	0.05	0.02	-0.04	0.02	0.10	0.19	0.09
0.05	-0.14	0.04	0.04	-0.12	0.08	0.12	0.12	0.10
0.07	-0.29	0.03	-0.04	-0.16	0.06	-0.04	0.13	0.04
0.09	-0.03	0.26	-0.05	-0.09	0.17	0.10	0.17	0.19
0.04	-0.01	0.28	-0.14	-0.08	0.09	0.25	0.01	0.19
0.03	0.03	0.32	-0.12	-0.08	0.27	0.37	0.16	0.31
0.08	-0.12	0.09	-0.03	0.01	0.02	-0.06	0.07	-0.05
0.15	-0.07	0.15	-0.02	-0.08	0.07	-0.01	0.13	0.08
0.05	-0.06	0.16	-0.03	-0.14	0.10	0.08	0.07	0.08
0.03	-0.21	0.13	-0.08	-0.08	0.16	-0.09	0.09	0.03
0.07	-0.06	0.28	-0.04	-0.08	0.17	0.03	0.09	0.14
0.12	-0.13	0.19	-0.10	-0.08	0.18	0.15	0.08	0.09
0.07	-0.10	0.21	-0.08	-0.03	0.24	0.24	0.07	0.21
-0.02	-0.38	-0.15	-0.02	-0.09	0.10	0.04	0.20	-0.04
0.00	-0.36	-0.12	-0.04	-0.11	0.09	0.06	0.18	-0.04
-0.02	-0.36	-0.15	-0.09	-0.15	0.08	0.05	0.15	-0.03
-0.03	-0.36	-0.09	-0.15	-0.21	0.07	-0.01	0.13	0.01
-0.05	-0.20	0.02	-0.11	-0.03	0.10	0.11	0.17	-0.04
-0.02	-0.29	0.06	-0.04	-0.13	0.16	0.12	0.12	0.09
0.04	-0.03	0.14	-0.10	0.00	0.19	0.13	0.12	0.20
0.02	-0.05	-0.06	0.13	-0.10	0.05	-0.02	0.23	-0.02
0.00	-0.05	-0.06	-0.09	0.05	-0.20	-0.56	-0.09	-0.23
-0.42	0.04	-0.07	0.12	0.09	-0.03	-0.18	-0.04	-0.07
1.00	0.02	0.01	-0.02	-0.03	0.00	-0.16	0.00	-0.08
-0.04	0.40	-0.01	0.00	0.11	-0.10	0.01	-0.18	0.04
-0.05	0.02	0.56	0.03	0.05	0.24	0.24	-0.10	0.47
0.06	0.02	-0.05	0.50	0.10	0.02	0.01	0.11	0.02
-0.01	0.13	0.13	0.07	0.51	-0.10	0.04	-0.01	0.07
0.02	-0.11	0.18	0.04	-0.10	0.35	0.18	0.21	0.27
-0.15	0.03	0.19	0.05	-0.02	0.31	0.77	0.20	0.38
0.02	-0.26	-0.16	0.03	-0.12	0.23	0.04	0.54	0.07
-0.04	-0.02	0.44	0.03	-0.04	0.36	0.35	0.09	0.73

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Ph.D. in Urban and Regional Science, Texas A&M University, College Station, Texas, (2006)

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Arlikatti, S. (2003). Can western styles of dispute resolution be applied to an Indian context? American Planning Association's online student publication "*The New Planner*."

ACADEMIC HONORS (selected)

- Jesus H. Hinojosa Endowed Scholarship in Urban Planning, Texas A&M University, 2005.
- Landscape Architecture and Urban Planning Department Head Honor Roll, 2005.
- Goodman Fellowship, International Board and International Student Services, TAMU, 2004.
- Susan Arseven Make a Difference Award, Women in Science and Eng., TAMU, 2004.
- Education Foundation Scholarship, Texas Chapter of the American Planning Association, 2002-2003.
- Association of Former Students' Graduate Fellowship, Texas A&M University, 2001-2002.