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EXPLORING BARRIERS TO MITIGATION BY HOMEOWNERS

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ABSTRACT

Mitigation techniques to prevent damage and injuries from earthquakes are relatively well understood, and most are inexpensive, yet they are underutilized by homeowners. Disaster research has typically focused on barriers to preparedness; relatively little research has been conducted on the barriers to mitigation. This pilot study expands the research in this area using a sample of over 300 faculty and staff at a western public university situated in a high seismicity area. Mitigation was more common for home structures and systems (mostly code regulated), but severely lacking for home contents. Heightened perceptions of earthquake threats, experience with earthquake injuries and damage, and social relationships were found to be critical predictors of mitigation. Demographic characteristics were not predictive of mitigation or stated obstacles to mitigation. Costs were a small obstacle to home structures and systems mitigation, but for home contents the primary obstacle was the belief that such were not important. Social networks are a key factor in determining mitigation: the more persons in respondents' networks experienced damage, and the more persons in their networks mitigated, the more likely respondents were to mitigate. Suggestions for new non-financial incentives are made.

Introduction

The purpose of this research is to explore barriers or impediments that prevent *homeowners* from implementing earthquake hazard or damage reduction measures, frequently referred to as mitigation. The focus on homeowners is consistent with the efforts of the California Seismic Safety Commission which has targeted homeowners for its hazard reduction outreach. Practically all earthquake mitigation measures are relatively simple, straightforward and can be very effective (Multihazard Mitigation Council 2005; U.S. Geological Survey 2005). They are also not prohibitively expensive, especially those protecting the contents of homes. Presently, significant amounts of educational materials on mitigation targeted at homeowners exist. These have typically been distributed by governments and non-profits. Despite availability of such materials, often including "how-to" instructions, mitigation has not been as widely adopted by the public as it could be (U.S. Geological Survey 2005).

Background

Extensive research assessing the importance of mitigation from a technical and financial perspective, particularly focusing on mitigation from an insurance and civil engineering aspect,

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has been done (Settle 1985; Kunreuther 1998; Multihazard Mitigation Council 2005). Much of this research focuses on public administration or commercial risk management. Mitigation research often revolves around what city planners and governments can do to reduce both property damage and the injury of residents in various natural disasters (Bolt 1991; Lamarre 1998; Nelson 2002; Palm and Hodgson 1992). Also, a solid body of research assessing disaster preparedness exists (Russel 1995), but there has been little focus solely on earthquake hazard mitigation among individuals.

Homeowners themselves do not take the proper precautions against disasters (Lindell 2000; U.S. Geological Survey 2005). In fact, Edwards (1993) shows that when asked about disaster preparedness in an area where earthquakes are a potential hazard, over 70 percent of individuals responded that they had taken actions toward personal preparedness, but less than four percent had participated in actual mitigation practices. Persons tend to increase disaster preparedness and/or mitigation efforts either directly after a major disaster has occurred or when there has been a large increase in awareness about the threat of a disaster (Duval 1999; Kreps 1984). Still, the majority of the population remains unprepared at all times (Council for Excellence 2007; National Center for Disaster Preparedness 2007; Department of Homeland Security 2007).

There are several predictors of disaster preparedness and/or disaster mitigation. Persons who are preoccupied with daily life are less concerned about preparing for a natural disaster (Lindell 2000; Clarke 2008). Many do not mitigate because they feel that such actions are the responsibility of others, such as government (Lindell 2000; City of Roseville 2004). For some, mitigation is financially prohibitive (Lindell 2000; Weber 2003). Past research has shown that demographics also matter. Full-time workers are more likely to prepare (Council for Excellence 2006). Preparedness varies with age group, with young adults being least prepared (Department of Homeland Security 2007). In disaster preparedness studies, African Americans were rated the most prepared of all ethnic categories, and Non-Hispanic Whites were ranked as the least prepared (Council for Excellence 2008). Finally, persons with less education are less prepared than those with higher education (Council for Excellence 2006; 2008).

In addition, more precautions are taken by persons who are aware of disaster risks or perceive that a disaster is imminent (Clarke 2008; Turner 1986), and those who personalize disaster threats (Lindell 2000; Weber 2003). Such perceptions may be conveyed to persons through the "disaster subcultures" in which they may live (Wenger 1978; Turner 1986). Regardless of local culture, learning that earthquakes are a threat activates persons to obtain information and inquire about preparedness (Turner 1986). Furthermore, those having experienced an earthquake are more likely to take precautions (Rea & Parker Research 2006). Finally, social networks are important predictors of preparedness and mitigation. Discussing earthquake concerns, and involvement in the community, have greater influence on taking precautions than things such as earthquake predictions and level of fear (Turner 1986). In fact, often persons' preparedness activities are associated with the same preparedness activities that were taken by others in their social networks (Mileti 1997).

It is in the interest of earthquake mitigation researchers to understand what incentives would work to encourage individuals to mitigate. Given the discussion above, incentives to encourage mitigation would be to help persons understand the realistic urgency of threats in their area, financial help for taking action, education and information provided by trusted persons, such as police and fire officials or friends and family (Council for Excellence 2006).

Research Methods

Since this project was the start of research on incentives that lead to mitigation, a socially diverse sample from a high seismicity area that would be more motivated to respond, and more capable of comprehending questions in a pilot survey, was sought. The faculty and staff of a western university, located in San José, California, were selected and surveyed online. The fact that such persons would be more educated than the general population furthered the goals of motivation and comprehension. These persons were recruited via email, using a distribution list supplied by the university. 331 persons opted to respond to the survey. However, analysis is restricted to persons who were homeowners. This reduced the sample size by over 1/3 to 215.

The questionnaire measured self-reports of mitigation behaviors and experiences, home characteristics, perceptions of others' mitigation behaviors and experiences, attitudes about mitigation, and demographic variables. Each set of variables were identified as likely related to mitigation activities. For the purposes of brevity, actual questions used are not reported here.

Respondents reported whether they had mitigated in these ways: researched earthquake damage prevention, had an engineer assess the home's earthquake resistance, secured home to its foundation, strapped down water heater, fitted gas and other appliances with flexible connections, bolted large furniture items into place, placed safety straps on large appliances, placed security latches on cabinets, secured heavy wall hangings, secured table tops items into place, braced or replaced masonry chimney into place, braced masonry or concrete walls, and placed plastic film over windows. For those who responded to questions in this section with a "not done" response, additional questions were asked to explore why they had not taken the cited step towards hazard mitigation.

To determine whether perceived risk affects level of mitigation, questions about the respondent's perception of the likelihood of an earthquake occurring were asked. Another set of questions measured the extent to which respondents have experienced or known others who have experienced injury or damage caused by an earthquake. Respondents were also asked whether they mitigated in response to others' damage or injury.

Potential effect(s) that incentives could have on mitigation were measured. The incentives were: discount on your insurance, tax break/tax incentive, free items needed to prevent damage, free advice to assist in prevention efforts, free service or labor to assist in prevention efforts, and more information on regulations and codes.

Results

The sample shows variation on many demographic characteristics. Women are overrepresented (64 percent). Out of the 215 homeowners, 79 percent own single-family homes. Eighty-four percent were married, and 68 percent did not have children under 18 living with them. The sample has more white persons (71 percent) and fewer Asian (15 percent) and Latino persons (eight percent) than the City of San José (U.S. Census Bureau 2007). The sample is also older (median category is 51 to 55), more educated (85 percent have a college degree or more), and has a higher median household income (median category is $110,000 to $129,999). Finally, the sample reported disposable income: 37 percent had less than $1,000, 50 percent had between $1,000 and $5,000, and 13 percent had over $5,000 left over after all expenses each month.

Earthquake Expectations and Experiences

A large majority believe a major earthquake is somewhat likely (73 percent) or very likely (11 percent) to occur within the next year. Far more individuals believe a major earthquake is very likely (60 percent) in the next 10 years, while 38 percent say such an event is somewhat likely. Further, most respondents acknowledge that a major earthquake is a possibility, if not a probability, during the time that that they are living in their current home. When asked whether they expected injuries or damage caused by an earthquake in their own homes in the near future, over half (57 percent) thought that injuries were somewhat or very likely to occur, and even more (88 percent) felt the same about damages occurring in their homes. Overall, then, most respondents not only expect a major earthquake to occur within the next 10 years, but they also expect to suffer losses in the near future.

Respondents also reported actual experiences with earthquake injuries and damage. In the area of injuries, there were very few (only 12) persons who reported that they or anyone they knew had been injured. Ten of those 12 reported that the injury prompted them to mitigate, or take steps to prevent injuries that may be caused by future earthquakes. Far more respondents (over 70 percent) knew someone who had who had suffered damage or had experienced damage themselves. When asked whether the damage experience caused them to mitigate, over half reported that it did.

Respondents were also asked who had experienced the damage from earthquakes in the past. Table 1 provides the relationships to respondents of those experiencing damage. It also shows the percentage of individuals reporting mitigation as a result of damages. The majority of persons who experienced damage themselves or knew someone who did reported that they mitigated. Chi-squared tests were run to discover whether particular relationships with damage experience led people to mitigate any more than other relationships. The only relationships that prompted more mitigation in such comparisons were “myself” and “neighbor.” This indicates

Table 1. Relationship to respondent of persons reported to have had earthquake caused damage in their home compared with those reporting that the experience caused them to mitigate against future damage, n = 151.

Relationship	Percent this relationship	n	Percent who mitigated	Comparing mitigation with those not reporting the relationship χ^2	df	p-value
Myself	46.4	70	70.0	8.20	1	.004
Spouse	19.2	29	62.1	0.30	1	.589
Parent	21.2	32	46.9	1.92	1	.166
Sibling	10.6	16	56.2	0.01	1	.907
Child	4.6	7	71.4	*		
Other family	9.3	14	57.1	0.00	1	.970
Friend	48.3	73	58.9	0.10	1	.757
Acquaintance	29.1	44	52.3	0.73	1	.394
Neighbor	23.2	35	74.3	5.18	1	.023

*Number is too small to produce a valid Chi-squared Statistic.

that the closer the damage is to one's own home, the more urgent mitigation acts seem to become. Closer relationships with those experiencing damage do not appear to make mitigation more urgent; physical proximity to self is more important.

Mitigation Activities

On several mitigation items, the majority of respondents said that they had not taken the step to prevent earthquake damage or injury (Table 2). Highlighting the importance of building codes, the mitigation items that were most commonly done were also those that are required, such as strapping water heaters (88 percent) which is required when one sells a home in California. Other home structures and systems mitigation activities had majorities reporting that they had been done (including others having done it before they moved in). The only item without majority implementation was placing plastic film over window glass (4 percent). Also reported was extensive neglect to prevent damage and injury by securing household belongings such as furniture and table top items. The most frequent mitigation activity among these, securing heavy wall hangings, does not even have a majority reporting having done it (45 percent). Generally, there is more mitigation of home structures and systems than there is for contents of the home. This indicates that any existing efforts to increase mitigation for those items have not affected this sample much.

Table 2. Percent reporting each status of mitigation activity by mitigation category.

Mitigation item, Structures and systems	Done	Mitigation item, Contents	Done
Secured home to its foundation	63	Researched earthquake damage prevention	58
Strapped down water heater	88	Engineer assessment of home	16
Fitted gas and other appliances with flexible connections	70	Bolted large furniture items into place	39
		Placed safety straps on large appliances	11
Braced or replaced masonry chimney	62	Placed security latches on cabinets	18
Braced masonry or concrete walls	73	Secured heavy wall hangings	45
Placed plastic film over windows	4	Secured table top items into place	17

Respondents who had *not* mitigated were asked to choose reasons for not having done so (e.g., not enough information, too expensive, etc.). Table 3 shows the percent of respondents choosing each reason. The most prevalent reason is highlighted in each row. Four of the items had very few respondents who had *not* mitigated in that area ("foundation," "water heater," "flexible connectors," and "masonry or concrete walls"). These four are aimed at preparing the home structures and systems, and many are mandated by codes that regulate contractors. Barriers to mitigating home structures and systems tend to be knowledge and perceived costs. However, most of these mitigation steps are more commonly reported than the others.

Mitigation involving home contents was generally considered inconvenient and unnecessary. Another popular response for these was that the mitigation step would take too much time to implement.

An important finding is that these homeowners assume responsibility for mitigation. For the two items where this option was chosen most frequently, bolting the house to the foundation and walls, only 7.4 and 7.1 percent, respectively, claimed that they were not responsible. Also, cost is generally not a concern for most mitigation items. Indeed, among those things that were largely not done, cost only appeared to be a prominent reason for not hiring an engineer.

Table 3. Percent who indicated reason for not mitigating for each mitigation item.

Mitigation item	Not enough information	Too expensive	Un-necessary	Too much time	Not useful	Incon-venient	Not responsible	n
Research	19.7	15.8	7.9	28.9	10.5	22.4	3.9	76
Engineer	19.9	38.2	15.4	9.6	6.6	12.5	3.7	136
Foundation	25.9	51.9	7.4	11.1	11.1	11.1	7.4	27
Water heater	12.5	0.0	25.0	0.0	0.0	18.8	6.2	16
Flexible connectors	45.5	0.0	0.0	0.0	0.0	9.1	0.0	11
Chimney	17.6	50.0	8.8	8.8	7.4	8.8	2.9	68
Walls	42.9	35.7	7.1	0.0	7.1	14.3	7.1	14
Film on windows	35.8	7.0	18.7	5.9	8.6	21.4	0.5	187
Bolted furniture	6.6	5.7	16.4	20.5	3.3	29.5	0.8	122
Strap appliances	18.9	1.7	22.2	9.4	8.3	24.4	2.2	180
Latches on cabinets	11.3	1.8	17.9	13.1	13.1	36.9	0.6	168
Secured wall hangings	15.0	1.9	24.3	16.8	4.7	15.9	0.0	107
Table top items	7.8	0.0	26.5	13.3	11.4	21.7	0.0	166

Finally, it appears that home structures and systems mitigation is far more commonplace than home contents mitigation. The pattern of reasons that mitigation was not done across these two types implies that mitigating home structures and systems is perceived as necessary, but mitigating home contents is perceived as not necessary. This perception (*not* cost or lack of information) is what prevents persons from taking measures to mitigate household items.

Effects of Mitigation by Others

Respondents also reported whether they knew others who had mitigated (two-thirds did), and they named the relationship type (such as “spouse” or “sibling”). Just over one-third of those persons who knew others who mitigated reported mitigating in response to the efforts by others. Table 4 shows relationships to those who had mitigated and the percent claiming they mitigated in response to them. Chi-squared tests were conducted to compare those who knew someone who mitigated with those who did not for each relationship type on the amount of reported mitigation in response to knowing someone who had mitigated. These tests showed that a mitigating “spouse” and “other family” were the only categories that made mitigation more

likely. Relationship closeness to others (family versus not family) who have mitigated may affect mitigation behaviors, but there is not enough evidence to declare that closeness within the familial realm affects mitigation.

Table 4. Relationship to persons who have mitigated against damage or injury compared with those reporting that the experience caused them to mitigate, n=122.

Relationship	Percent this relationship	n	Percent who mitigated	Comparing mitigation with those not reporting the relationship χ^2	df	p-value
Spouse	13.1	16	68.8	8.03	1	.005
Parent	23.8	29	48.3	2.12	1	.145
Sibling	17.2	21	42.9	0.39	1	.533
Child	6.6	8	62.5	*		
Other family	20.5	25	56.0	4.94	1	.026
Friend	66.4	81	35.8	0.12	1	.728
Acquaintance	32.0	39	46.2	2.12	1	.146
Neighbor	37.7	46	43.5	1.38	1	.240

*Number is too small to produce a valid Chi-squared Statistic

Incentives

Respondents were presented with a list of potential incentives that might make mitigation more likely. For each one, respondents reported the likelihood that such an incentive would lead to greater mitigation (results not shown). Generally, all incentive types were reported by overwhelming majorities (over 75 percent) as likely to increase mitigation. Financial assistance was more popular. The two less popular items were free advice and more information on regulations and codes. Nonetheless, a sizeable majority indicate that advice and information would make them somewhat or very likely to mitigate more.

Predictors of Mitigation

The final objective was to determine whether there are variations in mitigation by demographic and cultural groups. In addition, other factors that may affect whether respondents mitigated were explored. The results in Table 5 indicate that there are only a few discernible patterns in predictors of mitigation. Bivariate tests (cross tabulations and correlations where appropriate) explored associations between predictors and reported mitigation. Mitigation was operationalized as (1) certainty that mitigation steps were taken versus (2) neglect of mitigation. This was achieved by creating two categories from reports: (1) “done” and “others did before I moved in” and (2) “not done” and “don’t know.” There are few predictors for most mitigation items. However, the respondent characteristics that are most related to mitigation appear to be “know a person who has had damage,” “know a person who mitigated,” and “age of home.” In fact, the item most related to mitigation behaviors appears to be having known a person who mitigated their own home. This finding points again to the social nature of mitigation behavior.

A few respondent characteristics were not related to any mitigation items. The characteristics not influencing certainty of mitigation were "expect a major earthquake in one year," "expect an earthquake that causes injury in the near future," and "children under 18 at home."

Table 5. Relationships between respondent characteristics and mitigation items where chi-squared tests indicated significant relationships.

	Research	Engineer	Foundation	Flexible connections	Chimney	Bolt furniture	Strap appliances	Cabinet latches	Secure wall items	Table top items
Single Family Home			+	+						
Earthquake 10 Years				+						
Damage Near Future	+			+						
Know Person Damage	+			+						+
Know Person Mitigated	+	+	+	+		+	+		+	
Male			+	+						
Married/Partnered	+									
Born in USA	+				+					
Disposable Income			+							
White			+	+						
Asian/Pacific Islander	–									
Age	+									
Income	+		+							
Education		+	+							
Years in Home	+							+		
Age of Home						–	–		–	

Binary logistic regression was used to test models of mitigation which took into account the likely simultaneous effects of respondent characteristics (results not shown). Included in the models were only those factors that were predictive of two or more mitigation items in Table 5. The findings are fairly simple. Knowing a person who has mitigated is the best predictor of mitigation. The second most important predictor was expecting an earthquake to cause damage in the near future. Other predictors, in comparison, affected only a couple of mitigation items.

Discussion and Conclusions

The findings showed that codes, perceptions of threat, and social experiences best explained why persons employed most types of mitigation. However, mitigation type also matters. For example, mitigation for home structures and systems was far more common than that for home contents. Demographic characteristics were surprisingly not related to mitigation steps.

Social relationships matter. Knowing someone who was injured or who had damage to their home prompted mitigation in response. In addition, those knowing someone mitigated were more likely to mitigate. Being close to someone who mitigated seems to make certainty of mitigation even more likely. This implies that social relationships may be leveraged somehow to

make mitigation more likely. Perhaps getting persons who have experienced damage, or persons who have mitigated, to share their experiences would influence others to take steps to prevent injury and damage. The importance of social relationships is accentuated by the fact these were the most robust predictors of mitigation.

Furthermore, the respondents felt that it was their own responsibility (not government or others) to mitigate. Therefore, neglect of mitigating—which was far more typical for less costly mitigation—seems the result of priorities rather than financial constraints. Financial incentives may work, however, to increase mitigation for home structures and systems. Mitigating home contents is not a high priority for respondents, but respondents may mitigate if someone else were to pay for it. Also, financial incentives may be more effective for home contents if persons perceive that that mitigation is important to do.

It should be noted that the incentives questions, based on those used in other research, largely assumed that the nature of incentives would need to be financial. More effort should be put into discovering effective non-financial incentives and to uncovering the interrelationships of other incentives to financial incentives. Personal relationships may be powerful motivators for homeowners to mitigate. Drawing from the findings, new incentives for mitigation that may work include: (1) campaigns that leverage knowledge of others' experiences and that normalize mitigation, and (2) campaigns that show mitigation techniques are important, effective, simple, and low in cost. Rather than simply continuing down the path (that is not working) of providing information, financial assistance, and regulation, policy makers should explore utilizing social relationships in the strategies aimed at influencing mitigation.

This new approach should be especially beneficial for mitigation of home contents because information is already out there, mitigating home contents is not costly, and it is impractical if not impossible to codify and regulate the things that persons do inside their homes. Social networks that prompt voluntary mitigation may be the answer to these difficulties.

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