Public Perception of Seismic Risk: The Educational Implications

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Introduction

Research (Thier and Gratton, 1986; Thier & Schnur, 1982) and extensive experience during the development and dissemination of the materials produced by the California Earthquake Education Program (CALEEP) has shown that it is quite easy to raise the public awareness of the threat of earthquakes and the need for preparedness. For example, state supported earthquake week and month activities in California over the years have brought to a focus public interest and actions regarding awareness, and to some extent preparedness. These activities have always been carried out in April, around the anniversary of the 1906 San Francisco Earthquake. You now see from time to time in the media questions or discussions about "earthquake weather." That is, people believe earthquakes take place at warm, somewhat humid, still times of the year (the weather in California in April). Perhaps the occurrence of the anniversary of the Loma Prieta Earthquake in October, when it tends to be cool and windy, will help to at least broaden the concept of "earthquake weather."

The great majority of the individuals surveyed during the research carried out in relationship to CALEEP expressed the **intentionality** to prepare for earthquakes, while only a small minority actually took **action** to prepare for an earthquake. This difference, which we found continuously between **intentionality** and **action**, is especially critical in schools. Teachers, for example, could reduce significantly the possibility of personal injury to students during earthquakes by taking action beforehand to provide effective earthquake education. This should include both planning and preparedness components, in addition to scientific information about earthquakes. An example of educational materials that meet these needs are those developed by CALEEP.

The California Earthquake Education Project (CALEEP) is a major activity of the Lawrence Hall of Science, University of California, Berkeley. CALEEP was a cooperative effort between the Lawrence Hall of Science and the California State Seismic Safety Commission. Curriculum development was funded by Chapter 785 of the 1981 Statutes of the State of California. Chapter 1558 of the 1984 Statutes of the State of California provided funds until December 31, 1987 for the implementation of these materials state-wide.

Independent evaluation, and direct user feedback, have proven these materials to be engaging and effective in school earthquake education and preparedness programs. In addition, CALEEP is a program that can be readily incorporated into the regular curriculum in science, math, language arts and social studies. The materials are specifically designed to help teachers meet their long term education goals in these areas, while teaching specifics about earthquakes and how to prepare for them.

No outside funds are currently available to support the work of CALEEP. Considering the need for earthquake education in California and the clear desire of teachers and schools to use CALEEP, the materials continue to be available on a cost recovery basis through the Lawrence Hall of Science.

CALEEP has developed extensive educational materials for school and community groups on earthquake science and earthquake preparedness. The goals of CALEEP are:

1. To motivate students and their families to take action to better prepare themselves to survive an earthquake with minimal injury, loss of property, and psychological upset.

2. To teach students about the science of earthquakes and related areas in the physical sciences.

3. To accomplish goals 1 and 2 in the context of a program that helps the teacher accomplish his or her goals for science and related educational experiences in the classroom.

Our evidence indicates that similar to the general public, many teachers intend to prepare and plan for earthquakes while far fewer take action to do so.

For example, after the September 1985 earthquake in Mexico City, a survey of 284 teachers carried out by the author and his associates clearly indicated this difference between intentionality and action on the part of teachers in schools directly impacted by the event.

The analysis of the data collected was carried out by using a test for significance and computing eta, a statistically determined index of practical importance, to determine the proportion of the variance associated with the differences between pairs of means. This provided extensive information regarding the differences between intentionality and action on the part of those leaders who experienced the Mexico City earthquake of September 19, 1985. This information is summarized in the Comparison of Selected Means from the study reprinted below.

Comparison of Selected Means

	Comparison	M1	M2	t	eta	Estimated eta magnitude
1	Adequacy of knowledge of the cause of the earthquake before/after	3.03 (1)	3.48 (12)	4.47*	03%	small
2	Adequacy of preparation for the earthquake before/after	2.77 (2)	3.14 (13)	3.70*	02%	small
3	Adequacy to act as a leader before/after	2.85 (4)	3.08 (10)	2.16	01%	small
4	Adequacy of knowledge of the cause before/desire to increase the adequacy of knowledge after	3.03 (1)	4.52 (6)	16.5*	33%	large
5	Adequacy of knowledge of preparation before/desire to prepare after	2.77	4.58	21.1*	45%	large
6	Desire after to know more/perception of information availability	4.52 (6)	3.24 (8)	14.8*	28%	large
7	Desire after to know how to prepare/ perception of information availability	4.58 (7)	2.96 (11)	18.2*	38%	large
8	Knowledge before/action after	3.03 (1)	3.91 (9)	9.25*	13%	moderate
9	Knowledge of preparation before/ action regarding preparation after	2.77	3.08	2.98	1.6%	small
10	Desire to know more after/actions to inform self	4.52 (6)	3.91 (9)	8.75*	12%	moderate
11	Desire to know how to prepare after/ actions to learn how to prepare after	4.58 (7)	3.08 (4)	17.19	34%	large

*significant at .01, t Dunn

The first two comparisons in the Table look at individuals' perception of the adequacy of their knowledge before and after the earthquake, of what causes earthquakes, and how to prepare for them. This is essentially a measure of what respondents think they have learned since the earthquake. Though the t ratio is significant, the value of eta is quite small and the actual mean difference is also quite small. This contrasts with comparisons 4 and 5, which compare individuals' perceptions of the same issues before the event with their desire for knowledge about earthquake causation and preparation after the event. This is essentially a measure of their desire or intentionality to learn since the earthquake. Note that the eta squared values are quite large and the actual differences in the means are quite large. Since one has to do something to learn something (items 1 & 2), these four comparisons clearly indicate the difference between intentionality (comparison 4 & 5) and action (comparisons 1 & 2) regarding knowledge of what causes earthquakes and preparation for earthquakes. Comparisons 3 and 9, which investigate individuals' perception of their capacity to be a leader afterwards compared with their perception of their knowledge of preparation or ability to act as a leader beforehand, are the only two comparisons with non-significant t's. This, combined with the previous comparisons, clearly indicates that even after a major earthquake, intentionality alone is not enough to develop in these respondents the confidence to act as leaders in a future disaster.

A partial explanation of the results may be that these respondents perceived a lack of satisfaction with the amount of information available to them after the earthquake. The means were close to neutral (3.24 for causes and 2.96 for preparedness) indicating a lack of strong agreement that sufficient information was provided. However, availability of information is closely related to the effort one makes to obtain it, particularly in major urban areas. Hence, we can assume that the intentionality of these respondents exceeded their efforts. Note that any bias resulting from sampling technique would be in opposition to this result. Teachers who came to meetings and participated in the survey would be expected to have more initiative than those who did not. These findings regarding the discrepancy between intent and action reinforce the information on these same issues obtained during the early survey research efforts related to CALEEP. In this research, 75% of over 600 representative Bay Area residents indicted that they expected a large earthquake would strike in their lifetime, that they would be affected by it, and that they did not anticipate receiving emergency services quickly. Nevertheless, less than a quarter of respondents had done anything to prepare for the event of an earthquake (Thier & Schnur, 1983).

Recently, especially at the community level, a number of efforts have been focusing on motivating people and neighborhood groups to organize themselves to respond effectively at the time of an earthquake. Many of these efforts also attempt to provide their public with the information they need to better prepare themselves beforehand for the eventuality of an earthquake.

Traditionally, earthquake preparedness and education programs have concentrated on making the public aware of earthquakes and the need to prepare for them. Fliers, brochures, slide shows, etc. have been produced which tell people about earthquakes, their causes, and appropriate preparedness measures. The distribution of the flier or brochure and the viewing of the slide show has too often been considered a measure of the success of the endeavor.

Frequently, the evaluation of the success of such efforts is based on the number of pieces of information distributed and/or the number of people who attended the events. Both of these are absolutely necessary, since, if the public you want to effect does not hear your message, your chances of bringing about change are zero. On the other hand, experience clearly shows that simply providing the public with information does not bring about action on the part of a significant percentage of the public. The provision of information by "public earthquake information" efforts increases awareness but is not enough to motivate action. Such long term concern and action can only be motivated by the kind of educational effort that involves the individual actively in the issue, so that they see earthquake preparedness as necessary to make possible the way they want to live their life. That is, earthquake preparedness concerns need to become an integral part of the individual's life.

Role of Risk Perception in Motivating Public Action

As stated above, needed beyond awareness is the motivation of the public to take action. The question is, "What prevents the public from taking action when they express the intentionality to do so?"

Rational policy making by society and action-based decisions by individuals regarding seismic events and preparing for them requires an understanding of the relative risks involved and how to control them. Prior and concurrent work by the author and his colleagues at the Lawrence Hall of Science and the University of California has identified the importance of considering the public perception of risk in fields as diverse as smoking prevention (RAY:S) and the use of chemicals in society (CEPUP). Major current efforts on the need for public understanding of risk is highlighted in the following statement. "They (the students) should be able to make informed choices regarding their own health and lifestyles based on evidence and reasonable personal preferences, after taking into consideration short- and long-term risks and benefits of different decisions." This was stated as a major goal for reform in science education by the National Science Board of the National Science Foundation in 1983. This expansion of the concept of "scientific literacy" to further emphasize both personal decision making about health and lifestyles and the consideration that risk plays in such decision making is part of the increased emphasis on the need for public perception and understanding of risk in our society generally.

As stated by Koshland (1985), in an editorial in *Science* magazine, the fundamental concepts and methods of risk assessment are outside the understanding of the vast majority of the public. According to Koshland, improved scientific literacy is required to bridge the "concept gap" between scientists and the public. Part of the problem lies in how the public comprehends concepts of risk. The public has a hard time comprehending unfamiliar mathematical concepts, and making analytical decisions based on information. Koshland further stresses the need to introduce concepts of risk assessment into the school system. "These concepts are directly transferable into public policy and should be taught to students at the elementary, high school, and college levels."

One of the means of bridging the "concept gap" is by developing adequate language to convey the conclusions of a complex and uncertain science. Dr. Frank Press, President of the National Academy of Sciences, claims that scientists must do a better job of communicating risk to the public. He supports identifying and evaluating alternative approaches to improving public understanding of risk. Furthermore, Fischhoff (1987) claims that a public-centered perspective by risk communicators is necessary. Risk communicators need to identify three aspects about the public: What the public wants and needs to know; what the public currently believes; and messages which are sensitive to how lay people process information (Fischoff, 1987).

Speaking a language that communicates risk effectively requires an understanding of the public perception of risk. Conversely, effective learning by the public requires them to identify their own perceptions of risk. The public perception of risk varies drastically from the scientific community's perception (CMA, 1986). Public perception is based upon a number of factors. These include: whether the risk is controllable or non-controllable; voluntary or involuntary; familiar or unfamiliar; catastrophic or, spread out over space and time; presented pessimistically or optimistically (CMA, 1986; McKean, 1985; Ruckelshaus, 1984). On the other hand, scientific determination of risk is numerically and experimentally based. Risk assessment by the public is more than a numbers game. According to Paul Slovic, "the risk assessments that experts give out when they evaluate risks often don't match the perceptions that the people have because they are really speaking two different languages" (CMA, 1986).

Public attitudes towards risk, which are subjective and based heavily on personal experience, need to be tempered by public information on the current scientific methods of risk analysis and assessment (AIHC, 1986; CMA, 1986). "The ultimate goal is to get the American people to understand the difference between a safe world and a zero-risk world" (Ruckelshaus, 1984).

Unique Nature of the Seismic Risk

The lack of public understanding of, and therefore informed reaction to, risk benefit analysis and risk management generally, is a major factor preventing the motivation of the public to take action regarding seismic risk. Another major factor affecting public reaction to seismic risk is the nature of the risk itself. All of the research described above indicates that the public reacts in a more positive, rational manner when it perceives the risk to be controllable, voluntary, familiar, and not catastrophic, but spread out over time. This is exactly the opposite of the public's perception of seismic risk which they think is uncontrollable, involuntary, unfamiliar, and catastrophic. Unfortunately, these perceptions by the public are largely accurate, and therefore, motivating the public to really take action to mitigate the seismic risk, is very difficult. The nature of the risk, the relatively low frequency of occurrence of major seismic events, and the catastrophic devastation that can be caused by a major earthquake all tend to cause the public to adjust by psychologically rejecting the possibility that it will happen to them, and, therefore, they don't make any real effort to prepare for it. They do this because to a large extent, they do not believe that anything they do can really make a difference. Our task as educators is to find ways to truly educate the public about the nature of earthquakes and the proven value of preparedness actions beforehand in reducing loss of life and economic devastation. An integral part of such education has to be an understanding of seismic risk assessment and seismic risk management, so that the public believes that their actions will increase their chances for survival when the major earthquake comes, even though we cannot tell them when that will be.

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Public perception determines public acceptance of risk

Factors influencing perception are:

voluntary	vs	involuntary
controllable	vs	uncontrollable
beneficial	vs	not beneficial

All related to the *individual.*