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RISK COMMUNICATION AND PUBLIC RESPONSE TO THE PARKFIELD EARTHQUAKE PREDICTION EXPERIMENT

Final Report
to the
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16. Abstract (Limit: 200 words)

The director of the U.S. Geological Survey issued a public statement on April 5, 1985, forecasting an earthquake of magnitude 5.5 to 6.0 (possibly 7) on the Parkfield segment of the San Andreas Fault with more than a 90% probability that it would happen. California's Office of Emergency Services prepared and mailed a brochure describing the prediction and recommended actions to the more than 122,000 central California households at risk assuming a magnitude 7 earthquake. This study was designed to: (1) examine the impact of the brochure and other risk communications on public risk perception and public preparedness and mitigation; (2) determine the relationship between public perception of risk and behavior (mitigation and preparedness); and (3) measure the impact of the brochure and other risk communications on readying the public to deal with a potential 72-hour warning of the earthquake. The findings not only document why members of the public responded as they did to the earthquake prediction, but also provide a comprehensive test of the risk communication theory for the social sciences.

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EXECUTIVE SUMMARY

The Parkfield earthquake prediction is for a moderate earthquake of magnitude 5 to 6 on the Parkfield segment of the San Andreas fault between 1985 and 1993. It was given more than 90% probability of occurrence when it was issued. Contained in the prediction was the possibility that the next Parkfield earthquake could be magnitude 7. The larger event would offset the fault by 10 feet; the characteristic magnitude 5 to 6 event would only offset the fault by one foot.

The director of the U.S. Geological Survey issued a public statement on 5 April 1985. This statement, in essence, forecast an earthquake of magnitude 5.5 to 6.0 in the next several years (1985-1993) with more than a 90% probability that it would happen. The forecast stated that there was potential for this quake to be larger (magnitude 7), and for the fault rupture to extend southward into the adjacent 25-mile Cholame segment of the San Andreas fault.

The release of this prediction was a national media event. The prediction was reported in national weekly news magazines. The national media came to interview the residents of Parkfield. The interviews and editorial comments were broadcast on national network evening news programs.

California's Office of Emergency Services (OES) prepared and mailed a brochure describing the prediction and recommended actions to more than 122,000 central California households--every household within the extended area at risk assuming a magnitude 7 earthquake. The brochure was mailed directly to households at risk and it covered information about the earthquake hazard, the prediction, a possible short-term warning of the impending earthquake, and what to do about each. The brochure was entitled "The Parkfield Earthquake Prediction" and looked like a large map that could be folded up. It was printed on both sides in multiple colors and represented graphical and textual information concerning the earthquake risk. Concentric circles depicted the areas of potential impact; pictures and diagrams showed the warning sequence for the short-term warning.

The major objective of our research was to determine the reason why the public mitigated and prepared for the next Parkfield earthquake. We especially sought to discover the impact that the OES brochure mailed to citizens' homes had on what people thought and did to get ready for that quake. The brochure's impact was assessed in the context of other information about the prediction that was available to the public. We also wanted to learn the process that operated to convince people to take action so that we could make recommendtions about how to make future earthquake predictions more effective from a public response viewpoint.

We picked three communities to study within the predicted area-at-risk. These communities were selected on the basis of two criteria: recent experience of a damaging earthquake, and distance from the predicted epicenter of the Parkfield earthquake. We wanted to be able to compare earthquake prediction response both between a community that had recent experience and those without it, and in a community close to the predicted epicenter and that in a community far away. We hoped to test the notion that experience and distance affect prediction response.

Each about 25 miles distant Paso Robles and Coalinga are the closest towns of any appreciable size to the predicted epicenter. Coalinga provided a unique opportunity to study a community with recent damaging earthquake experience. Paso Robles provided a comparison because it is equally distant from the predicted epicenter, but without recent damaging earthquake experience. A third town, Taft, is located approximately 75 miles from the predicted epicenter, yet still falls within the identified area-at-risk. Taft is about the same size as Coalinga and Paso Robles, yet had no recent earthquake disaster experience.

Most people had heard about the prediction, ranging from 94% in Coalinga and 86% in Paso Robles to 65% in Taft. Printed materials delivered to homes were clearly the most effective way to inform the population. The brochure reached 83% of Coaliga respondents, 71% in Paso Robles, and 49% in Taft. Newspapers were the second most effective channel, followed by television. Although the study samples were drawn from the mailing list used to send the brochure to households, some respondents did not remember receiving a brochure--28% in Coalinga, 38% in Paso Robles, and 49% in Taft. Most who remembered getting a brochure reported that it could be understood.

The Parkfield prediction altered the public's perception of earthquake risk. Findings on earthquake risk perception were virtually identical across the three study communities. Respondents perceived greater potential for harm and losses during the period up to 1993 than for any later time. For example, more than half of Coalinga respondents said that they believed that they or another family member would experience harm or losses from the Parkfield earthquake. Although people tended to admit that they are at risk in the distant future more readily than in the near term, the Parkfield prediction apparently helped the warned public to accept their risk from earthquakes in the near future.

Respondents remembered the information and recommendations in the brochure selectively. In general, people in each study community remembered guidance actions that were easiest to do and forgot those that would take longer or were more complicated.

No matter what items were measured, Coalinga respondents were more likely to remember them, Taft respondents were the least likely, and Paso Robles respondents fell between the other two.

People tended to forget such aspects of the predicted earthquake as its magnitude, the damage it would cause, how hard it would shake, and probability of occurrence. Coalinga residents were the most likely to remember the brochure's statement about damage, but even at that, only about 20% of Coalinga respondents remembered both damage parameters. Only 18% of Paso Robles and 13% of Taft respondents did so. This pattern was similar for each prediction and warning aspect included in the study.

We never found even half of the respondents in any community remembering accurately any aspect of the prediction. Respondents were most likely to remember whether they would feel the earthquake or not; next most likely to remember the magnitude; then probability of occurrence and then likely damage.

The public's ability to recall aspects of the potential 72-hour warning followed the same pattern. Most likely to be recalled were that the public may receive a 72-hour warning and that it will be delivered over the media. Least likely to be recalled was that there would be a public information hotline and that the warning would be cancelled if the earthquake did not occur in 72 hours.

The brochure presented some 20 recommendations for preparedness activities. People were most likely to recall guidance about what to do during the earthquake: for example, get under a table or desk; and what to do to better cope with an earthquake disaster: for example, have a flashlight and radio ready. People were least likely to recall guidance about preparedness actions that would require extra time and energy: for example, form a neighborhood watch group and learn the emergency plans at school and work. Other specfic recommendations were recalled in an almost identical pattern across the three communities.

The brochure listed 6 mitigation guidance recommendations. In general, the more costly and time intensive the mitigation actions, the less likely they were to be recalled. For example, fewer people recalled advice to anchor their house to its foundation and buy earthquake insurance than advice to move heavy objects off high shelves, strap water heaters, and protect dishes and glassware.

People tended to be selective regarding the actions they took in response to the prediction. They followed recommendations that could be done quickly and tended not to do what would take more time. No matter what actions were performed, Coalinga respondents did most to prepare, Taft respondents did the least, and Paso Robles respondents fell in between.

The actions people took fell into three categories: (1) seeking additional information, (2) preparedness, and (3) mitigation activities. Many sought more information about earthquake prediction science and how to prepare for and mitigate the effects of the earthquake. About three-quarters of respondents in each of the three study communties sought additional information. About half in each engaged in prepareness and mitigation activities.

To prepare, people were most likely to learn what to do during an earthquake and to stockpile emergency supplies. Developing a family emergency plan or forming a neighborhood watch group were least frequently undertaken.

To mitigate the earthquake's effects, respondents were most likely to rearrange household items to be safe from earthquakes, with 13% to 23% of the respondents taking this action. Next most likely was protecting the house through the purchase of earthquake insurance; 10% to 20% took this action. The third most likely action, taken by 7% to 17% was bolting the house to its foundation. Fewer respondents mitigated their potential losses by delaying large purchases or investments. Coalinga residents consistently took the most action, followed by Paso Robles and then Taft residents.

People suspected that their households and communities were not adequately prepared to face the Parkfield earthquake. For example, 63% of Coaliga respondents said their households were inadequately prepared, as did 78% in Paso Robles and 81% in Taft. Even more respondents said their communities were ill-prepared.

Respondents reported strong feelings--both positive and negative--about having been targeted for an earthquake prediction. For example, positive feelings included thinking that people were better prepared for earhthquakes because of the prediction; negative feelings included thinking that their community was worse off economically because of the prediction. Of Taft respondents, 71% perceived positive impacts from the prediction, as did 62% of Paso Robles and 56% of Coalinga residents. Negative impacts were percieved in the opposite order, with 43% of Coalinga residents, 29% of Paso Robles, and 27% of Taft residents reporting them. Very few people viewed being the recipient of an earthquake prediction neutrally. Interestingly, Coalinga respondents--who assessed the impacts most negatively--were also the most likely to have taken action to ready for the predicted earthquake.

About three-quarters of respondents want future prediction information to come from government sources, and about half prefer it to arrive as special printed matter such as a brochure sent directly to their homes.

The Parkfield earthquake prediction was a public information success. Almost everyone heard about the prediction; it enhanced the public's perception of earthquake risk; and it prompted many people to prepare for the next Parkfield earthquake.

The Parkfield earthquake prediction brochure was also a public information success. The brochure reached more people than any other means of communicating about the risk. People could understand the brochure's message. Most people would prefer to receive future earthquake prediction information in a brochure issued by the government. The brochure was the most effective, understandable, and preferred vehicle for communicating predicted earthquake risk information.

Our research also enabled us to learn about the process that led respondents from first hearing about the prediction to engaging in mitigation and preparedness actions. This process had several steps:

- hearing or reading the prediction
- understanding it
- believing that it was accurate and true
- defining the risk as personally relevant ("personalizing" it)
- taking protective action.

We found no difference in public perception or response to the earthquake prediction by typical demographic characteristics such as age, income, and educational levels. Instead we found differences because of personal characteristics; response was greater among those:

1. with recent damaging earthquake experience
2. whose friends and neighbors took preparedness and mitigation action
3. who had taken protective action against earthquake risk prior to the Parkfield earthquake prediction.

We found that characteristiscs of the information received (not simply the brochure itself, but all remembered information about the earthquake prediction and what to do about earthquakes) affected people's response to the prediction more than anything else. People were more likely to feel that they had "heard of" the Parkfield earthquake prediction; to understand, believe, and personalize the risk from it; and to have taken protective action the more they:

- perceived the many prediction messages as basically consistent with each other

- remembered the predicted earthquake's magnitude, potential for damage, and other characteristics, which made the prediction seem more certain to them

- remembered specific guidance for appropriate protective actions to take, such as strapping the water heater and stocking emergency supplies

- remembered that they had received these messages through numerous vehicles or channels, and especially that they had received them through printed word in the mailed brochure and newspapers

- remembered that they had received these messages from numerous information sources including scientists and relatives, and especially that they had received them from official sources.

In risk communication theory, these message characteristics are termed consistency, certainty, specificity, use of multiple channels, and use of multiple information sources. The study's findings generally confirm that these factors have a positive impact on what people think and do.

Using a statistical technique called "path analysis," we were able to shed more light on the response process. The fact that this process was found to be identical in Coalinga, Paso Robles, and Taft indicates that the response pattern reveals the most significant influences in risk communication.

One important factor is reinforcement. We have seen how risk communication is most effective when it is in a written form. However, to be most effective, the written prediction has to be reinforced by multiple messages delivered through multiple channels and from, importantly, official sources, as well as from other sources. Prediction is also reinforced by individuals observing others taking preparedness and mitigation action.

The direct next step is taken when the individual begins to seek additional information about the prediction, the risk, what to do about it, and to learn what others are doing about it. This information search occurs when members of a community interact to discuss the earthquake hazard and how to deal with it. The outcome of the search is that the person forms his or her individual definition of the risk and picture about how to proceed--actions to take to mitigate and prepare. This process of coming to "own" the risk information is essential to taking protective action.

Protective actions are taken after the following three steps.

- Officials communicate public risk information in print and reinforce it by other means;

- and then, people gather more information through interaction with others;

- and then, people come to "own" the earthquake prediction information as well as the advice they were given to prepare for it and to mitigate its effects.

This study has significant implications for those responsible for informing the public that an earthquake is likely and that they are at risk. Doing this successfully is more simple than we'd originally thought.

1. Go to the public with a written brochure and, if funding exists, mail it to their homes. If insufficient funding exists for a mailing, publish it in area newspapers.

2. The brochure should come from official government sources, but also identify a range of other sources.

3. The brochure should explain specifically:
   - what the risk is
   - where the quake is going to happen
   - when it is going to happen
   - what the effects will be

- what people should do before, during and after the quake
- where to get more information about it.

This information should be as clear and certain as possible.

4. Mailing a brochure is not enough--it must be supplemented. The public needs to get the message from as many different sources, through as many different channels, as possible. This supplemental "barraging" makes the mailed brochure effective. Go to the media with consistent supplemental information before and after the brochure is disseminated.

5. People need multiple information sources to reinforce the risk information in the brochure. People seeing neighbors, friends, and relatives preparing for the earthquake risk is also useful reinforcement. Consider visible demonstration projects in communities that are targets for earthquake predictions.

6. Capture people's attention, spark their interest, and have them begin considering that they should do something about the risk. They need to discuss the risk at local organizations, seek out additional information on their own, and talk with their friends and neighbors about it. This process permits them to gather information and induce their own ideas about the level of risk and what they should do about it. They may need to feel that taking some protective action is their own idea, but information "ownership" takes time. Preparedness and mitigation actions result from this process, but not from merely receiving a mailed brochure.

7. This being the case, position supplemental information in the local community for use during this process, such as coloring books, brochures, slide shows, film strips, additional advice on emergency plans and mitigation actions and so on.

8. It might be better not to name earthquake predictions after towns (like Parkfield) because this may limit the perception of risk in towns distant from the epicenter of the predicted earthquake, but still in the area of risk. This is suggested by the apparently lower salience of the Parkfield earthquake prediction among Taft residents.

There is still much which we do not know about the communication of public risk information about earthquakes, and how such communication can influence public behavior. We do not know, for example, how to persuade the public off the course of least resistance--how can the public be persuaded to undertake more time-consuming and more costly preparedness and mitigation actions? Additionally, we did not know how to persuade a larger proportion of people in communities that are the targets of earthquake predictions to engage in any activities at all.

As more experience with communicating earthquake risk information through scientifically credible earthquake predictions accumulates, and more research is accomplished on effective approaches, answers to these questions may be expected.

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CHAPTER I

INTRODUCTION

This work is an account of our study of and findings on public response to the first formally approved and scientifically credible earthquake prediction in the United States. This prediction and our study of public response to it can best be understood within their historical contexts. This chapter provides these contexts, and also outlines the purpose of this work.

A. The Goals of Earthquake Prediction

Earthquakes impose large losses on humanity. Catastrophic quakes worldwide have taken the lives of hundreds of thousands of people in the last several decades; the estimated dollar cost of a repeat of the 1906 San Francisco Earthquake is $100 billion. The financial costs of great earthquakes pale in importance when compared to the death, injuries and social disruption that quakes can cause. For example, in 1988 a 15 second earthquake in Soviet Armenia left 25-50,000 people dead, thousands injured and some half-million people displaced. The potential for earthquake-imposed death and human suffering increases in less developed nations, since those nations are less able to afford seismic resistance in construction.

It is little wonder that earth scientists dream of being able to predict earthquakes. Scientifically credible earthquake predictions could provide people and communities added incentive to mitigate earthquake losses. Short-term earthquake warnings, like those now available for other natural hazards such as hurricanes, could also save lives. Earthquake prediction and warnings are both scientific and humanitarian goals.

Scientists from around the world have searched for successful earthquake prediction techniques for about two dozen years. Soviet scientists began prediction research in the mid-1960s; in 1971 they announced at a scientific meeting in Moscow that they had learned to recognize some signs thought to be associated with impending earthquakes. Japanese scientists conducted prediction research concurrently. Prediction efforts first received attention in the United States in the late 1960s; this was about the same time that the Chinese research program began to be expanded. Currently, scientists seek to predict several parameters of an earthquake event: the time, place, and magnitude of an earthquake's occurrence, along with some estimate of the confidence associated with these predictors.

Some earthquakes have been successfully predicted. For example, China has predicted several destructive earthquakes: the Haicheng earthquake, Liaoning Province, February 4, 1975; a pair of earthquakes 97 minutes apart, Richter magnitude 6.9, near the China-Burma border, May 29, 1976; and a three-event cluster, Richter magnitudes 7.2, 6.7, and 7.2, on August 14, 22, and 23, 1976, at Sungpan-Pingwu, Szechuan Province. The Haicheng and Sungpan-Pingwu predictions were both followed by effective public actions to reduce property losses and injuries. Predictions have also been made in the United States, for example, small events have been predicted in New York (Stolz, Sykes, and Apparwall 1973) and in South Carolina (Stevenson, Talwani, and Arnick

1976). The U.S. Geological Survey (USGS) has detected tilt anomalies prior to at least two moderate earthquakes, but these anomalies gave no information about the expected time of occurrence. A quake in January of 1974 was predicted in southern California as to time and place, but the actual magnitude was less than was predicted. The recent 1989 Loma Prieta earthquake came as no surprise to scientists; its occurrence as well as its major effects were anticipated:

> The Loma Prieta earthquake ruptured a segment of the San Andreas fault in the Santa Cruz Mountains that had been recognized as early as 1983 as having a high probability for rupture in the following few decades. In a study in 1988, this segment was assigned the highest probability for producing a M 6.5 to 7 earthquake of any California fault segment north of the Los Angeles metropolitan area (U.S. Geological Survey Staff 1990, p. 286).

The USGS has leading responsibility for earthquake prediction research in the United States. The Survey's role in the National Earthquake Hazards Reduction Program (NEHRP) includes an active internal and external research program. A large part of the Survey's in-house prediction research program is based in Menlo Park, California. Major study areas are along the San Andreas fault in central California and on several active faults in southern California, where the program cooperates with the California Institute of Technology. In addition, the Survey has emphasized geodetic measurements including tilt, regional strain, and fault creep. Seismic networks are also deployed to determine regional seismicity and its relation to geological structure in other important seismic zones of the United States: Alaska and the Aleutian Islands; the Puget Sound area; Nevada, Utah; the upper Mississippi embayment; South Carolina; and other areas.

The research was provided additional resources to propel prediction technology when the Earthquake Hazards Reduction Act (P.L. 95-124) was first enacted into law in 1977. Formation of the National Earthquake Prediction Evaluation Council (NEPEC) was announced on January 28, 1980. NEPEC is composed of not fewer than eight federal and non-federal earth scientists. The NEPEC reviews data collected by other scientists and recommends to the USGS director whether a formal earthquake prediction or advisory is warranted. The State of California also has an earthquake prediction evaluation council. The California Earthquake Prediction Evaluation Council (CEPEC) serves the same function as NEPEC; however, recommendations are made to the state's governor.

Scientists believe that seismic activity in the U.S. is on the increase and that there will be highly destructive earthquakes in densely populated areas in the near future. As the ability of scientists to predict earthquakes improves, this forecasting capability will likely be put to increased use (Governor's Board of Inquiry 1990, p. 91). To be effective, the information in an earthquake prediction, advisory or warning must be clearly communicated and then usefully acted upon by the people at risk.

B. The Social Aspects of Prediction

The nation became interested in determining the social utility of earthquake prediction in the early 1970s. The earliest effort to estimate the social impacts of predictions was by the Panel on Public Policy Implications of Earthquake Prediction in the National Research Council. The panel was established in 1974, and it drew ". . . widely on experience with warning of other types of disaster . . . [and made research recommendations including] . . . the need to study response to actual instances of earthquake prediction and warning as they occurred" (Turner, Nigg and Paz 1986, p. 5). A study of behavioral intentions in response to predicted earthquake scenarios was performed at about the same time (Mileti, Hutton and Sorensen 1981). This study gathered data on what organizational decision makers and members of the public thought they would do in response to a scientifically credible prediction. The major conclusion was that scientifically credible predictions for great earthquakes (with time, place, and magnitude specified) would cause pre-event economic losses of major proportions.

In 1978, the National Research Council issued a second report on the topic which was the result of the Committee on Socioeconomic Effects of Earthquake Prediction (1978). The Committee called for study of response to near predictions as well as to predictions. A third non-empirical report was also issued at about this same time; it was a technology assessment of earthquake prediction (Weisbecker, Stoneman and Staff 1977). It also foretold social and economic disruptions from scientifically credible predictions of large earthquakes.

Empirical research on an actual earthquake forecast began in early February 1976 when the USGS reported that a land uplift about 25 centimeters in height was detected along a portion of the San Andreas fault just north of Los Angeles. The uplift was centered near the town of Palmdale in the Mojave Desert. The USGS stated that the uplift was not fully understood, that it may or may not have been a precursor to an earthquake. The USGS, however, did express concern because the uplift was along a section of the San Andreas fault inactive since the great 1857 earthquake in that area.

This news led to research by Ralph Turner and others to assess the social aspects of the prediction. These researchers classified the announcement of the Palmdale Bulge as an approximate prediction since neither the place, time, nor magnitude was precisely stated. It was, in effect, earthquake hazard information that constituted a near prediction (Turner, Nigg and Paz 1986, p. 5). The investigation was intended, according to the authors,

> . . . as a first step toward understanding how communities respond to the announcement of near predictions, and by inference, how they may respond to earthquake predictions in the future (Turner et al. 1986, p. 6).

The major conclusion of this work was that there was little evidence of serious individual or household preparedness for the earthquake despite the fact that nearly everyone believed that the quake was coming soon. The event not only did not precipitate negative economic impacts as prior work had suspected predictions would elicit, but not many positive prediction effects were detected.

Then in 1980, Brady and Spence predicted an earthquake in Lima, Peru for the summer of 1981. The former scientist's affiliation with the U.S. Bureau of Mines and the latter's with the USGS gave the prediction scientific credibility. Several assessments of the socioeconomic consequences of the prediction were performed. It was concluded that the prediction precipitated an enflamed political controversy (Olson, Podesta and Nigg 1989), and that

> . . . over half of the population of Lima took some precautionary measures, that the total economic damage for the prediction was roughly $50 million, and that the poorer groups in society bore a disproportionate share of the prediction costs (Echevarria, Norton and Norton 1986, p. 175).

The brief record of research into the social aspects of earthquake prediction and other events which resemble them suggests that predictions may go ignored or cause major socioeconomic dislocations. Additionally, the record suggests that some predictions may resemble disaster warnings with large-scale public response, while others may actually be more like general public hazards education. This can increase public awareness and, sometimes, preparedness and mitigation behavior.

Research findings to date are not actually contradictory. The events and methods used in the research referenced above were not comparable. Consequently, findings should have been somewhat unique to each investigation. The existing research record sheds only minor light on public response to a scientifically credible earthquake prediction since no such prediction--approved by some formal scientific earthquake prediction evaluation council--has ever emerged; that is, until the Parkfield Earthquake Prediction Experiment.

C. The Parkfield Experiment

The Parkfield earthquake prediction is for a moderate earthquake of Richter magnitude 5.0 to 6.0 on the Parkfield segment of the San Andreas fault between 1985 and 1993 (give or take five years). It has been ascribed a 90 percent probability of occurrence. The prediction and some public information about it are based on historical recurrence evidence. Contained in the prediction is a possibility that the next Parkfield earthquake could be a magnitude 7.0. The larger event would offset the fault by 10 feet; the characteristic 5.0 to 6.0 magnitude event would only offset the fault by one foot. In the larger earthquake, there would be significant damage (Modified Mercalli Intensity VII damage) up to 40 miles from the point of fault rupture. This would mean

> . . . significant damage to unreinforced masonry could be expected from near the coast to the Central San Joaquin Valley (Southern California Earthquake Preparedness Project 1985, p. 2).

The Parkfield Earthquake Prediction Experiment (as it has become known) began when William Bakun and Al Lindh (two USGS scientists) submitted data to the NEPEC on November 16, 1984. The NEPEC endorsed the prediction and agreed that the Director of the USGS be advised to issue a statement about the prediction. The NEPEC agreed that this statement contain reference to a significant potential of a larger earthquake (magnitude 7.0) and its associated fault rupture. The California Earthquake Prediction Evaluation Council (CEPEC) met on February 13, 1985 and agreed with the high probability for a magnitude 6.0 earthquake. The Director of the USGS issued a public statement on April 5, 1985. This statement, in essence, forecast an earthquake of magnitude 5.5 to 6.0 in the next several years (1985-1993) with over a 90 percent probability. The forecast noted the potential for this quake to be larger, and for the fault rupture to extend into the adjacent 25-mile segment of the San Andreas fault. The release of this prediction was a national media event; to date, no new or revised Parkfield predictions have been issued, and the earthqake has not occurred.

The Parkfield prediction is categorized as an experiment. It is an attempt by geological and seismological scientists to detect short-term anomalies that might foretell an earthquake a few days beforehand. A public warning will be used if anomalies indicate that the quake could occur within a 72-hour period.

Response by government to the April 5 Parkfield prediction has been documented (Southern California Earthquake Prediction Project 1985), as has public response (Mileti and Hutton 1987). The California Office of Emergency Services (OES) contracted with a consultant to prepare county-level prediction response plans. On October 7, 1985, the consultant distributed information to five counties that could be affected by a magnitude 7.0 quake. On September 28, 1985 the Governor of California appropriated one million dollars to enhance prediction monitoring at Parkfield, and the OES was instructed to develop a comprehensive emergency response plan for short-term earthquake predictions. Local governments in the risk counties

> . . . expressed a desire to initiate public education/ awareness efforts to promote an understanding of the earthquake threat and to provide practical preparedness and hazards mitigation information to citizens in their jurisdictions (Southern California Earthquake Preparedness Project 1985).

The California Governor's Office of Emergency Services distributed a brochure to the public residing in the area that could be affected by the next Parkfield earthquake. Some 122,000 households in a seven-county area received the brochure by mail in the spring of 1988. The brochure was designed to convey information and educate the public about a variety of risk-related factors. In brief, the brochure was a carefully designed attempt to provide the public with risk information about the hazards, the prediction, a possible subsequent short-term warning, and what they could do about each. Its dissemination provided a unique research opportunity.

D. Purpose of this Study

The dissemination of a public brochure to people at risk in the next Parkfield earthquake provided a unique research opportunity for several reasons. First, the contents of the brochure were prediction based; this was the first scientifically credible, NEPEC and CEPEC-approved, U.S. earthquake prediction specifying time, place, magnitude, and probabilities. Second, the brochure was not a one-shot hazard prediction, warning, or education effort. Instead, it became part of an ongoing information distribution campaign about this risk. For example, much media attention followed on the heels of the April 5, 1985 announcement, and occasional updates on the experiment continued by the media.

Because of that, the process character of risk communication can be traced in this research. Finally, the contents of the brochure were sufficiently diverse and comprehensive that they actually covered the topic variables which research has documented as relevant to explaining differences in how people perceive and respond to risk information (these factors will soon be outlined). This guaranteed that data could be obtained regarding, for example, respondent perceptions on risk location, source credibility, consistency between messages, and the many other factors important to consider in a study based on a comprehensive theory of risk communication.

The communication of earthquake hazard and risk information to increase hazard awareness and prompt mitigation and preparedness activities is an integral part of the National Earthquake Hazards Reduction Program (NEHRP). It informs activities performed by responsible agencies including the Federal Emergency Management Agency (FEMA), the USGS, and the National Science Foundation (NSF). Moreover, a variety of other efforts and projects (i.e., the Southern California Earthquake Preparedness Project, the Bay Area Regional Earthquake Preparedness Project, the Central United States Earthquake Consortium, and other efforts) have long labored to enhance public awareness of the earthquake hazard. Mounting research evidence suggests that communication of risk information and public education helps the public better perceive earthquake risk and hazard; this, in turn, prompts mitigation and preparedness behavior (cf., Kunreuther 1978; Mileti et al. 1981; Turner et al. 1981).

This study was designed to (1) examine the impact of the brochure and other risk communications on public risk perception and public preparedness and mitigation, (2) determine the relationship between public perception of risk and behavior (mitigation and preparedness), and (3) measure the impact of the brochure and other risk communications on "readying" the public to deal with a potential 72-hour warning of the earthquake. Additionally, our findings not only document why members of the public responded as they did to the nation's first NEPEC and CEPEC-approved earthquake prediction, but also they provide a comprehensive test of the risk communication theory for the social sciences.

E. About this Volume

Chapter II presents a review and synthesis of past research and theory on public risk communication. A summarizing model is introduced, as are the major study hypotheses. The methods used in our research are then described in Chapter III. The range of information made public about earthquakes, the prediction and readiness are described in Chapter IV in reference to each of our study communities. Chapter V presents a description of what the public did and did not think and do because of the prediction. Study community differences and comparisons are contained in Chapter VI. The full range of risk communication hypotheses in Chapter II are tested in Chapter VII. The conclusions from this analysis are combined in Chapter VIII to determine the most significant paths of influence in the process by which people perceive risk and then respond to a prediction. Finally, in Chapter IX, the findings from all analyses are integrated into general conclusions for risk communication theory and recommendations for issuing future public earthquake risk information and predictions.

CHAPTER II

THE THEORY THAT GUIDED THIS RESEARCH

This research examined how people interpreted and responded to information about the first scientific earthquake prediction in the United States that had been approved by the California and National Earthquake Prediction Evaluation Councils. Previous research has examined public risk communication in reference to other hazards; the findings from this past research helped to guide our work theoretically and methodologically.

Past research was readily divided into two types. The first type examined public interpretation and response to communications about long-term risk, for example, general flood hazard information given to citizens living along the Mississippi River. The second research type examined public interpretation and response to communications about risk in the immediate future, for example, hurricane and tornado warnings. The findings from both types of research informed our study's hypotheses. A summary of the findings from these research areas follows. The last section of this chapter synthesizes the theoretical conclusions that can be drawn from the research record, and presents the hypotheses that guided our investigation.

A. Communication of Long-term Risk

Public education and information dissemination about risk do help the public perceive long-term earthquake risk and hazards more accurately (Kunreuther 1978; Mileti et al. 1981; Turner et al. 1981). However, ". . . a good deal about how this might actually be done is yet to be learned; especially if upgraded perceptions are intended to yield upgraded mitigation and preparedness activities" (Mileti 1982:518).

In fact, relatively few formal empirical attempts have been made to measure the impact of non-emergency hazard education on public risk perception and subsequent risk reduction behavior. And the conclusions that can be drawn from existing studies are unclear at best. For example, Roder (1961) distributed flood plain maps to residents of Topeka; the study concluded that the maps had no effect on public hazard awareness. Haas and Trainer (1974) examined the effect of a tsunami hazard public education effort; they concluded that no significant changes were observed in public knowledge about the hazard or in behavior. They did document that public perception of risk was elevated as a result of risk communications in the mass media and personal contact. An assessment of the effect of a publically disseminated flood brochure concluded that the brochure increased hazard knowledge, hazard awareness and the adoption of family emergency plans (Waterstone 1978). Ruch and Christenson (1980), however, concluded that a hurricane awareness program actually served to decrease public perception of risk. Palm (1981) conducted a study of the impacts of the 1977 Alquist-Priolo Act disclosure requirements, and concluded that this earthquake risk information had little impact on public behavior. Bauman (1983) found that public flood education not only increased hazard awareness, but also increased public flood mitigation behavior.

This research record suggests that public hazard education efforts can enhance risk perception in some limited ways (Bauman 1983; Haas and

Trainer 1974; Waterstone 1978), decrease risk perception (Ruch and Christenson 1980), as well as have no effect on what the public perceives (Haas and Trainer 1974; Roder 1961). Results concerning actual public behavior in response to hazard education are also mixed. Findings range from those claiming no effect (Haas and Trainer 1974) to those saying mitigation (Bauman 1983) and preparedness were encouraged (Waterstone 1978).

The effect of public hazard education on risk perception and behavior may not be fully understood and the varied research record may not be rendered consistent without first specifying the varied character of public education and how its constituent variables--for example, who the information comes from--might differentially affect the public. In fact, several attempts have been made to specify how the source of risk education might have affected public risk perception and behavior; unfortunately, these efforts do not provide a sound basis for conclusions about what is successful.

For example, Sorensen (1983) concluded that the public did not view official sources such as pamphlets, phone book instructions, and civil defense programs as significant sources of learning, but that the media and schools were significant sources although their effect did not last over time. Sorensen also concluded that the media were the most effective information sources in convincing people about the risk. Wenger (1985) concluded that the public judged the media as ineffective and unreliable, while they saw civil defense as most useful. However, this study also concluded that information source and the judged usefulness of different sources were unrelated to public knowledge and behavior. Finally, Turner and colleagues (1979) illustrated that the impact of source type may change over time. They concluded that the electronic media decreased in importance as the print media increased, when threat from an earthquake in southern California continued over time. This suggests that public hazard education efforts may affect risk perception, preparedness and mitigation behavior differently across time.

Education's link to public perception and behavior may not become clear unless education is viewed as a process rather than as a discrete event. A process concept permits the definition of stages between the initial information source and content (or input), and eventual public behavior (or output). It further permits a connection between external stimuli and perceptual or cognitive events at different stages in the process, so that the stimuli have the highest probability of eliciting public response. Many researchers have used a process concept to suggest normative prescriptions for effectively conveying risk information.

Despite the paucity of consistent empirical findings on the effectiveness of public risk education efforts, the following suggestions for risk education have been offered by researchers. First, agencies should provide a means to reinforce public risk information and use multiple media channels (Planning and Management Consultants 1980). Second, communications should be continuous, with two-way communications and feedback mechanisms (Anderson 1978). Third, they should use clear, simple language (Kaplan 1978), and rely on the best available scientific data (Davenport and Waterstone 1979). Fourth, information sources that people trust should be used (Key 1986).

Finally, agencies should use information from credible sources with demonstrated technical competence (Perry and Nigg 1986).

These and other suggestions about the character of public risk education and their implied effect on risk perception and hazard reduction behavior exemplify some ways that variation in risk information has been conceptualized. For example, source credibility in a public education program has long been recognized as important for explaining how information affects the public receiver. Studies have found that as the credibility of the communication source increases, the extent of attitude change also increases (Arnet et al. 1931; Aronson et al. 1963; Hoveland and Weiss 1952; Kelman and Hoveland 1953); and that repeated communications, even from "untrustworthy" sources, are eventually accepted by the public (Hoveland and Weiss 1952).

The state of knowledge regarding the stages in the process from the issuing of public risk information, to risk perception, and then to mitigation and preparedness behavior is somewhat unclear and inconsistent. This literature is more useful when it is viewed in concert with findings from the related research area of communicating short-term risk information or warnings to the public during the prelude of emergencies. While public education research is relatively sparse and contains some inconsistent findings, warnings research is relatively rich with somewhat consistent empirical findings. A review of the findings from the warnings research literature follows.

B. Communication of Short-term Risk

Public warning systems exist for a range of hazards, for example, hurricanes, tornadoes and flash floods. These systems are typically designed to elicit relatively quick protective behavior by people in danger from fast-onset agents of disaster. Public protective actions, however, do not follow automatically from receiving warning information. Perception of risk is an influential intervening factor between receiving and responding to warning information. Public warning information works through people's perception and cognitive processes to influence behavior. Thus, a challenge to any warning system is to disseminate information that leads a heterogeneous public to homogeneous and "accurate" cognitions and risk perceptions, and then to effective protective actions.

The risk perceptions people have in a warning situation are shaped by two forces: the characteristics of the information receiver, and those of the information itself. Consequently, warnings research bears a distinct resemblance to research on pre-emergency public risk education: both areas involve risk information presented to a public; both generally presume that preparedness and mitigation behavior are generally a consequence of perceived risk; both recognize that sender and/or information as well as receiver and/or public characteristics are necessary to consider in understanding risk communication; and finally, both research areas view risk communication as a process rather than as a discrete event.

Warnings research findings consistently suggest that people warned during emergencies go through a sequential process that eventually shapes their risk perceptions and subsequent behavior. A typical model of this process is the following sequence: hear the warning, seek confirmation of it, understand it, believe it, personalize the risk, and then respond to it by deciding among alternative preparedness and mitigation actions and then performing them. This sequence may not be the same for every person, and each stage can be affected by both receiver and sender factors.

The first stage in the process is actually receiving--or "hearing"--the risk information. People then attempt to confirm the warning received through various mechanisms, for example, direct observation, checking with other people, or seeking an alternative media source. This behavior has typically been referred to as the confirmation process (Drabek 1969; Mileti et al. 1975). Third, the risk information must be understood; understanding is not just interpretation of the information, but it is actually the meaning that people attach to the information. Meanings can vary among people and may or may not conform to the intended meaning in the message. For example, a 50 percent probability may be interpreted as "certain" by some and as "unlikely" by others. In this sense, understanding includes the perception of risk. The fourth stage in the process is belief that the risk information received is accurate and that it is directly germane to the receiver. Generally, people must believe and personalize the warning information before acting. The fifth stage is that people must decide what to do about the risk, and, lastly, perform that behavior.

A person typically goes through the stages of this model each time new warning information is received. Response to the information follows from a series of decisions and unfolds over time. The formation of a perception of risk is not a single consequence of one risk communication, but is instead the result of an emerging process.

Important sender or risk information factors fall into four general categories: (1) the content of the warning message, (2) aspects of the channels through which messages are conveyed, (3) attributes of the frequency with which messages are given, and (4) traits associated with the person(s) and organization(s) or sources from which the message emanates.

Empirical findings suggest that message attributes important to consider vary in reference to both message content and style. Message content is relevant to consider along three lines: information about risk location, the character of that risk--for example, effects of impact and time to impact--and guidance about what people should do before impact.

Message style is also important. Important style attributes are: (1) specificity, or the degree to which the message is precise about risk, guidance, and location; (2) consistency, or the degree to which a message is internally consistent, as well as consistent across separate messages regarding risk, guidance, and location; (3) accuracy, defined as the extent to which message content about risk, location, and guidance is factually accurate; (4) certainty, or the degree to which those giving the message seem certain about what they are saying about risk, location, and guidance; and (5) clarity, which is the degree to which risk, location and guidance information in the message is stated in words that people can readily understand.

Sender characteristics include channel attributes (the type of channel used, for example, personal versus impersonal, and the number of different channels used); frequency attributes (the number of times a particular message is conveyed, the number of different messages, and the pattern between different conveyances, for example, every 15 minutes or randomly); and source attributes such as the level of familiarity between those giving the message to those receiving it, the degree to which the message giver is an official, and the credibility level of the message giver to those who receive the message.

Research also documents that three basic types of warning receiver characteristics are important to consider in explaining public perception and response to warnings: the receiver's (1) environment, (2) social attributes, and (3) psychological attributes.

Relevant attributes of the receiver's environment include both physical and social cues. For example, confirming cues include if it is raining when flood warnings are received, or if neighbors are seen evacuating in concert with receiving evacuation advisements.

Social attributes of the warning information receiver have been grouped into four categories (Sorensen and Mileti 1987): (1) social network characteristics of the warning recipient, such as whether or not the family is united, social ties and bonds, and the existence of nearby friends and relatives; (2) resource characteristics, including physical resources, such as having a car in which to evacuate, and economic resources, such as having the money to pay for a hotel; (3) demographic characteristics, such as sex, age, ethnicity and social class; and (4) activity characteristics involving what the warning recipient is doing when the warning is received, for example, eating, sleeping, working, or recreating.

Important psychological attributes of the warning recipient are pre-warning knowledge, for example, about the risk associated with a particular hazard agent, about protective actions, or about emergency plans; prewarning cognitions such as psychosocial stress level and locus of control of the warning recipient; and experience with the hazard agent, including type of experience and its recency.

The effect of these sender and receiver factors on both public risk perception and then on response has been documented in numerous studies over the last three and one-half decades. More elaborate summaries are available elsewhere (for example, Drabek 1986; Perry, Lindell and Greene 1981; and Sorensen and Mileti 1987); nevertheless, the following review illustrates what has been learned regarding information or sender risk communication factors in public warning emergencies.

Public understanding of emergency warning information is increased if it has the following characteristics: it is specific regarding the risk, the hazard, what the public should do and how much time is available before impact (Drabek and Boggs 1968; Greene, Perry and Lindell 1981:60; Quarantelli 1984:512); it is consistent (Rogers 1985:5; Sorensen 1985:13); it is communicated over multiple channels (Rogers 1985:5; Turner et al. 1981:25); it is frequently disseminated (Mikami and Ikeda 1985:109-110; Rogers 1985:5; Turner 1983:323; Turner et al. 1979:17); it is from official sources (Quarantelli 1980:120); and it is confirmed (Hammarstrom and Thronstam 1977:16-17; Perry 1982:62).

Public belief in emergency risk information has also been documented as being enhanced by similar factors. Specific information is more likely believed (Drabek 1969; Perry and Greene 1982:326-327; Quarantelli 1984:512; Sorensen 1982:20), as is information which is consistent (Demerath 1957; Foster 1980:1920; Mileti 1975:21; Turner et al. 1981:64), certain (Mileti et al. 1981:79; Perry, Lindell and Greene 1982:55-57; Turner et al. 1979:61), delivered personally (Clifford 1956; Perry and Greene 1983:55-57; Sorensen 1982:20), repeated frequently (Baker 1979:13; Drabek and Boggs 1986; Mileti and Beck 1975: 41; Perry and Green 1983:66; Turner 1983:312), from official sources (Perry and

Greene 1983:50; Quarantelli 1980:120; Rogers and Nejevajsa 1984:113; Wenger 1972:52-53), and then confirmed (Danzig et al. 1958; Drabek 1969; Perry, Lindell and Green 1981:31; Quarantelli 1984:512).

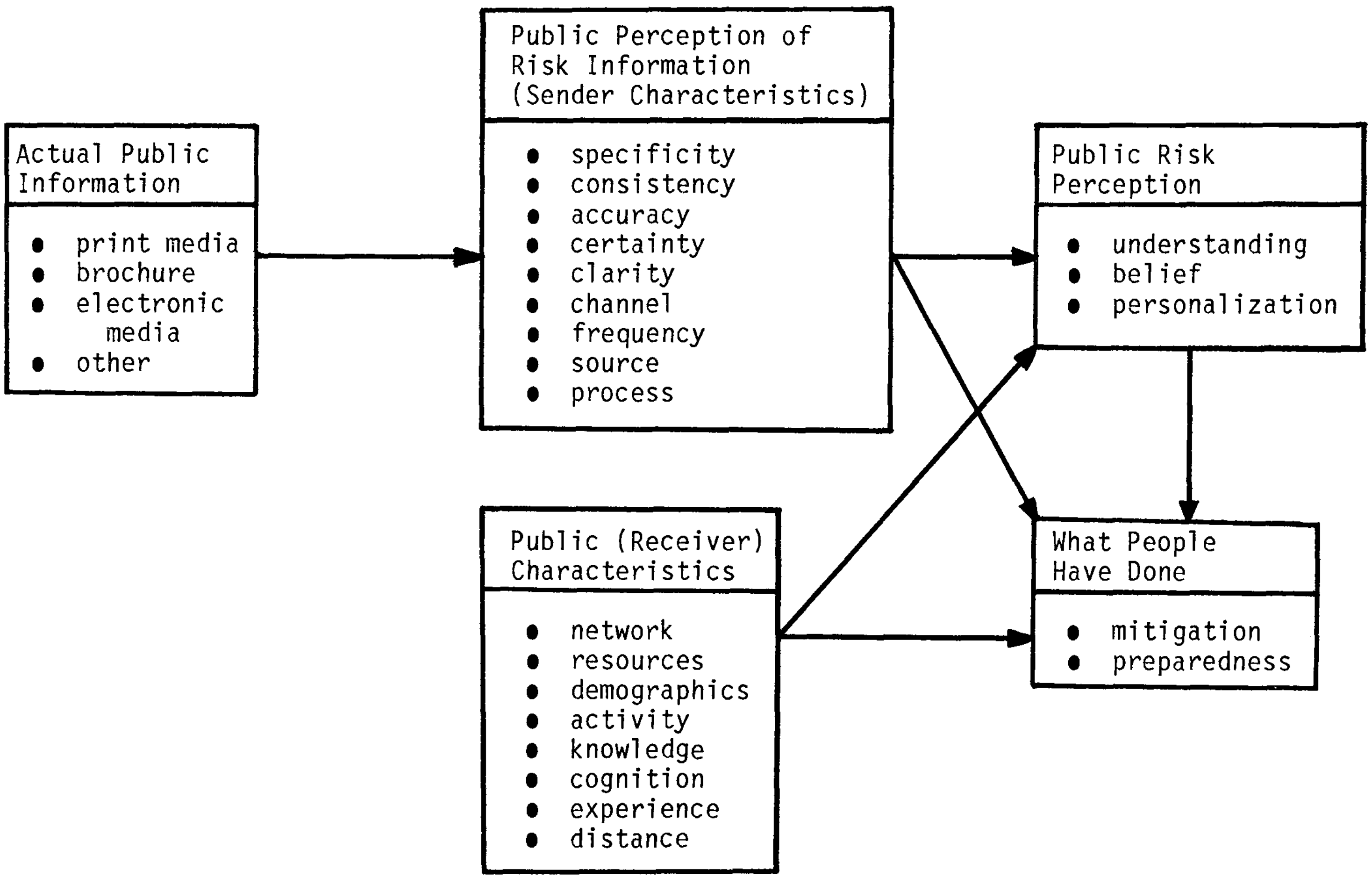
Findings regarding public personalization of risk as a result of emergency warning information are almost identical to those just reviewed. In brief, risk personalization is enhanced by information which is specific (Perry, Greene and Mushkatel 1983:62, 282), consistent (Foster 1980:192), personally delivered (Perry, Lindell and Greene 1981:154), frequently repeated (Mileti and Beck 1975:39), from official sources (Perry 1979:34), and confirmed (Hodler 1982:46).

Finally, public response to warnings has been documented to be strongly affected by communicated risk information which is specific (Dynes et al. 1979:152; Houts et al. 1984:36; Perry and Greene 1982: 326), consistent (Chiu et al. 1983:115), clear (Quarantelli 1980:104), delivered personally (Gray 1981:363), frequently repeated (Fritz and Marks 1954; Gruntfest 1976:19; Perry, Lindell and Greene 1981:156), from official sources (Baker 1986:20; Goldstien and Schorr 1982:51), and then confirmed (Drabek 1969:344; Liek et al. 1981:36-39).

C. Synthesis of Ideas Guiding this Research

The findings from risk communication research were synthesized into the general theoretical model presented in Figure II-1; this model guided our investigation. The model presented in Figure II-1 suggests that the public response variables in this study--actual mitigation and preparedness actions taken by members of the public--were likely to be the consequence of the risk which the public perceived, the perception which the public had of the risk information that they received, and characteristics of the people who received the risk information. Public

Figure II-1. Synthesis of Ideas Guiding this Research



risk perception is seen as a function of both the characteristics of the receiver of the risk information and perception of the risk information received. Last, public perception of the risk information received is seen as a function of the characteristics of the receiver of risk information, and the actual information which has been disseminated.

Summarized in Figure II-1 is a straightforward set of principles: (1) risk communication is a process and the effect of one attempt to communicate risk information--for example, in a brochure-- cannot be fully understood unless that communication act is placed in the context of other risk communications; (2) risk communcation involves the interaction of risk information or sender characteristics--repetition, source credibility, specificity, and so on--with the characteristics of those who receive that information--role, ethnicity, contextual cues, cognitive ability, experience, distance to risk and so on; (3) the public risk perception which results from risk communication is multidimensional and includes risk understanding, belief and personalization; and (4) public response to communicated risk information is not the simple result of being informed about the risk, but instead is the result of a somewhat complex, interrelated yet understandable set of social psychological intervening factors.

Each of the concepts present in Figure II-1 was measured in this research. Each of the hypotheses suggested by the model in Figure II-1 was tested, for example, the more times a person heard about the prediction, the more likely he or she was to personalize the risk being communicated and, consequently, the more likely they were to engage in preparedness activities. The methods we used to test these hypotheses and perform this research are described in the next chapter.

CHAPTER III

METHODS USED IN THE RESEARCH

This research studied public perception and response to the Parkfield prediction in three separate California communities. Each study community was in the "area at risk" for the next Parkfield earthquake. Therefore, each method in this study used to sample, collect and analyze data was repeated three times. This chapter describes the methodological decisions and approaches.

We will discuss our quasi-experimental field design, how we selected communities for study, the qualitative field research we did in those communities, the cross-sectional surveys of community populations we performed, how we collected the data, how we measured the study's concepts to enable hypothesis testing, the descriptive statistical analysis of the survey data we employed, and the hypothesis testing and path modeling techniques that we used. Obviously, we used a diverse range of social science methodological approaches to collect and analyze data in this study. This strengthens the work considerably by providing triangulation on the phenomena observed and measured.

A. The Study Population

The California Office of Emergency Services (OES) identified all or portions of seven counties as "areas at risk" in the event that the Parkfield earthquake were a magnitude 7.0. These were Monterey, San Benito, Western Fresno, Kings, San Luis Obispo, Western Kern, and Santa

Barbara counties. More than a dozen cities and towns and some 122,000 households fell within this risk area. We assumed that residents of these communities would have similar reactions to communications about the Parkfield earthquake prediction. Two reasons why this assumption may not have been the case were: (1) the community's distance from the predicted epicenter of the Parkfield earthquake, and (2) prior community experience with damaging earthquakes. Therefore, distance and experience served as stratification factors in the selection of study communities.

B. The Samples

The following sections describe how specific study communities were selected, the sample frames for community households, how the actual household samples used were selected, and how the representativeness of each sample was assessed.

1. Selection of study communities. Prior research has clearly confirmed that distance from risk is influential in altering both public perception and response to risk communications (Danzig, Thayer and Galater 1958; Mileti, Hutton and Sorensen 1981; Zeigler and Johnson 1984). Researchers have also long suspected that disaster experience influences both risk perception and response to subsequent communications about risk (Fogleman 1958; Perry and Greene 1983). Therefore, communities selected for study had to fall within the identified area of risk, had to be somewhat similar in size, and had to vary by distance from the epicenter of the predicted earthquake and by prior experience with a damaging earthquake.

Parkfield itself was not considered for inclusion as a study community even though it was the community which was closest to the predicted quake's epicenter. Parkfield is a small community comprised of only some three dozen people, and most of these are children. Additionally, research on these citizens' response to the prediction had already been completed (Mileti and Hutton 1987).

Coalinga and Paso Robles are the towns of any appreciable size closest to the predicted epicenter. They are both about 25 miles from Parkfield. Coalinga had a devasting earthquake in 1983. Inclusion of Coalinga as a study community provided an opportunity to represent in the study a community with recent experience with a damaging earthquake. Inclusion of Paso Robles provided a comparison group for Coalinga because it is equally distant from the predicted epicenter but without recent earthquake disaster experience. Thus, inclusion of these two communities permitted us to compare risk perception and response to the prediction across communities at like distances to the predicted epicenter, but with and without recent earthquake disaster experience.

A third town, Taft, is located approximately 75 miles from the predicted epicenter yet still falls within the identified area at risk. Taft is about the same size as Coalinga and Paso Robles, yet has no recent earthquake disaster experience. Taft was included as a study community to providc a comparison to a community without close proximity or earthquake experience.

Results from the three selected communities permitted comparisons of distance from the risk (Paso Robles versus Taft) and of recent damaging earthquake experience (Coalinga versus Paso Robles). Results also permitted comparisons of the combination of experience and distance when Coalinga was compared to Taft. This approach is a pre-experimental field research design (Campbell and Stanley 1963). Its use permitted us to control for some relevant variables through the sampling procedure rather than through the use of statistical tests. This strengthens the conclusions which could be drawn regarding the causal effect of experience and distance. The opportunity to use this sort of research design occurs infrequently in social science research, although it is one of the strongest.

2. Household sampling frames and samples. The California OES contracted with a private firm to send out the Parkfield prediction brochure to all 122,000 residential addresses in the seven-county area at risk. We purchased an identical copy of the mailing list used by that firm to select household samples for study. We extracted a complete enumeration of all residential addresses for each of the three study communities by using the zip codes of our selected study communities.

The household samples for each community were randomly drawn from each of those community sampling frames. The first household for inclusion in the sample for each community was randomly selected. Successive addresses were then drawn on the basis of a sampling fraction specific to each community. The sampling fraction was constructed so that the resulting sample would be 1200 households in each study community. We anticipated that a sample of 1200 households in each study community would yield at least 400 returned questionnaires from each community. We judged that 400 returned questionnaires would constitute an adequate number to statistically represent all of the households in each study community (Laserwitz in Blalock and Blalock 1968:280-286). These procedures yielded sampling fractions of one in three for Coalinga, and one in six for Paso Robles and Taft. The actual number of households selected for sample inclusion was 1149 for Coalinga, 1106 for Paso Robles, and 1056 for Taft.

The actual size of the samples was reduced for reasons that did not affect the samples' representativeness. For example, addresses were lost from the sampling frame due to nondelivered mail because of incorrect addresses or vacant residences, addresses were not households but were churches or businesses, and we made a decision to exclude post office boxes to prevent double sampling of households. The final sample sizes, after addresses were excluded for the above-listed reasons, were as follows: 662 for Coalinga; 887 for Paso Robles; and 756 for Taft. A total of 347 questionnaires were returned from Coalinga, 357 were returned from Paso Robles, and 234 were returned from Taft. These figures represent response rates of 52.4%, 40.2%, and 31.0%, respectively, for Coalinga, Paso Robles and Taft. These response rates are somewhat lower than what would ordinarily be expected from the mailing procedures we used for data collection.

3. Assessment of representativeness. We attempted a comparison of the samples' demographic characteristics with 1980 Census data on gender, tenancy, age, ethnicity, household size, and household income. However, data limitations prevented a complete analysis. The Census data were nearly 10 years old, which meant comparing the demographic profile of the communities in 1989 with what it had been in 1980. Some Census data were available only at the county level and not for the city. These could not be compared because to do so would mean comparing demographic profiles of an entire county with city characteristics. We had no reason to believe the county and city data were comparable. The

following conclusions were made on the basis of the comparisons that we were able to perform.

Regarding gender, we found that our Coalinga sample overrepresented females by about 9%, our Paso Robles sample underrepresented females by about 4%, and our Taft sample overrepresented females by about 11%. With respect to age, we found that our Coalinga sample overrepresented senior citizens (age 65 and older) by about 11%, our Paso Robles sample overrepresented them by about 19%, and our Taft sample by about 8%. In reference to ethnicity, our Coalinga sample underrepresented nonwhites by about 4%, our Paso Robles sample underrepresented nonwhites by about 3%, and our Taft sample represented whites and nonwhites almost exactly matching their Census distribution. The last factor that we could compare on was household size. For all three communities, the household size of the samples matched the Census data almost perfectly. The average number of persons per household according to the 1980 Census for Coalinga was 2.76, whereas it was 2.70 in our Coalinga sample. The average number of persons per household according to the Census for Paso Robles was 2.51, whereas it was 2.46 in our Paso Robles sample. The average number of persons per household according to the Census for Taft was 2.48, whereas it was 2.56 in our Taft sample. We concluded from this that the community samples did not markedly overrepresent senior citizens; if they had, the household size characteristics of the samples would be more different from the Census data than was the case. The differences observed between age structure from 1980 to 1989 may simply have been due to an aging population.

The observed differences between the demographic characteristics of the community samples and the 1980 Census data appeared to us to be like those which are characteristic of most mail questionnaire surveys. The community samples were not perfectly representative of the demographic profiles of the study communities. Additionally, our questionnaires were distributed in English. This would have excluded from study participation persons not able to read English and the non-literate.

Bias in our samples was not profound, but it did exist. Bias is a particular problem in research such as ours if it results in minimizing variation on a variable in a tested hypothesis. For example, a problem would exist if bias excludes poor people from a sample if income is used in a hypothesis to predict a dependent variable like risk perception. If poor people are less likely to perceive risk than middle class or very affluent people, the exclusion of the poor from a data set would lead to the incorrect conclusion that income has no effect on risk perception when that hypothesis is tested. Consequently we took care to insure that sufficient variation existed on all variables used to test hypotheses in this research so that no hypotheses would be accepted or rejected because of sample bias.

C. Data Collection

Qualitative and quantitative data collection methods were used in this research. The following sections review the techniques used to collect both types of data.

1. Descriptive field work. Field investigations were conducted in each study community in January of 1989 to profile the full range of risk information available to the public about both the Parkfield earthquake prediction and earthquakes in general. Our field work used a variety of techniques to collect qualitative data on relevant public information. Unobtrusive measures such as written materials and records

were used as much as possible (cf. Webb et al. 1966). We obtained relevant newspaper clippings from the Southern California Earthquake Preparedness Project (SCEPP) in Los Angles. Community artifacts were also collected, including earthquake response plans, brochures, comic books, and other materials available to the public at county offices of emergency services and local offices of the American Red Cross. We collected and reviewed available scripts and tapes of relevant radio and television broadcasts. We interviewed knowledgeable local officials and media staff regarding publicly available information about the earthquake prediction and about earthquake readiness. Additional interviews were conducted with staffs in city government, fire departments, county offices of emergency services, schools and school district offices, American Red Cross offices, radio and television stations. Approximately 36 interviews of this type were performed.

Obtaining information from the broadcast media proved to be more difficult than anticipated. Although Federal Communications Commission (FCC) regulations require that public service announcements be logged, considerable clerical time would have been needed to review the logs for all the relevant information. Also, radio and television stations did not necessarily maintain tape libraries of their entire programming. Given these constraints, we approximated local television and radio coverage in the study communities by working with cooperative broadcasters.

This descriptive field work enabled us to catalogue a rich array of the kind of information made public regarding the Parkfield earthquake prediction in our study communities. This information informed the questions asked on our households questionnaire.

2. The questionnaire. The questionnaire was constructed to collect quantitative household level data on the concepts included in each of the study's hypotheses (see Chapter II). The Dillman (1978) method guided questionnaire construction to enhance response rates. We attended to both the content and form of the questionnaire to make it as attractive as possible. Within a printed booklet, we employed simplicity, flow of questions, clear instructions, and transitional phrases to make the data collection instrument understandable. We used clear printing and numbering sequences to create an orderly impression. Response categories were exhaustive and mutually exclusive. In a word, we designed the mail questionnaire to be "user friendly." The appendix presents the questionnaire and cover letter used in the study.

The questionnaire was pretested through review by Parkfield residents and by policy makers in California communities, and was subsequently revised in keeping with reviewer comments. Each community's questionnaire booklets were printed with a different color cover to make returned questionnaires easy to code by community. Included with each questionnaire was a cover letter and a stamped self-addressed envelope for respondent convenience in returning completed questionnaires.

Sample households first received a postcard alerting them that they had been selected to be part of a scientific study on public response to the earthquake prediction. The postcards were mailed April 10-12, 1989. The first mailing of questionnaires took place April 24-28, 1989. Follow-up postcards were mailed May 13-20, 1989. The second and final follow-up questionnaire mailing occurred June 14-19, 1989.

Data were cleaned and coded using a computer program written especially for this data set. The community data sets were input twice by two independent coders; the resulting two data sets were scrutinized by computer for differences, and the differences were resolved. The cleaned data were stored for analysis using a Statistical Package for the Social Sciences (SPSS/PC+) program.

D. Data Analysis

The quantitative data from household questionnaires were analyzed in four ways: (1) descriptive analysis showed proportions of respondents having done or thought the things we asked about, (2) comparative analysis statistically compared grouped community responses to determine if the factors of experience and distance affected what people thought and did in response to the prediction, (3) multiple regression analysis tested the individual risk communication hypotheses suggested by the literature (see Chapter II), and (4) path analysis determined the major causal paths that linked getting information about the prediction through a variety of intervening factors to explain and predict actual public response to the prediction.

1. Descriptive analysis. The descriptive analysis was straightforward. We selected measures of all variables we sought to describe that were measured on an interval scale. This enabled the descriptive data to be presented as percentages for each study community. Observed response patterns within and across communities were then identified and discussed.

2. Comparative analysis. This analysis used Student's t-tests for analyzing the difference-of-means on selected variables between the study communities. This statistical test was selected for several

reasons. First, each study community had a different number of respondents. Student's t-tests do not require an equal number of respondents in each group being compared to assess for statistical differences (Klockars and Sax 1986:76). Second, the true population parameters from which the samples were drawn were not known. Consequently, the t-distribution yields more confidence than the normal curve in drawing conclusions about the data being examined (Leonard 1976:242). Third, the variances in each population from which the samples were drawn could not be assumed to be equal; the t-test is one of the most appropriate statistics for testing difference-of-means between groups when this characteristic holds. A separate-variance t-test was used to test all hypothesized difference-of-means between the independent samples because we could not confidently assume equal variance between compared groups on all variables being compared. A one-tailed test was used because each hypothesis being tested had direction.

The Student's t-test provides information on significant differences between means, but it does not yield information on the strength of the relationship. The strength of a relationship can be inferred from how close the observations in each group are to the mean of that group. Hence, in measuring the strength of the relationship we sought to improve the prediction of a dependent variable by knowing the group to which respondents belonged. Improvement in predictions comes from determining the difference between the loss derived from the total sum of squares (TSS) when the group to which households belong is unknown, and the loss derived from the residual sum of squares (RSS) when the group to which households belong is known. This improvement in prediction is called eta squared (eta^2). The square route of eta^2 thus becomes a measure of the strength of a relationship. Both eta and eta^2 are interpreted the same as r and r^2 in regression analysis (Iversen 1979:194-197).

These statistical techniques were used to determine the presence of statistically significant differences between communities. Differences were assessed on factors of perception and behavior in response to the prediction. Patterns of significant community differences were observed. These patterns were then interpreted in terms of how the factors of disaster experience and distance to the predicted quake's epicenter affected what people thought and did after being informed about the anticipated earthquake. The effect of experience was assessed on the basis of Coalinga-Paso Robles comparisons. The impact of distance was determined by comparing responses in Paso Robles to those in Taft. The interactive effect of experience and distance was inferred from Coalinga-Taft comparisons.

3. Multiple regression analysis. The Ordinary Least Squares (OLS) estimating technique was used in all multiple regression tests performed. This technique is based on several assumptions. For example, that there is no specification error in an equation which suggests that the relationships between variables are linear, no relevant independent variables have been excluded from the equation and no irrelevant independent variables have been included in the equation; that there is no measurement error; and that the error term for the dependent variable has a mean of zero, with homoskedasticity, without autocorrelation, is uncorrelated with the independent variables and is normally distributed (Lewis-Beck 1988:26). Regression coefficient

estimates are best linear unbiased estimates (BLUE) when these assumptions can be met.

Multiple regression analysis in this study had a straightforward application. It was used to determine the predictive value of alternative types of one set of independent variable categories against separate dependent variables taken one at a time. For example, one multiple regression equation was run to determine which channels of prediction information (television, radio, newspapers, the brochure, face-to-face and so on) affected a dependent variable (for example, belief in the prediction). This use of multiple regression enabled us to easily determine the major factors that shaped public perception and response to the Parkfield earthquake prediction; it also allowed us to compare findings across each of the three communities, and determine quickly which of the many risk communication hypotheses being tested (see Chapter II) could be accepted or rejected.

We dismissed as not important any independent variables that were consistently--across all three study communities--not significantly related to any of the dependent variables examined. We also dismissed independent variables that resulted in marginal and inconsistent effects on a dependent variable. For example, an independent variable was seen as marginal if it did not have a significant effect on a dependent variable across all communities, if its effect on a dependent variable was very weak in the community where it did display a significant relationship to a dependent variable, and where we could conclude that it played a very minor statistical and theoretically insignificant role in explaining the dependent variable or variables under examination.

Comparable findings across communities and some unique findings within communities were identified and explained.

This application of the multiple regression technique did not markedly differ from the computation of zero-order correlation coefficients between independent and dependent variables. Estimated regression coefficients for each independent variable in a multiple regression equation are identical to zero-order correlation coefficients. Multiple regression equations were calculated instead of individual zero-order correlations because they provided a handy way to group categories of independent variables. This made data processing easier from a purely practical viewpoint. The strength and statistical significance of individual multiple regression coefficients were interpreted. Although the explained variance for each equation is reported, this estimated parameter of the equations must be interpreted carefully. Explained variance in a multiple regression equation can be artificially deflated due to the direction of the relationships between individual independent variables in an equation on the dependent variable. This effect does not impact the strength nor statistical significance of individual coefficents within each equation.

4. Path analysis. Path analysis attempts to use a series of interlocking multiple regression equations in order to resolve questions ". . . about possible causes by providing explanations of phenomena (effects) as the result of previous phenomena (causes). . . (Asher 1983:5)." No statistical technique can extract causal proof from a data set; however, path analysis can model a set of interrelated theoretical propositions, estimate the equations representing the theory simultaneously, and provide answers regarding the relative magnitude of

linkages in the model suggesting insights into what may be underlying causal processes. Multiple correlation coefficents inform us as to how much of a particular dependent variable in the model has been explained by the set of independent variables and alternative causal paths to that dependent variable contained in the model.

Path analysis was used in this research to model the basic risk communication theory presented in Chapter II, and to determine which variables and paths of causal influence provided the greatest ability to explain and predict what the public thought and did in response to the Parkfield earthquake prediction.

CHAPTER IV

PUBLIC INFORMATION ABOUT THE EARTHQUAKE PREDICTION

Different kinds of information about the Parkfield prediction, the expected quake, and how to ready for it were available for public consumption after the prediction was announced. This chapter describes the prediction brochure that was mailed to all households in the area-at-risk. Also presented are brief descriptions about the three study communities, and summaries of other available information about the prediction and earthquakes in each of those communities.

A. Contents of the Public Prediction Brochure

The California Governor's Office of Emergency Services (OES) developed a public brochure for distribution to households in the area at risk for the predicted Parkfield earthquake. The brochure provided the public with risk information about the earthquake hazard, the prediction, a possible future short-term warning of the impending earthquake, and what they could do about each. The brochure also contained a map with concentric circles that depicted the area of probable impact when the predicted earthquake occurs. The impact areas for both 6.0 and 7.0 magnitude earthquakes were characterized on this map. Each of our study communities was readily located on the map. Coalinga and Paso Robles were both obviously closer to the predicted epicenter than was Taft. The majority of information contained in the brochure had to do with providing answers to several proposed questions: (1) What is the Parkfield earthquake prediction, and how will central Californians be warned?; (2) What should you do to prepare for the earthquake?; (3) What type of earthquake effects can be expected in your area?; and (4) Where can you get additional information and instructions?

1. The prediction. The Parkfield area has been the epicenter for many moderately damaging earthquakes. Most recently, earthquakes hit there in 1922, 1934, and 1966. The brochure explained that damage from these quakes was minor, involving items like windows, chimneys, plastered walls, and glassware. Surrounding commmunities, including Paso Robles and Coalinga, experienced even fewer impacts like merchandise falling from shelves and a few broken dishes. The brochure said that the next Parkfield earthquake could possibly be larger, although scientists have said this is much less likely. "Some scientists have said the earthquake could be up to a magnitude 7," the brochure advised.

The brochure defined an earthquake prediction as "a statement from an authoritative government source that there is an increased likelihood that an earthquake may occur. The statement includes an estimate of the earthquake's size, location, time and probability (likelihood) of occurrence." The brochure also stated that, "based on state-of-the-art research, scientists have predicted that a moderate-sized earthquake, about magnitude 6, is likely to occur near Parkfield, California between now and 1993." USGS and California Division of Mines and Geology scientists are monitoring instrumentation installed near Parkfield to detect changes in the earth possible before the next Parkfield earthquake.

"A short-term prediction means that the likelihood of an earthquake occurring within a specified period has increased, not that an earthquake is certain to occur," the brochure stressed. The brochure defined the Parkfield earthquake prediction as an experiment in making a short-term prediction, with the hope that lives might be saved and property losses decreased. The brochure explained that the U.S. Geological Survey (USGS) would review data from instruments located near Parkfield, and monitor "alert levels"--the various probability levels that an earthquake would soon occur. When "alert level A" is reached, the brochure said, the USGS will issue a short-term earthquake prediction. The A alert level means that the USGS believes the chance of a magnitude 6 earthquake near Parkfield within three days is at least 37 percent.

A large section of the brochure was dedicated to depicting graphically "How the Earthquake Warning Will Be Issued." Californians will be warned through radio, television, and newspaper announcements. Information hot-line numbers will be announced. Local and state officials will advise the media. Scientists will initiate the warning process after scanning the Parkfield instrumentation data, which they receive by telemetry. When USGS scientists in Menlo Park determine that they have a level A alert, they will call the warning controller at the Office of Emergency Services, Sacramento Warning Center. This Center will then issue the warning to county offices of emergency services (OESs) in Fresno, Kern, Kings, Monterey, San Benito, San Luis Obispo, and Santa Barbara Counties. The county OESs, in turn, will transmit the warning to the media, and to other organizations in keeping with their local disaster plans.

If there is no earthquake within 72 hours after the warning, the USGS will probably advise the state to cancel the warning unless data show that the earthquake is still possible. Radio, television, and newspapers will announce the cancellation or extension of the alert period. The brochure noted, "It is very possible that 1 or 2 warnings may be issued without the earthquake occurring," and emphasized that the warning means that the chances are great, but not that the earthquake is certain.

2. Preparedness. The brochure discussed what people should do immediately, during the 72-hour warning period, and during and after the earthquake. The immediate actions recommended were storing a three-day supply of food and water for people and pets; assembling an emergency kit with first aid, flashlight, portable radio, batteries, heavy gloves, and a crescent wrench; inspecting homes and workplaces for hazards like unsecured water heaters, bookcases, file cabinets, and heavy objects on high shelves; preparing a home emergency plan and learning about the emergency plans at schools and workplaces; maintaining a fire extinguisher and a reserve supply of medications; participating in neighborhood programs; and obtaining additional earthquake preparedness materials from other organizations.

During the 72-hour warning period, the brochure recommended that people stay in touch with media information; use the brochure itself as a guide; check emergency supplies and make certain they are secure; check hazard resistance of the home and close curtains to prevent shattered glass from flying into the room; discuss the impending earthquake with others in order to review personal protection measures; note any special needs of family members and neighbors; and review the family emergency plan.

During and immediately after the earthquake, the brochure advised people to undertake a number of activities. First, take appropriate safety measures. If indoors, stay there. Get under a desk or sturdy table. If outdoors, get into an open area away from trees, buildings, walls, and power lines. Second, check for injuries. Apply first aid. Do not move seriously injured persons unless they are in immediate danger. Third, do not use the telephone immediately unless there is a serious injury or fire. Do not use your vehicle unless there is an emergency. Keep the streets clear for emergency vehicles. Fourth, check for hazards: for gas and water leaks, broken electrical wiring or sewage lines--turn utilities off at the sources, if necessary. Fifth, check your food and water supply. In addition to stored water, water heaters, melted ice cubes, and toilet tanks are sources of water. Sixth, be prepared for aftershocks. Last, turn on your portable radio for instructions and news reports.

3. Earthquake effects. Earthquake magnitudes and the Richter Scale were explained, as was the Modified Mercalli Scale which measures earthquake intensity, or how strongly the ground shakes at a particular location. The intensity scale was presented in some detail (see Table VI-1). The terms "foreshocks" and "aftershocks" were also defined.

As noted earlier, a magnitude 6 earthquake was described by the brochure as most likely and a magnitude 7 as less likely to occur. The brochure explained that an earthquake of magnitude 5 is roughly 10 times larger than a magnitude 4, magnitude 6 is about 100 times larger than a magnitude 4 quake, and that damage often begins when earthquakes reach 5.5 magnitude or greater.

Table IV-1. The Modified Mercalli Intensity Scale*

Intensity	Description of Effects
VIII	Damage slight in specially designed structures; considerable in ordinary substantial buildings with partial collapse; great in poorly built structures. Panel walls thrown out of frame structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned. Sand and mud ejected in small amounts. Changes in the condition of well water.
VII	Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable in poorly built or badly designed structures; some chimneys broken. Noticed by persons driving motor cars.
VI	Felt by all. Some heavy furniture moved; a few instances of fallen plaster or damaged chimneys. Damage slight.
V	Felt by nearly everyone, many awakened. Some dishes, windows, etc., broken; a few instances of cracked plaster; unstable objects overturned. Disturbance of trees, poles, and other tall objects sometimes noticed. Pendulum clocks may stop.
IV	During the day felt indoors by many, outdoors by few. At night some awakened. Dishes, windows, doors disturbed; cracking sound from walls. Parked cars rocked noticeably.
III	Felt quite noticeably indoors, especially on the upper floors of buildings, but many people do not recognize it as an earthquake. Parked cars may rock slightly.
II-I	Not felt except by a few under especially favorable circumstances. Delicately suspended objects may swing.

*Modified Mercalli Intensities IX and X were not described in the brochure.

4. Additional information. The brochure also listed the names and telephone numbers of key organizational resources the public could turn to for more information. These included the OESs in the counties at risk, the Governor's OES Sacramento headquarters, and the regional OESs serving the relevant counties.

B. Other Information in Coalinga

Coalinga is in the Pleasant Valley area of Fresno County in the San Joaquin Valley. Currently a town of about 8,000 population, Coalinga began as a loading point for the Southern Pacific Railroad Company, which transported coal from area mines. The developing oil fields turned the Coalinga District into a boomtown, complete with permanent homes, businesses, and saloons along Whiskey Row. On April 2, 1906, Coaling Station A officially incorporated as the City of Coalinga.

The Coalinga Chamber of Commerce declared the area "the greatest oil field in the United States" in 1910; in 1928 the Kettleman Hills oil fields opened, and in 1938 the Gatchell discovery led to the opening of the Coalinga Nose field. These fields are currently in operation. The city is accessible from Interstate 5, with Los Angeles 200 miles south, and San Francisco 160 miles north. As the crow flies, it lies about 18 miles from Parkfield, the expected epicenter of the predicted earthquake.

At 4:42 p.m. on May 2, 1983, a magnitude 6.7 earthquake originating 10 km northeast of town did considerable damage to the buildings of Coalinga. No deaths resulted, but more than $31 million in property damage occurred. Most of the downtown business district collapsed, and one-third of the town's 2,700 homes, many of them unattached to their foundations, were lost in the 28-second quake. Almost 200 people were injured, 20 of them seriously.

Many persons thought that the earthquake was an explosion. One police officer thought it was a terrorist bombing. Damage was immediate and widespread, although most spectacular in the downtown trading district. Coalinga's downtown, an area concentrated with one- and two-story unreinforced masonry buildings constructed between 1909 and 1940, collapsed. A dense dust cloud enveloped the community; visibility was limited to 500 feet. Several people were trapped or struck by falling masonry. A fire erupted in a collapsed building in the downtown area. Local phone service and electrical power failed. The police department and hospital radios went off the air (Frederickson and Donelan n.d.: 4).

One-and-one-half hours after the quake, a unified command post was established at the Coalinga Police Department. Representatives from agencies involved were eventually incorporated into the command structure. This post reached its maximum level of effectiveness at three hours into the incident. Subsequently, the post was overtaken by such problems as failure of personnel to remain, overextension of the span of control, a perception that the emergency had lessened, lack of familiarity with the system, and the omission of the public utilities from the command. Nevertheless, the Coalinga earthquake "was credited as being the most efficiently coordinated disaster of its size or kind to strike California" (Frederickson and Donelan n.d.: 7).

The initial earthquake was followed by 10 major aftershocks within a 12-hour period. Ground movement was almost continuous. The seismograph located at West Hills Community College consumed a week's supply of ink in five hours. The aftershocks hindered emergency response; however, the injured were removed to hospitals and the fires brought under control in a timely manner.

The Coalinga earthquake has had major impacts on the community. Currently, downtown Coalinga is composed of completely new buildings, with no historic buildings in evidence. In the lobby of a local motel, a collage of photographs of the 1983 earthquake was still eliciting interest and comment some five years later. The earthquake was an historical benchmark for residents; people talk about things in reference to before and after the earthquake.

The Coalinga population has grown from approximately 7,000 at the time of the 1983 earthquake to about 8,000 in late 1988. Growth has been the result of increased oil and farming activities, and the new prison located in nearby Avenol. Area farmers are changing from dryland agriculture to row cropping with inexpensive water currently available.

Evidence exists that the Parkfield prediction was less than welcome in Coalinga. People there, we were told, wanted to forget about earthquakes. In early 1989, a Coalinga respondent noted:

> We're trying to get business in town and here comes another earthquake in the Parkfield prediction. The City Council thought it was stirring up old wounds. . . . The earthquake prediction brochure came out in April of 1988 and people want to get on with their lives.

Despite what may be a wish to forget about earthquakes, a variety of information sources beyond the mailed OES prediction brochure served to remind the town's residents about the topic and the Parkfield prediction. These included information from newspapers, broadcast media, drills, training exercises, posters, and other sources.

Coalinga is served by several newspapers: the Fresno Bee, the Coalinga Record, the Coalinga Courier, and the Hanford Sentinel.

Between January of 1984 and September of 1988, there were 42 articles and editorials in these newspapers pertaining to earthquakes and earthquake prediction. Only 7% of these were about the Parkfield earthquake prediction experiment, 38% were about earthquakes and earthquake damage, 24% were about earthquake policies, 17% were focused on preparedness, and 14% were on earthquake science. The official city newspaper is the City Informer. This paper had no articles on earthquakes or the prediction during the period from mid-1988 until January 1989, when our field work was performed.

Coalinga is served by eight television stations, four cable television stations, and 17 radio stations. It seems a reasonable conclusion, therefore, that Coalinga residents have been exposed to some broadcast earthquake and earthquake prediction information. The majority of broadcast earthquake information was disseminated over television; however, television coverage was uneven across stations. For example, KMTF public television (Channel 18) had broadcast no information on the Parkfield earthquake prediction nor on earthquake preparedness from the time the prediction was issued until we performed our field work in January of 1989. In fact, the station managers were unaware of the prediction. KSEE-TV, Channel 24, had covered earthquake topics in their programming. They broadcast two general special programs on earthquakes. Additionally, KSEE-TV had two weekly series on the evening news, one on earthquake risk and the other on preparedness. They did three stand-alone pieces on the Parkfield prediction, and followed these with five short news "blurbs" over time, whenever there was something to cover about Parkfield. In May of each year, they revisit the Coalinga earthquake on its anniversary. KSEE broadcast a special in May 1987 on the fourth year anniversary of the Coalinga earthquake.

The California Office of Emergency Services conducts monthly communications drills on the Parkfield earthquake prediction; they started in February, 1988. The Parkfield prediction monthly exercises may also be considered a source of information in the community about earthquake risk. Each county's office of emergency services is responsible for handling the drill at the county level. The county OES receives the alert from the State via radio, telephone, and teletype. Each technology is backup for the others. The county has a call-down procedure in which the first person called calls five other people in their group. The County of Fresno will initiate the Emergency Broadcast System if the Parkfield alert is actually received. The county OES also contacts other agencies, such as medical organizations, schools, fire, sheriff, and police departments, and they in turn activate their call-out lists to notify their own groups. According to Fresno County officials, the monthly exercise reinforces the process by repetition. They stated that they wanted to activate the drill anyway, and the Parkfield prediction is the vehicle by which this can be accomplished.

Fresno County officials started the process of public education about the prediction some six months after the Parkfield prediction was first issued. They held press conferences on the prediction and told medical personnel how to get more information. County officials have also told other groups about the Parkfield prediction: the U.S. Forest Service, the California Division of Forestry, the U.S. Department of Agriculture, the California Highway Patrol, California State University in Fresno, and varied police and fire departments.

Coalinga no longer has a local American Red Cross office; it is served by the Fresno office. The Fresno Red Cross office has given many presentations about preparedness to various groups, including parent-teacher associations, service organizations, ham radio operators, the hearing disabled, and school staffs. However, none of these presentations have been in Coalinga. Brochures and films about earthquake preparedness are available in the Fresno Red Cross office; none have been sent to Coalinga.

The schools in Coalinga have earthquake plans. Staff and teachers are required to read the plan once a year. The schools hold duck and cover drills once a month. Schools also have evacuation drills with a buddy system for staff and students. Children have walking routes that they would always use to go home in a disaster so that they could be located by their parents. Each school has a rendezvous area and disaster kits, including buckets, crowbars, and other basic tools. They also distribute coloring books about earthquakes and preparedness to students.

Neighborhood Watch in Coalinga was the vehicle used to get information to the citizens, particularly about earthquake recovery and fire suppression. The woman's club in Coalinga also put out information on the earthquake hazard a few years after the earthquake. They also provided information on preparedness. The County Health Department held puppet shows for children after the earthquake to aid in discussing and venting feelings about it. The telephone company reportedly put an insert into the phone book, although we did not find it. Sunset Magazine sent out their article on earthquakes after the Coalinga earthquake. Pacific Gas and Electric Company and General Telephone both put on public earthquake preparedness presentations.

Most of this earthquake relevant public information seems to have been disseminated after the 1983 earthquake rather than in response to the Parkfield earthquake prediction. Coupled with the community's seeming reluctance to hear about the prediction, it appears that levels of public information available since the prediction could be somewhat lower than they were in other central California communities.

C. Additional Information in Paso Robles

Paso Robles is located about halfway between San Francisco and Los Angeles on Highway 101, approximately 25 miles from Parkfield as the crow flies. The area is marked by rolling hills and valleys with an average elevation between 600 and 1900 feet. The Santa Lucia Mountain Range protects the valley on the west and south, with the Cholame Hills on the east. Nearby communities include San Luis Obispo which is the county seat of San Luis Obispo County, Atascadero with a zoo for endangered species, and Morro Bay with its harbor and beaches.

Tourism is an important element of the local economy, with opportunities for fishing and waterskiing on nearby lakes, deep sea fishing on the coast, and visiting California missions. Wine grape vines were introduced into the area in 1797 by Franciscan missionaries at San Miguel Archangel. From humble beginnings, the area grew to have more than 20 wineries, with more than 6,000 acres planted.

Between 1980 and 1987, the Paso Robles growth rate was 7 to 8% per year, with a current population of approximately 17,000. Many of the inmigrants came from Los Angeles and San Francisco, seeking a quieter lifestyle. According to city officials, these newcomers were responsible for precipitating planning for earthquake preparedness in Paso Robles. They were familiar with earthquake plans in the larger communities from which they had moved, and they were concerned about earthquake preparedness in their new homes.

San Luis Obispo County officials responsible for emergency services have developed emergency response planning in connection with the nearby Diablo Canyon Nuclear Power Plant; the area is within the power plant's emergency planning zone. The county developed a public information function geared toward large-scale disasters as a result of the power plant's proximity. Pacific Gas and Electric (PG&E) provided San Luis Obispo County with communications equipment for its 24-hour emergency operations center (EOC), a centralized command post functioning through the sheriff's dispatcher.

In January 1988, the California Office of Emergency Services, to dramatize the earthquake prediction, staged a media event at Aggie's Cafe at Cholame on the highway to Parkfield. Local radio stations interviewed the San Luis Obispo County emergency preparedness officials attending the event. The radio stations occasionally play these interviews, reminding the radio audience that "it's still ticking." These programs, when first aired, elicited a "flurry" of calls from the public, according to officials.

Although county officials had already developed emergency response plans, the City of Paso Robles developed its plan in response to contacts from concerned citizens. Local custom had it that Parkfield has had earthquakes for years, and Paso Robles had never experienced a problem from them, so no particular preparedness action was needed. However, some of the Paso Robles newcomers asked the city fathers about the city's earthquake prepareness plans and were surprised to learn that none existed. Subsequently, city officials drafted a plan, which was presented to the public on June 7, 1988.

One of the city's actions was to locate and inspect emergency supplies that dated back to the 1950s civil defense drills. These supplies were moved from basement storage where they would be inaccessible if buildings collapsed during an earthquake and brought to ground level. The city is planning to replace emergency medical and other supplies with up-to-date material.

The California Division of Forestry (CDF) is responsible for providing emergency response to unincorporated areas of counties. CDF personnel work with both city and county disaster response officials. A county official said:

> Rural people are tough. They'll do OK. Their housing tends to be new, built according to good stringent building codes which the building inspectors enforce. They tend to live in wood frame houses which do well in earthquakes. People on ranches have their own food and water.

In contrast, however, officials perceived those who have moved to the area from Los Angeles and San Francisco as probably having more difficulty in an emergency. Officials thought that these persons are used to having immediate emergency services, and that will not be the case in a rural setting.

Despite some apparent complacence about the risk from a Parkfield earthquake, a variety of information sources served to increase both public's and officials' awareness.

Paso Robles is served by the following newspapers: the Daily Press, the Paso Robles Country News, the San Luis Obispo Telegram Tribune, the Journal, and the Central Coast Times. Additionally, relevant earthquake articles were also found in other papers read by some Paso Robles residents; these included the Carpinteria Herald, the Goleta Sun, the Five Cities Times Press Recorder, the Atascadero News, the Santa Ynez Valley News, the Lompoc Record, the Santa Maria Times, the Santa Barbara News Press, and the Paso Robles Press. Table IV-2 summarizes the types of information presented in these articles during the study period. Compared with Coalinga newspaper articles, Paso Robles articles appeared to stress earthquake preparedness and response somewhat more (45% compared with 17%), while Coalinga articles stressed earthquakes and related damage more (38% compared with 30%).

Paso Robles is served by 3 television stations, 3 cable stations, and 16 radio stations. Most people use KSBY-TV and KCOY-TV. A typical family in Paso Robles has probably been exposed to some broadcast information on earthquakes and the Parkfield prediction, probably on television.

The most active television station covering earthquake risk in the Paso Robles area was KSBY-TV, the NBC affiliate in San Luis Obispo. KSBY-TV provided coverage of the Parkfield prediction and earthquakes for the entire study period. At the time the prediction was first issued in April of 1985, KSBY-TV provided the national media coverage on the prediction itself, the science of earthquake prediction, and historical Parkfield earthquakes. In August of the same year, the station ran another story on the Parkfield prediction which was followed with another story that November. San Luis Obispo County adopted their earthquake prediction response plan in January of 1987, and KSBY-TV ran a story on this the same month. The Parkfield prediction was also the topic of two additional stories during the rest of 1987. Finally, in

Table IV-2. Types of Earthquake and Prediction Information in Paso Robles Newspaper Articles

Article Type	Percent	Number
Earthquake preparedness and response	45%	33
Earthquakes and earthquake damage reported	30%	22
Earthquake science	12%	9
Earthquake politics	11%	8
Parkfield prediction/experiment	1%	1
Total	99%	73

the month of February of 1988, KSBY-TV ran a month-long series in the evening news called "Project Earthquake." The Parkfield prediction was worked into the series. This series comprised the most comprehensive coverage of earthquakes and dealt with the following topics:

- the science of studying earthquakes and of earthquake prediction,
- the size and magnitude of the predicted earthquake,
- the effect of the Parkfield earthquake on San Luis Obispo County and on the cities of San Luis Obispo and Paso Robles (the reporting stated that if the quake were magnitude 7.0 this could devastate Paso Robles),
- the warning system in connection with the prediction,
- stories about earthquakes, county response to the prediction, earthquake prediction policy in California, what earthquakes do, and what people should do to prepare.

KPRL radio carried some minimal reporting on the prediction as part of their regular news stories. Other area radio stations either had reported nothing, or their staff members were unaware of any reporting.

In April 1988, as part of Earthquake Awareness Month, the county OES did a poster and flyer campaign that also involved some radio interviews on the Parkfield prediction and earthquake preparedness. Then, in May 1988, the California OES mailed out the Parkfield prediction brochure coincident with the Nostradamus prediction of a large earthquake and fires. The national media were covering the Nostradamus prediction and people were leaving the Los Angeles area because of it. The brochure mailed by the State OES reached San Luis Obispo County households two days before the Nostradamus-predicted earthquake. The county office was "bombarded" with telephone calls (approximately 100) asking whether in fact there was going to be a large earthquake. In response to these calls, the office mailed out informational material on earthquake preparedness and the Parkfield prediction. The staff also did radio spots on why the state had mailed out the brochure, urging listeners to contact the county office of emergency preparedness for more information.

The San Luis Obispo County Office of Emergency Services thought that county preparedness for earthquakes had been positively influenced by planning for a Diablo Canyon nuclear power plant emergency. In June 1988, the County held training with its department heads on the Parkfield prediction, preparing them with consistent information concerning the prediction. (County department heads are also public information officers.) An emergency response manual details the functions of each of the offices, and training was specifically held for the Parkfield situation. If a Parkfield earthquake warning occurs, the county will activate the emergency response plan, declare a local emergency, and provide public information. The county has also trained the emergency broadcast systems broadcasters, all radio and television stations except cable stations, and the print media.

In addition, the American Red Cross (ARC) does disaster training for all types of disaster response, including earthquakes. The ARC receives funding from Pacific Gas and Electric Company (PG&E) for providing disaster training and producing disaster training tapes. ARC personnel bring to training sessions their "earthquake bucket"--a red plastic garbage can containing emergency supplies--as an example of what people should have at home to be prepared for earthquakes. The American Red Cross is active in San Luis Obispo County in making presentations to community groups, including classes, slide shows, and literature. For example, in early 1989, groups requesting presentations included Paso

Robles High School, Pacific Gas and Electric Co., other high schools, a hospital, and the Embassy Suites Hotel. They have consistently provided this service to county communities and did not increase it subsequent to the Parkfield prediction. The ARC also responds to individual requests for information, with brochures available in both English and Spanish. Occasionally, the ARC issues a news release offering their informational and educational services to community groups.

The San Luis Obispo County OES receives 20 to 30 calls a month from the public requesting information on earthquake preparedness. In response, they mail out the brochures on earthquake preparedness that they have available. The OES also works on preparedness with neighborhood groups. People in 5-acre plots (20 to 30 households) have been forming neighborhood watch groups to prepare for the earthquake. For these groups, the OES provides a larger package of materials that comes from the state. County officials observed that the state materials are geared more toward urban than rural areas. The county OES also does some limited training activities with these groups.

In January 1989, the Paso Robles Public Schools were working on a plan concerning the 72-hour warning for the Parkfield earthquake that would go out to every school. Materials they used included an American Red Cross brochure, an earthquake preparedness workbook, California OES pamphlets, FEMA brochures, and county OES materials. In preparing their plan for the 72-hour warning, school personnel relied heavily on the Los Angeles Unified School District Staff Home Emergency Preparedness Plan as a model. The Paso Robles schools hold annual drills and large-scale earthquake exercises. They planned to conduct a drill for their 72-hour warning plan, once it was developed. The schools would not be closed in the event of the 72-hour Parkfield warning. School children in the area receive material and basic instruction on how to behave during and after earthquakes. We located California OES brochures, ARC brochures and posters, and Yogi Bear comic books in Paso Robles. The telephone directory did not contain earthquake information as it does in other California communities.

County officials noted that it is difficult to keep up interest until 1993 when the prediction period ends. They give new county employees disaster training with emphasis on the Parkfield prediction. They also do talks and speeches before community groups on all types of hazards about once a month. Most of the time, these talks focus on earthquakes and on the Diablo Canyon facility.

The San Luis Obispo County OES was notable in how it both encouraged and responded to public inquiries for earthquake information. One of the biggest problems the OES had, in fact, was that its supply of brochures is limited and it has no authority to print more brochures. In general, the staff did not believe in flooding the market with preparedness literature, an activity which they thought does not lead to effective citizen action. Instead, they prefer to do radio spots and use posters strategically placed around the community to elicit queries, and then provide information when they are asked about it. They reported an increase in requests for information after earthquakes and special media coverage, and during Earthquake Awareness Month in April each year.

D. Information Supplementing the Brochure in Taft

Taft is about 40 miles southwest of Bakersfield, the Kern County seat, and 75 miles from Parkfield. The city has a population of approximately 6,250 and lies in the heart of one of the nation's largest oil-producing regions. A city slogan is "Helping Supply America's Energy thru Petroleum." At 1,000 feet in elevation, Taft boasts of being above the "fog belt" and of being smog-free. The climate is arid, with an annual rainfall of 5.58 inches.

Oil is Taft's principal industry. Large gushers began coming in on the Midway Sunset Field southeast of Taft in 1910, the same year that the city was incorporated. The U.S. Naval Oil Reserve is about 6 miles from Taft, and it has an estimated production potential of about 200,000 barrels a day. Currently, the west side produces about 25% of California's total oil production. However, with the decline in the oil industry during the 1980s and cuts in oil company crews, Taft's population has declined, and its age composition has shifted to a preponderance of older citizens. Only 8 to 10 new houses had been built in Taft during the last few years.

Kern County has 70 different earthquake faults within its borders, including such major faults as the San Andreas, the Garlock, White Wolf, Kern Canyon, and the Sierra Nevada. The Kern County American Red Cross office in Bakersfield provides a fault map as part of its public information materials. Taft residents are concerned about attracting new industry to their community; not surprisingly, earthquake risk is not advertised in their publications about their city. Nevertheless, the same earthquake information sources exist in Taft as in the other study communities: (1) newspapers, (2) broadcast media, (3) official drills, training, and exercises, and (4) community action, brochures, coloring and comic books, and other information products.

The principal newspapers serving Taft are the Bakersfield-Los Angeles-Bay News Observer, the Bakersfield Californian, and the Taft Midway Driller. For the study period January 1984 to September 1988, there were 20 articles and editorials pertaining to earthquakes and the earthquake prediction. Of these, 70% were stories about earthquakes and earthquake damage, 25% were earthquake preparedness stories, and 5% were on earthquake science. Taft was notable for its relative lack of newspaper information about earthquakes and prediction during the study period when compared with Paso Robles and Coalinga.

Taft is served by three television stations and 10 radio stations that also serve the broader Bakersfield area. KTFR is the only local radio station. KMJ is the Emergency Broadcast System (EBS) key, and other stations tune in to KMJ, tape their broadcast, and then rebroadcast the EBS message on their own stations.

Bakersfield's KERO-TV has broadcast the most extensive coverage on earthquakes, earthquake response, and the Parkfield prediction of any television station in the three study communities. The award-winning station carried a week of coverage on earthquakes on the evening news on the first anniversary of the Coalinga quake (May 1-7, 1984). Among other topics, this coverage evoked the 1952 Bakersfield earthquake, during which the downtown Beale Memorial Clock Tower fell. The series ended with a town meeting at which KERO-TV handed out a pamphlet on earthquake preparedness. A sampling of their ongoing earthquake-related coverage follows:

- Extensive coverage of the Coalinga earthquake when it occurred broadcast on May 2, 1983.
- Coverage of the Palm Springs earthquake on Highway 111 on April 7, 1986.

- Coverage of the Los Angeles/Whittier Earthquake on October 11, 1987.
- On the evening news, coverage of the Parkfield experiment broadcast November 16, 1987.
- Evening news coverage of the Parkfield experiment and the scientific study of earthquakes on November 23, 1987.
- Follow-up story precipitated by a slight earthquake at Parkfield. The story described the different types of faults--dip slip, strike slip, and thrust--and aired December 1, 1982
- A drill for earthquake preparedness broadcast November 30, 1988.

During coverage of the Whittier-Narrows Earthquake, KERO-TV reviewed California's history of major earthquakes. The coverage is summarized as follows:

- April 18, 1906: San Francisco's magnitude 8.3 earthquake; 2,000 fatalities; 3,000 left homeless; $4 million in property damage. This was the worst one in the state's history.
- February 9, 1971 and October 1, 1987: magnitude 6.4 earthquakes in southern California, with fatalities and extensive property damage.
- May 2, 1983: Coalinga's magnitude 6.7 earthquake, resulting in extensive property damage to the downtown area.
- July 8, 1986: Palm Springs magnitude 6.0 earthquake.
- August 22, 1952: Bakersfield's magnitude 5.8 earthquake. Pacific Bell said that 300,000 people made calls on that occasion.

Kern County OES began working in 1986 to interest locals in planning for earthquake disaster response. An exercise in early summer of 1986 included small towns and unincorporated areas around Taft. Meetings were held with ham radio operators and the civil air patrol; and EBS broadcast plans for the Parkfield earthquake prediction were prepared.

Regional OES managers coordinate the work of county OES offices. The regional managers work to get state resources to the local level and send information back to Sacramento. County OES offices are part of county government and do not work for the state OES. The regional office of the state OES is a link to EBS stations when EBS is activated. Fresno County Fire is a secondary emergency operations center in case the state OES is closed for the evening. The Parkfield Alert A (warning) would go from Sacramento to local officials; one-half hour later it would go out over the wires to all the media for them to disseminate. KMJ has the widest broadcast area; they cover the area from Sacramento to Bakersfield. The City of Taft has its own earthquake response plan. The alert system in Taft for a short-term Parkfield earthquake warning comes through the City Police Department. The dispatcher calls the first telephone tree (city manager, schools, and so on). The city calls the local newspaper and radio station, who receives a canned Parkfield notice.

The city has identified all of the unreinforced masonry buildings located within the city limits. City officials personally warned building owners and occupants about the earthquake risk in those buildings. Each one of the unreinforced masonry dwellers (in some 60 to 70 buildings) will be notified in the event of a warning, no matter how long it takes to call them.

The Taft schools have undertaken extensive preparations for earthquake events both because of the Coalinga earthquake and the Parkfield prediction. Taft elementary schools reported holding quarterly earthquake drills for their pupils. After the Parkfield prediction was issued, the schools provided brochures to the children to take home. Subsequently, the schools focused more on what the children should be doing during and after an earthquake. The schools have an earthquake response plan. School personnel undergo periodic drills in accordance with existing plans. Teachers were supplied with pocket cards that list what to do in case of an earthquake. Evacuation plans are detailed, including routes and locations to gather.

The Kern County Public Schools hold earthquake prediction exercises once a month. An emergency contact person at each school will receive the telephone call for exercises and for the actual Parkfield earthquake warning. The procedures involve reinforcing take-cover drills, closing drapes and blinds, moving objects from high shelves, removing vehicles from enclosed areas, keeping students from common areas of buildings, and reviewing emergency plans. These plans include building evacuations after earthquakes. Entire school staffs have been trained; materials on what to do were collected from anywhere that they could be located.

The American Red Cross (ARC) in Taft met with city officials, the police and fire departments, and members of the public to discuss earthquake preparedness. The ARC has made presentations, and provided brochures and training in first aid and disaster preparedness to interested groups. ARC has presented to churches, Girl Scouts, Boy Scouts, utility companies, and other groups. Requests for classes increased after the Coalinga earthquake, the Parkfield prediction, and the Armenian earthquake.

In the judgment of local ARC personnel, the fact that there had been no Parkfield earthquake by January 1989 had dampened interest. However, local interorganizational drills continue with some regularity to keep staff members sharp on the procedures. The City Fire Department distributed a brochure on earthquake preparedness to every household within the Taft city limits. However, the county OES apparently did not distribute brochures to households in unincorporated areas.

The state OES offered suggestions to the city staff members about how to respond to the prediction. The city staff prepared a slide show and gave presentations about the Parkfield prediction and earthquake preparedness to the Rotary Club and other service organizations, people in the commercial sector, the local college, and other groups and organizations. The county OES held a Taft area meeting after the first notification on the Parkfield earthquake prediction.

Despite the extensive coverage provided by KERO-TV in Bakersfield, and the efforts of local officials, the levels of information available on the Parkfield prediction and earthquake preparedness generally appear to be the lowest of the three study communities. Part of this may be due to the community's comparative distance from the predicted earthquake's epicenter, and part to the perception that the earthquake did not occur during the period of time in which public interest was at its peak.

E. Selected Community Comparisons

Unique characteristics of each community no doubt have a bearing on the level and kinds of earthquake information available to typical households in those communities. For example, Coalinga had an extremely damaging earthquake in recent memory. Although the economy there is doing reasonably well, Coalinga residents were not anxious to hear more or think more about earthquakes because of their experience. Only a few of the most sophisticated professionals were aware of the impact that population turnover can have in community knowledge levels. New people moving into Coalinga and young schoolchildren are examples of those without the experiential base concerning earthquakes that the rest of the community shares.

On the other hand, there has never been a damaging quake in Paso Robles, and people there seemed inclined to discount the earthquake risk in their community, pointing to their immunity even in the face of damaging earthquakes elsewhere. Paso Robles' situation was further affected by two other unique factors: (1) its location within the Diablo Canyon nuclear power plant emergency planning area, and (2) its population of newcomers from California's major population centers. Both of these factors contributed to Paso Robles finally taking action with respect to the Parkfield prediction and to earthquake planning.

Taft is further different. With a sagging economy, some community influentials may be interested in suppressing any information that could be viewed as detrimental by business or industry thinking about locating in the community. On the other hand, Taft has gone further than any of the study communities in individually contacting and meeting with residents whose buildings are at potentially high risk in any damaging earthquake.

All three communities had the levels of information they did because of earthquake preparedness "champions." In Coalinga, the fire chief is the champion of earthquake preparedness, apparently because of his first-hand experience in dealing with the Coalinga quake and his familiarity with the conditions that led to damage. In Paso Robles, the San Luis Obispo County emergency services staff is responsible for a great deal of the earthquake information available in the county and thus in Paso Robles. For Taft, without question, the news staff at KERO-TV have championed earthquake preparedness information in the entire Bakersfield area more than any other individual or entity.

Each of the three areas has a unique plan for getting the Parkfield earthquake prediction warning out, and each is concerned about liability in connection with the earthquake warning. Yet each study community appears to be using the same strategy for dealing with this by preparing scripts in advance that can be used to announce the warning. This may have been the result of state OES training of local emergency services personnel on the Parkfield earthquake prediction and how to deal with it.

Common problems faced by emergency response officials in each community include insufficient supplies of public brochures to fill the need, coupled with insufficient funding to have more brochures printed. In addition, each community faces the problems of personnel turnover and dwindling interest in the prediction as time passes without the predicted earthquake. Keeping personnel trained "up to snuff" and fostering ongoing concern has been difficult for those responsible.

CHAPTER V

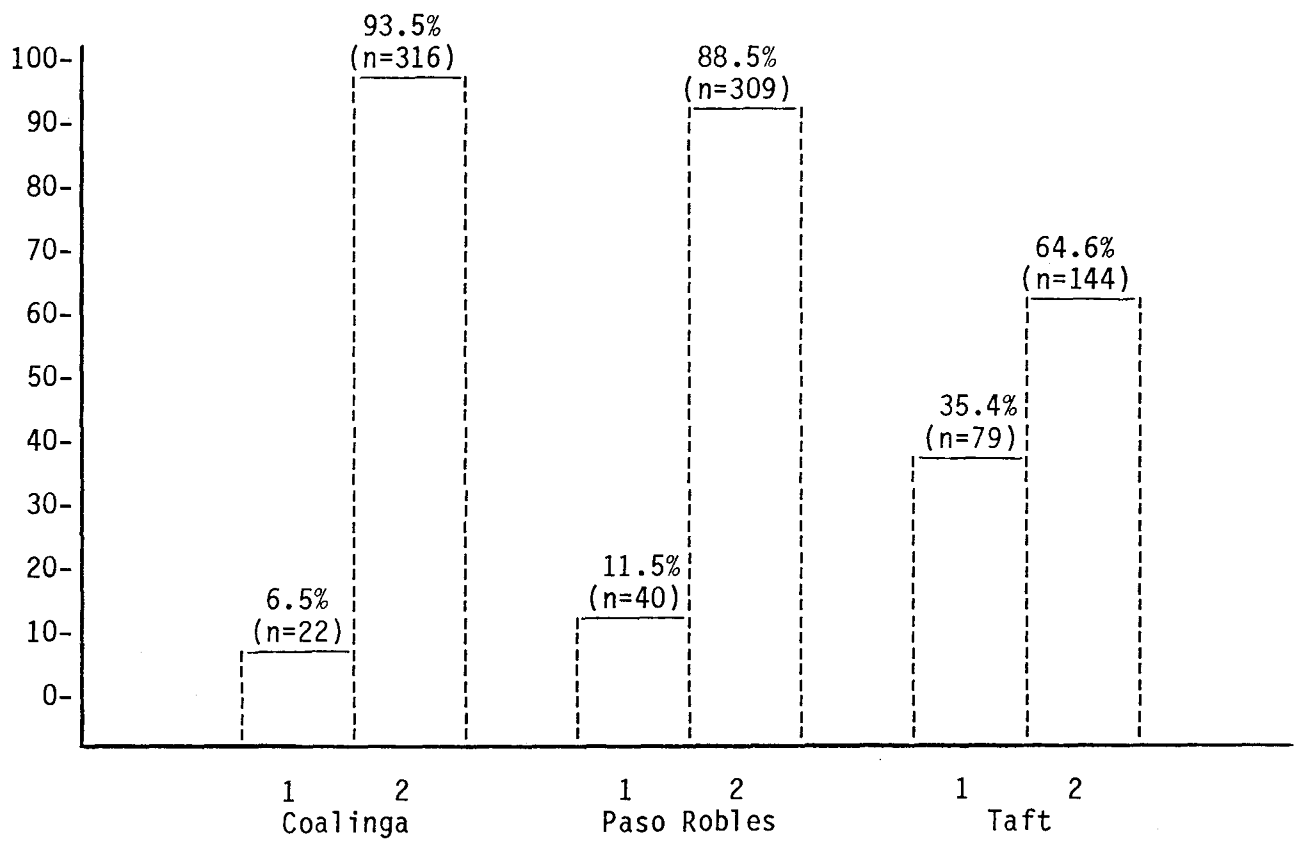
A DESCRIPTION OF PUBLIC PREDICTION RESPONSE

Most of our respondents in Coalinga, Paso Robles and Taft heard about and believed the Parkfield earthquake prediction. People, however, were selective about what they remembered about, and did because of, the prediction. Consistently, people remembered and performed actions along the line of least resistance. For example, people were more likely to remember getting guidance and then taking actions that were easier, while ignoring and forgetting about more time-consuming actions. When people reflected, almost everyone thought that more needed to be done to get ready for the Parkfield earthquake, that the prediction had impacts on their community, and that future prediction information would best come from government in brochures sent to their homes. This chapter describes these and other public perceptions and responses to the prediction.

A. Hearing About the Prediction

A variety of communication modes were available to inform the residents of Coalinga, Paso Robles and Taft about the prediction. In fact, most residents of these communities heard about the prediction from more than one source; however, the brochure was the most effective communication device. Respondents who had heard about the prediction ranged from 93.5% in Coalinga and 88.5% in Paso Robles to 64.6% in Taft (see Figure V-1). Each individual prediction information source reached

Figure V-1. Percent of Respondents by Community Who Heard About the Parkfield Earthquake Prediction*



*Where 1 = no/don't know and 2 = yes

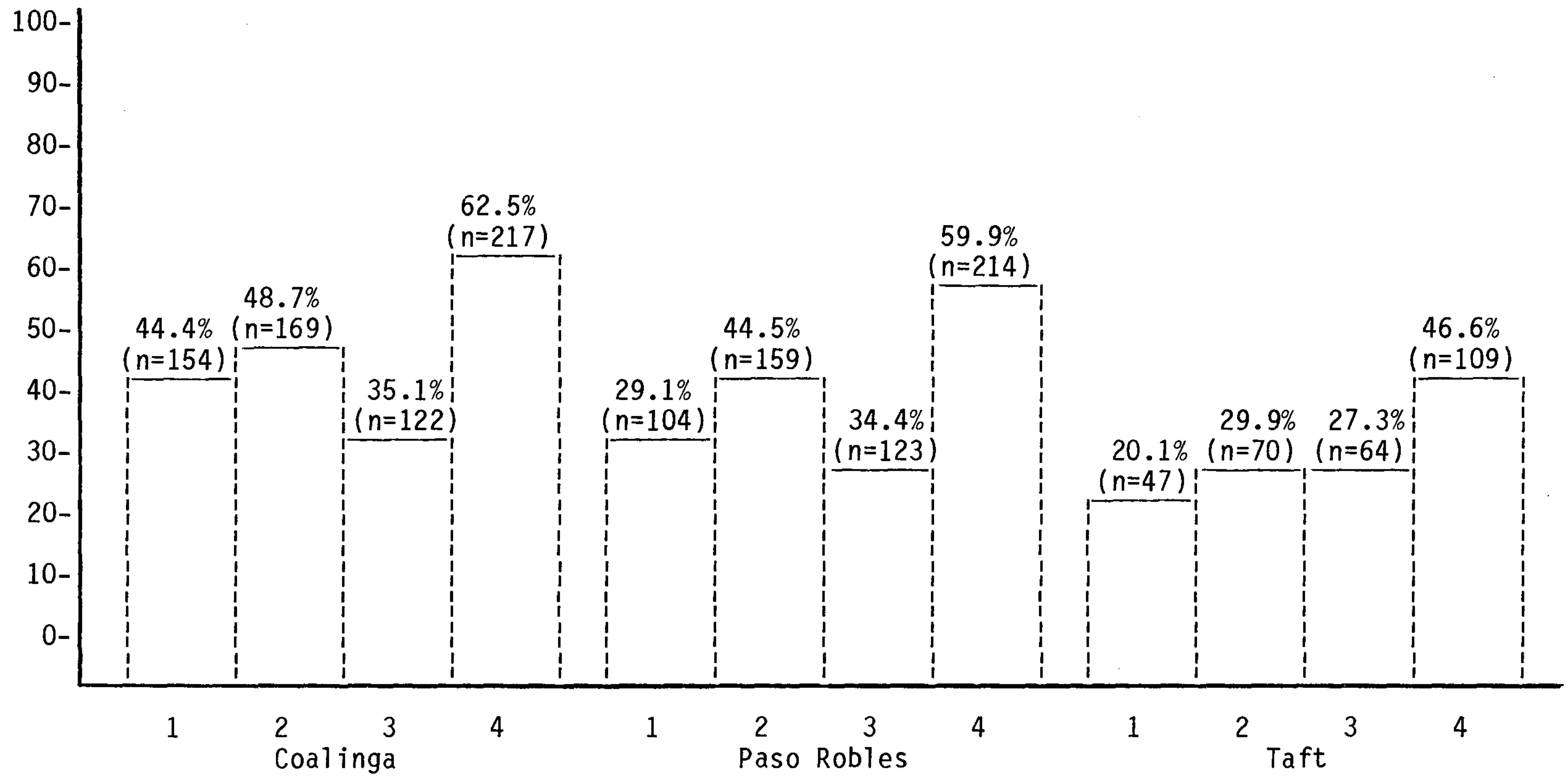
a substantial portion of the population but, as Figure V-2 illustrates, two sources reached the most people: government organizations and the mass media. Printed matter, including the brochure, reached the largest number of respondents in all three communities (see Figure V-3): 82.2% of Coalinga respondents, 70.9% in Paso Robles, and 48.7% in Taft. Newspapers were the second most effective communication channel, followed by television. Radio was the least effective, reaching, for example, only 12.8% of the Taft population. Although some respondents did not remember getting a brochure--from 28.4% in Coalinga and 37.9% in Paso Robles to 48.6% in Taft (see Figure V-4)--more than 85% of the respondents who remembered getting a brochure reported that it could be understood.

Printed material delivered to homes was clearly the most effective vehicle to inform the population about the prediction, while radio was the least effective. These findings are the exact opposite of those for short-term risk warnings, where electronic media are more effective than the print media (cf. Mileti and Sorensen 1990), but they are identical to those from other research on longer-term earthquake prediction information (Turner et al. 1984).

B. Earthquake Risk Perceived

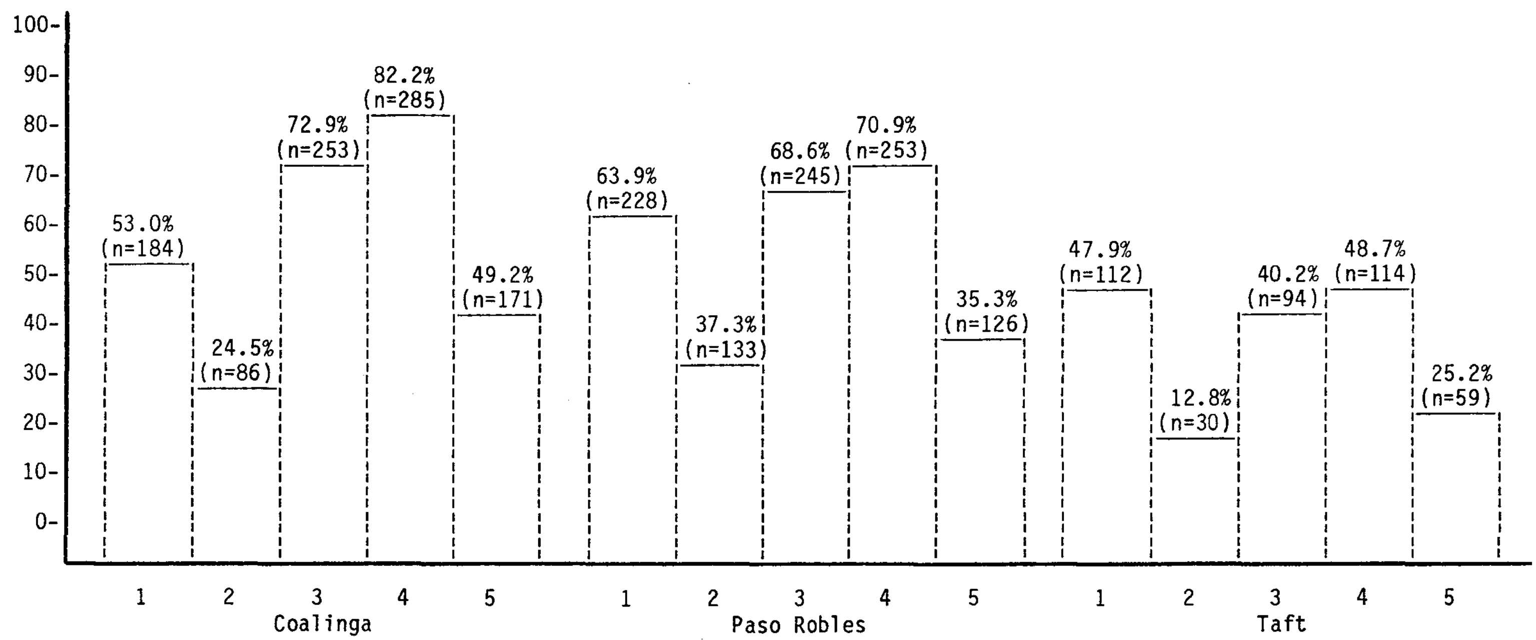
The public's perception of earthquake risk was definitely altered by the Parkfield prediction. Findings regarding the perception of general earthquake risk and of the predicted earthquake were almost identical in all three communities studied. Respondents perceived greater risk in terms of physical harm and economic losses during the predicted earthquake period (see Figure V-5) than they had perceived at any point in their lifetimes (see Figure V-6). For example, respondents reporting

Figure V-2. Percent of Respondents by Community Regarding Source of Information about the Parkfield Earthquake Prediction*



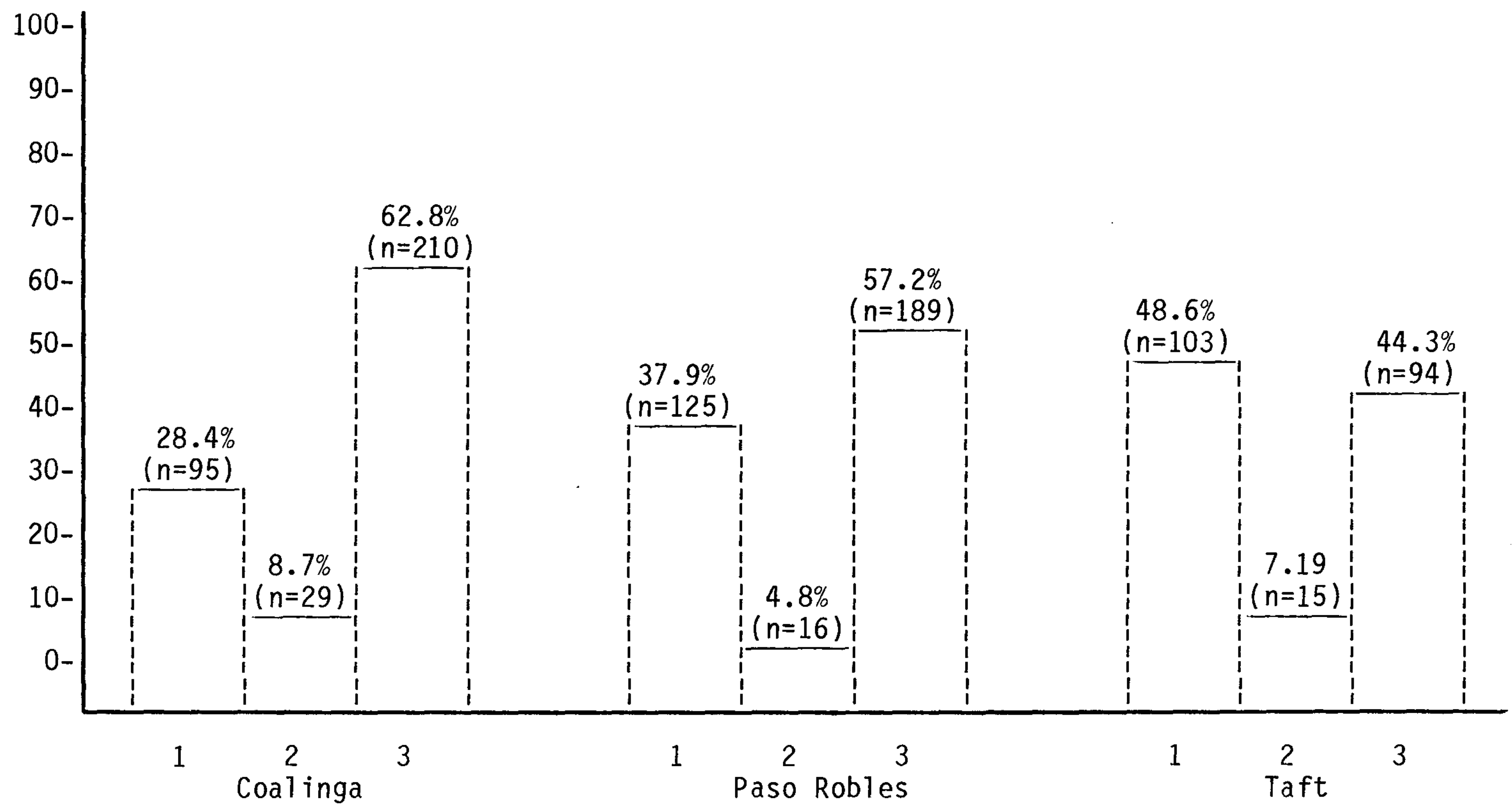
*Where 1 = informal sources, 2 = government organization sources, 3 = non-government organization sources, and 4 = mass media sources. Respondents could report multiple sources of information about the Parkfield earthquake prediction.

Figure V-3. Percent of Respondents by Community Regarding the Channels through which Information about the Parkfield Earthquake Prediction was Received*



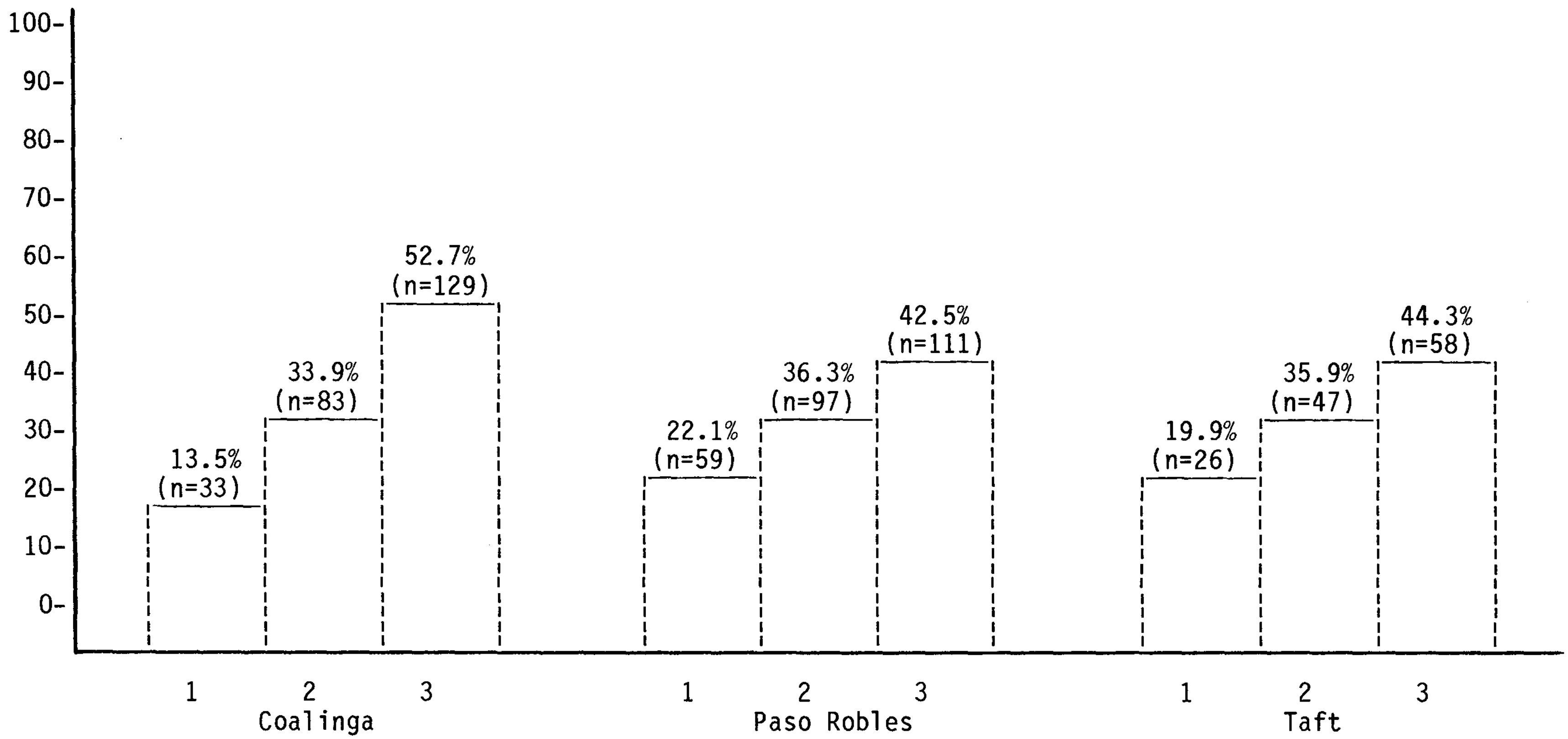
*Where 1 = television, 2 = radio, 3 = newspapers, 4 = other printed matter, and 5 = meetings/conversations. Respondents could report multiple channels through which information was received about the Parkfield earthquake prediction.

Figure V-4. Percent of Respondents by Community Regarding Ease of Understanding of the Parkfield Earthquake Prediction Brochure*



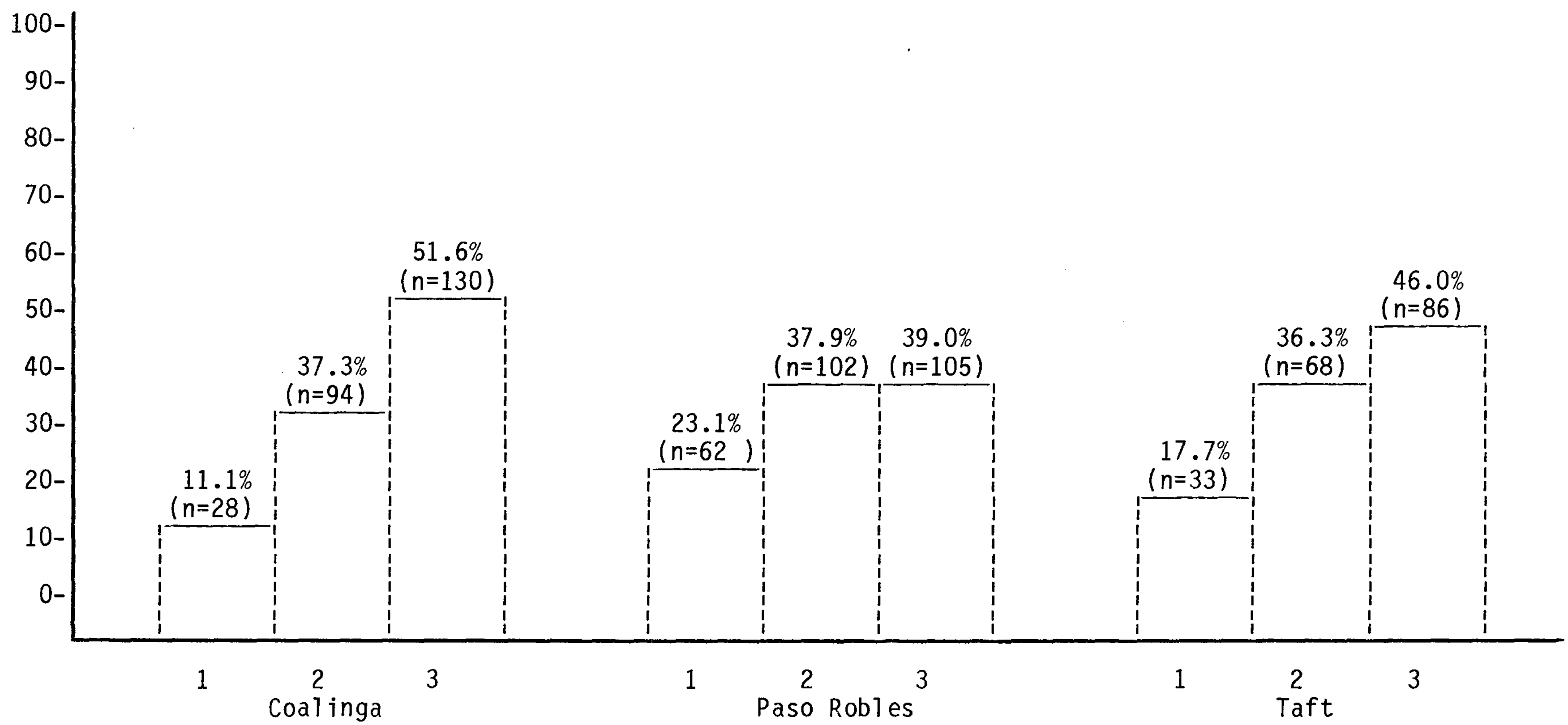
*Where 1 = did not get one, 2 = difficult/unsure to understand, and 3 = easy to understand

Figure V-5. Perception of Parkfield Earthquake Risk by Community*



*Where 1 = I do not believe that I will experience the Parkfield earthquake, 2 = in my lifetime I or someone in my family will experience the Parkfield earthquake and it will cause physical harm and/or economic losses, and 3 = in the next few years I or someone in my family will experience the Parkfield earthquake and it will cause physical harm and/or economic losses.

Figure V-6. Perception of General Earthquake Risk by Community*



*Where 1 = I do not believe that I will experience an earthquake, 2 = in my lifetime I or someone in my family will experience an earthquake and it will cause physical harm and/or economic losses, and 3 = in the next few years I or someone in my family will experience an earthquake and it will cause physical harm and/or economic losses.

that they believed they or another family member would be affected by the Parkfield earthquake and have physical harm or economic losses from it were 52.7% in Coalinga, 42.5% in Paso Robles, and 44.3% in Taft.

These findings are the opposite of how a public typically perceives earthquake risk (cf. Mileti et al. 1981). People tend to admit to risk off in the distant future more readily than to admit risk in the short-run. The Parkfield prediction apparently helped the public to stop postponing perceived earthquake risk into the future and to accept it in the nearer term.

C. Public Selectivity

The residents of Coalinga, Paso Robles and Taft recalled and acted on the Parkfield earthquake prediction. However, they tended to be selective regarding the parameters of the prediction they remembered and the guidance recommendations they recalled. They were also selective about the actual mitigation and preparedness alternatives which they performed. In general, people in each study community selected items to remember and perform along the path of least resistance. People were more likely to remember and take actions that could be done quickly; they tended to forget about, and were less likely to perform, actions that would take a great amount of their time. This general pattern was observed regarding prediction parameters recalled, short-term warning parameters recalled, preparedness and mitigation guidance recalled, and in reference to actual prediction response. A discussion of each of these categories follows.

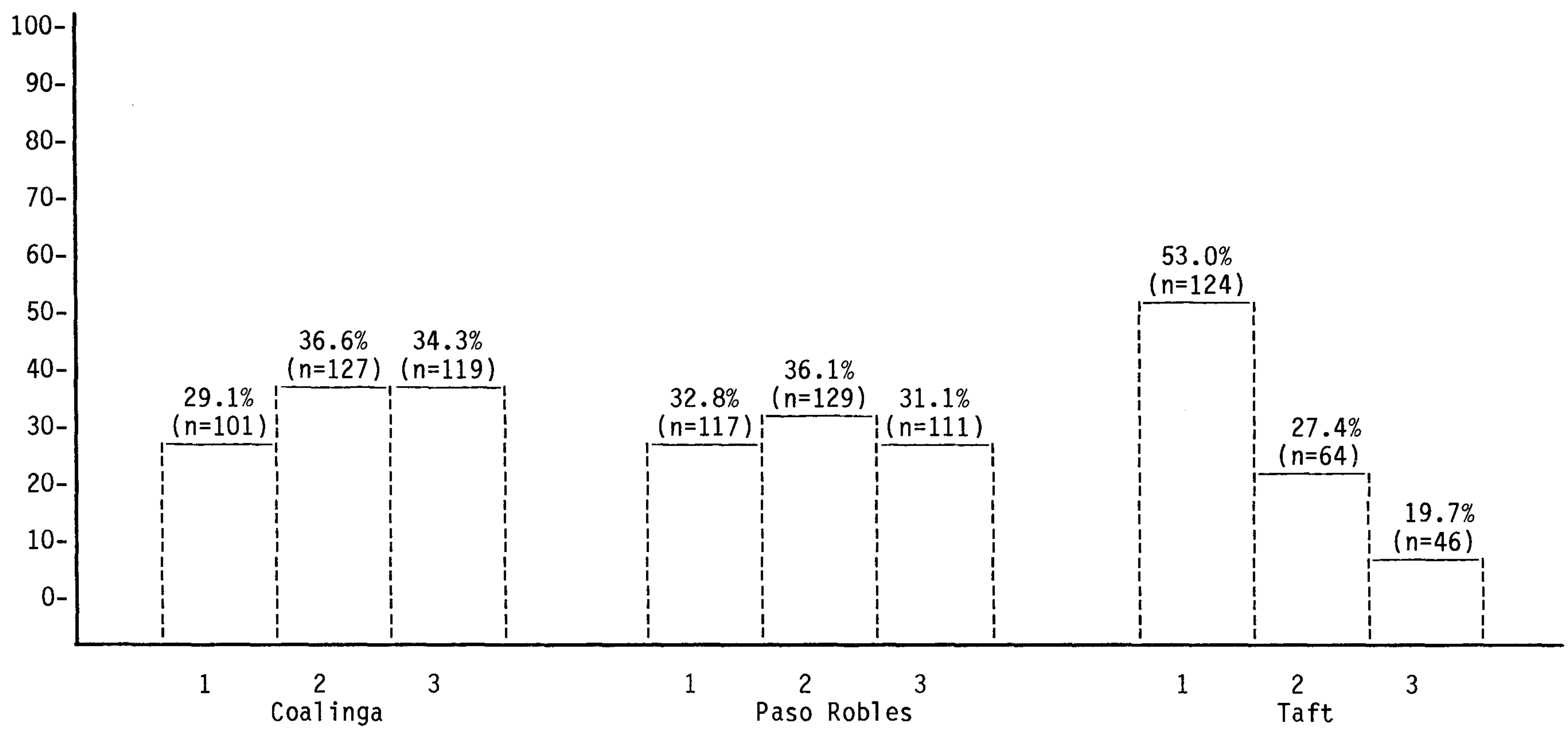
1. Prediction parameters recalled. Some respondents in each study community could accurately recall the basic prediction elements contained in the brochure: the earthquake's magnitude, potential

damage, ability to feel the quake, probability and time parameters of the predicted earthquake. However, more people could not accurately recall the prediction's parameters than could recollect them correctly.

About a third or fewer of the respondents accurately recalled that the predicted earthquake could be either a magnitude 6 or 7 (see Figure V-7). Some 34.3% of Coalinga residents, 31.1% of Paso Robles residents and 19.7% of Taft residents accurately recalled the prediction's statements of magnitude. Figure V-8 presents the findings regarding potential damage statements about the predicted earthquake. About a fifth (21.9%) of Coalinga residents accurately recalled the earthquake's potential damage, while 17.9% and 13.2% of Paso Robles and Taft respondents, respectively, accurately recalled potential damage statements. Generally, more people in each community were able to recall that the earthquake would be felt in their community (see Figure V-9). However, more people in each community recalled this parameter inaccurately than accurately; 42.4% of Coalinga respondents, 37.3% in Paso Robles, and 29.1% in Taft. Figure V-10 presents the findings regarding accurately recalled predicted earthquake probabilities. Those who recalled probabilities accurately were 24.2% in Coalinga, 21.8% in Paso Robles and 15.0% in Taft. Accurate responses concerning the time window for the predicted earthquake were provided by 44.7% of Coalinga residents, 39.5% of Paso Robles respondents and 22.6% of the people in Taft (see Figure V-11).

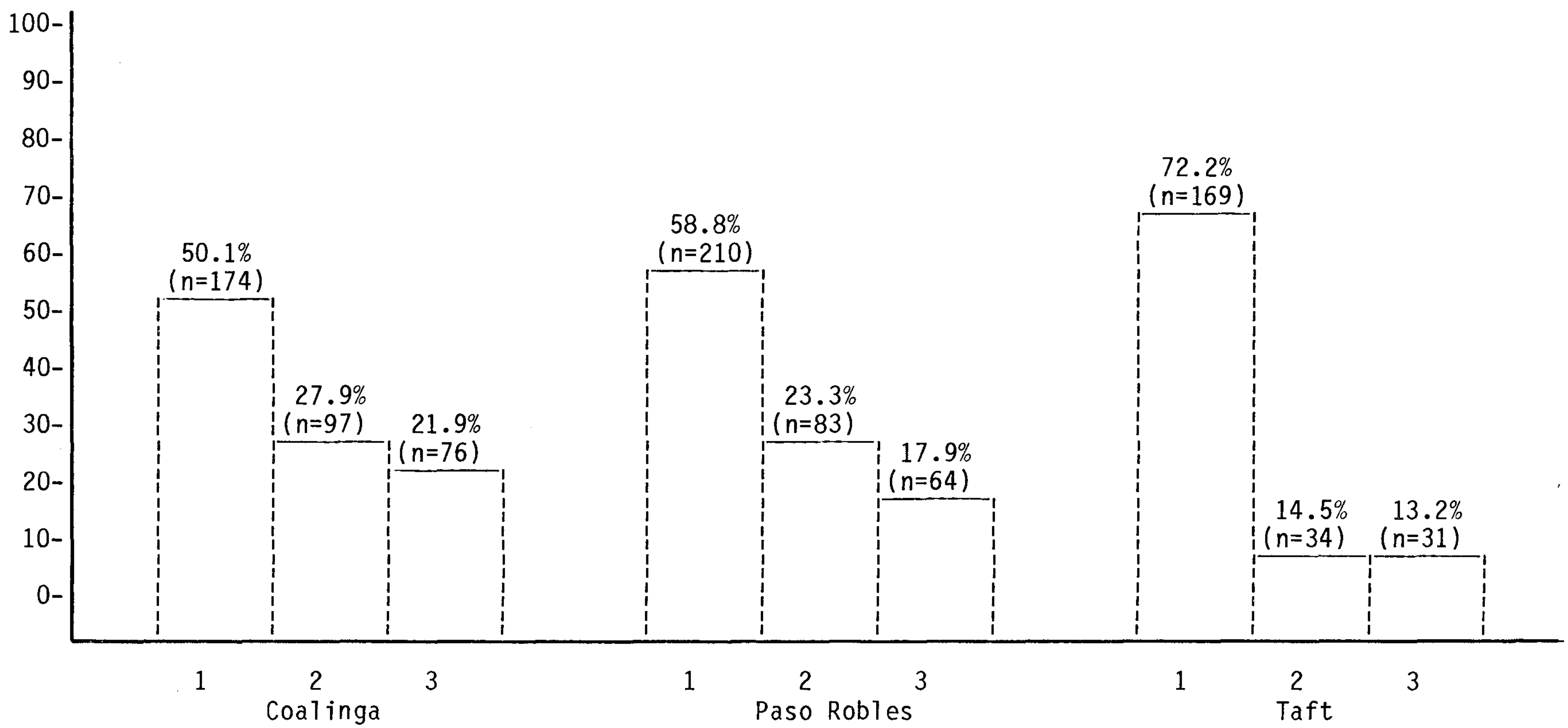
2. Short-term warning parameters recalled. The public's ability to recall the parameters of the potential short-term warning that could be issued 72 hours before the predicted earthquake followed the same pattern observed regarding the prediction parameters already presented.

Figure V-7. Percent of Respondents by Community Accurately Recalling the Magnitude Parameters of the Predicted Parkfield Earthquake*



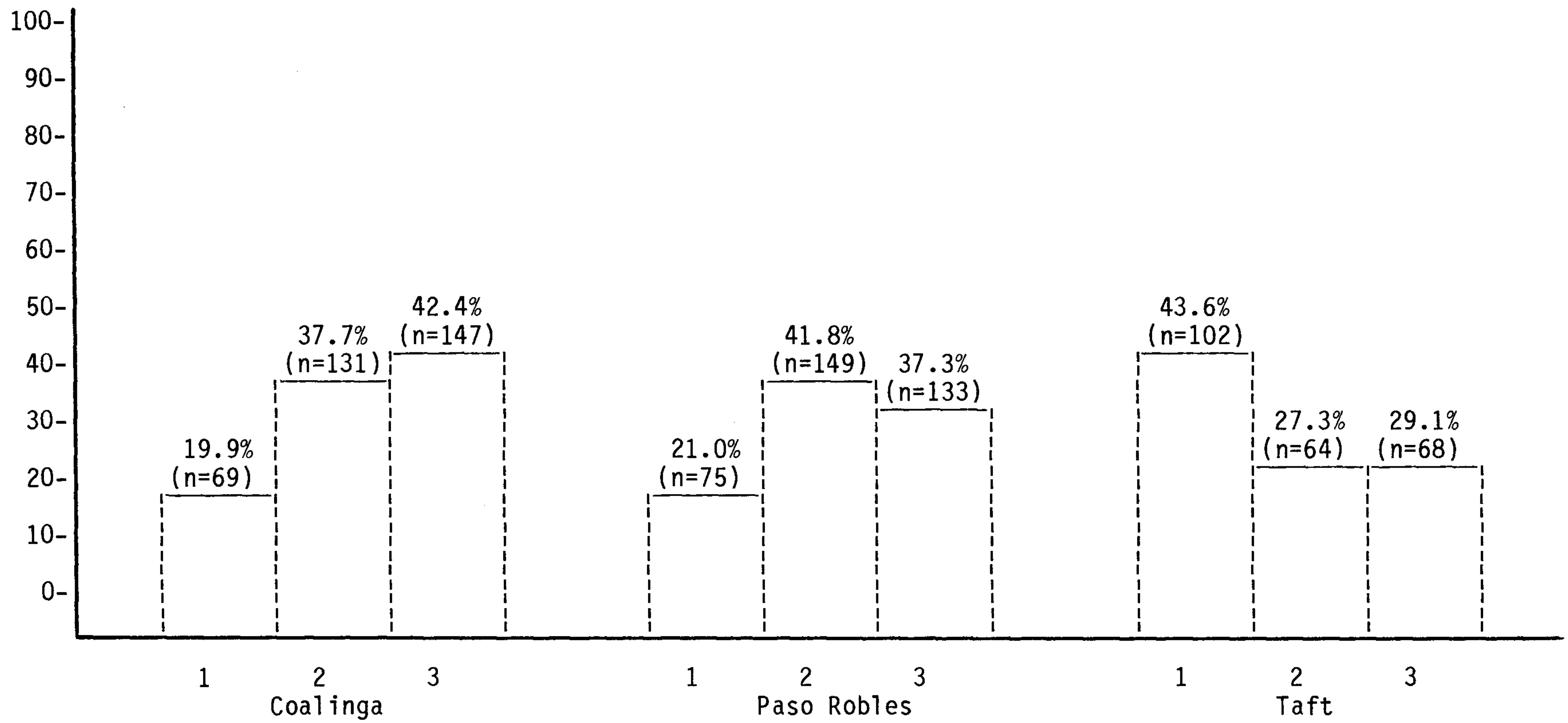
*Where 1 = no magnitudes were recalled, 2 = either magnitude 6 or 7 was recalled, and 3 = both magnitudes 6 and 7 were recalled.

Figure V-8. Percent of Respondents by Community Accurately Recalling the Building Damage Parameters of the Predicted Parkfield Earthquake*



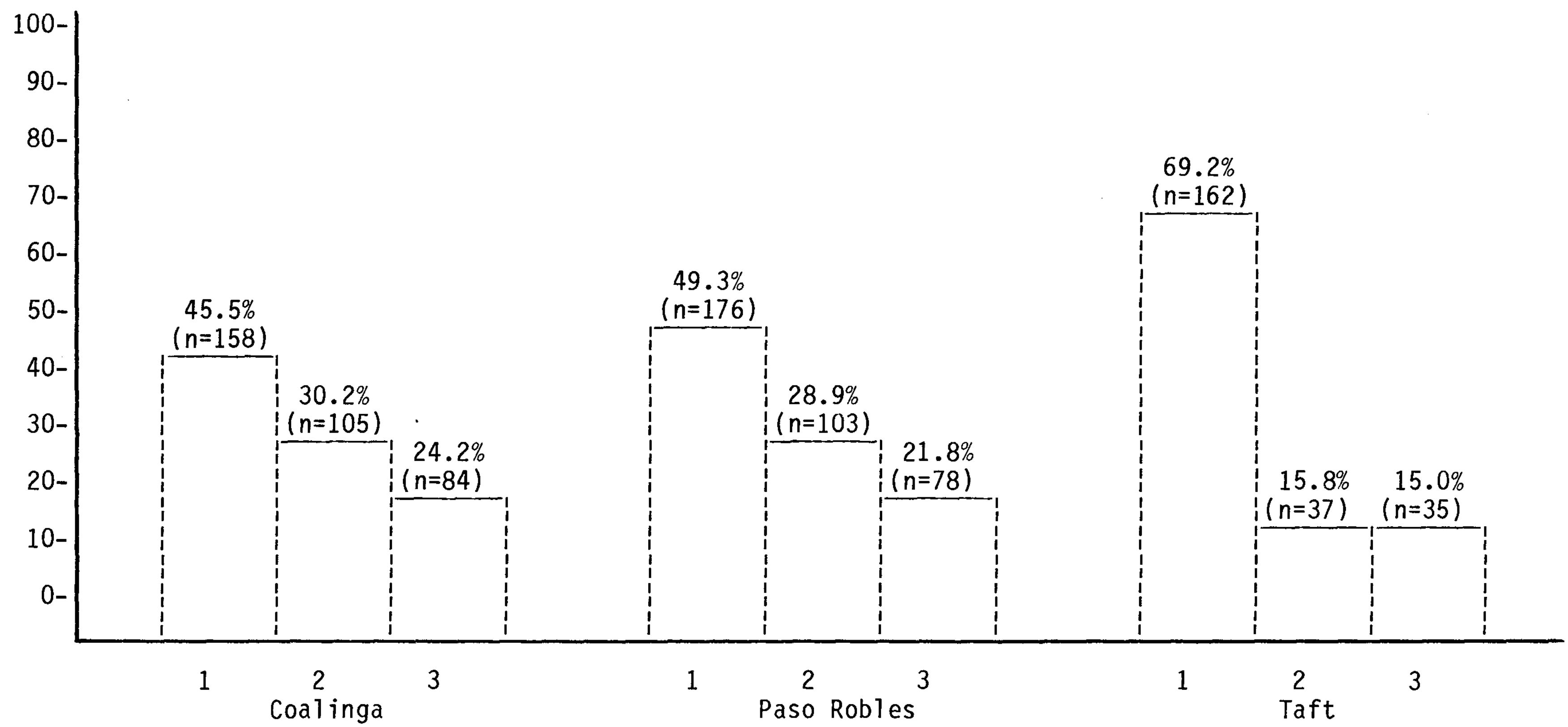
*Where 1 = no damage parameters were recalled, 2 = either magnitude 6 or 7 damage parameters was recalled, and 3 = both magnitude 6 and 7 damage parameters were recalled.

Figure V-9. Percent of Respondents by Community Accurately Recalling the Felt Parameters of the Predicted Parkfield Earthquake*



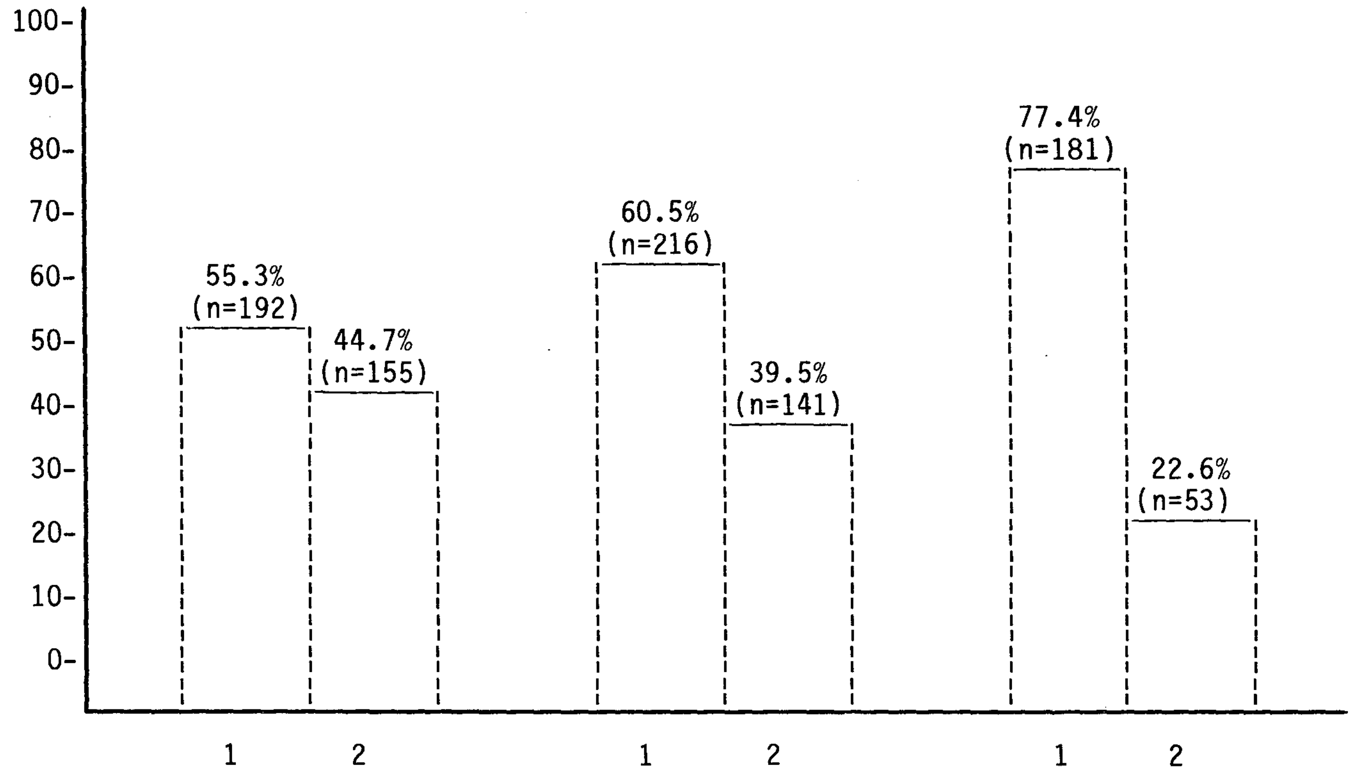
*Where 1 = no felt parameters were recalled, 2 = either the magnitude 6 earthquake will be felt or the magnitude 7 earthquake will affect places like Paso Robles, Coalinga and Taft was recalled, and 3 = both magnitude 6 and 7 felt parameters were recalled.

Figure V-10. Percent of Respondents by Community Accurately Recalling the Probability Parameters of the Predicted Parkfield Earthquake*



*Where 1 = no probability parameters were recalled, 2 = either the magnitude 6 earthquake has a 90% chance of happening or the magnitude 7 earthquake has a 10% chance of happening was recalled, and 3 = both magnitude 6 and 7 probability parameters were recalled.

Figure V-11. Percent of Respondents by Community Accurately Recalling the Time Window Parameter of the Predicted Parkfield Earthquake*

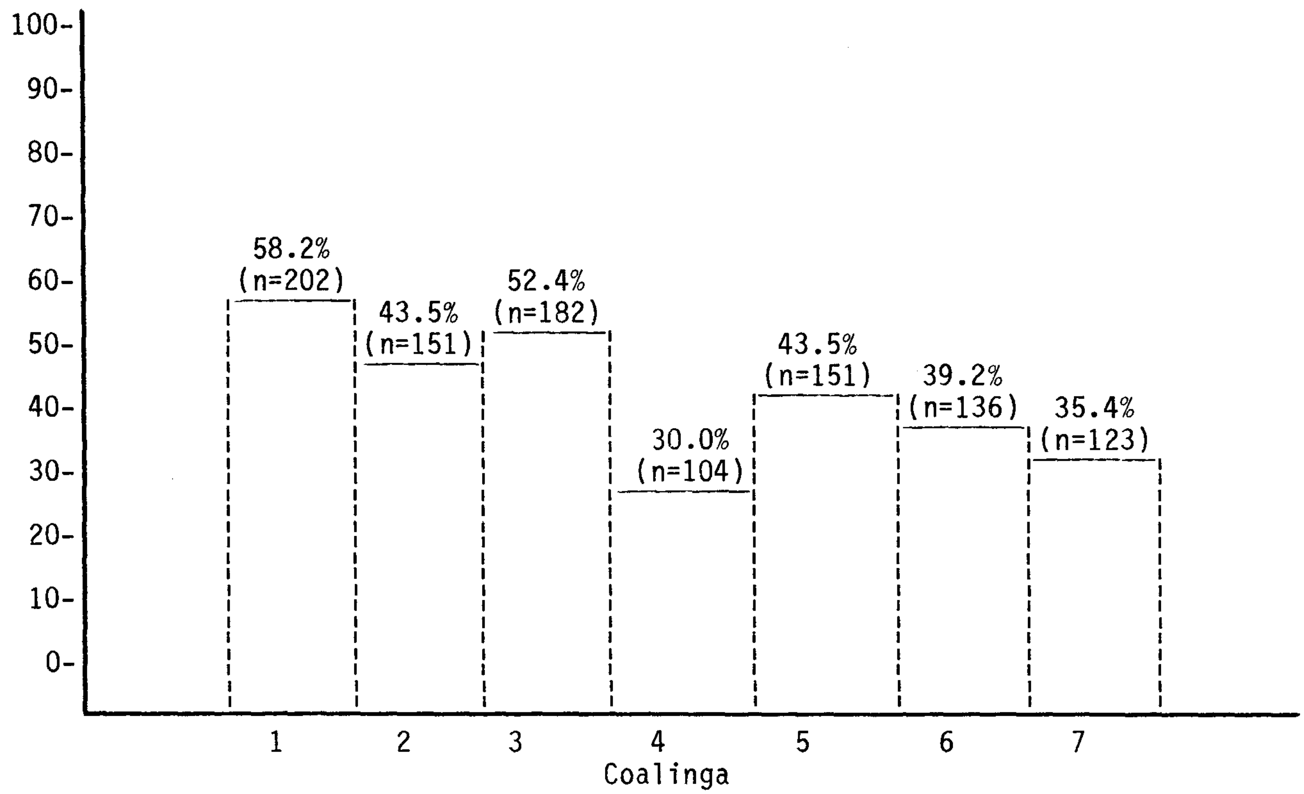


*Where 1 = regardless of the earthquake's size it will happen by 1993 was not recalled, and 2 = regardless of the earthquake's size it will happen by 1993 was recalled.

About 20 to 60% of respondents accurately recalled the specifics of the possible short-term warning, depending on the detail and the community. The parameters most likely to be recalled were perhaps the most important: that the public may receive a 72-hour warning, and that the warning will be delivered over the media. The least likely to be recalled were that there would be a public information hot line, and that the warning would be cancelled if the earthquake did not occur. Figures V-12, V-13, and V-14 present the proportion of respondents accurately recalling different parameters of the possible short-term warning for Coalinga, Paso Robles and Taft, respectively. As was the case with the other findings, more Coalinga residents recalled accurately than did residents of Paso Robles, and Taft residents had the least accurate recollections.

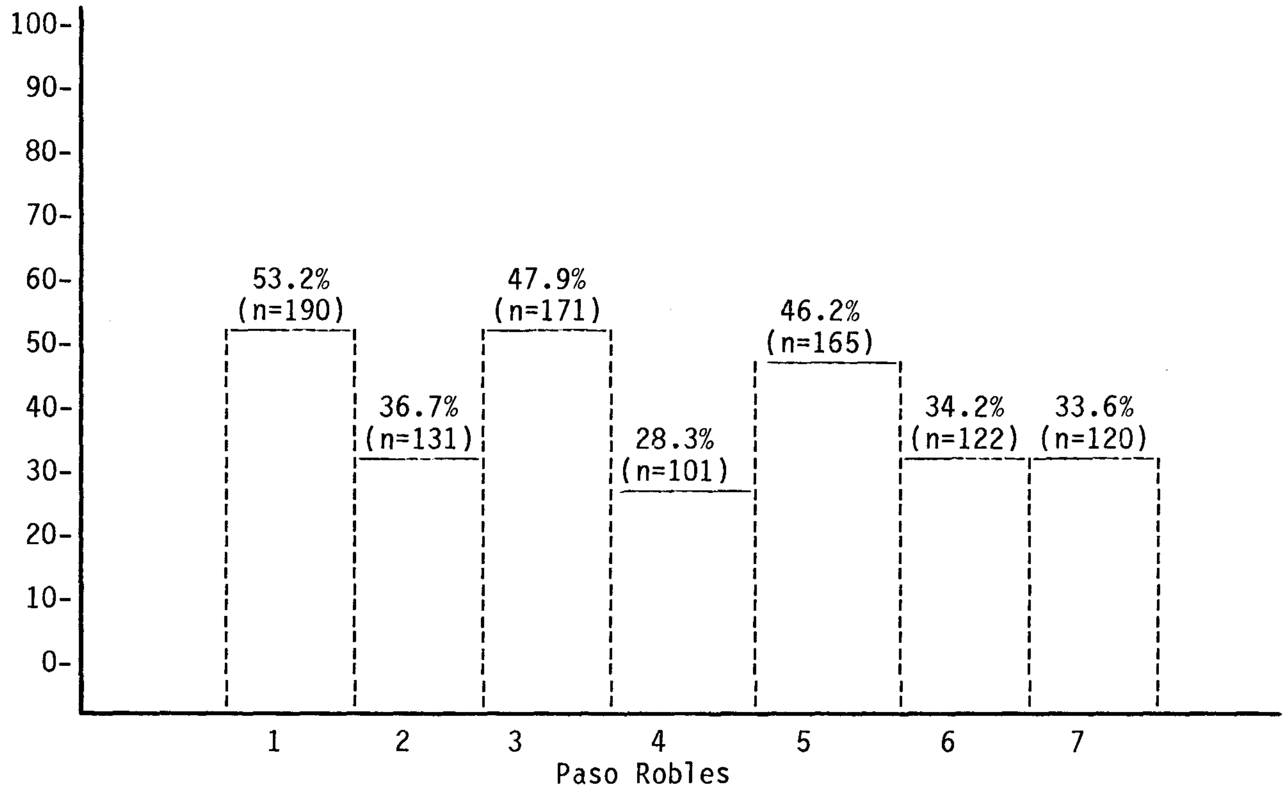
3. Preparedness guidance recalled. Respondents were asked if they had ever been provided information about preparedness recommendations in reference to the some 20 suggestions in the brochure. Specific guidance recommendations were recalled in an almost identical pattern across the three study communities (see Figures V-15, V-16, and V-17 for Coalinga, Paso Robles and Taft, respectively). People were most likely to recall guidance about what to do during the earthquake, for example, get under a table or desk; and what to do to better cope with an earthquake disaster, for example, have a flashlight and radio ready. People were least likely to recall guidance about actions to take to prepare that would require extra time and energy to perform, for example, forming a neighborhood watch group and learning the emergency plans at school and work.

Figure V-12. Percent of Coalinga Respondents Accurately Recalling the Short-Term Warning Parameters of the Predicted Parkfield Earthquake*



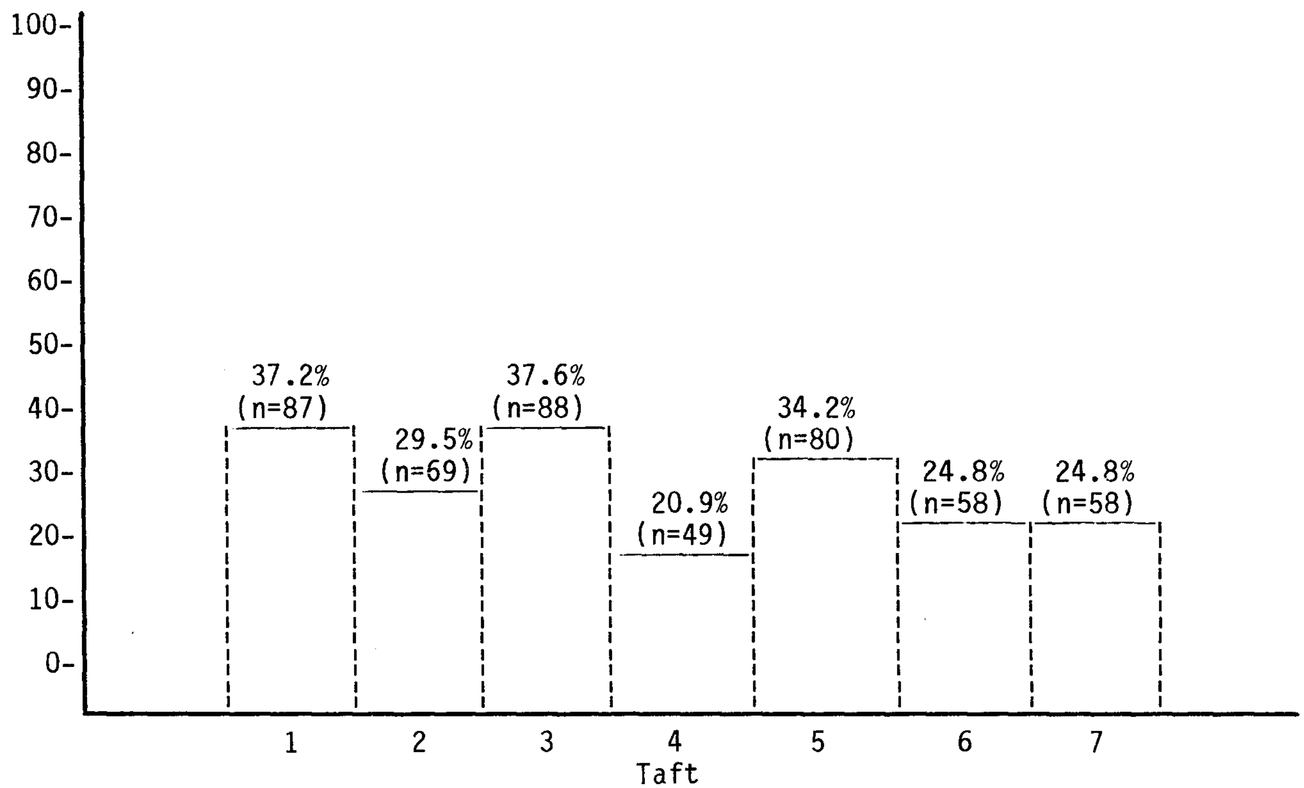
*Where 1 = the public may receive a warning of a 72-hour period during which the earthquake could occur, 2 = the 72-hour warning will come from local and state officials, 3 = the warning will be announced over radio, television and in newspapers, 4 = a telephone hotline number will be provided to the public, 5 = the warning will be followed by other information over radio, television and in newspapers, 6 = several 72-hour warnings may be issued, and 7 = the warning will likely be cancelled within 72 hours if the earthquake does not happen. Respondents could report more than one answer.

Figure V-13. Percent of Paso Robles Respondents Accurately Recalling the Short-term Warning Parameters of the Predicted Parkfield Earthquake*



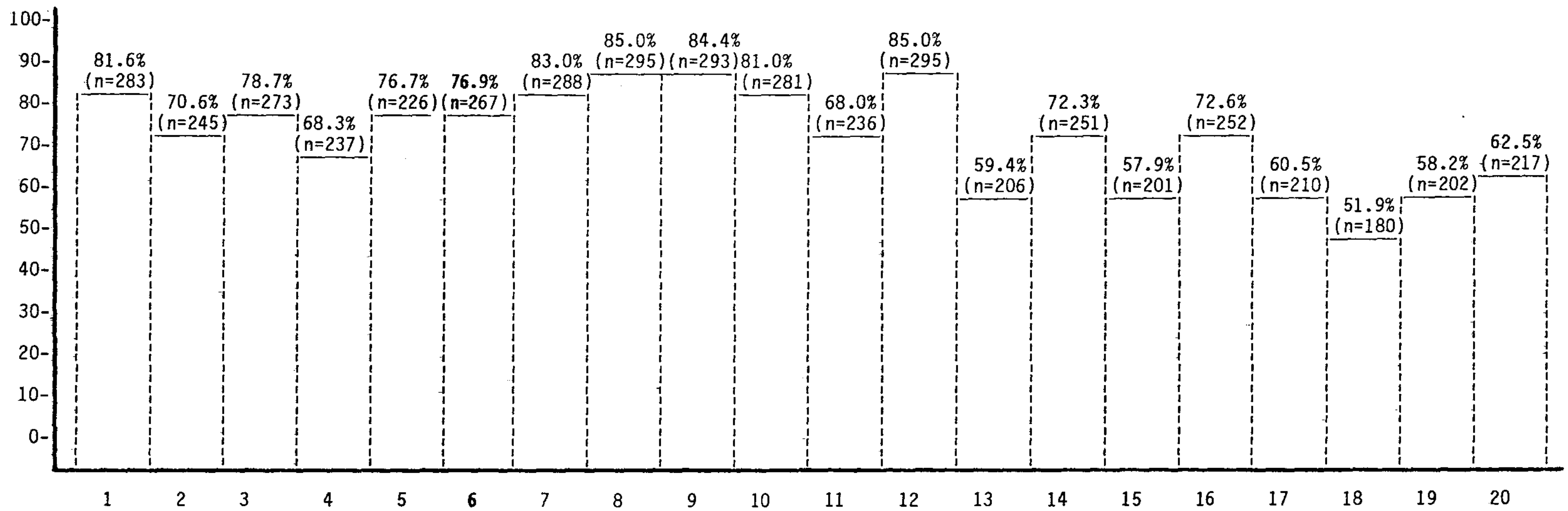
*Where 1 = the public may receive a warning of a 72-hour period during which the earthquake could occur, 2 = the 72-hour warning will come from local and state officials, 3 = the warning will be announced over radio, television and in newspapers, 4 = a telephone hotline number will be provided to the public, 5 = the warning will be followed by other information over radio, television and in newspapers, 6 = several 72-hour warnings may be issued, and 7 = the warning will likely be cancelled within 72 hours if the earthquake does not happen. Respondents could report more than one answer.

Figure V-14. Percent of Taft Respondents Accurately Recalling the Short-term Warning Parameters of the Predicted Parkfield Earthquake*



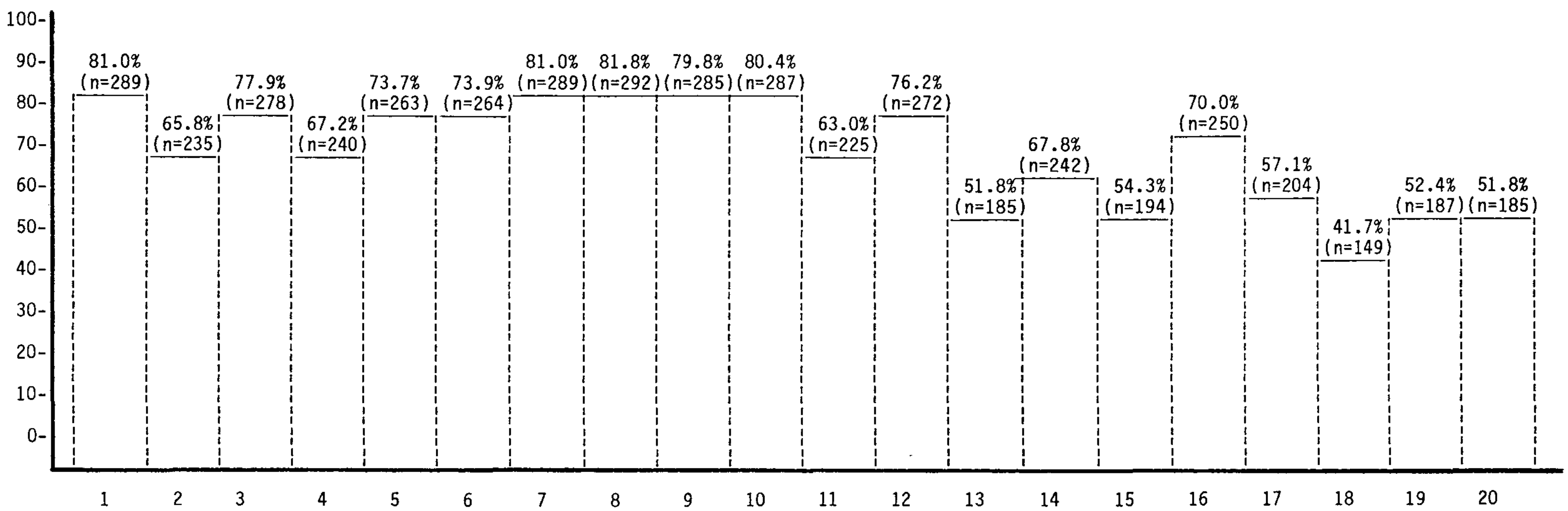
*Where 1 = the public may receive a warning of a 72-hour period during which the earthquake could occur, 2 = the 72-hour warning will come from local and state officials, 3 = the warning will be announced over radio, television and in newspapers, 4 = a telephone hotline number will be provided to the public, 5 = the warning will be followed by other information over radio, television and in newspapers, 6 = several 72-hour warnings may be issued, and 7 = the warning will likely be cancelled within 72 hours if the earthquake does not happen. Respondents could report more than one answer.

Figure V-15. Percent of Coalinga Respondents Recalling Preparedness Guidance to Get Ready for the Parkfield Earthquake*



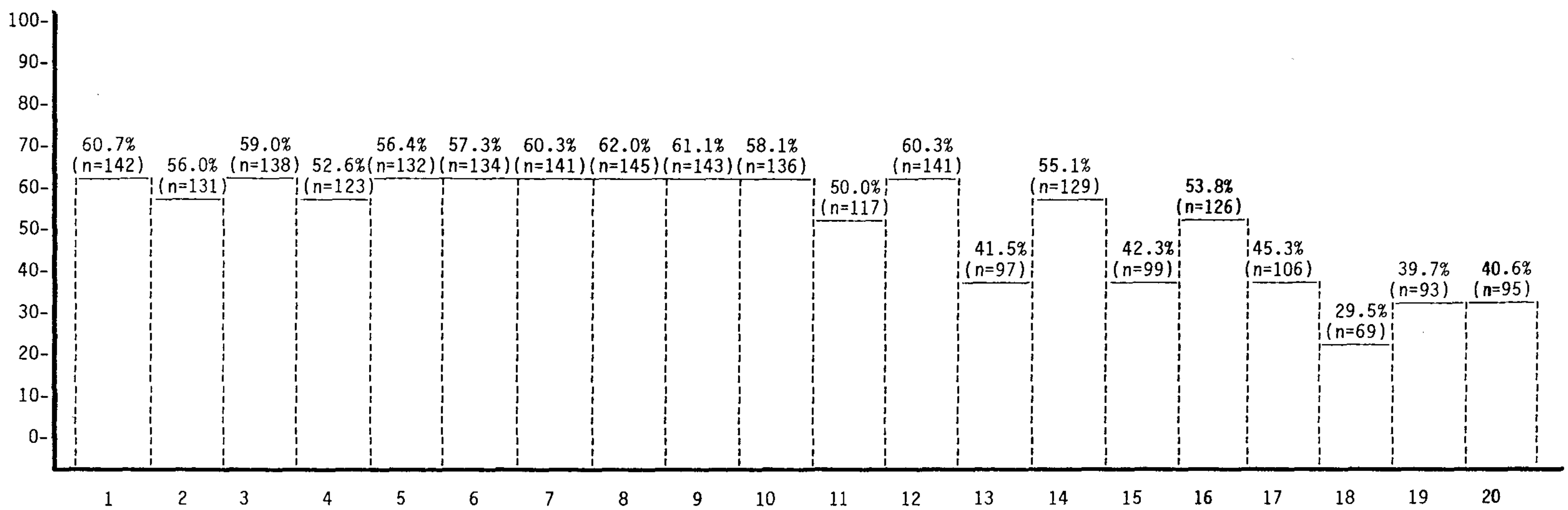
*Where 1 = store food and water, 2 = learn first aid, 3 = have first aid kit available, 4 = maintain an emergency supply of needed medication, 5 = developing family emergency plan, 6 = if indoors during earthquake stay indoors, 6 = get under a table or desk when earthquake cocurs, 7 = get under a table or desk when earthquake occurs, 8 = if outdoors during earthquake get to areas clear of anything that can fall on you, 9 = have a flashlight ready, 10 = have a portable radio available, 11 = have heavy gloves and a crescent wrench handy, 12 = turn off utilities after the earthquake, 13 = hang up phone after the earthquake, 14 = do not use phone after earthquake unless there is an injury, 15 = learn how to prevent fires, 16 = have a fire extinguisher handy, 17 do not use vehicle after earthquake unless for emergency, 18 - form neighborhood groups for emergency preparedness, 19 = study emergency plans at your work, and 20 = study your children's school emergency plans. Respondents could report more than one answer.

Figure V-16. Percent of Paso Robles Respondents Recalling Preparedness Guidance to Get Ready for the Parkfield Earthquake*



*Where 1 = store food and water, 2 = learn first aid, 3 = have first aid kit available, 4 = maintain an emergency supply of needed medication, 5 = develop family emergency plan, 6 = if indoors during earthquake stay indoors, 7 = get under a table or desk when earthquake occurs, 8 = if outdoors during earthquake get to areas clear of anything that can fall on you, 9 = have a flashlight ready, 10 = have a portable radio available, 11 = have heavy gloves and a crescent wrench handy, 12 = turn off utilities after the earthquake, 13 = hang up phone after the earthquake, 14 = do not use phone after earthquake unless there is an injury, 15 = learn how to prevent fires, 16 = have a fire extinguisher handy, 17 = do not use vehicle after earthquake unless for emergency, 18 = form neighborhood watch groups for emergency preparedness, 19 = study emergency plans at your work, and 20 = study your children's school emergency plans. Respondents could report more than one answer.

Figure V-17. Percent of Taft Respondents Recalling Preparedness Guidance to Get Ready for the Parkfield Earthquake*

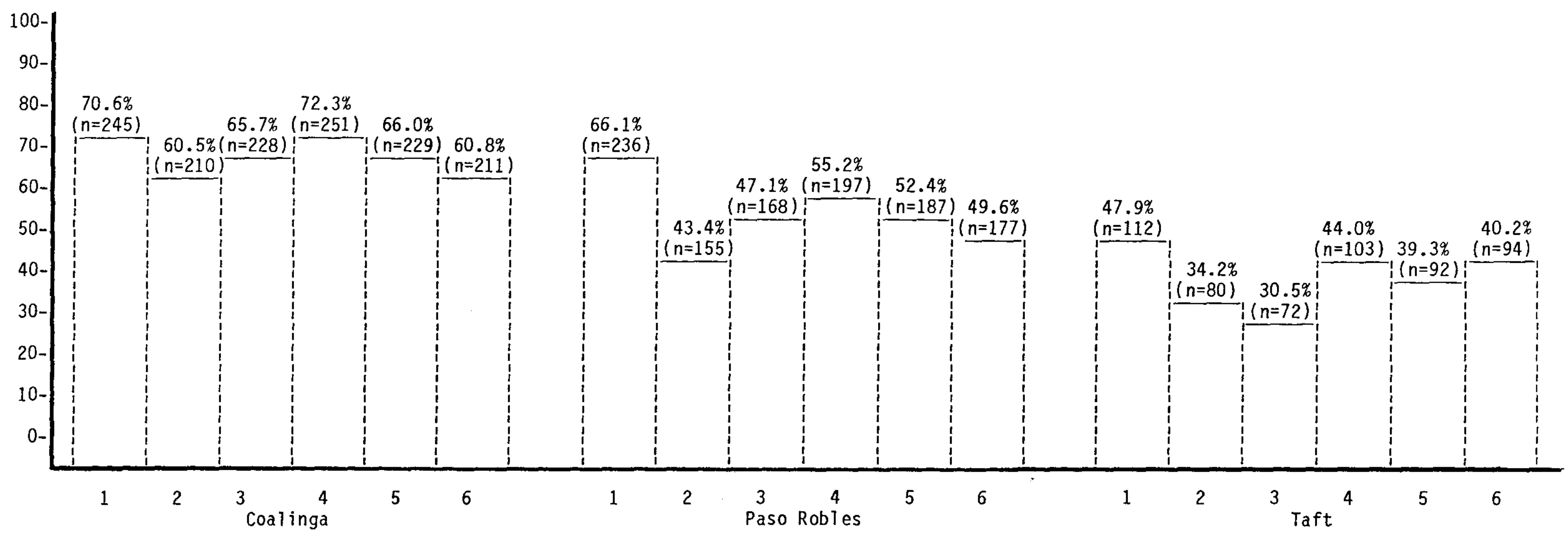


*Where 1 = store food and water, 2 = learn first aid, 3 = have first aid kit available, 4 = maintain an emergency supply of needed medication, 5 = develop family emergency plan, 6 = if indoors during earthquake stay indoors, 7 = get under a table or desk when earthquake occurs, 8 = if outdoors during earthquake get to areas clear of anything that can fall on you, 9 = have a flashlight ready, 10 = have a portable radio available, 11 = have heavy gloves and a crescent wrench handy, 12 = turn off utilities after the earthquake, 13 = hang up phone after the earthquake, 14 = do not use phone after earthquake unless there is an injury, 15 = learn how to prevent fires, 16 = have a fire extinguisher handy, 17 = do not use vehicle after earthquake unless for emergency, 18 = form neighborhood watch groups for emergency preparedness, 19 = study emergency plans at your work, and 20 = study your children's school emergency plans. Respondents could report more than one answer.

4. Mitigation guidance recalled. Respondents in the three study communities were also asked if they recalled receiving guidance about what to do to mitigate future earthquake losses. They were asked this in reference to each of the six mitigation guidance recommendations in the Parkfield earthquake prediction brochure. Figure V-18 presents the findings. People's ability to recall guidance about specific mitigation recommendations ranged from about one-third to three-quarters of the residents in a community, depending on the specific mitigation recommendation and the community. In general, the more costly the mitigation recommendations, the less likely they were to be recalled. For example, anchoring the house to its foundation and buying earthquake insurance, more costly recommendations, were remembered by fewer respondents than less expensive recommendations that could be performed without a great investment of time, such as moving heavy objects off high shelves, strapping the hot water heater, and protecting dishes and glassware. Once again, more Coalinga respondents had accurate recollections than did those in Paso Robles, and Taft respondents had the least accurate recollections.

5. Public prediction response. Respondents were asked what they had actually done in response to the Parkfield prediction. In general, people said they had sought additional information about earthquake prediction as a science and about mitigation and preparedness. This was done on their own and in addition to officially provided information on these topics. People sought additional information by talking to other people like friends and acquaintances who were easily accessible. Additionally, the preparedness actions and mitigation alternatives most likely to be performed were those most easy to take.

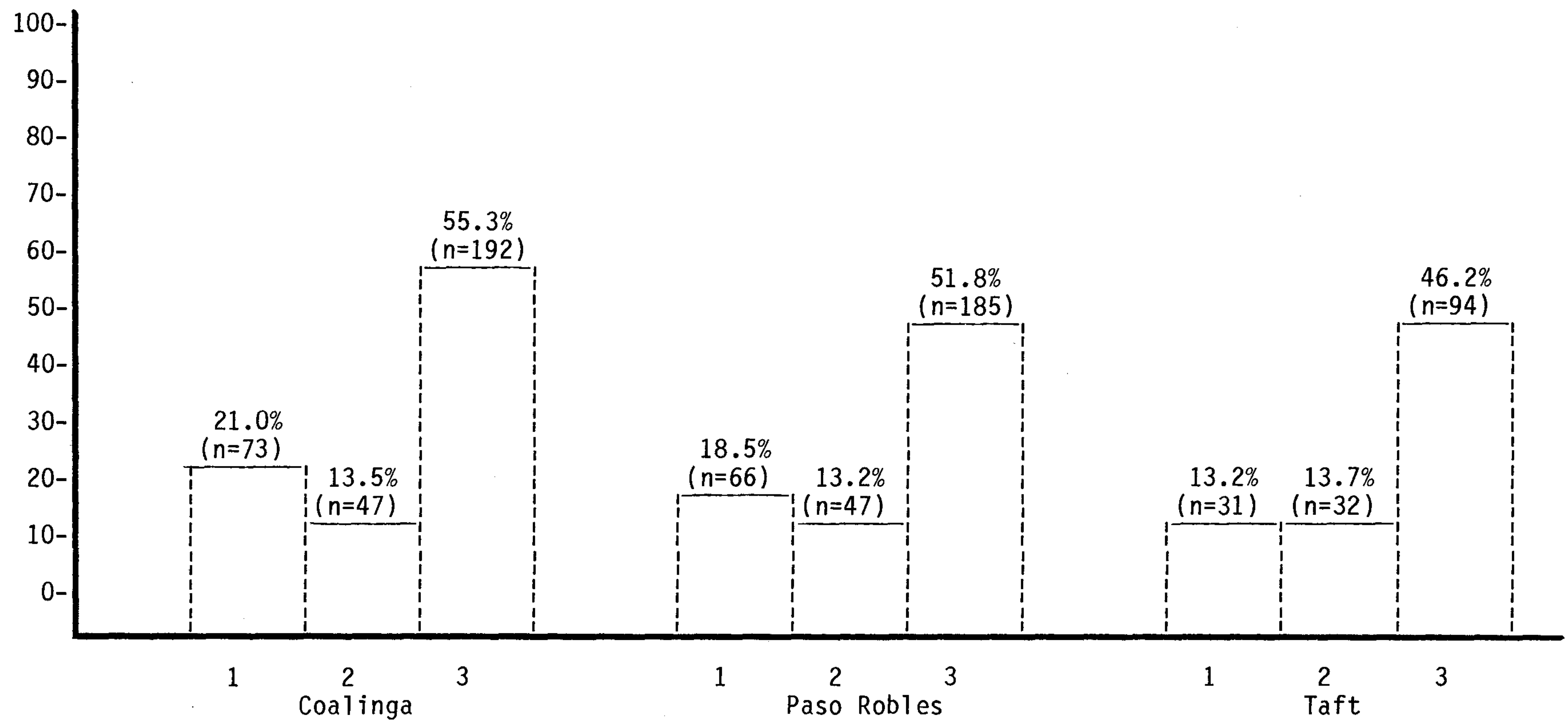
Figure V-18. Percent of Respondents by Community Recalling Mitigation Guidance to Get Ready for the Parkfield Earthquake*



*Where 1 = move heavy objects off high shelves, 2 = anchor house to its foundation, 3 = buy earthquake insurance, 4 = strap down hot water heater, 5 = protect dishes and glassware, and 6 = secure heavy furniture to walls. Respondents could report more than one answer.

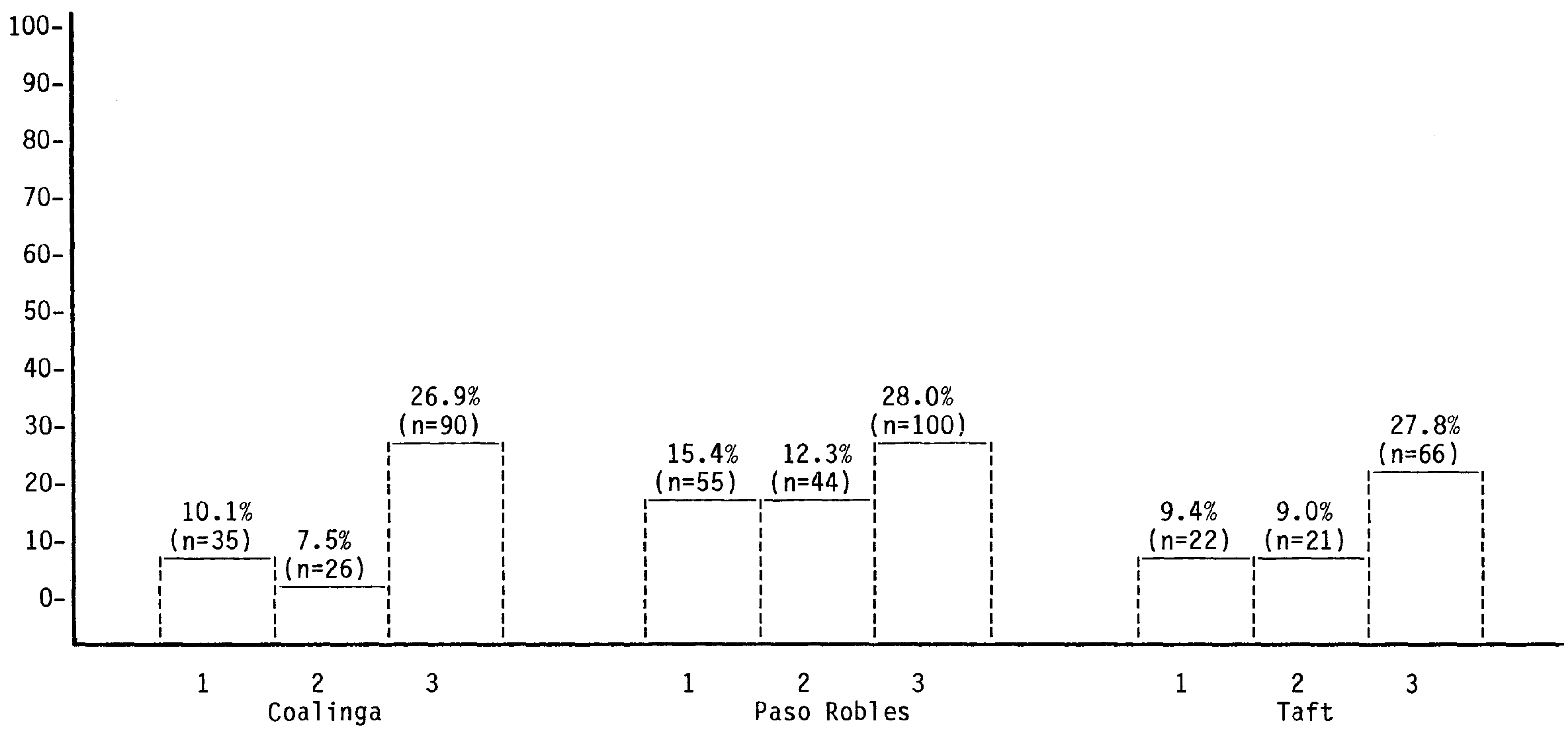
As mentioned, respondents sought more information about earthquake prediction science (see Figure V-19) and about mitigation and preparedness (see Figure V-20). About 75% of respondents in the three communities did the former, while about half did the latter. People in the study communities were most likely to prepare by taking action that was easy and quick, for example, by learning what to do during an earthquake and stockpiling emergency supplies (see Figure V-21). Preparedness actions that would take a greater effort and more time were those least likely to be performed, such as developing a family emergency plan or forming a neighborhood watch group. The mitigation response most likely to be induced by the prediction was rearranging household items to be safer from earthquakes, with some 13.2% to 22.5% of people in the study communities performing this mitigation action (see Figure V-22). Most people would find this action easy to perform; the next most likely mitigation action was protecting the house. The easiest way to do this is through the purchase of insurance, and 10% to 20% of respondents across the study communities purchased earthquake insurance. The third most likely mitigation action, taken by 6.5% to 17% of respondents across the study communities, was protecting the house through more time-consuming options for making a home more earthquake-resistant, such as bolting the house to its foundations. Few, if any, respondents mitigated their potential earthquake losses by taking actions that would have resulted in negative community-level prediction impacts, for example, by delaying larger purchases or community investments. Once again, Coalinga residents took the most action, followed by those in Paso Robles and then Taft.

Figure V-19. Percent of Respondents by Community Regarding the Source from Whom Additional Information about Earthquake Predictions was Sought since First Hearing of the Parkfield Earthquake Prediction*



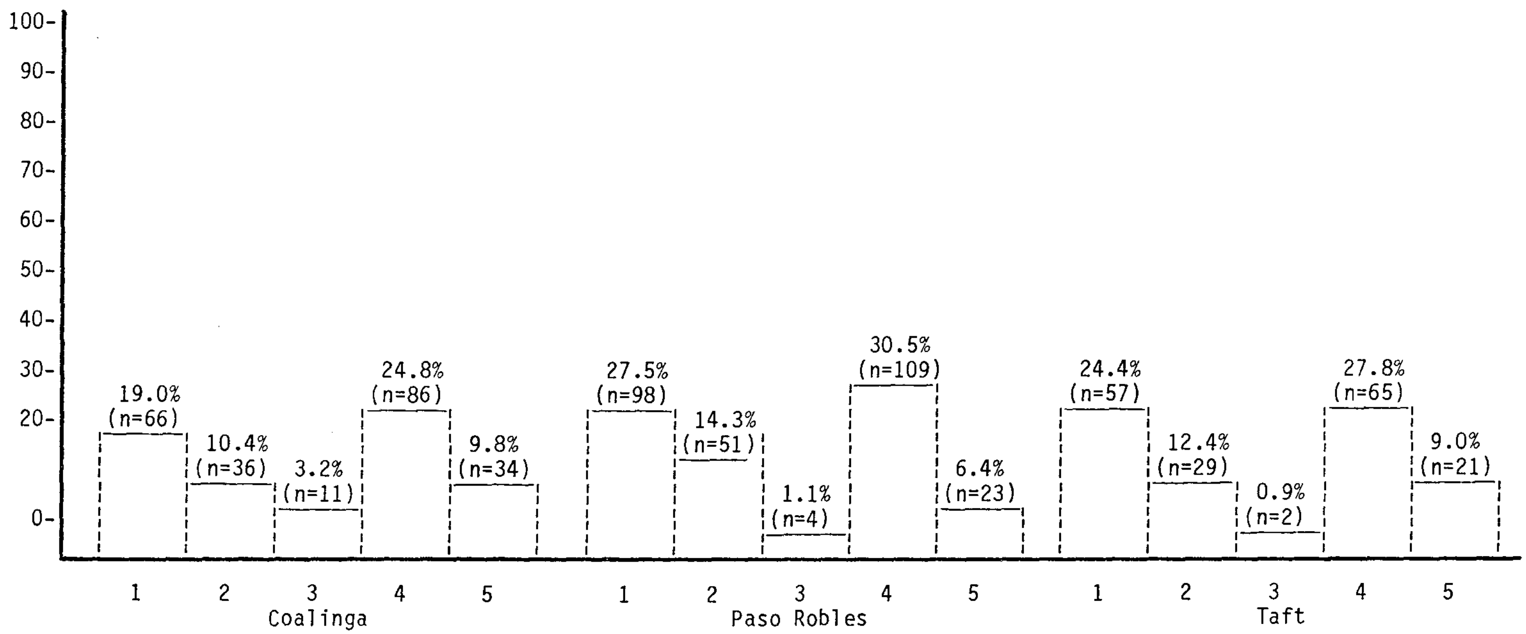
*Where 1 = government organizations, 2 = non-government organizations, and 3 = talked with other people. Respondents could report more than one answer.

Figure V-20. Percent of Respondents by Community Regarding the Source from Whom Additional Information about Readiness was Sought since First Hearing of the Parkfield Earthquake Prediction*



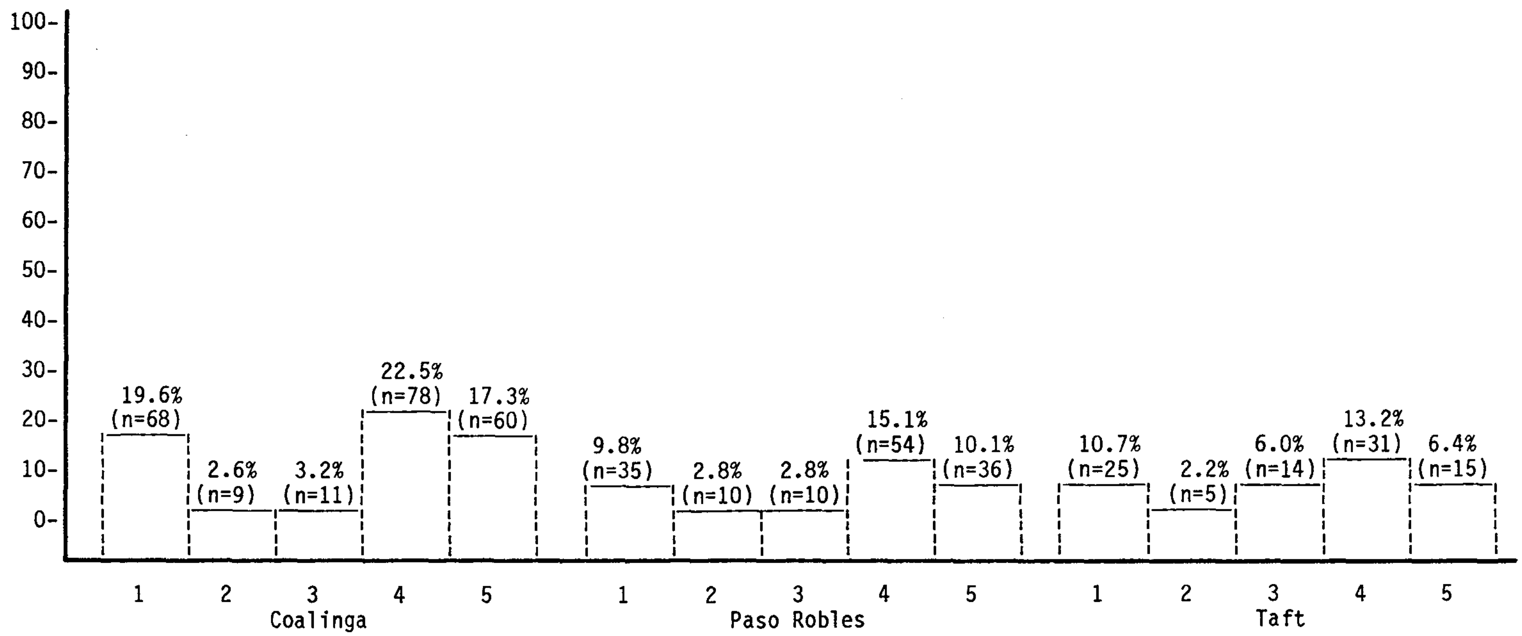
*Where 1 = government organizations, 2 = non-government organizations, and 3 = talked with other people. Respondents could report more than one answer.

Figure V-21. Percent of Respondents by Community Who Engaged in Preparedness Actions since First Hearing of the Parkfield Earthquake Prediction*



*Where 1 = stockpiled emergency supplies, 2 = developed a family emergency plan, 3 = formed a neighorhood watch group for emergency response, 4 = found out what to do during an earthquake, and 5 = learned first aid. Respondents could report more than one answer.

Figure V-22. Percent of Respondents by Community Who Engaged in Mitigation Actions since First Hearing of the Parkfield Earthquake Prediction*



*Where 1 = bought earthquake insurance, 2 = cancelled or delayed large purchases and/or investments, 3 = saved more money, 4 = rearranged household items so they would be safer from earthquakes, and 5 = did things to make my house more earthquake resistant. Respondents could report more than one answer.

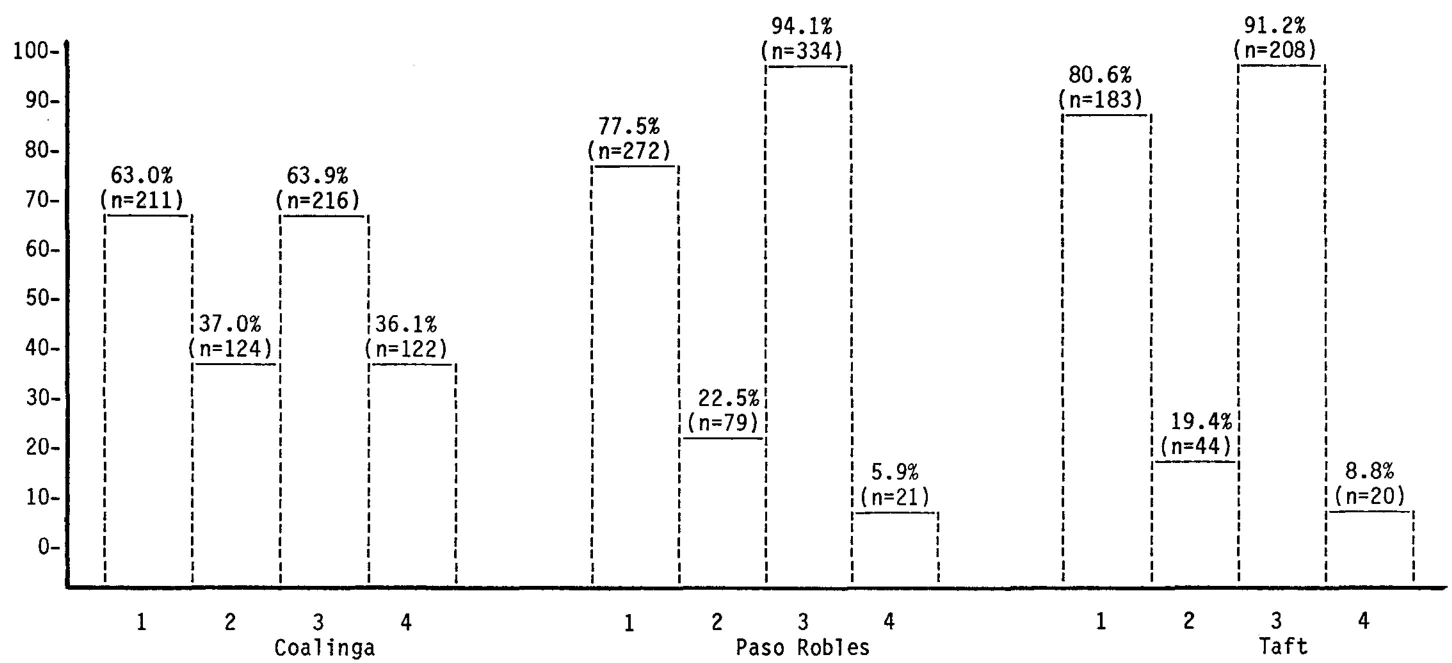
D. Public Perceptions

Respondents in the study communities were also questioned regarding their perceptions about current community and household earthquake preparedness, prediction impacts, and their preferences for sources of future prediction information. The answers that people gave to these questions follow.

1. Community preparedness. On reflection, people did not perceive that their households or communities were really prepared for the Parkfield earthquake (see Figure V-23). For example, 63.0% of Coalinga respondents indicated that their households were inadequately prepared, compared to 77.5% in Paso Robles and 80.6% in Taft. Of Coalinga respondents, 63.9% did not think that their community was adequately prepared, compared to 94.1% in Paso Robles and 91.2% in Taft. These perceptions are probably somewhat accurate since they are in direct proportion to, but the opposite of, actual actions taken--for example, Coalinga residents were more likely to engage in mitigation and preparedness actions and more likely to perceive adequate household and community preparedness.

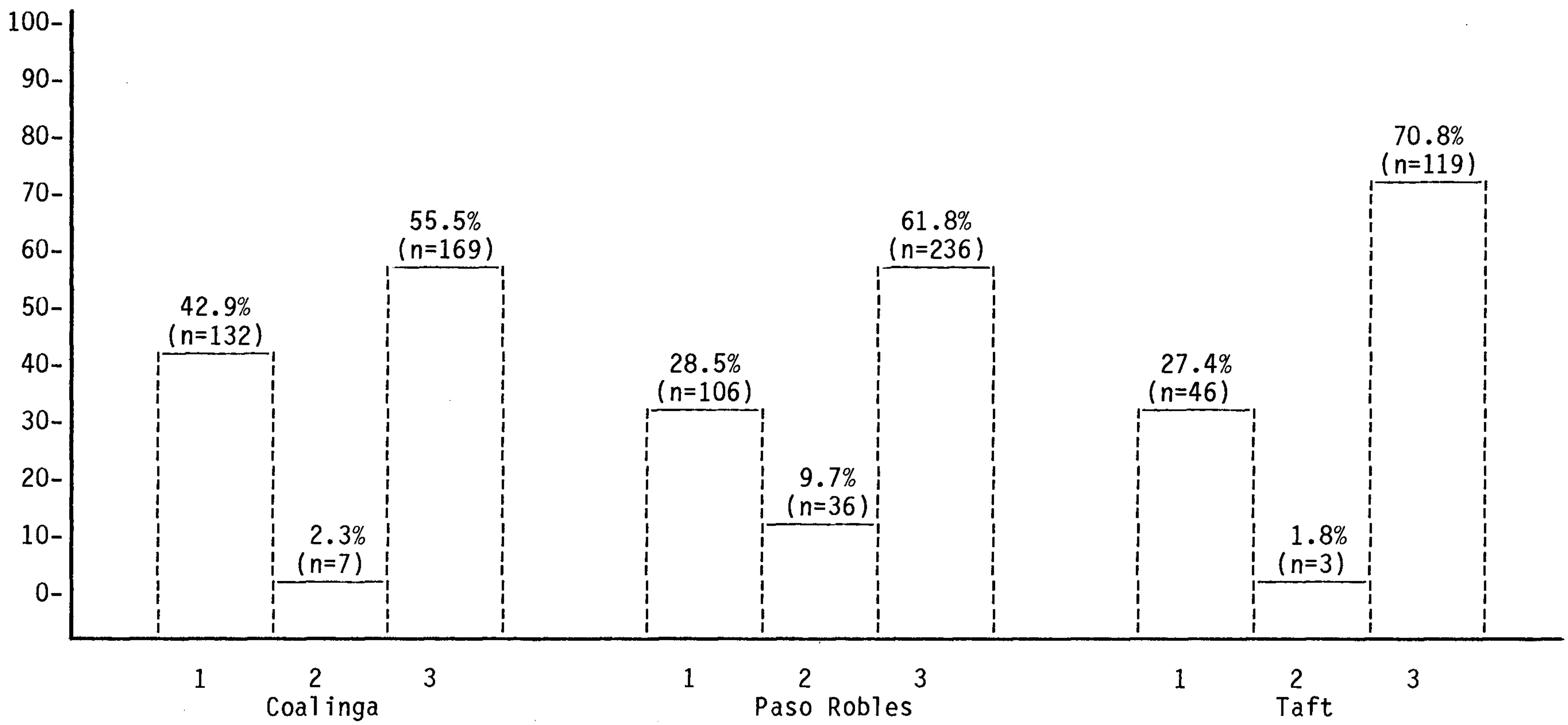
2. Prediction impacts. Respondents in each community reported strong feelings about being the target of an earthquake prediction (see Figure V-24). Overall, prediction impacts were perceived as positive; 71% of respondents in Taft perceived positive prediction impacts, 62% did in Paso Robles, and 56% did in Coalinga. Negative impacts were perceived in the opposite order, with Coalinga residents most likely to perceive them, Paso Robles residents next most likely, and residents of Taft least likely to perceive negative perception impacts. Very few respondents in any study community viewed the earthquake prediction

Figure V-23. Percent of Respondents by Community Regarding Perceived Household and Community Preparedness for the Parkfield Earthquake*



*Where 1 = no, don't know or unsure about household preparedness, 2 = yes, household is adequately prepared, 3 = no, don't know or unsure about community preparedness, and 4 = yes, community is adequately prepared.

Figure V-24. Percent of Respondents by Community Regarding Perceived Consequences of Having the Parkfield Earthquake Prediction*



*Where 1 = negative consequences, 2 = neutral consequences, and 3 = positive consequences. Percentages are based on the total number of responses and not respondents.

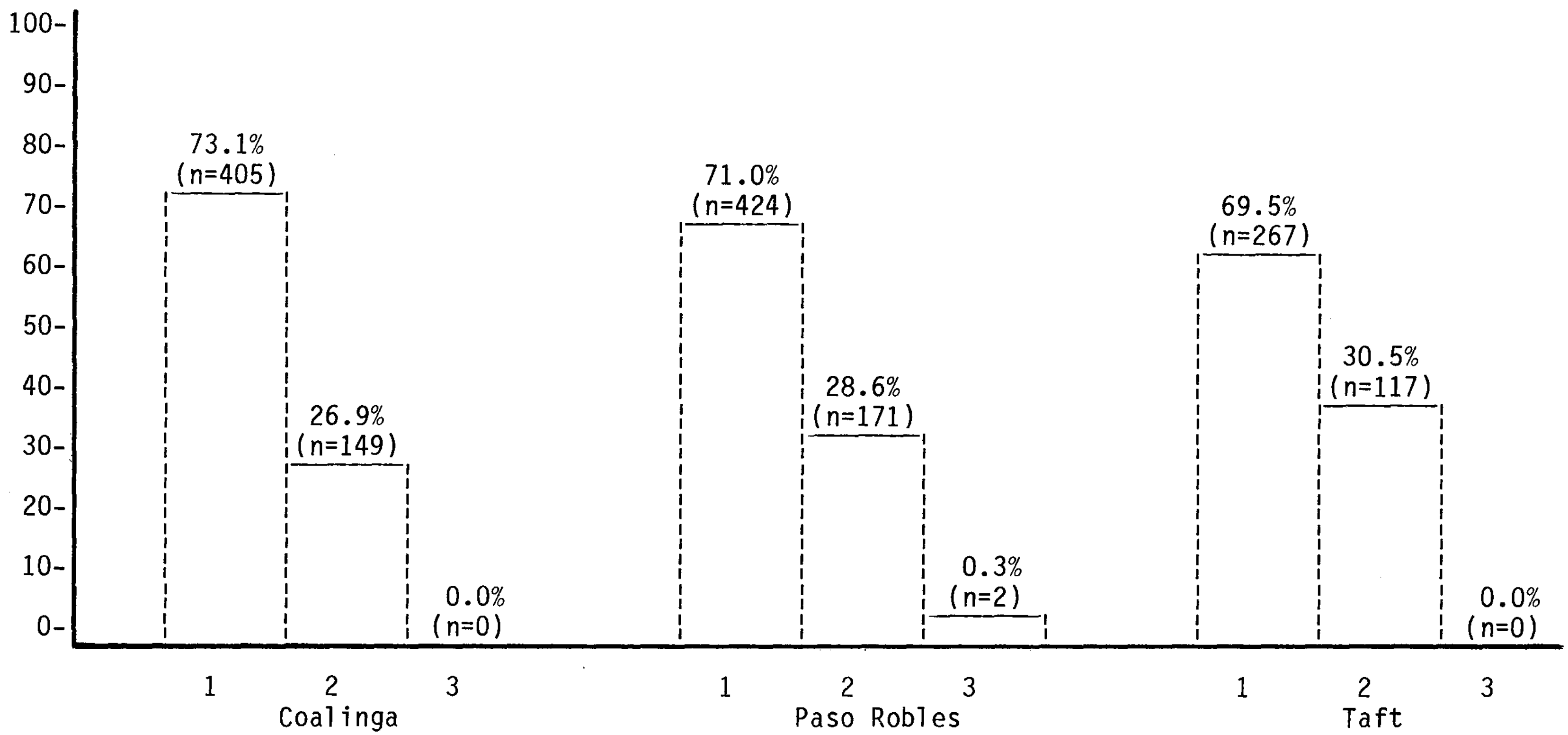
neutrally. Interestingly, Coalinga respondents were more likely to perceive negative impacts; Coalinga was also the community with residents most likely to mitigate and prepare for the predicted earthquake.

3. Preferences for sources of future information. Overwhelmingly, about three-quarters of respondents in the study communities want future prediction information to come from government sources (see Figure V-25). Additionally, about half of all respondents would prefer future prediction information to come via special printed matter such as a brochure sent directly to their home (see Figure V-26).

E. Conclusions

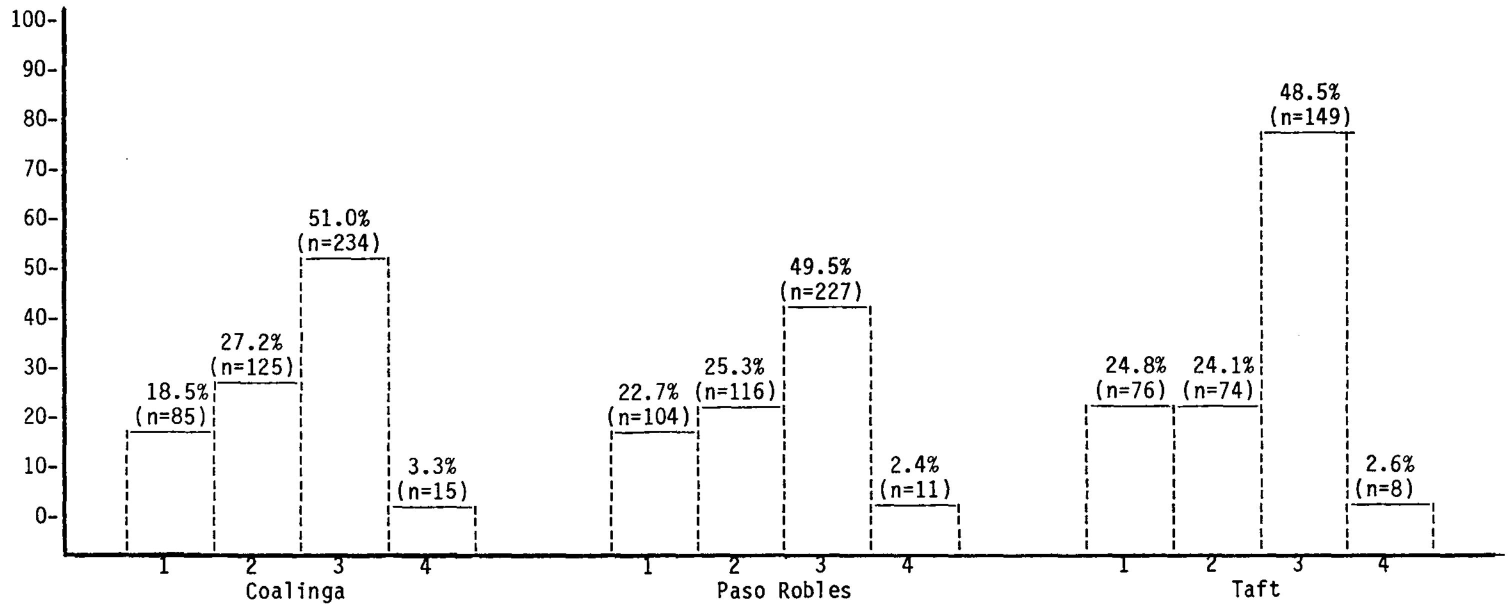
The conclusions that can be drawn from the descriptive data presented in this chapter are clear and rest on amazingly consistent data sets. First, the Parkfield earthquake prediction must be judged by even the most casual observer of these data as a public information success. Almost everyone in the study communities had heard about the prediction. The prediction enhanced the public's perpection of short-term earthquake risk. In fact, people perceived greater short-term earthquake risk from the predicted earthquake than at any future point in their lives. The prediction obviously inverted how the public typically perceives risk, and this is not an easily accomplished task. Finally, the prediction resulted in many people taking action to mitigate and prepare for the next Parkfield earthquake. Consequently, many Coalinga, Paso Robles and Taft citizens are better equipped to face the next Parkfield earthquake as a direct result of informing the public about the earthquake prediction.

Figure V-25. Percent of Respondents by Community Regarding Preferences on Sources for Receiving Additional Earthquake Prediction Information*



*Where 1 = government organizations, 2 = non-government organizations, and 3 = other sources. Percentages reflect percent of responses based on the total number of responses and not respondents.

Figure V-26. Percent of Respondents by Community Regarding Preferences on Channels for Receiving Additional Earthquake Prediction Information*



*Where 1 = electronic media, 2 = print media, 3 = other printed matter, and 4 = meetings and/or conversations. Percentages reflect percent of responses based on the total number of responses and not respondents.

Second, the brochure issued by the Governor's Office of Emergency Services must also be viewed as a public information success. The brochure was the one prediction communication vehicle that reached the most people; it reached more people than newspapers, television or any other available communication vehicle. Additionally, almost the entire public was able to understand the brochure's message. As well, most people in the three study communities would prefer receiving future earthquake prediction information fron goverment officials via another home-mailed brochure.

Third, the public in the study communities were extremely selective in terms of what they remembered and what they did. This included the parameters of the prediction, the parameters of a future short-term warning, preparedness and mitigation guidance, and what public actions were actually taken in response to the prediction. People simply and consistently opted for the path of least resistance. In reference to preparedness and mitigation, this meant taking action that could be accomplished quickly, while tending to forget actions that would be more time-consuming to accomplish.

Fourth, the more mitigation and preparedness actions which people performed because of the prediction, the more likely they were to perceive that the prediction elicited negative impacts in their community. For example, Coalinga residents did the most to ready for the earthquake and they perceived greater negative prediction impacts than residents of any other community. Taft residents did the least among the three study communities to mitigate and prepare, yet they perceived more positive prediction impacts than did people in any other community.

Fifth, the residents of the study communities generally said that more could be accomplished to ready their households and the general community for the next Parkfield earthquake. Perhaps this reflects an attitude that one can never be fully ready to face an earthquake. Nevertheless, the more mitigation and preparedness behaviors in which people engaged, the more likely was their perception of adequate readiness.

Last, and perhaps most important, is a conclusion that rests on the observed quantitative differences among the three study communities. In reference to almost every factor of perception and behavior examined in this study, Coalinga residents always had more of it than those in the other two study communities, Taft residents had less of it, and the citizens of Paso Robles fell in between. As discussed earlier, these three communities were selected for study on the basis of two criteria: recent damaging earthquake experience, and geographic distance to the predicted earthquake epicenter. On this basis, one could say that Coalinga residents had two reasons to take the prediction seriously, Paso Robles residents had one reason, and Taft residents had no reason.

In fact, this logic seems to have held when one views the proportion of residents in these communities who remembered and then acted on the basis of the prediction. The same thesis is supported when one views the salience of the prediction in terms of the ability of our questionnaire to elicit study participation in the first place (see Chapter III). The highest study participation rate was in Coalinga; Taft had the lowest rate of returned questionnaires, and Paso Robles fell in the middle. Although the impact of experience and distance on prediction response may now seem obvious, the influence of these factors must still be subjected to rigorous statistical testing. This is the subject of the next chapter.

CHAPTER VI

THE STATISTICAL IMPACTS OF EXPERIENCE AND DISTANCE

The descriptive findings presented in the last chapter provided intuitive evidence for the conclusion that both earthquake experience and distance from the predicted epicenter of the Parkfield earthquake affected public prediction perceptions and response. Intuitive evidence is appealing, but it does not provide a basis for scientific conclusions. To determine if experience, distance and their combined effects did in fact affect what the public thought and did in response to the predicted earthquake, we made statistical comparisons of grouped data across the three study communities.

Coalinga had relatively recent experience with a damaging earthquake which the other two communities did not; Coalinga was also close to the epicenter of the predicted quake. Paso Robles was also close to the predicted epicenter but lacked recent experience with a damaging earthquake. Taft was almost as far from the epicenter as was possible while still being in the area-at-risk; Taft also lacked recent damaging earthquake experience. The statistical comparative analyses performed in this chapter were as follows. Coalinga versus Paso Robles comparisons revealed the effect of experience while controlling for distance. Paso Robles versus Taft comparisons revealed the impact of distance while controlling for experience. Finally, Coalinga versus Taft comparisons revealed the interactive or joint effect of both experience and distance.

A. <u>How Experience and Distance Affected Prediction Perceptions</u>

Comparisons of mean scores between Coalinga and Paso Robles were performed on over a dozen factors regarding people's recollections about the earthquake prediction (see Table VI-1), for example, how people remembered hearing about the prediction, the parameters of the prediction, and the elements of the possible short-term warning that could be issued. These comparisons provided a basis to assess the effect of experience on people's ability to recollect these prediction elements. The results of the analysis (see Table VI-1) revealed that experience had an extremely weak affect on recollections about the prediction. Significant differences existed between these study communities for some factors at the .05 level or better (hearing about the prediction, recalling the source of the prediction, recalling the damage expected to result from the predicted earthquake, mitigation and preparedness advise, and the source of the potential 72 hour warning), but not for others (recalling the channel through which the prediction was heard, understanding the prediction, accurately remembering the predicted magnitude of the quake, whether the earthquake will be felt, the predicted probability of occurrence, the time window of the prediction, the 72 hour warning interval that could occur, and the channel through which that warning will be sent).

The significant differences were all in the positive direction; that is, experience increased the ability of people to recollect aspects of the prediction. The strongest correlation found among statistically significant relationships--for the variable of ability to recollect advise about mitigation--was .16. Although many of these differences were statistically significant, the findings suggest that experience had

Table VI-1. The Effect of Experience (Coalinga versus Paso Robles) on Recollections about the Parkfield Earthquake Prediction*

RECOLLECTIONS	t-test	$\bar{X}$ Coalinga	$\bar{X}$ Paso Robles	s Coalinga	s Paso Robles	Number of Cases	Level of Significance	eta Correlation
Heard	2.28	.94	.88	.25	.32	687	.01	.09
Source	2.24	2.75	2.35	2.36	2.40	704	.01	.08
Channel	.47	2.96	2.89	2.12	2.09	704	N/S	.02
Understanding	-1.41	.88	.92	.32	.27	443	N/S	-.07
Magnitude	.90	.34	.31	.48	.46	704	N/S	.03
Damage	2.32	.50	.41	.50	.49	704	.01	.09
Felt	.37	.80	.80	.40	.41	704	N/S	.01
Probability	1.00	.54	.51	.50	.50	704	N/S	.04
Time to Quake	1.39	.45	.40	.50	.49	704	N/S	.05
Mitigation	4.43	3.96	3.14	2.40	2.51	704	.0001	.16
Preparedness	1.61	14.94	14.05	7.24	7.45	704	.05	.06
Warning Time	1.33	.58	.53	.50	.50	704	N/S	.05
Warning Source	1.85	.44	.37	.50	.48	704	.03	.07
Warning Channel	1.21	.52	.48	.50	.50	704	N/S	.05

*Where df = the number of cases less two, $\bar{X}$ = the mean score by community, s = the standard deviation by community, and level of significance for the one-tailed t test and eta correlation is identical.

an affect on prediction recollections that was too weak to offer any real predictive value.

The effect of distance on people's ability to recall these same prediction elements was assessed by comparing mean scores between Paso Robles and Taft (see Table VI-2). Statistically significant differences existed with all indicators examined at the .05 level or better. All relationships were in the positive direction; that is, closer proximity to the quake's predicted epicenter enhanced the odds that people would remember different aspects of the prediction. Moreover, all correlations were of moderate or greater strength. For example, the strongest correlation between distance and recalling having heard about the prediction was .29; this suggested that distance could explain 8.4 percent of the variance in this indicator. The evidence seems incontrovertable that the closer a community was to the quake's predicted epicenter, the more likely residents were to recall accurately the prediction and its substance.

The combined effect of experience and distance was statistically tested by comparing the mean scores of Coalinga and Taft residents (see Table VI-3). The combined impact of these factors on prediction recollections far exceeded the effect of these two factors when taken individually. All recollections on which differences were assessed were statistically significant except one: there was no significant difference between Coalinga and Taft on understanding the brochure. All significant differences were in the hypothesized direction; residents with experience who were in close proximity to the predicted epicenter better recalled the prediction than those farther away without experience. Moreover, most correlations were strong. For example, the

Table VI-2. The Effect of Distance (Paso Robles versus Taft) on Recollections about the Parkfield Earthquake Prediction*

RECOLLECTIONS	t-test	$\bar{X}$ Paso Robles	$\bar{X}$ Taft	s Paso Robles	s Taft	Number of Cases	Level of Significance	eta Correlation
Heard	6.59	.89	.65	.32	.48	572	.0001	.29
Source	3.92	2.35	1.63	2.40	2.03	591	.0001	.15
Channel	6.39	2.89	1.82	2.09	1.91	591	.0001	.25
Understanding	1.56	.92	.86	.27	.35	314	.05	.10
Magnitude	3.20	.31	.20	.46	.40	591	.001	.13
Damage	3.41	.41	.28	.49	.45	591	.0001	.14
Felt	5.79	.79	.56	.41	.50	591	.0001	.24
Probability	4.96	.51	.31	.50	.46	591	.0001	.20
Time to Quake	4.47	.40	.23	.49	.42	591	.0001	.18
Mitigation	3.61	3.14	2.36	2.51	2.59	591	.0001	.15
Preparedness	4.59	14.05	10.83	7.45	8.89	591	.0001	.19
Warning Time	3.89	.53	.37	.50	.48	591	.0001	.16
Warning Source	1.83	.37	.29	.48	.46	591	.04	.07
Warning Channel	2.49	.48	.38	.50	.49	591	.01	.10

*Where df = the number of cases less two, $\bar{X}$ = the mean score by community, s = the standard deviation by community, and level of significance for the one-tailed t test and eta correlation is identical.

Table VI-3. The Combined Effect of Experience and Distance (Coalinga versus Taft) on Recollections about the Parkfield Earthquake Prediction*

RECOLLECTIONS	t-test	$\bar{X}$ Coalinga	$\bar{X}$ Taft	s Coalinga	s Taft	Number of Cases	Level of Significance	eta Correlation
Heard	8.31	.93	.64	.25	.48	561	.0001	.37
Source	6.11	2.76	1.63	2.36	2.03	581	.0001	.24
Channel	6.75	2.97	1.82	2.12	1.91	581	.0001	.27
Understanding	.51	.88	.86	.32	.35	347	N/S	.03
Magnitude	4.01	.34	.20	.48	.40	581	.0001	.16
Damage	5.55	.50	.28	.50	.45	531	.0001	.22
Felt	6.09	.80	.56	.40	.50	581	.0001	.26
Probability	5.87	.54	.31	.50	.46	581	.0001	.23
Time to Quake	5.75	.45	.23	.50	.42	581	.0001	.23
Mitigation	7.50	3.96	2.36	2.40	2.59	581	.0001	.30
Preparedness	5.88	14.94	10.83	7.24	8.89	581	.0001	.25
Warning Time	5.09	.58	.37	.49	.48	581	.0001	.21
Warning Source	3.50	.44	.29	.50	.46	581	.0001	.14
Warning Channel	3.57	.52	.38	.50	.49	581	.0001	.15

*Where df = the number of cases less two, $\bar{X}$ = the mean score by community, s = the standard deviation by community, and level of significance for the one-tailed t test and eta correlation is identical.

correlation between the combined effect of experience and distance on recalling mitigation advice was .30, which explains 9 percent of the variance in this factor. The combination of experience and distance affect affected remembering the prediction and what it said.

The following conclusions were made on the bases of the analyses reported in Tables VI-1 through VI-3. Experience had no meaningful predictive value on what people could remember about the prediction. Close proximity to the predicted epicenter did enhance people's ability to recall the prediction and the substance of what it communicated. The combined effect of experience and distance had the greatest impact on remembering what was said and that a prediction was in effect. It appears that the more reasons that the people in a community had for the prediction to be salient to them, the more likely they were to have accurate prediction recollections.

B. The Impact of Experience and Distance on Prediction Technology Perceptions

Residents of Coalinga, Paso Robles and Taft were asked several questions to measure their opinions regarding earthquake prediction in general (efficacy, belief in psychic's prediction ability and belief in scientist's ability to predict earthquakes), as well as their perceptions regarding positive and negative impacts of the Parkfield prediction. The effects of experience and distance on these perceptions were assessed individually and in concert.

The impact of experience on these prediction perceptions was statistically tested by Coalinga versus Paso Robles comparisons, and the results are presented in Table VI-4. The indicators measuring prediction technology perceptions and negative and positive impacts of

Table VI-4. The Effect of Experience (Coalinga versus Paso Robles) on Prediction Technology Perceptions*

PREDICTION TECHNOLOGY PERCEPTIONS	t-test	$\bar{X}$ Coalinga	$\bar{X}$ Paso Robles	s Coalinga	s Paso Robles	Number of Cases	Level of Significance	eta Correlation
Efficacy	-1.00	.87	.90	.33	.30	687	N/S	-.04
Negative Consequences	2.39	.29	.22	.46	.41	704	.01	.09
Positive Consequences	-2.48	.48	.58	.50	.50	704	.01	-.09
Superstition Belief	.54	.39	.36	.65	.64	682	N/S	.02
Belief in Science	-2.94	1.16	1.33	.76	.76	673	.001	-.11

*Where df = the number of cases less two, $\bar{X}$ = the mean score by community, s = the standard deviation by community, and level of significance for the one-tailed t test and eta correlation is identical.

the Parkfield prediction were significantly different at the .05 level or better, but the directions were not the same for all indicators. Experience was negatively related to belief in scientists' ability to predict earthquakes and belief in positive Parkfield prediction impacts; experience was positively related to perceptions of negative Parkfield prediction impacts. It seems that Coalinga residents were less likely to believe that scientists could predict earthquakes (perhaps because the earthquake they experienced several years ago was not predicted), and were more likely to perceive negative impacts on their community from being targeted with a prediction (perhaps because Coalinga residents sought to forget about the quake experienced several years beforehand). The actual correlations for these relationships were all relatively weak despite their statistical significance (see Table VI-4). Consequently, experience offered little real predictive value for these perceptions.

The effect of distance was determined by Paso Robles versus Taft comparisons of community means (see Table VI-5). The indicators for prediction technology perceptions as well as positive and negative Parkfield prediction community impacts perceptions were all statistically significant. Perceptions of both negative and positive prediction consequences were positively correlated with distance. The closer community to the epicenter (Paso Robles) was significantly more likely to score higher on both the negative and positive perceived consequences of the earthquake prediction than was the community (Taft) farther away from the predicted epicenter. However, the correlations were weak. This suggested that distance alone had little ability to explain variances observed in these perceptions.

Table VI-5. The Effect of Distance (Paso Robles versus Taft) on Prediction Technology Perceptions*

PREDICTION TECHNOLOGY PERCEPTIONS	t-test	$\bar{X}$ Paso Robles	$\bar{X}$ Taft	s Paso Robles	s Taft	Number of Cases	Level of Significance	eta Correlation
Efficacy	.58	.90	.88	.30	.32	567	N/S	.02
Negative Consequences	2.83	.22	.13	.41	.36	591	.001	.11
Positive Consequences	2.45	.58	.47	.50	.50	591	.01	.10
Superstition Belief	-.51	.36	.39	.64	.65	576	N/S	-.02
Belief in Science	1.55	1.33	1.23	.76	.74	565	N/S	.07

*Where df = the number of cases less two, $\bar{X}$ = the mean score by community, s = the standard deviation by community, and level of significance for the one-tailed t test and eta correlation is identical.

The only indicator to reveal significant differences for the combined effect of experience and distance (based on a Coalinga versus Taft comparison) on prediction perceptions was perceived negative Parkfield prediction impacts (see Table VI-6). It showed that being close to the predicted epicenter combined with relatively recent quake experienced enhanced the formation of perceptions of negative community consequences. This relationship was of moderate strength since it was characterized by a .19 correlation coefficient.

It would seem that experience of a damaging earthquake soured community perception of earthquake prediction technology. Coalinga residents perceived that there were more negative community impacts on their town than positive ones because of the Parkfield prediction. A community like Coalinga may be in no mood to be reminded of the potential to suffer another quake any time soon. An earthquake prediction may serve as such a reminder in a community where the salience of the hazard is still high due to experience. Furthermore, Coalinga is now recovering; any indication to the outside world that another quake is forthcoming may seem to the community to diminish the economic and social desirability of the community.

On the other hand, Paso Robles (which is just as likely to be damaged from the Parkfield quake as Coalinga) had no recent history with a damaging earthquake. Paso Robles may have had no reason to see more negative than positive consequences resulting from the earthquake prediction. The same held for Taft, which had even fewer reasons than Paso Robles to view earthquake prediction technology negatively.

Distance and experience do affect community perceptions of earthquake prediction technology. Being close to a predicted epicenter

Table VI-6. The Combined Effect of Experience and Distance (Coalinga versus Taft) on Prediction Technology Perceptions*

PREDICTION TECHNOLOGY PERCEPTIONS	t-test	$\bar{X}$ Coalinga	$\bar{X}$ Taft	s Coalinga	s Taft	Number of Cases	Level of Significance	eta Correlation
Efficacy	-.31	.87	.88	.33	.32	564	N/S	-.01
Negative Consequences	5.04	.24	.13	.46	.34	581	.0001	-.19
Positive Consequences	3.28	.69	.55	.47	.50	581	N/S	.01
Superstition Belief	-.03	.39	.39	.65	.65	560	N/S	-.001
Belief in Science	-1.12	1.16	1.23	.76	.74	556	N/S	-.05

*Where df = the number of cases less two, $\bar{X}$ = the mean score by community, s = the standard deviation by community, and level of significance for the one-tailed t test and eta correlation is identical.

or having relatively recent experience with a damaging earthquake yield somewhat more positive perceptions about earthquake prediction technology than do being farther away without experience. Conversely, being close or having experience yield perceptions of negative prediction impacts. A high salience environment (being both close to the predicted epicenter combined with having damaging earthquake experience) enhances the formation of negative impact perceptions and does nothing toward developing positive perceptions.

C. The Influence of Experience and Distance on Perceived Risk

The mean scores for study communities were compared in reference to earthquake risk perceptions. The perceptions compared included those regarding the risk of an earthquake in both the long- and short-terms, as well as perceptions of household and community earthquake preparedness. The effects of experience and distance on these perceptions were examined, both individually and together.

Experience had a consistent and positive impact on both perceptions of future earthquake risk and preparedness; all of these relationships were statistically significant at the .003 level or better (see Table VI-7). The strongest correlation found, .37, was for the effect of experience (Coalinga versus Paso Robles) on perceived community preparedness. In this case, experience served to explain almost 14 percent of the variance in perceptions of adequate community preparedness for the predicted earthquake; Coalinga was much more likely to perceive itself as an earthquake-prepared community than was Paso Robles. Perceptions of general earthquake risk, the risk perceived from the predicted Parkfield quake, and household preparedness were all statistically significant and in the hypothesized direction. These data

Table VI-7. The Effect of Experience (Coalinga versus Paso Robles) on Earthquake Risk Perceptions*

EARTHQUAKE RISK PERCEPTIONS	t-test	$\bar{X}$ Coalinga	$\bar{X}$ Paso Robles	s Coalinga	s Paso Robles	Number of Cases	Level of Significance	eta Correlation
General Earthquake Risk	3.53	2.25	1.81	1.38	1.45	521	.0001	.15
Parkfield Earthquake Risk	2.73	2.17	1.84	1.35	1.43	512	.003	.12
Community Preparedness	10.40	.36	.06	.48	.24	693	.0001	.37
Household Preparedness	4.19	.37	.23	.48	.42	686	.0001	.16

*Where df = the number of cases less two, $\bar{X}$ = the mean score by community, s = the standard deviation by community, and level of significance for the one-tailed t test and eta correlation is identical.

suggest that experience with a damaging earthquake did heighten perceptions of risk to future earthquakes and of adequate preparedness. This effect was more pronounced with community perceptions than personal ones, for example, perceived community versus household preparedness.

The effect of distance to the predicted quake's epicenter revealed a different set of conclusions. Distance only had a statistically significant effect on one perception--perception of general earthquake risk (see Table VI-8). The remaining indicators of perceived Parkfield earthquake risk, and community and household preparedness were each not significantly different. Additionally, while there was a statistically significant difference between the two communities, it was in the negative direction. This indicated that the more distant community of Taft scored higher on general earthquake risk perception than did the closer community of Paso Robles. However, the correlation coefficient for this relationship was too weak to base a conclusion of theoretical significance on it. These data led us to reject the hypothesis that the closer a community is to the predicted epicenter of an earthquake, the greater would be the perceived earthquake risk.

The combined effect of experience and distance on earthquake risk and preparedness perceptions was assessed through Coalinga versus Taft comparisons, and the resulting data are presented in Table VI-9. The combined effects were not significant. However, statistically significant differences at the .0001 level did exist for perceptions of both community and household preparedness: correlations were .31 and .19, respectively. It appears that the combined effect of experience and distance leads a community to perceive itself and its households to be better prepared for future earthquakes.

Table VI-8. The Effect of Distance (Paso Robles versus Taft) on Earthquake Risk Perceptions*

EARTHQUAKE RISK PERCEPTIONS	t-test	$\bar{X}$ Paso Robles	$\bar{X}$ Taft	s Paso Robles	s Taft	Number of Cases	Level of Significance	eta Correlation
General Earthquake Risk	-2.07	1.81	2.09	1.45	1.41	456	.02	-.10
Parkfield Earthquake Risk	-1.07	1.84	2.00	1.43	1.46	398	N/S	-.05
Community Preparedness	-1.27	.06	.09	.24	.28	583	N/S	-.05
Household Preparedness	.91	.23	.19	.42	.40	578	N/S	.04

*Where df = the number of cases less two, $\bar{X}$ = the mean score by community, s = the standard deviation by community, and level of significance for the one-tailed t test and eta correlation is identical.

Table VI-9. The Combined Effect of Experience and Distance (Coalinga versus Taft) on Earthquake Risk Perceptions*

EARTHQUAKE RISK PERCEPTIONS	t-test	$\bar{X}$ Coalinga	$\bar{X}$ Taft	s Coalinga	s Taft	Number of Cases	Level of Significance	eta Correlation
General Earthquake Risk	1.15	2.25	2.09	1.38	1.41	439	N/S	.05
Parkfield Earthquake Risk	1.11	2.17	2.00	1.35	1.46	376	N/S	.06
Community Preparedness	8.48	.36	.09	.48	.28	566	.0001	.31
Household Preparedness	4.73	.37	.19	.48	.40	562	.0001	.19

*Where df = the number of cases less two, $\bar{X}$ = the mean score by community, s = the standard deviation by community, and level of significance for the one-tailed t test and eta correlation is identical.

Experience with a damaging earthquake did increase perceived risk to future earthquakes. Second, relatively recent earthquake experience likely led to increased preparedness activities for other earthquakes. Consequently, experience enhanced perceptions of adequate preparedness for future quakes. Third, distance alone had no effect on perceptions nor did the combined effect of experience and distance. Finally, the combined effect of experience and distance did enhance preparedness perceptions. This was likely statistically demonstrated for the same reason that experience alone had a positive effect on these perceptions.

D. How Experience and Distance Affected Public Behavior

The range of public responses to the prediction examined in this analysis included attempts to get more information, a variety of different mitigation actions and different ways to prepare for earthquake disaster response. Coalinga versus Paso Robles comparisons were made to determine the effect of experience, the impact of distance was assessed through Paso Robles versus Taft comparisons, and Coalinga versus Taft comparisons were performed to examine the joint effect of experience and distance.

Table VI-10 shows that a few of the indicators measuring Parkfield prediction response were not statistically significant, but most were significant at the .05 level or better. Experience had a negative effect on seeking more information, stockpiling emergency supplies and learning what to do in an earthquake. The correlations for these relationships were -.08, -.10 and -.06. The negative impact of experience on these prediction responses likely indicates that these actions had already been taken in response to the experienced earthquake; people in Coalinga were less likely to do them in response

Table VI-10. The Effect of Experience (Coalinga versus Paso Robles) on Parkfield Earthquake Prediction Response*

PARKFIELD PREDICTION RESPONSE	t-test	$\bar{X}$ Coalinga	$\bar{X}$ Paso Robles	s Coalinga	s Paso Robles	Number of Cases	Level of Significance	eta Correlation
Seeking Information	-2.06	.44	.56	.76	.85	704	.02	-.08
Confirmation	.96	.89	.83	.85	.86	704	N/S	.04
Buy Insurance	3.69	.20	.10	.40	.30	704	.0001	.14
Cancel or Delay Purchases	-.23	.02	.02	.13	.14	704	N/S	-.01
Cancel or Delay Investments	.03	.01	.01	.09	.09	704	N/S	.00
Safe More Money	.29	.03	.03	.18	.17	704	N/S	.01
Rearrange Household Items	2.50	.22	.15	.42	.36	704	.006	.09
Do Things to Make House Resistant	2.79	.17	.10	.38	.30	704	.003	.11
Stockpile Supplies	-2.66	.19	.27	.39	.45	704	.005	-.10
Family Emergency Plan	-1.58	.10	.14	.31	.35	704	N/S	-.06
Neighborhood Watch	1.87	.03	.01	.18	.11	704	.03	.07
Other Community Activities	.05	.02	.02	.13	.13	704	N/S	.01
Learn What to Do in EQ	-1.71	.25	.31	.43	.46	704	.04	-.06
Learned First-Aid	1.63	.10	.06	.30	.25	704	.05	.06

*Where df = the number of cases less two, $\bar{X}$ = the mean score by community, s = the standard deviation by community, and level of significance for the one-tailed t test and eta correlation is identical.

to the prediction simply because they had already been performed as a consequence of the experienced earthquake.

Three of the mitigation responses assessed had statistically significant differences between communities: buying earthquake insurance, rearranging household items to make them safer, and doing things to make the household's residence structurally safer. The correlation coefficients for these relationships were .14, .09 and .11, respectively. Finally, experience had a positive effect on two preparedness actions: forming a neighborhood watch group, and learning fist aid. It appears that earthquake experience without a subsequent prediction precipitates a range of readiness actions that are not necessary to repeat after the emergence of a post-earthquake prediction. Experience, however, also elicits additional actions aimed at readiness when fcllowed by a prediction that includes some of those least likely to be performed (see Chapter V), for example, taking the time and trouble to form a neighborhood watch group and to learn first aid.

The presence of statistically significant differences for the relationships between distance and the same set of response actions were also examined (see Table VI-11). Only the one indicator of saving more money to ready for the earthquake emergency was statistically significant. It was in the negative direction with a correlation of -.08, which is extremely weak. The obvious conclusion was that distance did not affect response to the Parkfield earthquake prediction. We had to reject the research hypothesis that the closer a community is to the predicted earthquake's epicenter, the more likely it was that the community would engage in prediction response.

Table VI-11. The Effect of Distance (Paso Robles versus Taft) on Parkfield Prediction Response*

PARKFIELD PREDICTION RESPONSE	t-test	$\bar{X}$ Paso Robles	$\bar{X}$ Taft	s Paso Robles	s Taft	Number of Cases	Level of Significance	eta Correlation
Seeking Information	1.40	.56	.46	.85	.74	591	N/S	.06
Confirmation	1.43	.83	.74	.86	.81	591	N/S	.06
Buy Insurance	-.34	.10	.11	.30	.31	591	N/S	-.01
Cancel or Delay Purchases	1.16	.02	.01	.14	.09	591	N/S	.04
Cancel or Delay Investments	-.50	.01	.01	.09	.11	591	N/S	-.02
Save More Money	-1.78	.03	.06	.17	.24	591	.03	-.08
Rearrange Household Items	.64	.15	.13	.36	.34	591	N/S	.03
Do Something to Make House Resistent	1.62	.10	.06	.30	.25	591	N/S	.06
Stockpile Supplies	.84	.27	.24	.45	.43	591	N/S	.03
Family Emergency Plan	.67	.14	.12	.35	.33	591	N/S	.03
Neighborhood Watch	.32	.01	.01	.11	.09	591	N/S	.01
Other Community Activities	-1.00	.02	.03	.13	.17	591	N/S	-.04
Learned What to do in EQ	.72	.31	.28	.46	.45	591	N/S	.24
Learned First-Aid	-1.11	.06	.09	.25	.29	591	N/S	-.05

*Where df = the number of cases less two, $\bar{X}$ = the mean score by community, s = the standard deviation by community, and level of significance for the one-tailed t test and eta correlation is identical.

The combined effect of experience and distance on prediction response was examined through Coalinga and Taft community comparisons. The results of these comparisons are presented in Table VI-12. The findings which resulted from this analysis are almost identical to those from the effect of experience alone. Consequently, the demonstrated impacts of the effect of combined experience and distance are likely due to the role of experience alone rather than to any real interaction between independent variables.

E. Conclusions

The preceding statistical comparisons of communities suggested several straightforward conclusions about how experience with prior earthquake disasters and distance to the predicted quake's epicenter affected public perceptions and response. First, relatively recent experience with a damaging earthquake was a dramatically important social variable in influencing both public perceptions and behavior in response to the predicted Parkfield earthquake. For example, almost consistently, the residents of Coalinga perceived greater risk for the predicted earthquake and did more to ready for the quake than did the people in Paso Robles. This difference was consistently obvious despite the fact that both cities are the same distance from the predicted earthquake's epicenter and are likely at similar risk.

Second, distance to the predicted epicenter also affected what people thought because of the prediction. For example, people in Paso Robles perceived greater risk than did Taft residents. The general effect of distance on public perception was not as strong as was the effect of experience, and distance did not statistically affect actual behavioral response significantly.

Table VI-12. The Combined Effect of Experience and Distance (Coalinga versus Taft) on Parkfield Prediction Response*

PARKFIELD PREDICTION RESPONSE	t-test	$\bar{X}$ Coalinga	$\bar{X}$ Taft	s Coalinga	s Taft	Number of Cases	Level of Significance	eta Correlation
Seeking Information	-.40	.44	.46	.76	.79	581	N/S	-.02
Confirmation	2.30	.90	.74	.85	.81	581	.01	.09
Buy Insurance	3.03	.20	.11	.40	.31	581	.002	.12
Cancel or Delay Purchases	.95	.02	.01	.13	.09	581	N/S	.04
Cancel or Delay Investments	-.47	.01	.01	.09	.11	581	N/S	-.02
Save More Money	-1.55	.03	.06	.18	.24	581	.05	-.07
Rearrange Household Items	2.92	.22	.13	.42	.34	581	.003	.12
Do Things to Make House Resistent	4.20	.17	.06	.38	.25	581	.0001	.16
Stockpile Supplies	-1.52	.19	.24	.39	.43	581	N/S	-.06
Family Emergency Plan	-.74	.10	.12	.31	.33	581	N/S	-.03
Neighborhood Watch	2.07	.03	.01	.18	.09	581	.03	.08
Other Community Activities	-.96	.02	.03	.13	.17	581	N/S	-.04
Learn What to Do in EQ	-.80	.25	.28	.43	.45	581	N/S	-.03
Learned First-Aid	.33	.10	.09	.30	.29	581	N/S	.01

*Where df = the number of cases less two, $\bar{X}$ = the mean score by community, s = the standard deviation by community, and level of significance for the one-tailed t test and eta correlation is identical.

Third, the strongest effect was when the two factors operated together or were able to interact. It was statistically demonstrated that the strongest cross-community difference emerged where Coalinga residents' perceptions (those who had recent experience and were close) were compared to those of Taft residents (those who lacked recent experience and were the farthest away). Experience and distance likely did not interact to elicit an actual effect on behavior.

Earthquake experience and distance to the predicted earthquake's epicenter certainly both indicate how salient the risk contained in an earthquake prediction can be for people and that the salience of the Parkfield prediction varied across the communities that were its targets. The importance of salience is also revealed through the use of different empirical measures based on different types of analyses presented in subsequent chapters.

Distance had an impact on perceptions, experience had an even stronger effect, and the strongest impact was from the combined affect of distance and experience. However, only experience taken alone affected actual mitigation and preparedness behavior. It could be that perceptual factors alone (as indicated by distance) did not directly impact behavior.

CHAPTER VII

FACTORS THAT INFLUENCED WHAT PEOPLE THOUGHT AND DID

Risk communication theory informed our research by elucidating the basic public risk communication process and the factors that influence its outcome (see Chapter II for a summary of this theory). The theory suggested that it is important to consider: (1) who in a public hears the communication and who does not, (2) what people understand or think they heard, (3) whether or not people believe what was said, (4) the degree to which communicated risk is personalized, (5) public attempts to confirm the risk message or seek additional information, and then (6) what protective actions the public eventually performs.

The theory also suggested that each of these factors is directed by traits of the actual risk communication itself, as well as by characteristics of the people who receive the communication. Communication traits (sender characteristics) include factors such as the consistency of what a risk message says in terms of other messages also heard, the source of the communicated message or who it is from, how frequently the message is received by the people for whom it is intended, and how specific the message is about what it says. Personal characteristics specified as important include demographic factors, observing environmental cues, whether or not the person is responsible for someone else like a child, and the degree to which someone is integrated into his or her community.

Multiple and simple regression equations were calculated to test the many hypotheses suggested by risk communication theory. Each of these hypotheses was tested in each of our three study communities. This analysis was performed by computing a separate regression equation for each class or category of independent variables known to impact each communication process factor. Each regression coefficient (b) obtained is identical to a zero-order correlation coefficient. This analysis enabled us to determine why people thought and acted as they did in response to the Parkfield earthquake prediction. The analysis also enabled us to test empirically the theory of risk communication. Our data sets were for risk communicated about the possible impact of an earthquake during a time window of several years. Findings from this analysis could help to refine risk communication theory for comparable intermediate term predictions/warnings, particularly when compared to knowledge about shorter- and longer-term hazard warning events.

The factors which this analysis sought to explain were: (1) hearing about the prediction, (2) understanding what the prediction said, (3) perception--a general composite index of perceived risk which included both message belief and risk personalization, (4) seeking more information from others on one's mind, and (5) actual preparedness and mitigation actions taken in response to disseminated information about the predicted quake.

A. Hearing About the Predicted Quake

Most of the respondents in this study reported that they had heard about the Parkfield earthquake prediction (see Chapter V), but some respondents had not. It was not possible for us to determine whether those who had not heard of the prediction in fact did not, or had simply forgotten about the prediction. The results of our regression analyses revealed that both message and personal characteristics were associated with having heard--or remembering having heard--the prediction (see Table VII-1). The results of this analysis were virtually identical for all three study communities. The following conclusions should be interpreted with some caution, since there was not much variance in our sample data in any of our communities on the variable "heard" about the prediction.

Message or sender characteristics had the greatest impact on having heard about the prediction. People were more likely to remember having heard about the prediction the more times and ways that the prediction was communicated to them. For example, the greater the number of message sources--for example, officials, scientists, and local organizations--from whom people received separate prediction messages, the more likely the prediction was to be remembered or registered in people's minds. The statistically significant regression coefficients were .28 for Coalinga, .36 for Paso Robles, and .50 for Taft, where numbers of sources, respectively, explained 8%, 13%, and 25% of the variance in respondents who had heard about the prediction (see Table VII-1). Additionally, the greater the number of ways (communication channels) that people heard about the prediction--for example, newspapers, the brochure, and television--the more likely they were to remember having done so. Statistically significant regression coefficients were observed for the effect of number of communication channels on hearing about the prediction in each study community. The coefficients were .34 in Coalinga, .52 in Paso Robles, and .66 in Taft; respectively, explained variance was 12%, 26%, and 43%.

Table VII-1. Standardized Multiple Regression Equations to Determine the Independent Effects of Categories of Sender and Receiver Characteristics on Hearing about the Earthquake Prediction in each Study Community

Independent Variables	Coalinga			Paso Robles			Taft		
Message/Sender Characteristics	b	α	r^2	b	α	r^2	b	α	r^2
Consistency	.29	.00	.05	.32	.00	.10	.53	.00	.27
Certainty	.38	.00	.14	.45	.00	.20	.66	.00	.43
Channel Type	--	.00	.18	--	.00	.38	--	.00	.48
television	.12	.06	--	.22	.00	--	.35	.00	--
radio	.00	N/S	--	.01	N/S	--	.05	N/S	--
newspapers	.35	.00	--	.43	.00	--	.34	.00	--
magazines	.05	N/S	--	.01	N/S	--	.08	N/S	--
brochures	.16	.00	--	.20	.00	--	.16	.00	--
posters	.01	N/S	--	.04	N/S	--	.02	N/S	--
meetings	.07	N/S	--	.00	N/S	--	.18	.01	--
conversations	.04	N/S	--	.07	N/S	--	.04	N/S	--
Channel Number	.34	.00	.12	.52	.00	.26	.66	.00	.43
Specificity of Guidance	.45	.00	.20	.58	.00	.33	.75	.00	.56
Message Source	--	.00	.09	--	.00	.13	--	.00	.25
familiar	.19	.00	--	.16	.00	--	.19	.00	--
official	.23	.00	--	.28	.00	--	.32	.00	--
scientists	.03	N/S	--	.05	N/S	--	.04	N/S	--
local organizations	.06	N/S	--	.07	N/S	--	.19	.00	--
Red Cross	.03	N/S	--	.01	N/S	--	.03	N/S	--
Number of Sources	.28	.00	.08	.36	.00	.13	.50	.00	.25
Receiver/Personal Characteristics									
Demographics	--	N/S	.02	--	N/S	.00	--	.00	.07
sex	.08	N/S	--	.02	N/S	--	-.24	.00	--
occupation	.06	N/S	--	.11	N/S	--	.20	.01	--
education	.11	.07	--	.00	N.S	--	.02	N/S	--
age	.01	N/S	--	.04	N.S	--	.03	N/S	--
own home	.11	N/S	--	.09	N/S	--	.05	N/S	--
Socioeconomic Status	.00	N/S	.01	.08	N/S	.00	.19	.01	.03
Belief in Psychics	.01	N/S	.00	.06	N/S	.00	.09	N/S	.00
Experience	.29	.00	.08	.19	.00	.03	.27	.00	.07
Community Integration	.21	.00	.04	.15	.01	.02	.10	N/S	.01
Roles of Responsibility	-.19	.00	.03	.03	N/S	.00	.05	N/S	.00
Situational Cues	.15	.01	.02	.09	.02	.01	.15	.02	.02
Pre-prediction Actions	.09	N/S	.01	.15	.00	.02	.13	.05	.01

The number of communication sources and channels did affect hearing or remembering having heard about the prediction. However all sources and channels did not carry equal weight; some were effective on their own, while others simply acted to reinforce the message. Only two communication channels out of eight were related to hearing/remembering having heard about the prediction (see Table VII-1); additionally, only two message sources out of five were able to statistially predict this variable. Official sources demonstrated statistically significant regression coefficients (.23 in Coalinga, .28 in Paso Robles, and .32 in Taft), as did familiar sources (.19 in Coalinga, .16 in Paso Robles, and .19 in Taft). The prediction brochure predicted hearing or remembering the prediction (significant coefficients were .16 in Coalinga, .20 in Paso Robles, and .16 in Taft), as did newspapers (.35 in Coalinga, .43 in Paso Robles, and .34 in Taft). These two print forms of communication explained 18%, 48%, and 38% of the observed variation in hearing/remembering the prediction in Coalinga, Paso Robles, and Taft.

It seemed safe to conclude that people were most likely to remember having heard about the Parkfield earthquake prediction if: (1) it was communicated to them via a printed channel of communication, (2) from an official and/or familiar source, and (3) reinforced by additional communications from other sources over other communication channels.

Other message (sender) factors also had a positive effect. Remembering or hearing about the prediction was also a function of the following: information that contained specific guidance about what people should do (the coefficient for Coalinga was .45 with 20% explained variance, .58 for Paso Robles with 33% explained variance, and .75 for Taft with 56% explained variance); information that was consistent across multiple messages about the faced risk (.25 for Coalinga, .32 for Paso Robles, and .53 for Taft); and information that was certain regarding the what, when, and where of the earthquake (.38 for Coalinga, .45 for Paso Robles, and .66 for Taft).

A variety of personal (receiver) factors were regressed on hearing about the predicted quake; these included sex, age, occupational prestige, income level, and many others (see Table VII-1). Only three personal characteristics were consistently and significantly related to hearing/remembering the prediction: people with earthquake experience were more likely to "hear" the prediction (the coefficient was .29 for Coalinga with 8% explained variance, .19 for Paso Robles with 3% explained variance, and .27 for Taft with 7% explained variance); as were those who had observed social cues like neighbors engaged in mitigation and preparedness (.15 in Coalinga, .09 in Paso Robles, and .15 in Taft); and those who were well integrated into the community (.21 in Coalinga, .15 in Paso Robles, and .10 in Taft).

Earthquake experience likely enhanced "hearing" the prediction since it likely made the prediction salient. Observing others engaged in taking protective action (observation of social cues) reinforced the communicated risk information contained in the prediction. Community integration was probably related to "hearing" the prediction simply because people who were more integrated into their community had made friends and associates who brought up the prediction in the course of conversation. Community integration, therefore, may have simply been another indicator for the message (sender) factor of the number of times that the prediction message was heard.

B. Understanding the Earthquake Prediction

The same sets of message (sender) factors and personal (receiver) factors were regressed against the perception factor of understanding the earthquake prediction. Interestingly, the results of these analyses for all three study communities (see Table VII-2) were very similar to those just presented on explaining variation in hearing about the earthquake prediction.

Message or sender characteristics had a greater impact on understanding the prediction than did receiver (personal) characteristics. People were more likely to understand the prediction the more times and ways that the prediction was communicated. The number of message sources enhanced understanding in Coalinga (.31, r^2 = 9%), Paso Robles (.33, r^2 = 12%), and Taft (.48, r^2 = 22%), as did the number of communication channels (.29, r^2 = 8% in Coalinga; .33, r^2 = 11% in Paso Robles; .46, r^2 = 21% in Taft). Official prediction sources were the only sources to enhance understanding (.46 in Coalinga, .36 in Paso Robles, and .48 in Taft).

The printed channels of communication were the only statistically significant predictors of understanding: for the brochure, the coefficents were .42 in Coalinga, .40 in Paso Robles, and .41 in Taft; the coefficients for newspapers were .15, .09, and .25, respectively, for Coalinga, Paso Robles, and Taft). This explained 20% of the variance in understanding in Coalinga, 21% in Paso Robles, and some 30% in Taft. Other sources and communication channels only served to reinforce printed communications from official sources. Other significant message (sender) factors were identical to those which affected hearing about the prediction: (1) information that had

Table VII-2. Standardized Multiple Regression Equations to Determine the Independent Effects of Categories of Sender and Receiver Characteristics on Understanding the Earthquake Prediction in each Study Community

Independent Variables	Coalinga			Paso Robles			Taft		
Message/Sender Characteristics	b	α	r^2	b	α	r^2	b	α	r^2
Consistency	.13	.02	.01	.20	.00	.04	.38	.00	.14
Certainty	.20	.00	.04	.33	.00	.12	.42	.00	.17
Channel Type	--	.00	.20	--	.00	.21	--	.00	.30
television	.06	N/S	--	.17	.00	--	.00	N/S	--
radio	.04	N/S	--	.02	N/S	--	.07	N/S	--
newspapers	.15	.01	--	.09	N/S	--	.25	.00	--
magazines	.05	N/S	--	.05	N/S	--	.08	N/S	--
brochures	.42	.00	--	.40	.00	--	.41	.00	--
posters	.01	N/S	--	.03	N/S	--	.02	N/S	--
meetings	.06	N/S	--	.00	N/S	--	.13	.03	--
conversations	.06	N/S	--	.09	N/S	--	.00	N/S	--
Channel Number	.29	.00	.08	.33	.00	.11	.46	.00	.21
Specificity of Guidance	.28	.00	.08	.31	.00	.09	.49	.00	.24
Message Source	--	.00	.22	--	.00	.16	--	.00	.29
familiar	.04	N/S	--	.02	N/S	--	.08	N/S	--
official	.46	.00	--	.36	.00	--	.48	.00	--
scientists	.01	N/S	--	.03	N/S	--	.03	N/S	--
local organizations	.00	N/S	--	.09	N/S	--	.09	N/S	--
Red Cross	.07	N/S	--	.04	N/S	--	.02	N/S	--
Number of Sources	.31	.00	.09	.33	.00	.12	.48	.00	.22
Receiver/Personal Characteristics									
Demographics	--	N/S	.01	--	N/S	.01	--	.02	.04
sex	-.10	N/S	--	.05	N/S	--	.02	N/S	--
occupation	.03	N/S	--	.08	N/S	--	.21	.01	--
education	.00	N/S	--	.07	N/S	--	.06	N/S	--
age	.08	N/S	--	.11	N/S	--	.03	N/S	--
own home	.11	N/S	--	.06	N/S	--	.10	N/S	--
Socioeconomic Status	.00	N/S	.00	.02	N/S	.00	.24	.00	.05
Belief in Psychics	.00	N/S	.00	.04	N/S	.00	.06	N/S	.00
Experience	.15	.01	.02	.07	N/S	.00	.13	N/S	.01
Community Integration	.00	N/S	.00	.12	.03	.01	.05	N/S	.00
Roles of Responsibility	.07	N/S	.00	.04	N/S	.00	.01	N/S	.00
Situational Cues	.13	.02	.01	.10	.06	.01	.10	.00	.01
Pre-prediction Actions	.10	N/S	.01	.08	N/S	.00	.21	.00	.04

specific guidance in it about what people should do (.28 for Coalinga, r^2 = 8%; .31 for Paso Robles, r^2 = 9%, and .49 for Taft, r^2 = 24%); information that was consistent in content with other messages (.13 in Coalinga, r^2 = 1%; .20 in Paso Robles, r^2 = 4%, and .38 in Taft, r^2 = 14%); and information that was certain regarding the earthquake's what, when, where, and so on (.20, r^2 = 4% in Coalinga; .33, r^2 = 12% in Paso Robles, and .42, r^2 = 17% in Taft).

Only one personal (receiver) characteristic was significantly related to understanding the prediction in all three study communities; it also explained variation in hearing about the prediction. Observing social cues like neighbors performing mitigation and preparedness actions was important (the coefficients were .13 in Coalinga and .10 in Paso Robles and Taft); it explained 1% of the variance in hearing about the prediction in each community studied.

As was the case with hearing about the prediction, it seems that people were more likely to understand the prediction if it was from an official source, communicated in writing, and then reinforced via other communications from other sources over other channels of communication. Reinforcement through observing social cues also enhanced understanding the prediction. It is likely that reinforcement of all types simply gave people the incentive to evaluate the prediction until it could be personally understood.

C. Perceiving Risk Because of the Earthquake Prediction

Risk perception is a multidimensional concept because people can perceive risk in different ways. For example, communicated risk information can be believed--the future risk event will occur--but not personalized. A person can believe that the risk event will occur, but not actually affect himself or herself negatively. An index was constructed for use in this analysis that combined both the belief and personalization elements of perceived risk.

The same message (sender) factors and personal (receiver) factors used in the prior two analyses were regressed against the index of perceived risk. The results of these analyses (see Table VII-3) were very similar to those obtained on hearing and understanding the earthquake prediction.

Message (sender) characteristics had a larger effect than did receiver (personal) characteristics. People were more likely to perceive risk (believe the prediction and personalize earthquake impacts) the more times and ways that the prediction was communicated. The number of message sources enhanced perceived risks in Coalinga (.35, r^2 = 12%), Paso Robles (.33, r^2 = 10%), and Taft (.45, r^2 = 20%), as did the number of communication channels (.30, r^2 = 9% in Coalinga; .30, r^2 = 9% in Paso Robles; and .49, r^2 = 19% in Taft). Official prediction sources were the only individual sources to increase perceived risk (.44 in Coalinga, .32 in Paso Robles, and .41 in Taft). The printed channels of communication were the only statistically significant predictors of risk perception (the coefficients for the brochure were .42 in Coalinga, .39 in Paso Robles, and .43 in Taft; while the coefficients for newspapers were .12, .03 and .25, respectively, for Coalinga, Paso Robles, and Taft), which explained 20% of the variance in perceived risk in Coalinga, 18% in Paso Robles, and 29% in Taft.

Other sources and communication channels only served to reinforce printed communications from official sources. Other significant message (sender) factors were identical to those which affected hearing about

Table VII-3. Standardized Multiple Regression Equations to Determine the Independent Effects of Categories of Sender and Receiver Characteristics on the Risk Perception Index in each Study Community

Independent Variables	Coalinga			Paso Robles			Taft		
Message/Sender Characteristics	b	α	r^2	b	α	r^2	b	α	r^2
Consistency	.14	.01	.02	.21	.00	.04	.40	.00	.15
Certainty	.17	.00	.03	.32	.00	.10	.40	.00	.16
Channel Type	--	.00	.20	--	.00	.18	--	.00	.29
television	.03	N/S	--	.12	N/S	--	.05	N/S	--
radio	.00	N/S	--	.00	N/S	--	.13	N/S	--
newspapers	.12	.04	--	.03	N/S	--	.25	.00	--
magazines	.08	N/S	--	.05	N/S	--	.06	N/S	--
brochures	.42	.00	--	.39	.00	--	.43	.00	--
posters	.06	N/S	--	.02	N/S	--	.00	N/S	--
meetings	.08	N/S	--	.00	N/S	--	.08	N/S	--
conversations	.02	N/S	--	.07	N/S	--	.04	N/S	--
Channel Number	.30	.00	.09	.30	.00	.09	.49	.00	.19
Specificity of Guidance	.28	.00	.07	.29	.00	.08	.46	.00	.21
Message Source	--	.00	.22	--	.00	.14	--	.00	.22
familiar	.06	N/S	--	.00	N/S	--	.10	N/S	--
official	.44	.00	--	.32	.00	--	.41	.00	--
scientists	.02	N/S	--	.00	N/S	--	.02	N/S	--
local organizations	.06	N/S	--	.11	N/S	--	.11	N/S	--
Red Cross	.04	N/S	--	.09	N/S	--	.00	N/S	--
Number of Sources	.35	.00	.12	.33	.00	.10	.45	.00	.20
Receiver/Personal Characteristics									
Demographics	--	N/S	.00	--	N/S	.01	--	.04	.03
sex	.06	N/S	--	.09	N/S	--	.03	N/S	--
occupation	.02	N/S	--	.12	N/S	--	.21	.00	--
education	.01	N/S	--	.08	N/S	--	.05	N/S	--
age	.08	N/S	--	.09	N/S	--	.05	N/S	--
own home	.08	N/S	--	.05	N/S	--	.03	N/S	--
Socioeconomic Status	.00	N/S	.00	.02	N/S	.00	.24	.00	.05
Belief in Psychics	.11	.05	.01	.13	.03	.01	.16	.03	.02
Experience	.12	.04	.01	.06	N/S	.00	.13	N/S	.01
Community Integration	.02	N/S	.00	.11	.05	.01	.01	N/S	.04
Roles of Responsibility	.04	N/S	.00	.03	N/S	.00	.01	N/S	.00
Situational Cues	.18	.00	.03	.09	N/S	.01	.28	.00	.07
Pre-prediction Actions	.10	N/S	.01	.07	N/S	.00	.19	.01	.03

and understanding the prediction: (1) information that had specific guidance in it about what people should do (.28 for Coalinga, r^2 = 7%; .29 for Paso Robles, r^4 = 8%, and .46 for Taft, r^2 = 21%); (2) information that was consistent about what it said with the content of other messages (.14 in Coalinga, r^2 = 2%; .21 in Paso Robles, r^2 = 4%, and .40 in Taft, r^2 = 15%); and (3) information that was certain regarding the earthquake's what, when, where and so on (.17, r^2 = 3% in Coalinga; .32, r^2 = 10% in Paso Robles; and .40, r^2 = 16% in Taft).

Essentially, only two personal (receiver) characteristics were significantly predictive of perceived risk across communities. Observing neighbors performing mitigation and preparedness actions enhanced perceived risk (the coefficients were .18 in Coalinga, .09 in Paso Robles, and .28 in Taft), as did pre-prediction belief in psychics' abilities to predict quakes (.11 in Coalinga, r^2 = 1%; .13 in Paso Robles, r^2 = 1%; and .16 in Taft, r^2 = 2%).

As was the case with hearing about and understanding the prediction, it seems that perceiving risk because of the prediction was more likely if it was from an official source, communicated in writing, and then reinforced through other messages from other sources over other channels. Reinforcement through observing social cues also increased the risk which people perceived. Interestingly, it also appears that the belief in the ability of psychics to predict earthquakes enhanced the credibility (belief and personalization) of scientists to predict the Parkfield earthquake. This affect likely does not operate in the opposite direction.

D. Seeking More Information Because of the Earthquake Prediction

Sender (message) and receiver (personal) characteristics were once again used in regression equations, but this time to predict attempts by the public to seek and find additional information on their own about the prediction, earthquakes, and what they should do to get ready for the Parkfield quake. Once again, these analysis results (see Table VII-4) were similar to the results obtained by prior analyses.

Message (sender) factors had a greater impact on seeking more information than did receiver (personal) factors. People were more likely to seek additional information on their own the more times and ways that the prediction was communicated. The number of message sources enhanced information seeking in Coalinga (.39, r^2 15%), Paso Robles (.46, r^2 = 21%), and Taft (.48, r^2 = 23%), as did the number of communication channels (.27, r^2 = 7% in Coalinga; .35, r^2 = 12% in Paso Robles; and .48, r^2 = 23% in Taft). Many individual message sources increased the odds that more information would be sought. For example, official sources predicted seeking more information (.12 in Coalinga, .15 in Paso Robles, and .23 in Taft), as did familiar sources (.15 in Coalinga, .14 in Paso Robles, and .14 in Taft), local organizational sources (.11 in Coalinga, .26 in Paso Robles, and .29 in Taft), and scientific sources (.16 in Coalinga, .14 in Paso Robles, and .06 in Taft). The brochure impelled people to seek more information (the coefficients were .19 in Coalinga, .11 in Paso Robles, and .30 in Taft), as did local meetings (.20 in Coalinga, .18 in Paso Robles; and .23 in Taft).

Other significant message (sender) factors were the same as those previously said to affect hearing and understanding the prediction:

Table VII-4. Standardized Multiple Regression Equations to Determine the Independent Effects of Categories of Sender and Receiver Characteristics on Seeking More Information in each Study Community

Independent Variables	Coalinga			Paso Robles			Taft		
Message/Sender Characteristics	b	α	r^2	b	α	r^2	b	α	r^2
Consistency	.17	.00	.03	.18	.00	.03	.20	.00	.04
Certainty	.10	N/S	.01	.22	.00	.04	.35	.00	.12
Channel Type	--	.00	.10	--	.00	.12	--	.00	.27
television	.11	N/S	--	.10	N/S	--	.14	.04	--
radio	.03	N/S	--	.08	N/S	--	.08	N/S	--
newspapers	.07	N/S	--	.07	N/S	--	.09	N/S	--
magazines	.05	N/S	--	.05	N/S	--	.00	N/S	--
brochures	.19	.00	--	.11	.03	--	.30	.00	--
posters	.04	N/S	--	.00	N/S	--	.11	N/S	--
meetings	.20	.00	--	.18	.00	--	.23	.00	--
conversations	.12	.03	--	.09	N/S	--	.00	N/S	--
Channel Number	.27	.00	.07	.35	.00	.12	.48	.00	.23
Specificity of Guidance	.14	.01	.02	.15	.01	.02	.40	.00	.16
Message Source	--	.00	.15	--	.00	.21	--	.00	.23
familiar	.15	.00	--	.14	.01	--	.14	.02	--
official	.12	.03	--	.15	.00	--	.23	.00	--
scientists	.16	.00	--	.14	.01	--	.06	N/S	--
local organizations	.11	.04	--	.26	.00	--	.29	.00	--
Red Cross	.15	.01	--	.06	N/S	--	.00	N/S	--
Number of Sources	.39	.00	.15	.46	.00	.21	.48	.00	.23
Receiver/Personal Characteristics									
Demographics	--	N/S	.01	--	.00	.04	--	N/S	.02
sex	.15	.01	--	.06	N/S	--	.00	N/S	--
occupation	.04	N/S	--	.12	N/S	--	.06	N/S	--
education	.03	N/S	--	.10	N/S	--	.09	N/S	--
age	.03	N/S	--	.02	N/S	--	.01	N/S	--
own home	-.05	N/S	--	-.16	.01	--	-.16	.03	--
Socioeconomic Status	.03	N/S	.00	.16	.00	.02	.12	N/S	.01
Belief in Psychics	.06	N/S	.00	.14	.01	.02	.03	N/S	.00
Experience	.04	N/S	.00	.00	N/S	.00	.11	N/S	.01
Community Integration	.02	N/S	.00	.09	N/S	.00	.11	N/S	.01
Roles of Responsibility	.04	N/S	.00	.05	N/S	.00	.05	N/S	.00
Situational Cues	.28	.00	.08	.27	.00	.07	.39	.00	.15
Pre-prediction Actions	.15	.00	.02	.18	.00	.03	.28	.00	.08

(1) information that had specific guidance about what people should do (.14 in Coalinga, r^2 = 2%; .15 in Paso Robles, r^2 = 2%; and .40 in Taft, r^2 = 16%); (2) information that was consistent about what was said across messages (.17 in Coalinga, r^2 = 3%; .18 in Paso Robles, r^2 = 3%; and .20 in Taft, r^2 = 4%); and (3) information that was certain regarding the earthquake's what, when, where, and so on (N/S in Coalinga; .22 in Paso Robles, r^2 = 4%; and .35 in Taft, r^2 = 12%).

Two receiver (personal) characteristics significantly predicted seeking more information across the communities studied: observing social cues like neighbors performing mitigation and preparedness actions (.28 in Coalinga, r^2 = 8%; .27 in Paso Robles, r^2 = 7%; and .39 in Taft, r^2 = 15%); and pre-prediction earthquake salience measured by prior mitigation and preparedness actions (.15 in Coalinga, r^2 = 2%; .18 in Paso Robles, r^2 = 3%; and .28 in Taft, r^2 = 8%).

These findings are generally similar to prior findings, but a few differences exist. It appears that seeking more information on one's own in response to the prediction was more likely if the prediction was communicated in a written brochure, but almost any source (not just an official source) sent people on a search for more information. Additionally, information reinforcement led to more action, as did information that was consistent, specific, and certain. Salience of the earthquake hazard also affected seeking more information.

E. Engaging in Mitigation and Preparedness Behavior Because of the Earthquake Prediction

The results of the regression analysis produced some very important findings. First, the tendency for message (sender) factors to impact mitigation and preparedness behavior was generally observed in a pattern similar to that of their effect on other perceptual and behavioral factors. However, the impact of message (sender) factors was generally much weaker as they explained far less variance (see Table VII-5) than previously observed. For example, information consistency was related to mitigation and preparedness, but somewhat weakly (N/S in Coalinga, .16 in Paso Robles, r^2 = 2%; and .20 in Taft, r^2 = 4%). This same conclusion was reached regarding information certainty (N/S in Coalinga; .14 in Paso Roles, r^2 = 2%; .24 in Taft, r^2 = 5%); the number of communication channels (.11 in Coalinga, r^2 = 1%; .18 in Paso Robles, r^2 = 3%; and .28 in Taft, r^2 = 7%); information specificity (N/S in Coalinga; .21 in Paso Robles, r^2 = 4%; and .27 in Taft, r^2 = 7%); and the number of information sources (.17 in Calinga, r^2 = 2%; .30 in Paso Robles, r^2 = 9%; and .28 in Taft, r^2 = 8%).

Second, only one personal attribute (observing social cues or others engaged in mitigation and preparedness activities) was significantly related across communities to readiness behavior (.22, r^2 = 4% in Coalinga; .25, r^2 = 6% in Paso Robles; and .33, r^2 = 11% in Taft). Third, perceived risk had a weak effect on mitigation and preparedness (.14, r^2 = 2% in Coalinga; .29, r^2 = 8% in Paso Robles; and .20, r^2 = 4% in Taft). Finally, there was a profound and very strong effect of seeking more information on subsequently performing mitigation and preparedness actions (.51 in Coalinga with r^2 = 26%; .50 in Paso Robles with r^2 = 25%; and .58 in Taft with r^2 = 34%).

These data suggest that mitigation and preparedness in response to the prediction were more the result of seeking more information about the prediction, the earthquake, and what to do to get ready than were they the direct result of anything else.

Table VII-5. Standardized Multiple Regression Equations to Determine the Independent Effects of Categories of Sender and Receiver Characteristics on Preparedness and Mitigation in each Study Community

Independent Variables	Coalinga			Paso Robles			Taft		
Message/Sender Characteristics	b	α	r^2	b	α	r^2	b	α	r^2
Consistency	.06	N/S	.00	.16	.00	.02	.20	.00	.04
Certainty	.03	N/S	.00	.14	.01	.02	.24	.00	.05
Channel Type	--	N/S	.01	--	N/S	.02	--	.01	.06
television	.14	.03	--	.10	N/S	--	.16	.04	--
radio	.01	N/S	--	.00	N/S	--	.01	N/S	--
newspapers	.02	N/S	--	.09	N/S	--	.07	N/S	--
magazines	.06	N/S	--	.01	N/S	--	.03	N/S	--
brochures	.00	N/S	--	.06	N/S	--	.13	.05	--
posters	.04	N/S	--	.02	N/S	--	.05	N/S	--
meetings	.09	N/S	--	.08	N/S	--	.06	N/S	--
conversations	.07	N/S	--	.03	N/S	--	.07	N/S	--
Channel Number	.11	.05	.01	.18	.00	.03	.28	.00	.07
Specificity of Guidance	.02	N/S	.00	.21	.00	.04	.27	.00	.07
Message Source	--	.00	.05	--	.00	.12	--	.00	.07
familiar	.04	N/S	--	.04	N/S	--	.19	.00	--
official	.03	N/S	--	.10	.05	--	.12	N/S	--
scientists	.16	.00	--	.14	.01	--	.03	N/S	--
local organizations	.00	N/S	--	.15	.01	--	.07	N/S	--
Red Cross	.16	.01	--	.18	.00	--	.06	N/S	--
Number of Sources	.17	.00	.02	.30	.00	.09	.28	.00	.08
Receiver/Personal Characteristics									
Demographics	--	.03	.02	--	N/S	.01	--	N/S	.01
sex	.15	.00	--	.13	.02	--	.06	N/S	--
occupation	.02	N/S	--	.02	N/S	--	.02	N/S	--
education	.07	N/S	--	.04	N/S	--	.02	N/S	--
age	.08	N/S	--	.05	N/S	--	.13	N/S	--
own home	.03	N/S	--	.00	N/S	--	.04	N/S	--
Socioeconomic Status	.09	N/S	.00	.04	N/S	.00	.08	N/S	.00
Belief in Psychics	.07	N/S	.00	.09	N/S	.01	.02	N/S	.00
Experience	.03	N/S	.00	.04	N/S	.00	.18	.01	.03
Community Integration	.02	N/S	.00	.00	N/S	.00	.10	N/S	.01
Roles of Responsibility	.01	N/S	.00	.05	N/S	.00	.03	N/S	.00
Situational Cues	.22	.00	.04	.25	.00	.06	.33	.00	.11
Pre-prediction Actions	.06	N/S	.00	.12	.02	.01	.11	N/S	.01
Process Characteristics									
Perception Index	.14	.01	.02	.29	.00	.08	.20	.00	.04
Seek More Information	.51	.00	.26	.50	.00	.25	.58	.00	.34

F. Tentative Conclusions

The analyses yielded data that suggest that risk communication theory was supported by public reaction to the Parkfield Earthquake Prediction Experiment. In general, how the risk was communicated and what it said affected the public more than did personal differences between people. The data also led to specific conclusions about public prediction reactions consistent with risk communication theory. For example, people were more likely to feel that they had "heard of" the prediction; to understand, believe, and personalize the risk from it; and to have taken protective action the more they:

- perceived the full array of received prediction messages as basically consistent with each other;
- remembered the predicted earthquake's magnitude, potential for damage, and other characteristics, which made the prediction seem more certain to them;
- remembered specific guidance for appropriate protective actions to take, such as strapping down the water heater and setting up an emergency supplies stockpile;
- remembered that they had received these messages through numerous vehicles or channels, and especially that they had received them through the printed word in the mailed brochure and newspapers;
- remembered that they had received these messages from numerous information sources including scientists and relatives, and especially that they had received them from official sources.

In risk communication theory, these message characteristics are termed consistency, certainty, specificity, use of multiple channels, use of multiple information sources, use of official information sources, and use of a printed communication channel. Our findings generally confirm the part of the theory that states risk communication factors such as these have a positive impact on what people think and do.

Second, the communication factors just reviewed did not have a consistently strong impact on all factors examined. These factors did consistently explain variation in people's ability to remember hearing about the prediction, understanding it, perceiving risk because of it, and seeking out additional information. However, the impact of these factors on actual mitigation and preparedness behavior was substantially below their impact on other factors--although their impact did remain statistically significant. This suggests that risk communication theory may be incorrect or in need of revision when it seeks to predict public action to reduce risk or prepare in response to risk communications. Communications about risk may actually have a greater indirect effect than direct effect, as the theory now states. This question has been raised by the results of our regression analysis. We answer this question in the next chapter based on another form of analysis.

Third, personal (receiver) characteristics fared quite poorly in explaining differences in what people thought and did because of the prediction. Personal characteristics, including age, sex, income, educational level, role membership, and home-ownership, made no consistent significant difference in people's response to the prediction. Instead, we found only a few differences because of a few personal characteristics:

- people were more likely to recall having heard about the prediction if they had earthquake experience and were well integrated into the community
- people were more likely to believe the prediction if they believed that psychics could predict earthquakes
- people who had done earthquake mitigation and preparedness before the prediction were more likely to seek information about what else they should do

- people who observed social cues (for example, friends and neighbors doing mitigation and preparedness) were more likely to recall the prediction, understand it, believe it, personalize the risk, seek additional information, as well as do more of their own mitigation and preparedness.

It appears that people differ in the degree to which the earthquake hazard is salient before a prediction is issued, for example, because of experience, already having engaged in earthquake readiness, or holding a belief in the ability to predict earthquakes. Pre-prediction saliance then affects reaction to a prediction. Consequently, we conclude that pre-prediction hazard salience might be the appropriate theoretical (personal characteristic) construct to include in risk communication theory and not its varied empirical indicators such as experience, pre-risk communication hazard mitigation and preparedness actions and so on. This conclusion is tentative based on the performed regression analyses in this chapter.

It also seems that risk information reinforcement (the perceptual corollary of seeing friends and neighbors ready for a predicted quake) enhances all aspects of the risk communication process: hear, understand, believe, personalize, and respond. Information reinforcement may be the applicable theoretical construct worth including in risk communication theory; it likely has many relevant operationalizations heretofore thought to be personal characteristics of the information receiver, for example, observing cues, rather than as aspects of information or sender characteristics. This conclusion is also tentative based on the analyses performed thus far.

These findings and our suspicions about needed reconceptualizations of constructs, concepts and indicators of information (sender) and personal (receiver) characteristics in risk communication theory helped to inform our subsequent analyses in the chapter which follows.

CHAPTER VIII

A CAUSAL EXPLANATION OF PUBLIC PREDICTION RESPONSE

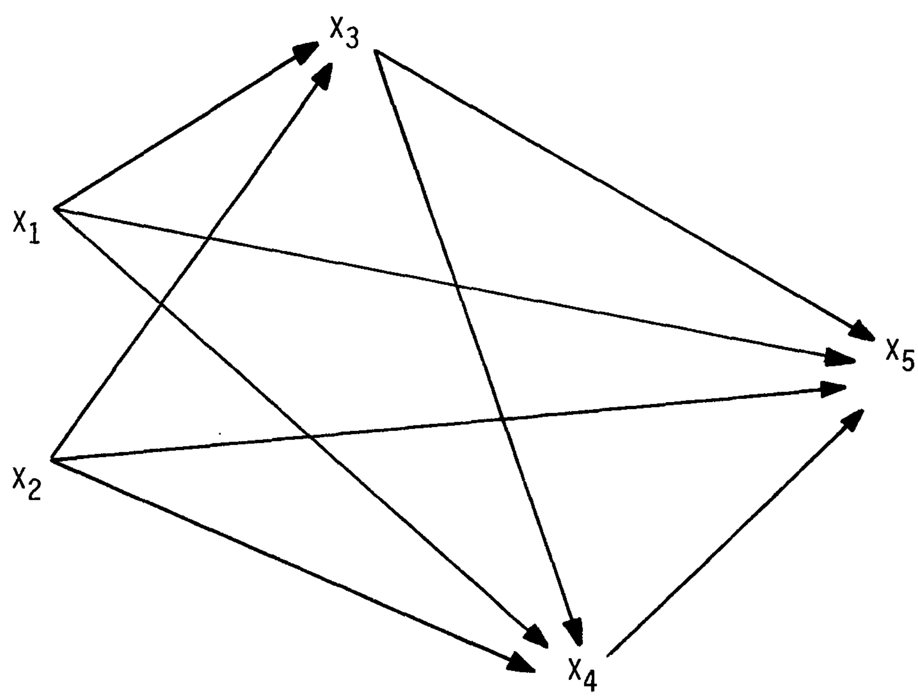
Causality is difficult to establish in the social sciences, even when statistical analyses are done on data that are part of the experimental method. Causal modeling based on cross-sectional data like that used in this chapter can reveal the most significant statistical paths influencing a behavior, and can implement relatively complex sets of statistical controls. These controls enable the effect of relationships between variables contained in a model to be determined, while holding constant all other variables in the model.

The causal modeling performed in this chapter draws together all the factors suggested by risk communication theory (see Chapter II), focuses only on those factors suggested as important in the multiple regression analysis (see Chapter VII), and clarifies the processes that best explains public prediction response. This was accomplished by using path analytic techniques, that is, simultaneous multiple regression equations.

A. The General Prediction Response Model

The general model constructed to guide the path analysis is presented in Figure VIII-1. This model subsumes the factors and relationships among them suggested by theory and past research (see Chapter II) and the reconceptualizations in theory suggested by our regression analyses (see Chapter VII). The model proposes that public

Figure VIII-1. The General Path Model for Public Prediction Response*



*Where X_1 = information or "sender" factors about what was communicated to the public, X_2 = "receiver" factors about the characteristics of the people who received the communications, X_3 = the perceptions which people held, X_4 = the information seeking behavior in which people engaged, and X_5 = the mitigation and preparedness behavior that people actually performed.

mitigation and preparedness behavior in response to the prediction was a direct consequence of the kind of information people received about the risk and what to do, their own personal characteristics, the perceptions which people held, and their information-seeking behavior about the risk and what to do. Information-seeking was cast as a consequence of received information, personal characteristics, and perceptions. Finally, risk perceptions were modeled as a result of received information and personal characteristics. Unfortunately, the concept of "hearing" about the prediction had to be excluded from our model. Insufficient variance on this concept existed in our sample data to include it in the path analysis; most people had heard about the Parkfield prediction. The personal characteristic of community integration was also excluded from the model, since it only had an effect on hearing about the prediction (see Chapter VII) and not on the other risk communication process factors included.

This model is parsimonious since it contains five theoretical constructs which represent dozens of factors known to be important to the process of risk communication and public response. The model also subsumes all factors which our prior analyses suggested were consistently relevant in our data sets. Although the model is simple enough to understand and interpret, it is far from being operationalized into a form that could be statistically estimated.

B. Operationalizing the Model

The general model presented in Figure VIII-1 lacks sufficient specification to enable it to be subjected to empirical test. For example, it is comprised of general constructs (like information factors) which stand for far more than one variable. These constructs actually represent many specific variables, for example, information factors represent variables like information specificity, understandability, and the number of communications received. This model must be brought down the ladder of abstraction to enable it to include the fuller array of relevant factors suggested by theory and prior research, and to be statistically estimated.

When the full array of variables of significance in operationalizing the general theoretical model was considered, the consequence became a model which could be tested empirically, but it was so complex that it would be uninterpretable. Additionally, this model contained so many variables that it violated practical statistical assumptions that must be met in order to trust the data produced by such an analysis. For example, explained variance in any endogenous variable in the model would be influenced by having many exogenous variables in any one equation: it would be hard to know if explained variance were attributable to the discovery of significant causal paths of influence between variables, or simply due to having included so many exogenous variables in any one equation.

Consequently, the dilemma posed by the attempt to operationalize the general model was straightforward. The more factors included in the operationalized empirical model, the more that model would represent what we believed influences behavior in the real world. However, the more factors we included, the less intelligible and statistically accurate would be our findings.

Obviously, the operationalization of the general model had to tap the rich set of factors subsumed by the model's general concepts. At the same time, the operationalized model had to maintain statistical integrity and understandability, and be parsimonious. An operationalized model was needed that was practical, theoretically complete, and correctly specified. Two strategies were used to achieve such an operationalized model.

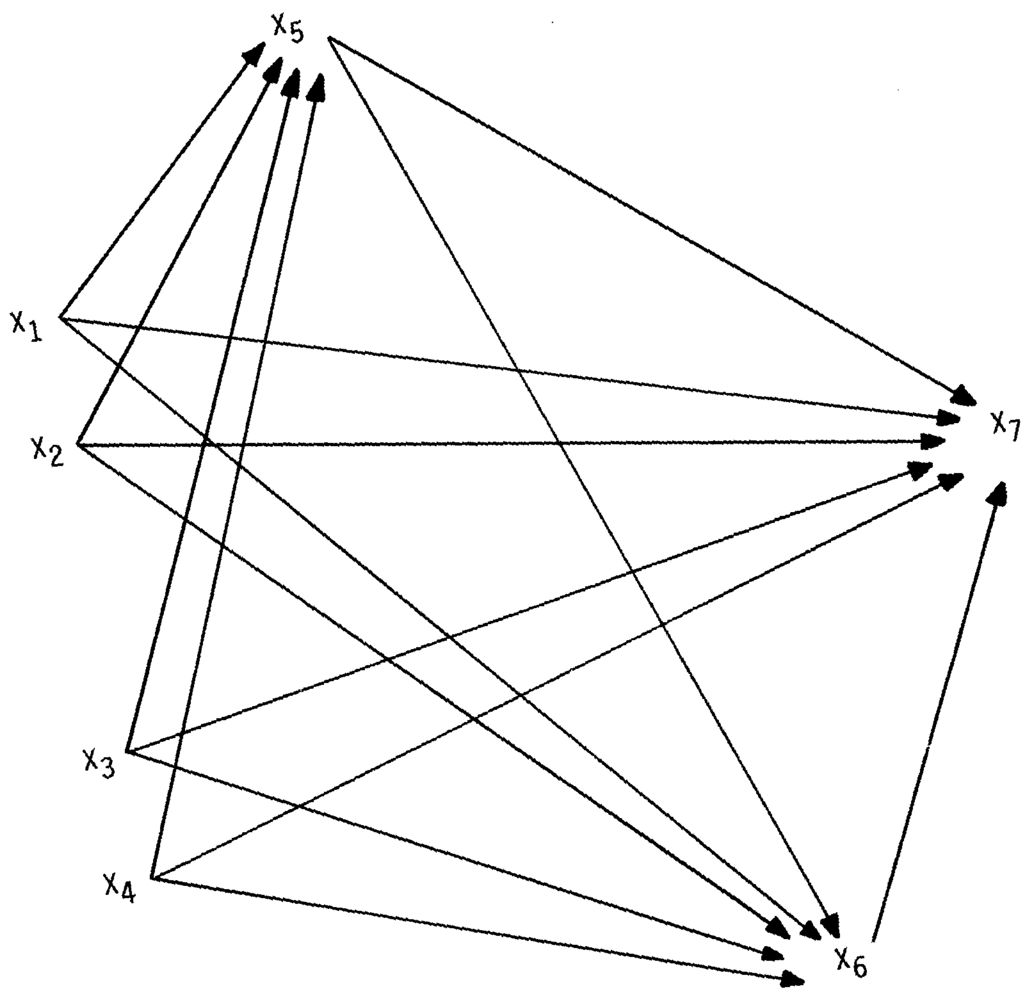
The first was to operationalize the model at the mid-range. For example, instead of proposing a model that included all relevant variables as unique factors, we operationalized the model at a higher level of abstraction with concepts that subsumed relevant individual variables. This approach produced a theoretically correct model, maintained parsimony, and still provided a vehicle whereby a statistically correct model could be produced. At the same time, this strategy enabled inclusion in the model of any and all collected data on variables subsumed by the mid-range concepts.

The second strategy was grounded in the empirical fit of the data with existing theory. It was possible to reduce greatly the number of variables in the operationalized model by excluding those that had no consistent statistical effect on any of the factors under consideration. For example, the multiple regression analyses (see Chapter VII) illustrated that variables like occupational prestige and level of education did not relate to the dependent variables of risk perception, information-seeking or mitigation and preparedness behaviors. Therefore, there was no reason to include these variables in the operationalized model since they did not fit the data gathered in this study.

C. The Operationalized Model

The operationalized model used to direct the path analysis of prediction response is presented in Figure VIII-2. This model includes

Figure VIII-2. The Operationalized Path Model for Public Prediction Response*



*Where X_1 = pre-prediction salience, X_2 = contextual cues, X_3 = frequency of receipt of prediction messages, X_4 = message style, X_5 = perception of risk, X_6 = information-seeking, and X_7 = mitigation and preparedness readiness behavior.

the two major personal or receiver characteristics that best fit these data: pre-prediction earthquake hazard salience, and post-prediction contextual cues. Two information or sender characteristics are also in the model: the frequency and divergence in the prediction messages received and message style. The model casts mitigation and preparedness response (X_7) as a function of information-seeking, risk perception, message style, message freqency, contextual cues and pre-prediction salience. Information-seeking (X_6) is the consequence of risk perception, message style, message frequency, contextual cues and pre-prediction salience. Risk perception is the result of message style, message frequency, contextual cues and pre-prediction salience. This model excludes other factors that were shown in the multiple regression analysis (see Chapter VII) not to affect prediction response, directly or indirectly. This model is comprised of mid-range concepts which subsume several other less abstract variables. This required that scales be constructed from the study's measures to represent the concepts contained in the model.

The construction of scales involved the addition of scores across two or more measures. Obviously, many of the factors added to construct a composite scale were not additive in the sense of basic arithmetic. For example, adding an information content score to an information source score presumes equality in these two information attributes and equality may not exist. All added scores used original scales that had a zero starting point. The use of the resulting composite scales enabled the inclusion of multiple indicators for a concept and the reduction of the number of factors in the model, and it dramatically enhanced the parsimony of the operationalized model. It was judged that the merits of this approach far outweighed any shortcomings. The following chapter sections describe how each concept in the operationalized model was measured and scaled.

1. Pre-prediction salience. Pre-prediction salience was measured by asking respondents about a range of mitigation and preparedness actions that they could have taken because of the earthquake hazard but before the issuance of the Parkfield prediction. Things asked about included the purchase of earthquake insurance, anchoring the house to its foundation, stockpiled emergency supplies, developing an emergency family plan, and eight other mitigation and preparedness actions. These actions were intervally coded and varied between 0 (no pre-prediction actions taken) and 12 (all types of actions asked about were taken). The logic underlying this composite measure was that the salience of the earthquake hazard was indicated by the actions a respondent had taken to mitigate the hazard and prepare for future earthquakes.

2. Contextual cues. Contextual cues was measured dichotomously simply by using respondents' answers to the following question: "Do you know of anyone (for example, friends, relatives, or neighbors) who has done anything to get ready for the Parkfield earthquake (for example, made their home or possessions safer)?"

3. Frequency of receipt of prediction messages. Persons who participated in the study were asked to tell us the channels of communication through which they received information about the earthquake prediction, as well as from whom they received information. Communication channels included television, radio, newspapers, magazines, brochures, posters, meetings, and informal conversations. Information sources included informal sources (friends, relatives,

neighbors), government sources (city, county, state, and federal government), scientists, the Red Cross, and other sources (fire department, schools, utility companies).

A frequency scale was constructed by adding the number of different channels through which people had gotten prediction information to the number of different sources from which information had been received. This index, therefore, combined the important channel and source dimensions of risk communication; its use allowed us to include a great deal of information in the model.

4. Message style. We also sought to develop a composite scale for the varied style attributes associated with communicated risk information. Two style attributes were revealed as important by the multiple regression analyses in Chapter VII: message specificity and consistency. Message specificity was measured by asking respondents about information contained in the official prediction brochure mailed to households regarding damage estimates, probability, time window, ability to feel the earthquake, what people had been advised to do to mitigate and prepare, and several specific aspects about the short-term warning that could be issued. A total of 39 individual items on the questionnaire covered these information attributes. These were summed for each respondent based on the logic that the more of these items a respondent reported hearing, the more specific was the risk information which that respondent perceived or remembered. This score was given weight equal to the dichotomous measure of risk information consistency. Consistency was measured by asking respondents if they agreed with the following statement: "Earthquake scientists agree about the Parkfield earthquake prediction." The index of message stye, therefore, was

equally indicative of both consistency and specificity of risk information.

5. Risk perception. The risk that people perceive regarding a future earthquake is a complex concept. Prior research and theory (see Chapter II) revealed that two important elements of risk perception are belief in the prediction and personalization of risk. An index of risk perception was constructed that included both of these elements. Belief was measured by asking the question: "Do you believe that scientists can predict earthquakes?" Risk personalization was measured by asking respondents if they thought there would be an earthquake that caused them economic losses and/or physical harm in their lifetimes and/or in the next few years. Responses were coded in terms of personalized Parkfield earthquake risk, which ranged from "I will not experience an earthquake in my lifetime that causes me or someone in my family economic losses" (the lowest risk personalization category) to "I will experience an earthquake in the next few years that causes me or someone in my family physical harm" (the highest risk personalization category). Belief and personalization scores were then added to create an index of risk perception that included both perceptual elements.

6. Information-seeking. The scale constructed for seeking more information was based on public attempts to obtain more information about both earthquake prediction and what to do to get ready for earthquakes. Respondents reported about attempts to get more information about the science of earthquake prediction and about what to do to get ready for the quake from government agencies, nongovernment agencies, and from informal groups and associates like friends and relatives. These data were use to construct a seven-point scale ranging

from zero for no information-seeking to six for seeking information about both topics from all three sources.

7. Mitigation and preparedness response. Respondents were asked about six mitigation and six preparedness actions they could have taken after the Parkfield prediction was issued. Each of these actions was recommended in the public prediction brochure, for example, purchase earthquake insurance and stockpile emergency supplies. These dozen factors were added to create a mitigation and preparedness readiness score that ranged from zero (no recommended actions taken) to 12 (all recommended actions taken).

D. Assessment of Data Quality

The measures used to construct scales and the scales themselves were assessed to determine data quality. Data used in path analyses yields more accurate and trustworthy results if those data have certain characteristics. For example, each measure and scale should possess variation across the range, be able to be treated as if it were an interval scale, and not have an oversized standard error. The data used in this analysis conformed to these requisites. Additionally, path analysis also requires that reasonable assumptions can be met regarding issues like the lack of strong multicolinearity among exogenous variables, the lack of specification error, and the presence of homoscedasticity (see Lewis-Beck 1980, pp. 26-30). The data used in the path analysis were assessed for their ability to conform to these assumptions and were judged to be adequate for the Ordinary Least Squares (OLS) estimation technique.

E. Data and Findings

The operationalized model (see Figure VIII-2) was represented by the following equations.

$$X_5 = \beta_{51}X_1 + \beta_{52}X_2 + \beta_{53}X_3 + \beta_{54}X_4 + e_5$$

$$X_6 = \beta_{61}X_1 + \beta_{62}X_2 + \beta_{63}X_3 + \beta_{64}X_4 + \beta_{65}X_5 + e_6$$

$$X_7 = \beta_{71}X_1 + \beta_{72}X_2 + \beta_{73}X_3 + \beta_{74}X_4 + \beta_{75}X_5 + \beta_{76}X_6 + e_7$$

The model was estimated for each study community. The estimated model parameters include path coefficients (betas), explained variance for each equation, and other estimates; these are presented in Table VIII-1, Table VIII-2 and Table VIII-3, respectively, for Taft, Paso Robles, and Coalinga. The data sets for all three study communities were not combined since each sample had different variances. If the data sets were to be combined, the resulting data could not represent any group or population. Path estimates are affected by alternative variances across samples. Consequently, the path estimates across the three study communities cannot be compared; however, the theoretical conclusions from each study community (see Tables VIII-1 through VIII-3) can be compared.

The estimated parameters of the models for Taft (see Table VIII-1), Paso Robles (see Table VIII-2), and Coalinga (see Table VIII-3) reveal the relative success of the model in explaining public perception and response in all three study communities. The explained variance for risk perception was 18%, 8% and 7%, respectively, for Taft, Paso Robles, and Coalinga; the explained variance in information-seeking was 39%, 25% and 20%, while it was 35%, 28% and 29% for mitigation and preparedness readiness response to the prediction. These are relatively high

Table VIII-1. Estimated Parameters of the Model for Taft*

Variables		Zero Order Correlation	Path		Equation	
Endogenous	Exogenous		Coefficient	Estimate	α	r^2
X_5	X_1	.29	51	.19	.00	.18
	X_2	.29	52	.18		
	X_3	.33	53	.15		
	X_4	.30	54	.13		
X_6	X_1	.28	61	N/S	.00	.39
	X_2	.39	62	.20		
	X_3	.52	63	.39		
	X_4	.35	64	N/S		
	X_5	.44	65	.24		
X_7	X_1	.11	71	N/S	.00	.35
	X_2	.33	72	.13		
	X_3	.30	73	N/S		
	X_4	.28	74	.13		
	X_5	.30	75	N/S		
	X_6	.60	76	.54		

*Where X_1 = pre-prediction salience, X_2 = contextual cues, X_3 = frequency of receipt of prediction messages, X_4 = message style, X_5 = perception of risk, X_6 = information-seeking, and X_7 = mitigation and preparedness readiness behavior.

Table VIII-2. Estimated Parameters of the Model for Paso Robles*

Variables: Endogenous	Variables: Exogenous	Zero Order Correlation	Path Coefficient	Path Estimate	Equation α	Equation r^2
X_5	X_1	.20	51	.17	.00	.08
	X_2	.08	52	N/S		
	X_3	.13	53	N/S		
	X_4	.25	54	.23		
X_6	X_1	.18	61	N/S	.00	.25
	X_2	.27	62	.19		
	X_3	.44	63	.40		
	X_4	.22	64	N/S		
	X_5	.23	65	.16		
X_7	X_1	.12	71	N/S	.00	.28
	X_2	.25	72	.11		
	X_3	.26	73	N/S		
	X_4	.24	74	.10		
	X_5	.25	75	.12		
	X_6	.50	76	.43		

*Where X_1 = pre-prediction salience, X_2 = contextual cues, X_3 = frequency of receipt of prediction messages, X_4 = message style, X_5 = perception of risk, X_6 = information-seeking, and X_7 = mitigation and preparedness readiness behavior.

Table VIII-3. Estimated Parameters of the Model for Coalinga*

Variables		Zero Order Correlation	Path		Equation	
Endogenous	Exogenous		Coefficient	Estimate	α	r^2
X_5	X_1	.21	51	.12	.00	.07
	X_2	.21	52	.12		
	X_3	.23	53	.13		
	X_4	.14	54	N/S		
X_6	X_1	.15	61	N/S	.00	.20
	X_2	.28	62	.16		
	X_3	.36	63	.25		
	X_4	.21	64	N/S		
	X_5	.31	65	.22		
X_7	X_1	-.06	71	-.17	.00	.29
	X_2	.22	72	.14		
	X_3	.15	73	N/S		
	X_4	.04	74	N/S		
	X_5	.16	75	N/S		
	X_6	.51	76	.51		

*Where X_1 = pre-prediction salience, X_2 = contextual cues, X_3 = frequency of receipt of prediction messages, X_4 = message style, X_5 = perception of risk, X_6 = information-seeking, and X_7 = mitigation and preparedness readiness behavior.

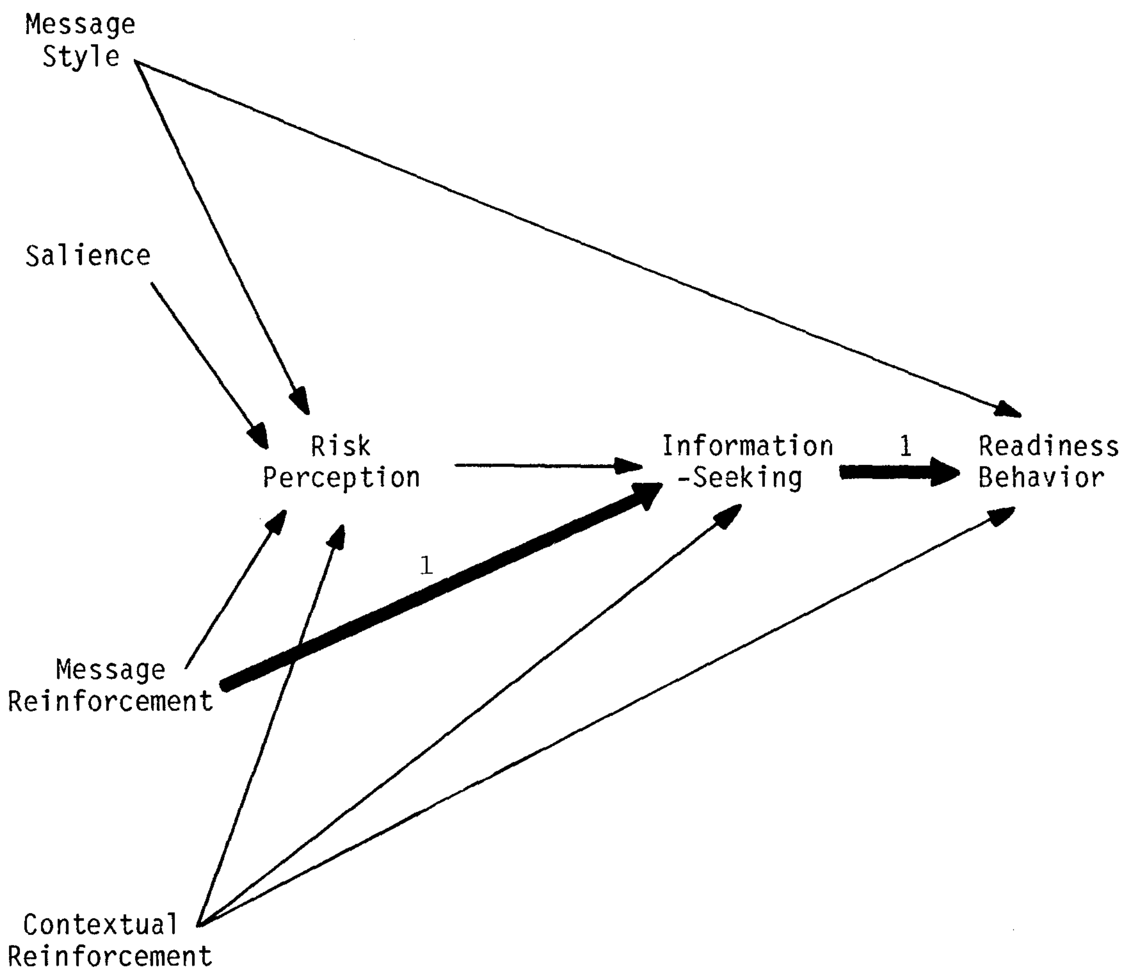
explained variances for a study based on data gathered from individuals, and they confirm the predictive power of the model.

An amazingly consistent set of conclusions can be drawn from these data. These conclusions confirm many parts of established risk communication theory, as well as add new insights to knowledge about communicating risk information to the public. The general conclusions are presented in diagram form in Figure VIII-3.

Validity is lent to general risk communication theory (see Chapter II) when the relationships in the models are examined. In general, risk communication theory suggests that: (1) risk perception in response to communicated information is the result of both sender and receiver factors, (2) information-seeking or confirmation is the result of sender and receiver factors as well as perceived risk, and (3) actual public response to communicated information is a consequence of sender and receiver factors, as well as perceived risk and information seeking or confirmation. In general, each of these sets of relationships existed in the model estimates for all three study communities.

Risk perception was the consequence of both sender and receiver factors, as suggested by risk communication theory. For example, risk perception (belief and personalization) was the result of salience in all three communities; β_{51} for Taft, Paso Robles and Coalinga was .19, .17 and .12, respectively. Message style (consistency and specificity) also affected risk perception in Taft (β_{54} = .13) and Paso Robles (β_{54} = .23), but not in Coalinga. Message style is an important factor in risk communication; however, it seems that, in places like Coalinga where salience is high due to experience, risk perception (belief and personalization) results from any message style that is heard. Finally,

Figure VIII-3. Common Findings Resulting from the Path Analyses



*Where 1 represents major causal paths in the estimated parameters of the models for all three study communities.

risk perception was the result of message reinforcement and frequency (β_{53} = .15 for Taft and .13 for Coalinga) and contextual reinforcement or cues (β_{52} = .18 for Taft and .12 for Coalinga) in Taft and Coalinga, but not in Paso Robles. Reinforcement did not affect risk perception in Paso Robles, perhaps because people in Paso Robles were more likely to deny risk because of their close proximity to the predicted quake's epicenter and because they lacked recent experience.

Receiver factors (contextual cues or reinforcement and salience of the earthquake hazard before the prediction was issued) and sender factors (message style and message frequency or reinforcement) both enhanced the perceptions which people held about risk (belief and personalization). This is exactly what risk communication theory would predict. Exceptions seem to be that people with recent experience are likely to perceive risk regardless of message stye because of their experience; reinforcement of the risk message does not overcome the tendency of people to deny risk if they are close to the risk's potential impact.

Information seeking, as would be predicted from existing theory, was the result of receiver factors, sender factors and risk perception. The receiver factor of contextual cues or reinforcement was positively related to information seeking in all three study communities (β_{62} was .20 for Taft, .19 for Paso Robles, and .16 for Calinga). The same was the case for message reinforcement, where β_{63} was .39 for Taft, .40 for Paso Robles and .25 for Coalinga. Finally, risk perception enhanced information-seeking in all three communities (β_{65} was .24 in Taft, .16 in Paso Robles and .22 in Coalinga).

Finally, the actual performance of mitigation and preparedness risk reduction behavior was the direct consequence of information-seeking (β_{76} was .54 for Taft, .43 for Paso Robles and .51 for Coalinga) and contextual cues or reinforcement (β_{72} was .13 for Taft, .11 for Paso Robles and .14 for Coalinga). Additionally message style had a positive effect on response in both communities without recent earthquake experience (β_{74} was .13 in Taft and .10 in Paso Robles), but not in Coalinga. There, message style likely had no impact because the hazard was salient for people because of experience and regardless of the style of the message which informed them of the risk. Finally, salience had a negative impact on response (β_{71} = -.17) only in Coalinga because salience was measured by pre-prediction readiness activities which Coalinga residents engaged in after the earthquake in the mid-1980s. This relationship indicates that people who mitigated and prepared following the earthquake but before the prediction did not have to do so after it.

F. Conclusions

The most interesting results of the modeled data analyses in the three study communities are the conclusions which can be drawn in reference to the causal paths discovered in the models, and not the effects of individual factors on separate dependent communities.

The strongest causal paths in the models for all three study communities were identical. In each study community, mitigation and preparedness actions were more a consequence of people engaging in information-seeking on their own than of anything else. The beta coefficients (β_{76}) for Taft, Paso Robles and Coalinga, respectively, were .54, .43 and .51 for this relationship. Additionally, and again consistently across all three communities, information-seeking was itself more a consequence of one factor than of anything else: information reinforcement. Message frequency in the models was operationalized as the reinforcement of communicated information by the receipt of multiple messages, through diverse channels and from varied sources. The beta coefficients (β_{63}) for Taft, Paso Robles and Coalinga, respectively, were .39, .40 and .25 for this relationship. An alternative form of reinforcement of communicated information was cues. This factor was operationalized as knowing others who were actually mitigating and preparing for the earthquake. The beta coefficients (β_{62}) for Taft, Paso Robles and Coalinga, respectively, were .20, .19 and .16 for this relationship.

Risk communication about the Parkfield earthquake prediction was most effective when it was a process of multiple messages through multiple channels and from multiple sources rather than a single act. This communication process likely reinforced the risk and the need to consider mitigation and preparedness actions in the minds of people who received multiple and diverse communications. Reinforcement of the risk and the need to consider actions also likely resulted through contextual cues, or knowing other people who were acting to mitigate and prepare.

Once reinforced, however, communicated information was indirectly a cause of protective action only through its affect on a significant intervening factor: seeking additional information on one's own. The act of searching for additional information about the risk, the prediction, and what to do was indicative of the need for people to interact on their own with others and with additional information. Out of this interaction personal ideas and definitions emerged about what to do because of that risk. The key causal findings from all three Parkfield earthquake prediction study communities are the same: (1) communicated public risk information that was reinforced precipitated an interactive public search for more information, (2) personal definitions about what to do emerged from this search, and (3) the resulting personal definitions and ideas about what to do directed what people actually did in response to the earthquake prediction.

CHAPTER IX

CONCLUSIONS FOR THEORY AND PRACTICE

The findings provide a basis from which to draw conclusions that refine and extend the theory of public risk communication. Additionally, the study's results have significant implications for future practical efforts to communicate earthquake risk information to the public.

A. Theoretical Implications

The theoretical implications that we draw from this study may be limited because it was based on the communication of an intermediate-term risk. The Parkfield earthquake was forecast for sometime during the next several years. Consequently, the findings and implications could be less applicable to other event types, for example, communicating risk to a public about a short-term risk in a few hours. Additionally, most, if not all, prior research on public risk communication has been performed on case events where something has gone wrong with public response, and where risk communications were less elaborate than was the case in the Parkfield Earthquake Prediction Experiment. In the case of Parkfield, almost every aspect of risk communication known to be effective was implemented. For example, the written brochure was comprehensive in content and it addressed the full range of topics that the theory of risk communication suggests as important; the written information was distributed personally to people's homes; the public was primed to receive the brochure because of much media attention devoted to the prediction experiment before the brochure was distributed; the information in the brochure was reinforced through continued media coverage after the brochure was distributed; the information in the brochure was very credible since it represented scientific concensus; the prediction was approved by the California (CEPEC) and National (NEPEC) Earthquake Prediction Evaluation Councils, it was endorsed by a mix of sources and came from an official government agency; and so on.

It is possible that our findings are less applicable to cases without such a credible prediction or in which risk is communicated in less comprehensive and sophisticated ways. For example, in none of our three separate studies did we find that factors like socioeconomic status had a significant impact on what the public perceived or did in response to the prediction; some past research suggests that such factors did impact what people thought and did in the event they investigated. It is possible that when public risk communication is done correctly--perhaps like it was done in the Parkfield case--that the biasing effects of personal differences between people on risk perception and response can be eliminated or at least dramatically minimized.

Our analyses were theoretically comprehensive. We tested every hypothesis suggested by prior risk communication research in each study community. Adequate variation existed on each variable included in our analyses to test our hypotheses. To the best of our knowledge, this work may be the most comprehensive test of risk communication theory ever performed. The findings from this research revealed relatively consistent conclusions across all three study communities. This gives us confidence with which to draw the following conclusions for risk communication theory.

The underlying theoretical process for effective public risk communication is more simple and parsimonious than heretofore imagined. Existing theory (see Chapter II) suggests that many different information factors (for example, message consistency, frequency and specificity) as well as different personal factors (for example, age, socioeconomic status and experience) have both direct and indirect effects on public behavior in response to communicated risk information. Our conclusion was consistently that many of these relationships may be spurious or only exist under certain circumstances.

Additionally, existing theory suggests a complex process intervenes between hearing risk communicated and engaging in a response or behavior, for example, hearing leads to forming an understanding, followed by a perception of belief in what was understood, which is then personalized or not, and then behavior ensues. Consistently, we found that these elements of perceived risk were not distinguishable from one another. We must, therefore, conclude that although risk perception is a complex concept, it is one concept and not comprised of a series of distinct perceptual factors. The two foregoing conclusions suggest a greatly simplified theory of public risk communication.

The public engages in mitigation and preparedness behavior as a direct consequence of a personal interactive process of searching for information and meaning on their own. This interactive process involves interacting with other people, talking things over, and encountering and internalizing new or additional information about the risk and available actions. It is likely that people come to "own" ideas about the risk and what to do as a result of this searching and interactive behavior. It is equally likely that personal definitions of risk are socially constructed during this interactive search, as are socially constructed ideas about appropriate behavior in response to the risk.

Communicated risk information is effective in eliciting mitigation and preparedness behavior only indirectly. Risk information is effective not because people mitigate and prepare in direct response to that information, but because they begin searching for personally obtained information and interaction with others when that information sparks interest and motivates them. Risk information is most likely to capture the public's attention and set people off on an interactive search for more information when it has unique characteristics: (1) when risk information is written so that it can be returned to and re-read over and over; (2) when it is credible, complete and clear; and (3) especially when it is reinforced through other messages using different channels of communication and coming from different sources. Visual social cues such as seeing others acting as if the risk is real also provides reinforcement.

Obviously, public response to communicated risk information is a dynamic, interactive social process. Quality information (credible, complete, clear) provides focus; reinforcement of that information (because it is written and can be returnd to time and again, because additional consistent messages from others are received, and because reinforcing social cues are observed) provides motivation; motivation elicits the search for personal definitions of risk and appropriate behavior which emerge from seeking more information and out of interaction with others; and behavior (mitigation and preparedness) that protects and prepares for the risk event is the consequence of the socially constructed definitions that result from searching and interacting with others.

This theoretical model outlines the basic fundamental social psychological process that underlies effective risk communication. It suggests that risk and behavior in anticipation of a hazard is socially constructed through human interaction. Interestingly, this process can be shortcut by some members of the public. A hazard can already be salient for some people before any risk information is communicated to them. Salience of a hazard can be high prior to risk communications because of, for example, experience with the hazard and having already come to perceive risk to the hazard for other reasons. This subset of the population requires less information, reinforcement and searching behavior to be convinced that protective actions are worthwhile performing.

B. Practical Recommendations

This study has significant implications for those responsible for informing the public about future earthquakes and risk. Among the elements of a successful risk communication campaign are first, go to the public with a written brochure and, if funding exists, mail it to their homes. A written document can be returned and re-read many times as the public considers the risk and what steps to take. If the brochure is mailed to citizens' homes, it also takes on a more personal character which helps people to believe that they are at risk. If insufficient funding exists for a mailing, publish the brochure in area newspapers. This is less personal than a mailed brochure, but it is still in writing so it can be returned to by the public over and over.

Second, the brochure should state that it comes from official sources. Government officials were the most credible information source for the public in our study. However, it is also important to recognize that no one information source is credible for everyone. It is best to use multiple sources on a brochure, for example, government officials, scientists and even emergency response organizations that are familiar to the public like the Red Cross.

Third, the information in the brochure should explain specifically: (1) what the risk is, (2) where the quake is going to happen, (3) when it is going to happen, (4) what the effects will be, (5) what people should do before, during and after the quake, and (6) where to get more information about the risk, preparedness and mitigations actions. This information should be as clear and certain as possible.

Fourth, a brochure is not enough--it must be supplemented with additional subsequent information. The public needs to get the message from as many different sources, through as many different channels, as possible. Exposure to additional information makes the brochure more effective since it motivates people to re-read it and take the risk more seriously. Consequently, the brochure should be supplemented by going to the media with consistent additional information. This should be done before the brochure is disseminated to prime people to receive it, as well as after dissemination to help reinforce the contents of the brochure.

Fifth, people need multiple information sources to reinforce the risk information in the brochure. Seeing neighbors, friends, and relatives preparing for the earthquake risk is useful reinforcement. Consider visible demonstration projects in communities that are targets for earthquake predictions. These projects will help convince some members of the public to take action themselves.

Sixth, it is of paramount importance that the public's attention is captured, that people's interest is sparked, and that they begin considering doing something about the risk. They need to discuss the risk at local organizations, seek out additional information on their own, and talk with their friends and neighbors about it. This process permits them to gather information and form their own ideas about the level of risk and what they should do about it. They may need to feel that taking some protective action is their own idea, but information "ownership" takes time. Preparedness and mitigation action result from this process, not from merely receiving a mailed brochure.

Seventh, this being the case, position supplemental information in the local community for use during this process, such as coloring books, brochures, slide shcws, film strips, and additional advice on emergency plans and mitigation actions.

Finally, it might be better not to name earthquake predictions after towns (like Parkfield) because this limits the perception of risk in other towns distant from the place after which the prediction was named. And this limited risk perception constrains public mitigation and preparedness actions.

C. What We Still Need to Know

We do not now know how to persuade the public off the course of least resistance: (1) how can the public be persuaded to undertake more time-consuming preparedness and mitigation actions, and (2) how can the public be convinced to engage in more costly preparedness and mitigation actions.

Additionally, we do not know how to persuade a large proportion of people in communities that are targets of earthquake predictions to engage in any readiness activities at all.

Finally, our study was based on data gathered through the use of mail questionnaires that were only distributed in English, as was also the case with the brochure disseminated by the California Office of Emergency Services. Significant portions of the population which we sought to study may have been excluded. For example, people who cannot read and people who cannot read English were obviously excluded from our research. Our findings and recommendations may not be applicable to non-participants in the research. We can suspect that social processes similar to those revealed in our research may also characterize people who cannot read English, but we have no scientific basis for knowing if this suspicion is or is not true.

As we have more experience communicating earthquake risk information through scientifically credible earthquake predictions, and more research is accomplished on effective approaches, answers to these and other questions can be expected.

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APPENDIX

COVER LETTER AND QUESTIONNAIRE

Colorado State University

Hazards Assessment Laboratory
C240 Clark Building
Fort Collins, Colorado 80523
(303) 491-7347

Date

Dear [Paso Robles, Coalinga, Taft] Resident:

The National Science Foundation is sponsoring a study of public response to the Parkfield, California earthquake prediction. The Governor's Office of Emergency Services Southern California Earthquake Preparedness Project also endorses this study. Because earthquake prediction is a new technology, more needs to be known about whether and how to predict earthquakes. This study is a step in answering such questions.

Your household is one of the many households chosen to participate in this survey. Your participation is voluntary, but we hope you will help provide information. Because your household is part of a scientific sample of households in central California communities, it's important that you, rather than neighbors to other people, complete the enclosed questionnaire. We ask that the [head of your household] [spouse of the head of your household, if there is one] complete the questionnaire. [If there is no spouse, then the head of household should complete the questionnaire.]

Your responses will be completely anonymous and confidential. When you return your questionnaire in the enclosed postage paid envelope, we will have no way of knowing who you are. Because we will not know who has responded, you will receive follow-up reminder mailings, whether or not you have mailed in your questionnaire. If you have already sent in your questionnaire, and you receive a reminder, please simply ignore it.

If you have any comments about the study or the questionnaire, please write them on the back cover of the questionnaire. If you have questions about the study, please telephone the Hazards Assessment Laboratory at (303) 491-6043. One of the Laboratory staff will be happy to discuss the study with you.

If you would be interested in receiving a summary of our results, all you need to do is provide us with your name and address either when you return your questionnaire or by separate mailing.

Thank you very much for your consideration.

Sincerely,

Dennis S. Mileti, Ph.D.
Principal Investigator

Barbara C. Farhar, Ph.D.
Co-Principal Investigator

Attachment

BCF/dd

PARKFIELD EARTHQUAKE PREDICTION QUESTIONNAIRE

Study on Public Response to the Parkfield Earthquake Prediction

Return to:

Hazards Assessment Laboratory
Colorado State University
Fort Collins, CO 80523

April 1989

PARKFIELD EARTHQUAKE PREDICTION STUDY QUESTIONNAIRE

THE FIRST EIGHT QUESTIONS CONCERN ALL THE INFORMATION YOU MAY HAVE RECEIVED ABOUT THE PARKFIELD EARTHQUAKE PREDICTION FROM ALL SOURCES.

1. Have you ever heard about the Parkfield Earthquake Prediction? **[CIRCLE ONE]**

   1 Yes
   2 Don't know
   3 No **[PLEASE COMPLETE AND RETURN QUESTIONNAIRE EVEN IF YOU HAVEN'T HEARD. SKIP TO QUESTION 9 ON PAGE 4]**

2. Consider <u>all</u> the information you have received about the Parkfield earthquake prediction from <u>all</u> sources. Which of the following statements have you heard or seen? **[CIRCLE ALL THAT APPLY]**

   1 The earthquake may be about magnitude 6.
   2 This magnitude 6 earthquake has a 90% chance of happening.
   3 This magnitude 6 earthquake will not likely cause damage to buildings.
   4 This magnitude 6 earthquake will be felt in places like Paso Robles, Coalinga and Taft.

   5 Or, the earthquake may be about magnitude 7.
   6 This magnitude 7 earthquake has a 10% chance of happening.
   7 This magnitude 7 earthquake will likely cause damage to buildings.
   8 This magnitude 7 earthquake will affect places like Paso Robles, Coalinga and Taft.

   9 Regardless of the earthquake's size, it will happen by 1993.
   10 Earthquake scientists agree about the Parkfield earthquake prediction.

3. Has any of the information you have received or heard ever advised you to do any of the following things to get ready for the predicted earthquake? **[CIRCLE ALL THAT APPLY]**

1 Store food and water
2 Learn first aid
3 Have first aid kit available
4 Maintain emergency supply of needed medication
5 Develop family emergency plan
6 If indoors, stay indoors
7 Get under a table or desk, when the earthquake occurs
8 If outdoors, get to areas clear of anything that can fall on you
9 Have a flashlight handy
10 Have a portable radio available and use it when the earthquake occurs
11 Have heavy gloves and a crescent wrench handy
12 Turn off utilities after the earthquake
13 Hang up phone after the earthquake
14 Do not use the phone unless there is an injury
15 Learn how to prevent fires
16 Keep fire extinguisher handy
17 Move heavy objects off high shelves
18 Do not use vehicle unless for emergency
19 Anchor house to its foundation
20 Buy earthquake insurance
21 Strap down hot water heater
22 Protect dishes and glassware
23 Secure heavy furniture to walls
24 Learn where you can get more information about earthquake preparedness
25 Form neighborhood watch groups for earthquake preparedness
26 Study emergency plans at your work
27 Study your children's school emergency plans

4. Did any of the information you have received or heard about the Parkfield earthquake prediction state any of the following? **[CIRCLE ALL THAT APPLY.]**

1 The public may receive warning of a 72-hour period during which the earthquake could occur.

2 The 72-hour warning will come from local and state officials.

3 The warning will be announced over radio, television, and in newspapers.

4 A telephone hotline number will be provided to the public.

5 The warning will be followed by other information over radio, television, and in newspapers.

6 The warning will likely be cancelled within 72 hours if the earthquake does not happen.

7 Several 72-hour warnings may be issued.

5. Did everyone giving information say much the same things about the Parkfield earthquake prediction and what to do to get ready? **[CIRCLE ONE]**

    1 Yes, they said much the same things
    2 They were fairly consistent with each other
    3 Unsure
    4 They were fairly inconsistent with each other
    5 No, they said different things

6. Considering all the information you have received about the Parkfield earthquake prediction from all sources, how easy to understand has it been? **[CIRCLE ONE]**

    1 Very easy to understand
    2 Easy to understand
    3 Unsure/it varied
    4 Difficult to understand
    5 Very difficult to understand

7. We're interested in knowing <u>how</u> you heard about the Parkfield earthquake prediction. Here is a list of some possible sources from which you may have received information. **[CIRCLE ALL THAT APPLY]**

    1 Television
    2 Radio
    3 Newspapers
    4 Magazines
    5 Brochures
    6 Posters
    7 Meetings
    8 Comic books/coloring books
    9 Seminars, classes, workshops
    10 Reports
    11 Journal articles
    12 Exhibits, demonstrations
    13 Informal conversations
    14 Speeches, talks
    15 Telephone book
    16 Slide shows and films

8. We're interested in knowing <u>who</u> you heard from regarding the Parkfield earthquake prediction. Here is a list of some possible sources from which you may have gotten information. **[CIRCLE ALL THAT APPLY]**

1 City government
2 County government
3 State government
4 Federal government
5 Fire department
6 Hospital
7 Public school
8 Community college
9 Public library
10 Utility company
11 Telephone company
12 American Red Cross
13 Service clubs, associations
14 Media organizations (TV, radio, newspapers)
15 Local businesses
16 Friends, relatives, neighbors, acquaintances
17 Scientists

NOW HERE ARE A FEW MORE QUESTIONS ABOUT EARTHQUAKE INFORMATION IN GENERAL AND EARTHQUAKE PREDICTIONS.

9. If you were interested in knowing more, how would you most like to receive that information (for example, brochures mailed to your home, newspaper articles, others)?

____

____

____

10. From whom would you prefer to receive information about earthquakes and how to prepare for them (for example, public schools, local government, others)?

____

____

____

11. How easy to understand was the brochure about the Parkfield earthquake prediction sent to your home by the California Office of Emergency Services? **[CIRCLE ONE]**

   1 Very easy to understand
   2 Easy to understand
   3 Unsure
   4 Difficult to understand
   5 Very difficult to understand
   6 Didn't get one

12. What do you think have been the positive or negative consequences of having the Parkfield earthquake prediction?

____

____

____

13. Do you think scientists should continue to work on trying to predict earthquakes? **[CIRCLE ONE]**

   1 Yes
   2 Don't know
   3 No

Why do you feel this way? ____________________

____

____

NOW, HERE ARE A FEW QUESTIONS CONCERNING WHAT YOU BELIEVE ABOUT THE PREDICTED EARTHQUAKE AND EARTHQUAKE PREDICTION IN GENERAL.

14. About what magnitude do you think the predicted Parkfield earthquake will be when it happens? **[CIRCLE ONE]**

   1 Less than magnitude 4
   2 About magnitude 4
   3 About magnitude 5
   4 About magnitude 6
   5 About magnitude 7
   6 About magnitude 8
   7 Don't know
   8 I don't believe it will happen.

15. About how far away would you say your house is from the epicenter (or starting point) of the predicted earthquake?

   Number of miles: ______________

16. Following are some statements about future events you or your family might experience. Please check any item that you believe will occur. Please show this for both the predicted earthquake and for any other earthquake. **[CIRCLE ALL THAT APPLY IN BOTH COLUMNS.]**

The PREDICTED Parkfield earthquake	ANY other future earthquake	I believe that:
1	1	In my lifetime, I will personally experience an earthquake that causes me economic losses (for example, damage to my house).
2	2	In my lifetime, I will personally experience an earthquake that causes me or someone in my family physical harm.
3	3	In the next few years, I will personally experience an earthquake that causes me economic losses (for example, damage to my house).
4	4	In the next few years, I will personally experience an earthquake that causes me or someone in my family physical harm.
5	5	I don't believe any of these statements.

THE NEXT QUESTIONS CONCERN WHAT YOU MAY HAVE DONE TO PREPARE FOR EARTHQUAKES.

17. The following items concern attempts you may have made to get information since hearing about the Parkfield earthquake prediction. Please circle those things you have actually done. **[CIRCLE ALL THAT APPLY]**

1 Sought information about earthquake prediction/warnings from government organizations (for example, state, county, city agencies, and so on).

2 Sought information about earthquake prediction/warnings from non-government organizations (for example, Red Cross, schools, utilities, and so on).

3 Talked with other people about earthquake prediction/warnings.

4 Done nothing to seek information about earthquake prediction/warnings since hearing about the Parkfield earthquake prediction.

5 Have not heard of the Parkfield earthquake prediction.

18. The following items concern things people can do to prepare for earthquakes. Please circle those things you have done, both before and since the Parkfield earthquake prediction. **[CIRCLE ALL THAT APPLY IN BOTH COLUMNS]**

Did BEFORE I Heard About the Parkfield Earthquake Prediction	Did AFTER I Heard About the Parkfield Earthquake Prediction	
1	1	Sought information about what to do to get ready for earthquakes from government (for example, state, county, city agencies, and so on)
2	2	Sought information about what to do to get ready for earthquakes from non-government sources (for example, Red Cross, schools, utilities, and so on)
3	3	Talked with other people about what to do to get ready for earthquakes
4	4	Bought earthquake insurance
5	5	Cancelled or delayed large purchases
6	6	Cancelled or delayed investments
7	7	Saved more money
8	8	Rearranged household items so they would be safer from earthquakes (for example, moved dishes to a lower cupboard)
9	9	Did things to make my house more resistant to earthquake damage (for example, strapped down the hot water heater or anchored the house to its foundation)
10	10	Stockpiled emergency supplies (for example, water, food, flashlight or radio)
11	11	Developed a family emergency plan
12	12	Formed a neighborhood watch group for emergency response
13	13	Engaged in other community activities to get ready for earthquakes
14	14	Found out what to do when an earthquake happens or immediately thereafter (for example, getting under a table or how to turn off the gas)
15	15	Learned first aid
16	16	Did anything else *(please specify)* ______ ______

19. Do you know anyone (for example, friends, relatives or neighbors) who has done anything to get ready for the Parkfield earthquake (for example, made their home or possessions safer)? **[CIRCLE ONE]**

1 Yes
2 Don't know
3 No

20. Do you feel your household is adequately prepared for a damaging earthquake at this time? **[CIRCLE ONE]**

1 Yes
2 Don't know/unsure
3 No

21. Do you feel your community is adequately prepared for a damaging earthquake at this time? **[CIRCLE ONE]**

1 Yes
2 Don't know/unsure
3 No

THE NEXT SET OF QUESTIONS IS ABOUT EARTHQUAKES AND OTHER DISASTERS YOU MAY HAVE EXPERIENCED.

22. In reference to the 1966 Parkfield earthquake, please circle as many of the following items as apply to you: **[CIRCLE ALL THAT APPLY]**

1 I felt it
2 I had damage from it
3 I had friends/relatives with damage from it
4 I didn't experience it
5 Other *(please specify)* ____________________

____

____

23. In reference to the 1983 Coalinga earthquake, please circle as many of the following items as apply to you: **[CIRCLE ALL THAT APPLY]**

1 I felt it
2 I had damage from it
3 I had friends/relatives with damage from it
4 I didn't experience it
5 Other *(please specify)* ____________________

____

____

24. Excluding the 1983 Coalinga and 1966 Parkfield earthquakes, please answer the following questions about the <u>largest</u> earthquake you have ever experienced:

a. Have you experienced an earthquake besides the Coalinga and Parkfield earthquakes?

1 Yes **[ANSWER b, c, d AND e BELOW]**
2 No **[SKIP TO QUESTION 25]**

b. In what year did the earthquake occur? Year: ____________________

c. Did it cause damage? **[CIRCLE ONE]**

1 Yes
2 Don't know
3 No

d. Did it cause injuries? **[CIRCLE ONE]**

1 Yes
2 Don't know
3 No

e. Did it cause deaths? **[CIRCLE ONE]**

1 Yes
2 Don't know
3 No

25. Have you ever experienced any natural disasters other than earthquakes? Please provide the following information about the <u>largest</u> non-earthquake disaster you've ever experienced.

[CIRCLE ONE]	Year It Occurred	Damage [CIRCLE ONE] None	Some	A Lot
1 I have not experienced a non-earthquake natural disaster				
2 Hurricane	________	1	2	3
3 Tornado	________	1	2	3
4 Flood	________	1	2	3
5 Tsunami (tidal wave)	________	1	2	3
6 Landslide, mudslide	________	1	2	3
7 Avalanche	________	1	2	3
8 Volcanic eruption	________	1	2	3
9 Other *(please specify)* ____________________________	________	1	2	3

FOLLOWING ARE A FEW QUESTIONS ABOUT YOU AND YOUR HOUSEHOLD.

26. Are you **[CIRCLE ONE]**

    1 Male
    2 Female

27. Do you own or rent your place of residence? **[CIRCLE ONE]**

    1 Own
    2 Rent
    3 Other *(please specify)* ______________________________

    ____

28. Excluding yourself, how many people in your household are you responsible for?

    Number of people: ____________

29. Besides your own household, how many of your family members or relatives live in your community?

    Number of family members/relatives: ____________

30. In how many local organizations do you regularly participate (for example, church, youth, and senior citizen groups)?

    Number of organizations: ____________

31. How many years have you lived in your community?

    Number of years: ____________

32. Please circle which one of the following categories **most nearly** describes the kind of work the chief wage earner in your immediate family does. **[IF CHIEF WAGE EARNER IS UNEMPLOYED, CIRCLE WHAT TYPE OF WORK HE/SHE WOULD DO IF EMPLOYED] [CIRCLE ONE]**

1 Professional worker
2 Skilled trade or craft worker
3 Semi-skilled worker
4 Manager, executive, or official
5 Runs own business with one or more employees
6 Farm owner, farm manager
7 Clerical or office worker
8 Sales worker
9 Manufacturer's representative
10 Service worker
11 Laboring worker (other than farm)
12 Farm laborer, farm helper, or farm foreman
13 Retired
14 Full-time student
15 Housewife
16 Other *(please specify in detail)* ______________________________

____

33. What is the highest level of education you have completed? **[CIRCLE ONE AND FILL IN BLANK IF APPROPRIATE]**

1 Some grammar school (completed ______ years)
2 Grammar school graduate
3 Some junior high (completed _______ junior high years)
4 Junior high graduate
5 Some high school (completed _______ high school years)
6 High school graduate
7 Some trade/technical school (completed ______ trade school years)
8 Trade/technical school graduate
9 Some college (completed ______ college years)
10 College graduate
11 Some graduate school (completed ______ graduate school years)
12 Completed Master's degree
13 Completed doctorate degree

34. Which of the following best describes your racial or ethnic identification? **[CIRCLE ONE]**

1 American Indian or Alaskan Native
2 Asian or Pacific Islander
3 Black, not of Hispanic origin
4 Hispanic
5 White, not of Hispanic origin
6 Other *(please specify)* ______________________________

____

35. What is your age?

Number of years of age: ____________________

36. What is the total annual gross income of all members of your household?

$ ________________ per year

FOLLOWING IS A QUESTION ABOUT BELIEFS SOME PEOPLE HAVE.

37. Do you believe that psychics or fortune tellers can predict earthquakes? **[CIRCLE ONE]**

1 Yes
2 Don't know
3 No

38. Do you believe that scientists can predict earthquakes? **[CIRCLE ONE]**

1 Yes
2 Don't know
3 No

THANK YOU VERY MUCH FOR PARTICIPATING IN THIS SURVEY!

JUST PUT THE COMPLETED QUESTIONNAIRE IN THE POSTAGE PAID RETURN ENVELOPE AND DROP IN THE MAIL.