Exploring the “Cry Wolf” Hypothesis*

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The “cry wolf” hypothesis argues that individuals who have experienced predictions of disasters that do not materialize will discount the validity of subsequent disaster warnings. This belief in the false alarm effect is widely mentioned in the disaster literature, and anecdotal material appears to support the validity of the hypothesis. This study of a false earthquake warning supports experimental findings indicating that cancellation of a disaster warning leads to a false alarm effect. Following cancellation of the threat by the nonappearance of the predicted earthquake, 46.7 percent of the panel respondents indicated that they would pay less attention whereas only 16.7 percent said that they would pay more attention to a future earthquake prediction. The panel data also suggest that the mass media were substantial contributors to the observed false alarm effect, while at the same time the media escaped blame for their contribution to the problem.

Officials responsible for issuing warnings about threats to public safety face a dilemma if the warning results in a false alarm, critics maintain that the public will pay less attention to future warnings (Economist 1997, July 1998). A decline in attention to disaster warnings following a false alarm has been labeled the “cry wolf” or false alarm effect. Field research support for the “cry wolf” hypothesis is limited; however, there is evidence, including casualties, to establish that at least some people do not believe warnings that are issued, or they may feel invulnerable and choose to ignore a serious threat (Berkelson and Steiner 1964).

An earthquake prediction issued by Iben Browning, a New Mexico business consultant and self-taught climatologist with a doctorate in physiology,

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provided the opportunity to explore the "cry wolf" hypothesis with a panel survey (N = 290) that assessed the correlates of the perceived importance of a seismic threat following a false alarm. At a meeting of the Missouri Governor's Conference on Agriculture in Osage Beach, Missouri, on December 12, 1989, Browning claimed that a "tidally triggered [Richter] magnitude 6.5-7.5 earthquake will occur in the New Madrid region of the Central United States on December 2-3, 1990, plus or minus 2 days." (Davis 1990).

The center of the New Madrid Seismic Zone (NMSZ) fault is located near western Tennessee, northeastern Arkansas, and southeastern Missouri. In 1983, the Center for Earthquake Research and Information at Memphis State University issued a report assessing the technical probabilities of a NMSZ earthquake as an 86-97 percent chance for a magnitude 6.3 earthquake within 50 years (Johnston and Nasa 1985). Although Browning's forecast had been reported in the news media since late 1989, it was not until October 18, 1990, that an Ad Hoc Working Group from the National Earthquake Prediction Evaluation Council (NEPEC) announced that the prediction had no scientific basis. Despite the NEPEC report, the Southeast Missourian, a local newspaper where the opinion surveys reported in this study were conducted, published news stories about the prediction after the mid-October report (Gao 1991). Government officials were concerned that the increased awareness resulting from the Browning prediction may have resulted in a loss of credibility for scientific and governmental information sources (Gori 1993).

The False Alarm Effect

Theoretically, false alarms should result in a loss of credibility for the hazard warning system, which should result in the public ignoring or paying less attention to subsequent warnings (Baker 1993; Davenport 1993; Levy and Salvadori 1995; Mileri and Fitzpatrick 1993; Mutch 1993; Stallings 1995; Turner et al. 1986). Experimental data suggest that every cancellation of a disaster warning produces a false alarm effect (Brezin 1984). Moreover, the more sensitive the warning system is for detecting potential threats (e.g., weather radar), the greater the likelihood of a false alarm (Brezin 1984; Poltrev 1993). Survey research has found evidence of a false alarm effect as well as a heightened concern for a future disaster (Killion 1954; Witzel et al. 1991).

Indirect evidence for a potential false alarm effect is suggested in a longitudinal analysis of earthquake warnings in California (Turner et al. 1986). Turner and his colleagues asked respondents if they recalled earthquake predictions for the Los Angeles area that either had been canceled or in which a predicted earthquake had failed to occur. Two years after two false alarms, 27
percent of the respondents recalled that a prediction had been withdrawn and 43 percent recalled that a predicted earthquake had not occurred.

Experiments assessing the false alarm effect hypothesis have found that subjects who are the most afraid before a disaster prediction is canceled are: (1) the least likely to pay attention to future warnings; (2) the most likely to downgrade the credibility of the warning system; and (3) the most resistant to taking protective action in future situations (Brezin 1984). These reactions may result from loss of face, the feeling of being foolish for believing the prediction, and believing that earlier actions, emotional and behavioral, were wasted (Brezin 1984).

The dissemination of disaster warnings by officials, the news media, and the public is a critical link in the chain of events from the detection of a threat to public response. If the public is informed about the reasons for a failed prediction, the effectiveness of future warnings is not necessarily diminished and may even be enhanced when "blame" for the false alarm is placed on circumstances or individuals outside of the official warning system (Brezin 1984; Milet and Fitzpatrick 1993). However, post-cancellation explanations by officials suffer serious limitations if it is assumed that by distribution of the explanation through the news media (1) the explanation will reach the same audience that heard the warning and/or its cancellation, and (2) the audience will understand and accept the explanation (Baker 1993; Ledingham and Masel Wathers 1985; Lindell and Perry 1993; Tom et al. 1990).

Milet and Fitzpatrick (1993) reported that some people who recently had experienced an earthquake were more likely to perceive greater risk regardless of the source of the new warning and that, when false predictions are explained by officials, false alarms can heighten public awareness and response to subsequent predictions. Clearly, some people who have had a warning reinforced by the event itself are likely to pay attention to a subsequent warning (Hudson 1954), and a positive event such as the cancellation of an earthquake warning could mobilize public attention to a chronic threat (Taylor 1993). However, in either case, the mobilization might be short-lived. For example, Burger and Palmer (1992) found that the mobilization effect they observed immediately after the October 17, 1989, California earthquake had dissipated after three months, and their respondents then exhibited an increase in unrealistic optimism, a condition that strongly resembles the false alarm effect.

Research conducted prior to the Browning prediction had assessed the awareness of the earthquake risk among residents of the NMSZ. In a 1983 study, Nigg (1987) found that 39 percent of the respondents were concerned about a possible earthquake. The opinion surveys reported here were among several independent surveys conducted to examine the Browning prediction. In a panel mail
survey of four communities in the NMSZ, Showalter (1993) reported that her respondents' concern about the possibility of an earthquake did not decline from November 1990 to May 1991 following the prediction's cancellation. In October 1990 and February 1991 surveys, wherein 69.7 percent of the second-wave interviews were conducted with the same respondents, Farley, Barlow, Finkelstein, and Riley (1993) found that the Browning prediction resulted in higher levels of preparedness after the prediction was cancelled.

Although there is some risk in drawing too close an analogy between experimental conditions and a real-time disaster prediction, contrary to the opinion surveys (Showalter 1993; Farley et al. 1993) of the Browning prediction, Breznitz's (1984) experimental evidence supports decreased levels of concern following a false alarm. One important difference that may lead to differences in outcomes between the findings of the present study and Breznitz's experiments is that Breznitz (1984) used an unambiguous warning whereas the Browning prediction was ambiguous (i.e., a 50-50 chance of an earthquake). Furthermore, "real" damage is unlikely to occur in an experiment, and it is unlikely that subjects would believe they might be injured (Cohen 1985; Thompson et al. 1993). If the earthquake forecast were true, hundreds of millions of dollars in property damage and substantial loss of life might result.

To examine Breznitz's experimental findings with tests using public opinion data collected before and after the cancellation of the Browning prediction, the following hypotheses are proposed. Based on past studies underscoring that following a false alarm, people are likely to ignore subsequent disaster warnings (i.e., a false alarm effect), it is hypothesized that:

H1. Following the cancellation of the Browning prediction, respondents' judgments of the importance of the potential earthquake threat in the NMSZ will decrease.

In the November 1990 and February 1991 surveys, the importance of the earthquake problem was measured by the question, "How important is the earthquake problem to you personally? Is it (4) very important, (3) somewhat important, (2) not very important, or (1) not at all important?" The measure of change in problem importance used to test hypotheses 2b, 3b, and 10b proposed in this study (below) was created by subtracting the November score from the February score. A negative score indicated a decrease in perceived importance (i.e., the false alarm effect), and a positive score indicated a heightened concern for the problem (i.e., the mobilization effect).

Breznitz's (1984) experimental evidence suggests that people who initially have the greatest fear of the threat are more likely than are others to report a false alarm effect. Therefore, it is hypothesized that:
H1: The respondents' initial belief in the prediction will be correlated negatively with their post-threat cancellation report of (a) paying attention to a future warning and (b) the change in their reports of how important the chronic earthquake problem is to them.

Respondents' initial beliefs in the prediction (i.e., in the November survey) were measured by the question, "How believable do you think the prediction of a major earthquake on December 3 really is? It is (4) very believable, (3) somewhat believable, (2) not very believable, or (1) not believable at all?" Future attention to earthquake warnings (a single item asked in February) was measured with the question, "If we were to have another earthquake prediction next fall, how much attention do you think you would pay to it? Would you pay (1) a lot less attention, (2) a little less attention, (3) about the same as last fall, (4) a little more attention, (5) a lot more attention."

Brehm (1984) reported that fear leads to thinking about the threat. If that is the case, then thinking about the threat prior to its cancellation should result in a false alarm effect.

H2: Thinking about the earthquake problem prior to the threat's cancellation will be associated negatively with respondents' post-threat cancellation report of (a) their likelihood of paying attention to a future warning and (b) the change in their reports of how important the chronic earthquake problem is to them.

Thinking about the problem (a single item asked in November and February) was measured by asking the respondent, "How often do you stop to think about a major earthquake hitting the Cape Girardeau area? Do you think about it (4) very often, (3) sometimes, (2) not very often, or (1) almost never?"

Cognitive reappraisal of the situation following the cancellation of the earthquake threat should lead to a reduction in thinking about the problem among respondents.

H3: Following the cancellation of the earthquake threat, thinking about the earthquake problem will decrease.

Information Seeking About the Threat

Findings reported by Tversky et al. (1986) and Miele and Fitzpatrick (1993) suggest that at some point in the life of an impending threat, the volume and tone of warning-related news media content and discussions will trigger sufficient public concern so that people begin seeking information about the threat. Although emergencies usually are characterized by an information surplus (Lombardi, 1993), there are no guarantees about the quality of information.
One problem with news as a source of disaster information is that what is important to scientists in providing timely and accurate public warnings often is of little importance to the news media (De Marchi 1993; Quarantelli 1989, 1993; Short 1984). News structure also contributes to the ambiguity of already uncertain situations and may either increase or reduce risk perceptions depending on the way the news stories are constructed (Gibson and Zillman 1993, 1994; Honig et al. 1991; Johnson-Cartee et al. 1993; Lipari 1996). In the fall of 1990, the ambiguity of the news reports about the prediction resulted in news reports noting that, although Browning’s forecast was not scientific, the reader was living in an active seismic zone, and “some day” there would be a major earthquake. Furthermore, newspaper advertising touting everything from flashlight batteries to shotguns clearly was designed to increase the perceived risk of the situation for the commercial gain of area retailers.

Although the news media are a primary source of information about disasters, this information is interpreted and evaluated in informal interpersonal channels (Coleman 1993; Milet and Fitzpatrick 1993; Quarantelli 1989; Robinson and Levy 1986; Slovic 1986). The literature on social comparisons and social support also suggests that when people are in ambiguous or fear-arousing conditions they seek company in their efforts to interpret the situation (Baum et al. 1983; Cohen 1985; Fleming et al. 1982, Taylor 1991). Discussions serve not only as sources of information but also as important sources of potential influence on how a threat is interpreted as participants adopt, reject, and revise views expressed by others who may or may not be better informed. In addition, some people seek information from government officials and others who hold formal, institutional positions. Although differences in willingness to attend to information also affect responses to threats, having help in evaluating problems and developing solutions is an effective way of coping with stress.

Following the prediction’s cancellation, it seems logical that respondents’ confidence in the news media would decrease. Breznitz (1984) reported that, following false alarms, subjects downgraded external information sources like the news media. Based on Breznitz’ work, it is therefore hypothesized that:

H1. Respondents’ judgments of the (a) confidence they had in and (b) perceived influence of earthquake-related messages in the news media will decrease significantly from November to February following the prediction’s cancellation.

Confidence in information from the news media was measured by an index created from the following three items (Cronbach’s α = .77): “How much confidence do you have in the information you have been getting about earthquakes from (newspapers/television/radio)? Do you have (4) a great deal of
confidence, (3) some confidence, (2) not much, or (1) none at all?” The questions were asked in November and February. The index measuring perceived news media influence was created from the following three items (Cronbach’s \( \alpha = .78 \)): “How much do you think (newspaper/television/radio) news has influenced your opinion about how important the earthquake is? Has the news had (6) a lot of influence, (3) some influence, (2) not much influence, or (1) none at all?” These questions were asked in November and February.

Despite the fact that most of the information discussed in conversations would have been obtained from the news media, evaluations of interpersonal sources of information would not be expected to decrease following the cancellation of the threat because studies have found that communicating about the threat is a coping mechanism (Baum et al. 1983; Cohen 1985; Fleming et al. 1982; Taylor 1991). Therefore, it is hypothesized that:

H1. Respondents' judgments of their (a) confidence in and (b) the perceived influence of earthquake-related discussions will not decrease significantly from November to February.

The index reflecting respondents' confidence in information from other people was created from the following three items (Cronbach’s \( \alpha = .78 \)): “How much confidence do you have in the information you have been getting about earthquakes from (family/friends/neighbors)? Do you have (6) a great deal of confidence, (3) some confidence, (2) not much, or (1) none at all?” These questions were asked in November and February. The perceived influence of discussions with other people was measured by an index created from the following three items (Cronbach’s \( \alpha = .89 \)): “Do you think what you talked about with (family/friends/neighbors) has had any influence on how important you think the earthquake problem is? Do you think those talks have had (6) a lot of influence, (3) some influence, (2) not much influence, or (1) no influence at all?” These questions were asked in November and February.

An additional test of the relationship between the false alarm effect and the evaluation of information sources involves a retrospective judgment of the perceived helpfulness of information received from the news media and earthquake experts. If the false alarm did cast doubt on the value of such information, there should be positive associations between post-threat cancellation evaluations of information from the media and from experts and evaluations of problem importance.

H2. Following the prediction's cancellation, there will be a positive association between respondents' evaluations of the helpfulness of earthquake-related information from the news media and their (a) estimates of the likelihood of paying attention to a future warning and (b) their February evaluations of the importance of the earthquake problem.
The index measuring the helpfulness of information from the news media (Cronbach's $\alpha = .82$) was created from the following three items: "How helpful would you say that information from (newspaper/television/radio) was in helping you prepare for the predicted earthquake? Would you say it was (4) very helpful, (3) somewhat helpful, (2) not very helpful, or (1) not helpful at all?"

H$_5$: Following the threat's cancellation, there will be a positive association between respondents' evaluations of the helpfulness of earthquake-related information from experts and their (a) likelihood of paying attention to a future warning and (b) their February evaluations of the importance of the earthquake problem.

The helpfulness of information from earthquake experts was created from the following two items (Cronbach's $\alpha = .64$): "How helpful would you say that information from (university experts/government officials) was in helping you prepare for the predicted earthquake? Would you say it was (4) very helpful, (3) somewhat helpful, (2) not very helpful, or (1) not helpful at all?"

The helpfulness measures were asked only in February.

Experts cited by the news media constituted the primary source of information contradicting the threatening prediction. If the public recognized this situation, then it would be expected that

H$_6$: Respondents' confidence in the information from experts will increase from November to February.

The confidence in official sources was measured by the following item asked in November and February: "How much confidence do you have in the information you have been getting from government officials about earthquakes? Do you have (4) a great deal of confidence, (3) some confidence, (2) not much confidence, or (1) none at all?"

**Protective Behavior**

Perception of whether a situation is alterable normally influences how individuals cope with that situation (Folkman 1984; Hallman and Wandersman 1992; Lehman and Taylor 1987). Protective behavior typically occurs where the situation or its consequences are perceived to be controllable (Brezinich 1984; Fiske and Taylor 1991; Hallman and Wandersman 1992; Russell et al. 1995; Schaefer et al. 1986). Protective behavior may involve physical action and/or the belief that something can be done to reduce the consequences of a threat. Both perception of control and physical preparation can reduce psychological stress (Cohen 1985; Fiske and Taylor 1991; Schaefer et al. 1986; Thompson et al. 1993). Protective behavior includes an
individual’s expectations about his or her ability to minimize the consequences of an earthquake as well as behaviors including reinforcing buildings, securing objects to walls, and, more likely, purchasing flashlight batteries and bottled water.

Perception of threat generally is believed to lead to attempts to establish some form of control over the situation. However, Lehman and Taylor (1987) reported that neither their respondents who lived in housing with poor earthquake resistance nor those in housing with good resistance prepared for a likely earthquake. Other studies have demonstrated that information campaigns can increase the proportion of people who make efforts to reduce the negative consequences of an earthquake (Mileti and Fitzpatrick 1983; Mileti et al. 1993; Mullins and Lippa 1990). However, the strength of the relationship between information campaigns and adoption of protective behavior declines over time (Turner et al. 1986; Mullins and Lippa 1990).

In experimental studies, protective behavior has not been found to be related to reporting a false alarm effect; however, following the cancellation of a threat, protective behaviors have been found to decrease (Bresnahan 1984; Fiske and Taylor 1991; Haltman and Wandersman 1992; Russell et al. 1993; Scheier et al. 1986) although increases in protective behavior have been reported (Farley et al. 1993). Based on these findings, it is hypothesized that:

H₀: Protective behavior reported before the prediction’s cancellation will not be related to (a) a change in respondents’ perceived importance of the earthquake problem or (b) their estimated likelihood of paying attention to a future warning.

H₁: Following the prediction’s cancellation, there will be a decrease in protective behavior.

Protective behavior was measured by an index created from the following three items (Cronbach’s α = .58): “If you personally tried to do something to help protect yourself and your family from a major earthquake, do you think your efforts would make (4) a lot of difference, (3) some difference, (2) not much difference, or (1) no difference at all?”; “How prepared do you feel you are in the event of a major earthquake? Are you (4) very well prepared, (3) somewhat prepared, (2) not very well prepared, or (1) not at all prepared?”; “Some people are trying to make their homes safer even if it might not make much difference. Is there anything you have done that might make your home safer if there were a major earthquake?” The open-ended responses were content coded and then dichotomized into (1) no and (2) yes. The questions were asked in November and February.
Research Question

The preceding hypotheses test mean differences or associations between variables for the entire panel. Although several theoretical and pragmatic bases for the false alarm effect have been explored, the literature does not address the question of how the variables tested above differentiate among respondents who increased, decreased, or did not change their evaluations of the earthquake problem’s importance after the threat’s cancellation. In particular, what kind of coping behavior identifies those respondents who decreased their estimate of problem importance following the cancellation of the threat? To explore the overall relationships among the variables tested above and the three groups of respondents, a multiple discriminant analysis was conducted using the response groups as the dependent variable. To create three mutually exclusive groups, respondents whose November problem importance score was smaller than their February score were defined as members of the mobilization group (score = 3). Those whose November score was larger than their February score were defined as the false alarm group (score = 1). Members of the no-change group were those whose November and February scores were the same (score = 2).

Methods

Data were collected during the first week in November 1990 and the third week in February 1991 from residents of Cape Girardeau, Jackson, and Sikeston in southeastern Missouri. The first-wave sample was selected using random-digit dialing, which generated 763 working contacts; 629 (82.5 percent) interviews were completed, of which a smaller subset of 480 (76.3 percent of the 629) agreed to participate in a second interview. Second interviews were completed with only 280 or 60 percent of those 480 (46 percent of the original 629). The reasons for the loss of the 130 respondents from the panel were primarily refusal to participate in the second interview or a telephone number no longer in service. Analysis of the panel’s demographic characteristics shows that they did not differ appreciably from the overall November sample. The panel sample included 55.9 percent women and 44.1 percent men. Nine percent of the respondents had not completed high school, 46.3 percent had completed high school, 20.0 percent had completed some college, 17.5 percent had completed college, and 7.0 percent had completed some graduate education. Over one-fourth (26.7 percent) of the respondents were between 18 and 29 years of age, 26.0 percent were between 30 and 39, 14.6 percent were between 40 and 49 years of age, 14.9 percent were between 50 and 59 years of age, and 17.8 percent were 60 or older.
To generate the sample of telephone numbers, the local telephone directory was sampled to provide proportions of prefix numbers in the local exchanges and the proportions of the first digit in the last four digits of each number. This procedure eliminated generating numbers in blocks that were not in use in the local exchanges. A FORTRAN computer program generated telephone numbers that were proportional to those in each exchange and to the first digit in the final set of four digits. The final three digits were random numbers. All interviews were conducted by undergraduate students in the Department of Mass Communication at Southeast Missouri State University. They were monitored by graduate students in research methods classes at Southern Illinois University at Carbondale. Faculty members from both institutions supervised all interviewing sessions.

Findings

Overall Patterns of Change

Changes in evaluation of the importance of the earthquake problem from the warning's pre-cancellation (November 1980) to post-cancellation period (February 1981) are shown in Table 1. Values on the principal diagonal in the table represent no change in perceived importance of the problem from November to February. Values above the diagonal indicate increased problem importance over time, whereas values below the diagonal indicate a decline in perceived importance of the problem. The proportion of respondents who evaluated the problem as not at all important or not very important increased from 25.2 percent in November to 35.5 percent in February; the proportion who rated the problem as very important or somewhat important declined from 74.8 percent in November to 64.5 percent in February. Although 164 of the 262 respondents (62.6 percent) changed their assessment of the problem, there was a net loss of only 27 judgments (10.3 percent) that the problem remained “important”: 53 respondents reduced their evaluations of problem importance from one of the two “important” categories to one of the two “not important” classifications whereas 26 respondents increased their evaluations from one of the “not important” to one of the “important” categories.

Tests of the Hypotheses

Hypothesis 1 specified that, following the threat's cancellation, there would be a significant decrease in the perceived importance of the long-term earthquake threat in the area; the hypothesis is supported (see Table 2). The mean importance score was 3.06 in November and 2.69 in February ($t = -6.02, df = 262, p < .001$).
Table 1. Changes in Perceived Importance of the Earthquake Problem From November 1990 to February 1991*

<table>
<thead>
<tr>
<th>November</th>
<th>Not At All Impt.</th>
<th>Not Very Impt.</th>
<th>Some-what Impt.</th>
<th>Very Impt.</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not at all important</td>
<td>n 6</td>
<td>6</td>
<td>2</td>
<td>2</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>% 37.5</td>
<td>37.5</td>
<td>12.5</td>
<td>12.5</td>
<td>6.1</td>
</tr>
<tr>
<td>Not very important</td>
<td>n 10</td>
<td>18</td>
<td>18</td>
<td>4</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td>% 20.0</td>
<td>36.0</td>
<td>36.0</td>
<td>8.0</td>
<td>19.1</td>
</tr>
<tr>
<td>Somewhat important</td>
<td>n 7</td>
<td>25</td>
<td>53</td>
<td>12</td>
<td>97</td>
</tr>
<tr>
<td></td>
<td>% 7.2</td>
<td>25.8</td>
<td>54.6</td>
<td>12.4</td>
<td>37.0</td>
</tr>
<tr>
<td>Very important</td>
<td>n 5</td>
<td>16</td>
<td>57</td>
<td>21</td>
<td>99</td>
</tr>
<tr>
<td></td>
<td>% 5.1</td>
<td>16.2</td>
<td>57.6</td>
<td>21.2</td>
<td>37.8</td>
</tr>
</tbody>
</table>

Total | n 28 | 65 | 130 | 39 | 262 |
| | % 10.7 | 24.8 | 49.6 | 14.9 | 100.0 |

$^*$Values on the principal diagonal represent no change in perceived importance of the earthquake problem from November to February. Values above diagonal indicate increased importance over time, while values below the diagonal indicate a decline in perceived importance of the earthquake problem.

N = 262, $\chi^2 = 38.2, p < .0001$; Contingency coefficient = 0.36.

Hypothesis 2 specified that there would be a significant negative correlation between the respondents' initial belief in the prediction and post-cancellation (a) likelihood of paying attention to a future warning and (b) the change in their reported assessment of the importance of the earthquake problem. The correlation between belief in the prediction and post-cancellation attention was significant and positive ($r = .12, df = 286, p = .024$). In the case of hypothesis 2a, a false alarm effect was not supported. The correlation between belief and post-cancellation change in the importance of the problem is significant.
and negative (r = .25, df = 286, p < .001). Hypothesis 2b is supported and supports the false alarm effect.

Table 2. Group Centroids Showing Relationships Between Each Group and the Two Obtained Discriminant Functions*

<table>
<thead>
<tr>
<th>Problem Importance Group</th>
<th>Function 1</th>
<th>Function 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>False alarm group (decrease concern)</td>
<td>.50</td>
<td>-.15</td>
</tr>
<tr>
<td>No change group</td>
<td>-.21</td>
<td>.39</td>
</tr>
<tr>
<td>Mobilizers (increased concern)</td>
<td>-.90</td>
<td>-.41</td>
</tr>
</tbody>
</table>

*Underscored groups in each column are those differentiated in Table 3.

Hypothesis 3 proposed that thinking about the earthquake problem prior to the threat’s cancellation would be associated negatively with (a) attending to a future warning and (b) a change in the perceived importance of the problem. The correlation between thinking and attention to a future warning is not significant (r = .09, df = 286, p = .061); thus, hypothesis 3a is not supported. However, the correlation between thinking about the earthquake threat and the change in the perceived importance of the earthquake problem was significant and negative (r = -24, df = 286, p < .001) and supports the false alarm effect.

Hypothesis 4 specified that following the cancellation of the warning, the amount of time respondents devoted to thinking about the earthquake problem would decrease. The mean score for thinking about the problem in November was 2.87 compared with 2.26 in February (t = -10.32, df = 286, p < .001). Hypothesis 4 is supported.

Hypothesis 5 specified that, following the prediction’s cancellation, respondents’ judgments of the (a) confidence they had in the news coverage about earthquakes and (b) the influence of the news media on their perceptions of the importance of the earthquake threat would decrease. Contrary to expectations, there was no difference in the mean confidence scores of the news media from November (X = 8.54) to February (X = 8.45); t = 0.56, df = 278, p = .288, and there was a significant increase in the mean influence score of the news media from November (8.08) to February (8.57); t = 2.71, df = 281, p = .004. Hypotheses 5a and 5b were not supported.

Hypothesis 6 specified that respondents’ judgments of their (a) confidence in and (b) perceived influence of earthquake-related discussions would not
decrease following the prediction’s cancellation. There was no significant difference between the mean November and February scores for either confidence in (X = 7.84 and 7.65 respectively; t = -1.08, df = 260, p = .141) or influence (X = 7.82 and 8.09 respectively; t = 1.59, df = 271, p = .057) of discussions. Hypothesis 6 is supported.

Following the prediction’s cancellation, respondents’ evaluations of the helpfulness of earthquake-related information from the news media is correlated positively with paying attention to a future earthquake warning (r = .14, df = 274, p = .013). Hypothesis 7a is supported. For Hypotheses 7b and 8b, only the earthquake problem importance question in February was used. However, respondents’ evaluations of the helpfulness of the information from the news media are unrelated to their February evaluations of the earthquake problem’s importance (r = .09, df = 249, p = .074); thus, Hypothesis 7b is not supported.

Hypothesis 8 states that associations between respondents’ estimates of the helpfulness of the earthquake information obtained from experts and their likelihood of paying attention to a future warning (r = .26, df = 281, p < .001) and their February estimate of the importance of the earthquake problem in the NMSZ (r = .19, df = 255, p < .001) are significant and positive. Hypothesis 8 is supported.

Hypothesis 9 specified that, following the prediction’s cancellation, respondents’ confidence in earthquake information from experts would increase. The mean November score was 2.28; the February score was 2.56 (t = 3.51, df = 279, p < .001). Hypothesis 9 is supported.

Hypothesis 10 specifies that protective behavior carried out before the cancellation of the warning would not be related to the false alarm, and Hypothesis 11 specified that protective behavior would decrease following the threat’s cancellation. Both hypotheses are supported. The correlations between the November protective behavior measure and (10a) attending to a future warning (r = -.09, df = 285, p = .494) and (10b) (quake change) the importance of the problem (r = .07, df = 258, p = .118) were not significant. For Hypothesis 11, the mean protective behavior score decreased from 6.79 in November to 6.32 in February (t = 4.70, df = 276, p < .001).

Correlates of Post-Cancellation Threat Assessment

The discriminant analysis was conducted to explore in a single model how the variables tested individually above distinguish among the three groups that had made different post-cancellation assessments of the earthquake problem’s importance. There were no significant differences among the groups in terms of age, gender, educational status, or occupational status, so demographic variables were not included in the analysis (see also Miley 1993).
Two significant discriminant functions were isolated in the analysis (Table 3). Function 1 separated the false alarm group (positive association with the function; \( n = 102; 46.1\) percent) from the mobilization group (negative association with the function; \( n = 38; 17.2\) percent) and accounted for 74.2 percent of the variance (\( \lambda = .71; \chi^2 = 71.6, \text{df} = 22, p < .0001 \)). Function 2 differentiated between the mobilization group, which was associated negatively with the function and the no-change group (positive association; \( n = 81; 36.7\) percent; \( \lambda = .91; \chi^2 = 19.6, \text{df} = 10, p < .05 \)).

Table 3. Mean Scores for Perceived Importance of the
Earthquake Problem

<table>
<thead>
<tr>
<th>Problem Importance</th>
<th>n</th>
<th>November</th>
<th>February</th>
<th>t</th>
<th>p &lt; tbf</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less important</td>
<td>120</td>
<td>3.57</td>
<td>2.29</td>
<td>13.95</td>
<td>.0001</td>
</tr>
<tr>
<td>(False alarm)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No change</td>
<td>98</td>
<td>2.91</td>
<td>2.91</td>
<td>---</td>
<td>n.s.</td>
</tr>
<tr>
<td>More important</td>
<td>44</td>
<td>2.05</td>
<td>3.27</td>
<td>-8.08</td>
<td>.001</td>
</tr>
<tr>
<td>(Risk mobilizers)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>262</td>
<td>3.06</td>
<td>2.69</td>
<td>6.02</td>
<td>.001</td>
</tr>
</tbody>
</table>

*The three group means within each month are significantly different at the .05 level by the Scheffé test.

One November variable, the perceived influence of discussions and one February variable, the perceived helpfulness of information from the media, did not have correlations of an absolute value of \( \pm .30 \) with either function. They were excluded from the interpretation.

The false alarm group scored higher on belief in the prediction, thinking about the problem, and perceived news media influence than did the mobilization group. In contrast, the false alarm group, relative to the mobilization group, reported that the information from experts was not very helpful and
that they would pay less attention to a future warning. These associations support the false alarm hypothesis. Neither group clearly identified with information use as a means of reducing stress. It appears that the false alarm respondents manage the pre-cancellation situation primarily by thinking about the warning and accepting news media interpretations of the situation, whereas in the post-cancellation period they reject the idea that information from experts had been helpful to them.

### Table 4. Correlations* Between Independent Variables and Observed Discriminant Functions

<table>
<thead>
<tr>
<th>Independent Variables</th>
<th>Function 1</th>
<th>Function 2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

*Function 1: False alarm effect (+); Risk mobilizers (-)
*Function 2: No change group (+); Risk mobilizers (-)

- Belief in the earthquake prediction*: 0.48, 0.11
- Thinking about earthquake problem*: 0.46, 0.35
- Pay attention to future earthquake warnings*: -0.41, 0.08
- Perceived influence of information from other people*: 0.18, 0.18
- Confidence in information in news stories about earthquakes*: 0.06, 0.22
- Preparations and belief in ability to mitigate consequences*: 0.21, 0.54
- Confidence in information about the prediction from other people*: 0.25, 0.46
- Perceived influence of news media*: 0.34, 0.43
- Information from experts was helpful*: -0.35, 0.35
- Confidence in information about the prediction from experts*: 0.07, 0.31
- Information from news media was helpful*: -0.22, 0.23

*Correlations of ≥ 0.30 or greater are included in the interpretation.

*Respondents who, over time, reported the earthquake problem became less important have a positive association and those who reported that the problem became more important have a negative association with Function 1. Respondents who did not change their evaluation of the problem have a positive association and those who reported the problem became more important have a negative association with Function 2.

*From data collected in November 1990.

*From data collected in February 1991.
All news media use and protective behavior variables have positive associations with Function 2 as do the respondents who did not change their evaluations of the earthquake problem from November to February. The mobilization group was associated negatively with Function 2 suggesting that, to a greater extent than the no-change group, the former group tended to ignore information about the situation prior to the threat’s cancellation. Following the threat’s cancellation, the mobilization group reported that the information from experts had not been very helpful. These outcomes indicate that members of the no-change group, to a greater extent than those of the mobilization group, utilized both protective behavior and information as ways of reducing the stress of the threat.

A post hoc analysis (Table 2) indicates that, for those for whom the earthquake problem became more important or less important, there are significant differences between the November and February scores. There also are significant differences among the three mean scores within each time period (Scheffe test, p < .05), and the pattern of score magnitude is reversed from November to February. These outcomes provide support for the observation discussed earlier that, when the causes of a false alarm are explained, some people will develop a heightened awareness of the danger of an earthquake (Mileti and Fitzpatrick 1993).

Discussion

Overall, results from the panel survey supported the false alarm effect hypothesis as well as a mobilization effect. Following the cancellation of the Browning prediction, there was a significant decrease in (1) the perceived importance of the earthquake threat, (2) protective behavior, and (3) time spent thinking about the prediction. Thinking about the threat and change in perceived importance of the threat were negatively correlated (false alarm effect). Initial high levels of belief in the prediction were associated with a decrease in perceived problem importance following the cancellation of the prediction again supporting the false alarm effect.

Contrary to expectations, belief in the earthquake prediction and the post-cancellation reports of attention to a future warning supported the mobilization effect not a false alarm effect. Thinking about the prediction was not correlated with post-cancellation attention to a future threat (no false alarm effect). Subsequent attention to the warning seems to be a problematic variable.

These findings lend support to Mileti and Fitzpatrick’s (1993) argument that false alarms can enhance concern for future earthquakes, although the proportion of the public so affected seems to be quite small (16.7 percent of the panel) compared with those who adopt a false alarm effect position (46.1 percent).
The negative associations between seven of the nine information variables and members of the mobilization group suggests that they may have been the most knowledgeable about the earthquake prediction and the least concerned about personal risk. A post hoc analysis indicates that one month prior to the failure of the earthquake to appear on schedule, the mobilization group did know significantly more (2.95) than did the false alarm group (2.61) about the predictability of earthquakes but not more than did the no-change respondents (2.84; F = 4.89, df = 2,242, p = .008).

The discriminant analysis also provides evidence that those who did not change their estimates of the problem's importance (36.7 percent of the panel) believed that some of the consequences of an earthquake could be controlled. These individuals reported using both protective behavior and information to deal with the threat. This suggests that the on-going acquisition of information about the situation from the news media and other people leads the no-change group to conclude that, for all of the uproar over the prediction and its cancellation, nothing had changed.

These respondents' attribution of media influence also suggests that the news media were substantial contributors to the false alarm effect while at the same time they escaped blame for the fiasco. To the extent that these individuals initially had confidence in the content of the news media and had thought about what they had read and heard, a belief in the prediction may have resulted from thinking about the media's continuing, and unwarranted, repetitive emphasis on the forecast (Schwartz, 1982). After the threat's cancellation, cognitive reappraisal may have lead the false-alarm respondents to conclude that the whole episode was, so to speak, a bad joke in which they had played the fool, and, as Breznitz (1984) suggests, they downgraded the importance of the chronic earthquake threat.

Notes
1. Seven of the variables employed in the analysis are indices that were created by first factoring the responses to sets of questions to obtain those items that clustered together. The procedure was a principal axis solution in which all factors with eigenvalues of 1.0 or greater were rotated to oblique criteria. The factors then were used in reliability analyses to obtain those subsets that resulted in the highest alpha coefficients. The items were then summed to create the indices. The variables in each factor were then used in separate reliability analyses to obtain those subsets of items that resulted in the highest alpha coefficients. The items in the best subset were then summed to create the indices below. For example, 11 questions regarding interpersonal communication were factor analyzed with four items regarding confidence of information from other people.
forming the first factor-confidence in information from friends, family, coworkers, and government officials. The reliability analysis produced the highest alpha coefficient, 0.78, when the official variable was dropped from the cluster. The scores for friends, family, and coworkers were then summed to create variable number 6 (below), confidence in information from other people. The fourth variable, officials, was used as a separate predictor variable. Names for the indices (and the initial factors) are based on the substantive thrust of the questions involved (i.e., influence, confidence, etc.).

2. Discriminant analysis is a statistical technique that broadly serves two purposes (Klecka 1980, Norensis 1988, 1994). One purpose is to identify differences between two or more mutually exclusive categories on the basis of a set of independent variables. In this instance, the group membership of all cases is known in advance, and the problem is to find and interpret group differences. The second purpose is to assign cases whose group membership is unknown to a known group on the basis of similarities between the characteristics, on a set of predictors, of the cases and the characteristics of the groups. The present study identifies and interprets differences among the members of three previously defined groups—those who decreased (false alarm), increased (mobilizers), or did not change their assessment of the importance of the earthquake problem.

In discriminant analysis, linear combinations of variables (discriminant functions) are created such that the scores contributing to a function are as similar as possible within a group but differ as much as possible between groups. The maximum number of functions that may be found is one fewer than the number of groups in the analysis. Because two predictor variables may be correlated with a function in opposite directions and cancel each other out in terms of the magnitude of their discriminant function coefficients, the correlations of the independent variables with the discriminant functions provide the best interpretations of a function's meaning (Klecka 1980). The procedure used entered all independent variables into the equation as a single block. The analysis sought to maximize Wilks' lambda, which measures the extent to which a function accounts for differences between groups. As lambda increases the discriminating power remaining decreases. Lambda may be converted to chi-square to test the statistical significance of a function. Only variables with correlations of ± 0.30 with one or more functions are included in the interpretation.

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