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MEDIA INFLUENCES ON RESPONSE TO A NATURAL HAZARD: THE MISSISSIPPI RIVER SALT WATER INTRUSION OF 1988*

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Abstract

This paper examines how attributes of local media reports may effect local responses to a natural hazard event. The natural hazard of interest is the intrusion of salt water up the Mississippi River to the New Orleans area during the summer of 1988. The independent variables were drawn from an intensive analysis of local newspaper articles and transcripts of local television newscasts which appeared during, and referenced, the hazard event, while response behavior was operationalized as retail sales of bottled water. Using time-series analysis, we then examine the utility of a model of response behavior which stresses that people's reactions to a natural hazard are a function of how they use personal experience and the relevance of the hazard and its consequences to selectively attend to complex and ambiguous media reporting. The results indicate some similarities and differences in the effects of the two types of media, while providing limited support for the model. Future research and development of the theoretical model are suggested.

Introduction

To the social scientist, a natural hazard is more than just a geophysical process. An earthquake in a remote, uninhabited part of the world is very real and its physical attributes and consequences can be measured. However, to the social scientist the same event would not be considered a disaster or hazard unless it "interacts with and affects human systems" (Sorenson and Mileti 1987, p. 209). Social science research abounds on many aspects of disasters including their effects on social organization, social psychological responses of victims, mitigation behavior, and the like.

An important link between natural hazards and the human systems which they affect is the mass media. Traditionally, studies of mass media and disasters have tended to focus on organizational changes in the media during disasters, inaccurate and "mythical" reporting practices (Needham and Nelson 1977; Quarentelli 1987), differences in information presented by different sources (Needham and Nelson 1977; Alexander 1980), and the power of the media to "create disasters" (Kepplinger and Roth 1980).

There have been few studies which empirically examine human response behaviors as a function of changes in characteristics of mass media reports during the course of a hazard event. This paper is intended as a contribution to the literature in this area. Our research question is: how does the public respond during the course of a local hazard event and to what specific aspects of the local media coverage of the event can these responses be attributed? Our study is based on data from the drought of the summer of 1988, during which salt water from the Gulf of Mexico moved up the Mississippi River threatening the water supplies of communities and industry along the river.

MEDIA, HAZARDS, AND BEHAVIOR

The mass media have been a central focus of much social science research and theory on hazards. The media can reach large audiences, provide basic information and create awareness (Rogers 1987). For example, the television news has been cited as the most important first source of information for many news events (Larson 1980). In most disaster situations, few people have had direct experience with the disaster-at-hand and for the majority of persons the media are their only source of information (Carter 1980; Wenger et al 1975). Thus, it seems reasonable to conceptualize the mass media as an important factor in the responses of human systems to natural hazards.

Some argue that the media directly creates social definitions of hazard situations. By continually presenting information

about a hazard situation, "the public begins to perceive as experiencing a disaster" (Rogers and Sood 1980, p. 140); even though media attention given to an event is often unrelated to its objective severity (Adams 1986), such as number of deaths (Singer and Endreny 1987). As Robinson and Levy (1986, p. 173) state: "public awareness and comprehension of the news...often bears a striking similarity to journalistically encoded reality". If people respond to media reports of a hazard, and the attributes of media coverage do not necessarily relate to the event itself, it seems reasonable to conclude that people often respond more to the social reality constructed by the media than to the reality of the hazard itself.

This conclusion is supported by Kepplinger and Roth (1979), who report on the analysis of data concerning the effects of the mass media on people's perceptions of the oil situation of 1973 in the Federal Republic of Germany. In interpreting their findings, Kepplinger and Roth (1979) suggest that the mass media directly influenced the development of social reality. Media reports created the impression of an oil shortage, to which the public responded by increased demand, creating a short term shortage. If the mass media create an image of a hazard congruent with the reality of the hazard itself, individuals react to reporting as they would to reality. However, if a false or inadequate image is created, individuals react differently than they would to reality. The more the individual's conception of reality depends on the reporting of the mass media, the more likely this is to happen.

It is probably unrealistic, however, to assume that the mass media would be able to singlehandedly persuade viewers to adopt a particular viewpoint or a particular behavior. The mass media more likely influence perception and behavior indirectly (Rogers 1987) or its effects interact with other variables. Specifically, attributes of mass media hazard reporting would seem to interact with other variables in producing definitions of the hazard event and, in turn, public responses. These other variables include, but are not limited to, interpersonal communication networks, individual attributes (e.g., previous experience and prior attitudes), and human cognitive and memory processes.

The lack of a simple and direct effect of the media on behavior may be due to how the audience receives and interprets the media reports. Humans are processors of limited information and memory research shows us that when presented with information, people store cognitive schema which comprise a limited number of details in a process termed "leveling" or "flattening" (Stauffer et al. 1983). This tendency toward selectivity is strengthened by the nature of some media. "Study, repetition, connection to prior knowledge and elaboration with additional redundant information all facilitate recall" while the "rapidly moving and non-repetitive format of television news is not

conducive" to the way we process information (Stauffer et al. 1983, p. 35).

Since recall is related to, among other factors, personal relevance, we might reasonably assume that the few details that are retained are those that relate to peoples' specific needs and risks. For example, the amount of space or time allocated to a story is often not proportionately related to the importance placed on the story by viewers. Rather, respondents are more likely to place importance on and recall more frequently those stories that related to their personal lives such as those of real or potential danger or human impact (Larson 1980; Robinson and Levy 1986; Stauffer et al. 1983).

Turner (1980) has also found that individuals have only a "rather vague and limited awareness of the media's predictions and announcements..." and that the public forms an overall impression of a situation or event rather than to retain any details of announcements or predictions that led them to that impression. (Turner 1980, p. 291).

The literature on risk perception also provides clues on the relationship between media hazard reporting and public responses by focusing on the decision-making processes which prompt response behaviors. Slovic et al. (1987) suggest that humans are "boundedly rational" and use imperfect methods to make sense of their environment. A simple or ideal risk decision-making model can be described as a linear process composed of assessing the probability or susceptibility of the hazard, reviewing available mitigating behaviors and their efficaciousness, evaluating costs or barriers to protective actions, receiving cues to action (such as symptoms of the hazard or mass communication information), and finally making a decision to act (Cleary 1987; Mileti and Sorenson 1987).

However, it is generally agreed that individuals are not this rational. Inadequate or incomplete information and preconceived notions about risks and precautions can alter the outcome of the decision-making process (Mileti and Sorenson 1987). These preconceived notions can distort the perception of informational material. Since new information is interpreted by articulating it with previously acquired knowledge, which exist as cognitive schema,

> If an individual has formed strong initial impressions about a hazard, results from cognitive social psychology suggest that those beliefs may structure the way subsequent evidence is interpreted. New evidence will appear to be reliable and informative if it is consistent with one's initial beliefs; contrary evidence may be dismissed as unreliable, erroneous, or unrepresentative (Slovic et al. 1987, p. 36).

Like any other form of social perception, risk assessment involves both objective as well as subjective elements (Johnson and Covello 1987). As a result, people usually do not correctly estimate risks and show a definite propensity to underestimate or even deny risk (Mileti and Sorensen 1987; Sandman et al 1987). This results, in part, from the fact that people rarely receive "serious instruction in the assessment of risks" (Slovic et al 1987, p. 19) and must therefore rely on media accounts and personal experience. Previous personal experience with a hazard and attributes of media reports (e.g., expertness of source, frequency of warnings, detail of information) interact in effecting risk assessment and, in turn, response behavior.

According to Ruch and Christensen (1981), persons with no prior experience with hurricanes were best motivated by a well respected authority figure, while persons with prior experience were best motivated by indicators which, through their prior experience, they associated with the seriousness of the storm threat. Leik et al. (1981) found that inexperienced persons take defensive action sooner in the face of frequent and detailed warnings, while for more experienced persons, detailed and frequent messages produced longer delays than did incomplete or infrequent messages.

Attributes of media reports also interact with interpersonal communication to effect the risk assessment process. The attributes of, and dangers posed by, most hazard situations are ambiguous and the media often exacerbates this ambiguity by its reporting practices. In an attempt to avoid mass panic, the media "... almost invariably ... combine warnings with reassurances that tend to undermine the seriousness of the threat" (Turner 1980, p. 284), resulting in a mixed message. People often look to their peers for cues and information to help reduce the ambiguity (Rogers 1987; Weinstein 1987; Nigg 1982) and more clearly define the hazard situation and choose among reponse alternatives. Unavailable information, questions about relevance to personal situations and unknown effectiveness of proposed precautions often lead people to follow neighbors' actions, "assuming (often incorrectly) that the neighbors have made a careful study of the situation" (Weinstein 1987, p. 330). Furthermore, the media's attempt to add entertainment as a feature of the news may lead to increased belief in information the media actually intends to downplay (Turner 1980) because of the perceived ambiguity.

We offer two general observations on the literature reviewed above. First, there has been little empirical research which directly examines the relatioship between public responses and the media's reporting of disaster-relevant information during the actual course of the hazard event. Some observers have noted this relative lack of empirical research (see for example, Kreps 1980; Lang and Lang 1980; Larson 1980) and have, in turn, noted

the need for such research. Since both media reporting and public responses undergo changes during the course of a hazard event, it would seem that a reasonable research design should include all phases of a hazard event in order to examine the concommitant changes in both media reporting and public responses.

Second, there have been few attempts at building a general model of public responses to media reports during hazard situations. Nigg's (1982) work represents one such attempt to develop a general model, focusing on many characteristics of media reporting and public response behavior which have been noted above. According to the model, there are specific characteristics of media reporting (e.g., ambiguity or discrepancies in information) which lead to uncertainty on the part of the public. As a result of this uncertainty, the public attempts to selectively interpret media reports of the hazard event vis-a-vis its personal relevance. When a hazard event is defined as posing relevant consequences, the public is seen as again looking to the media's presentation of possible response alternatives.

This study is designed to contribute to the literature in the area by addressing these two points of research and theory on media and hazards. Utilizing the extant literature, we first develop a general model of public responses to media hazard reports. We use this model to generate specific hypotheses concerning the relationships between attributes of media reports and public responses, and how these relationships change during the course of the hazard event. Finally, using a time series analysis, we examine these hypotheses vis-a-vis data on a single hazard event.

A MODEL OF PUBLIC RESPONSES TO HAZARD REPORTING

On the basis of the extant literature on media and hazards, we construct the following model of response behaviors. First, media reports of most hazard events are likely to be ambiguous, often presenting conflicting information. Since hazard events often evoke anxiety, the ambiguity of media reports would be expected to heighten that anxiety.

Second, how people respond to a hazard event is a function of how they define it. These definitions are, in turn, to a great extent a function of media reports rather than the attributes of the event itself. While media reports provide a major, if not the sole, source of information about a hazard event, the ambiguity that characterizes media reporting makes this definitional work a complicated endeavor. This ambiguity turns on several dimensions. First, media reports often combine information which stresses the likelihood of the hazard event and/or its negative consequences. Second, media reports also contain information about various consequences of the hazard, some directly relevant to peoples' everyday lives, others less directly relevant.

Since people cannot and do not process all the information contained in media reports, they selectively attend to them. This selectivity is two-fold. First, people may selectively attend to specific parts of the content of reports; they may attend to some but not other pieces of information. Second, they may listen to or read reports to glean an overall image or gestalt of the hazard event. The specific kind of selectivity people use is most likely a function of previously acquired knowledge about the hazard event, which people use to interpret media information. Aspects of media reports will interact with these other variables to influence responses; given different configurations of background knowledge, different aspects of media reports will have different effects. The interactions between specific types of background knowledge and specific aspects of media information is probably complex, but we can propose the following.

First, in the absense of prior experience with a hazard event, people will not highly discriminate between personally relevant consequences of a hazard and other, less relevant consequences. When people have personal experience with a hazard, they will be more discriminating; the more relevant the consequence, the more active the responses will be.

Under the condition of a lack of personal experience, ambiguity concerning the severity or likelihood of the hazard will have the same effects as reports which more simply stress the severity or likelihood of the event. In short, people will attend less to the specific content of the report when they lack personal experience. Under the condition of personal experience, people will be more discriminating in their attention to the details of the content.

In the absense of personal experience and in the face of ambiguous media information, two factors will influence peoples' responses. First, people will utilize personal experience with other hazards which are similar to the present one. Responses which have proven efficacious in dealing with a previous, related hazard will provide people with alternatives. In addition to, or in lieu of experience with related hazards, people will look to others to help define the hazard event. This most likely takes place in the context of interpersonal communication networks. In addition to, or in lieu of, these communication networks, media reports of others' responses will serve the function of defining possible or appropriate responses. Others' responses will have the effect of providing a model for responses and/or defining the hazard event. Under the condition of personal experience, others' responses will have less of an effect.

THE HAZARD EVENT

The hazard event of interest in this study occurred during the summer of 1988. The midwest United States was experiencing a

lengthy and severe drought which, among other things, was producing low water levels and decreased flow in the Mississippi River and its tributaries. This decrease in the water flow, in turn, allowed salt water from the Gulf of Mexico to move up the Mississippi River much farther than it usually does during low water. The resulting salt water concentrations posed a threat to communities and industries who depended on the Mississippi for water supplies.

The salt water intrusion is an annual event during late August and September when the river flow is typically low. However, the intrusion is typically limited to communities adjacent to the mouth of the river and the concentrations of salt are generallly low enough that standard treatment procedures can remove it. In short, it generally does not pose a hazard to communities along the river. This particular summer, however, the severe drought coupled with a recent dredging of the river by the Corps of Engineers, allowed the salt to move significantly farther up the river and in increased concentrations than was typically the case. An intrusion of this magnitude had not occurred since 1937, when newspapers reported people catching salt water fish off the docks in downtown New Orleans. The current event created a hazard situation that threatened municipal water supplies, industrial equipment and machinery as far up river as New Orleans, a metropolitan area of approximately one million persons, one hundred miles from the mouth of the river.

There are several attributes of this event that make it particularly interesting to study in the context of the media and hazard events. Although an annual event, since the salt rarely intruded as far up river as New Orleans, few people in the metropolitan area had direct experience with the hazard. According to the literature, this would mean that most people in the metropolitan area would rely almost exclusively on the media for information.

In addition, the event lasted approximately two months during which time it occupied a relatively prominent place in both the print and electronic media. Further, the intrusion allowed for little predictive ability; officials seemed unable to unequivocally state how severely the hazard would impact the New Orleans area: how high the concentrations of salt would reach, whether or not it would pose a health hazard, whether or not people would be able to taste the salt in their tap water. In fact the media reports were filled with the kinds of ambiguities discussed above in the literature review. The event was big news in the local media and received much time and space; on the other hand the reports were filled with statements which also downplayed the severity and significance of the event. For example, while smaller communities downriver were able to barge in drinking water, the New Orleans area, being so large and densely populated, had no such option. In effect, New Orleans faced a

threat to drinking water to which there were few viable mitigation responses. This fact received much play in the media reports while the same reports also included reports which stated that the event would most likely not impact the area in any significant way.

In addition to all of this, the New Orleans area (and in fact, most of southeastern Louisiana) has exhibited a growing concern with the quality of drinking water. Since the metropolitan area draws its drinking water from the Mississippi River, concerns over the presense of industrial and toxic waste in the water have traditionally generated high levels of bottled water sales. This concern is heightened by the fact that along the River between Baton Rouge and New Orleans there is a series of chemical plants. Within the previous twelve months, Greenpeace had demonstrated at several places along the river between Baton Rouge and New Orleans. The local and national media has recently been focused on the cancer rates in the area, reportedly several times the national average.

The slow onset of the hazard, its relative unpredictability, the ambiguity which characterized the local media reports, and the lack of response options beyond purchasing bottled water, coupled with the lack of direct experience on the part of the public allows for a unique opportunity to examine changes in the content of media reporting and changes in response behavior.

DATA

The data came from three sources. We used records of retail sales of bottled water between June 17th and August 14th from the water company with the largest market share in New Orleans at the time of the salt water intrusion. Also, we examined news stories from the only New Orleans newspaper, The Times-Picayune, and the television station with the largest market share in the summer of 1988. Only stories concerning the low level of the Mississippi River were analyzed.

The dependent variable was the retail sales of bottled water in number of gallons per day. The company does not deliver water to stores seven days a week; thus there were days when sales were zero. Linear interpolation was used to calculate estimates of sales for these days. A natural logarithmic transformation of the sales was necessary. The variability of the sales figures was greatest when the sales were highest and the series was positively skewed.[1]

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[1] The sales figures used in this study are confidential. We are unable to report descriptive statistics for this variable or to include plots of the series.

Six independent variables were used. Proximity was a dummy variable coded 0 before the salt water wedge arrived in New Orleans and 1 after the wedge arrived. Media mentions of five topics related to the increased salt content in the river were counted for each day. Toxins was the number of mentions in the stories concerning the potential hazard of increased levels of toxins in the tap water. Salt was the number of mentions of the salt content in the tap water. Health was the number of mentions of health consequences due to drinking the tap water. Taste was the number of mentions concerning the taste of the tap water. Buying water was the number of mentions of people buying bottled water. Mentions of these topics were calculated separately for the two media, the newspaper and the television.

METHODS AND RESULTS

Before examining the effect of the independent variables on sales, we did an interrupted time series analysis of the sales using the ARIMA procedure in SPSS-PC+. We used the first differences of the natural logarithms because the series was not stationary, but no further modeling was necessary. We found nine significant changes in the sales. Four significant increases occurred before the salt water wedge arrived in New Orleans and two were during the week immediately prior to the arrival of the wedge. Five significant changes occurred after the wedge arrived. Four were decreases and two were within nine days after the arrival of the wedge. The increase occurred two and a half weeks after the wedge arrived.

Next, we used multiple regression to analyze the effect of the independent variables on sales of bottled water. Seven regression equations were used for each independent series. First, the natural logarithm of the interpolated sales series was regressed on the independent series. For the newspaper, the independent series was the same day mentions of health, taste, toxins, salt and buying water. For the television, the independent series was the mentions the previous day. Second, the sales series was regressed on the independent series and proximity. Third, the sales series was regressed on the independent series, proximity and their interaction. Fourth, the sales series was regressed on the independent series and the lag of the independent series. For the newspaper data, the lag of the independent series was the previous day's mentions of the media topics. For the television data, the lag of the independent series was mentions 2 days previously. Fifth, the sales series was regressed on the independent series, the lag of the independent series and proximity. Sixth, the interaction of proximity and the independent series was added. Seventh, the interaction of proximity and the lag of the independent series was added to the equation containing the independent series, the lag of the independent series, proximity, and the interaction of proximity and the independent series.

The ARIMA procedure in SAS was used to analyze the residuals. These analyses showed that none of the models above fit the data because an autoregressive term was omitted. Thus, the models presented above were run a second time with the lag of the dependent variable included to account for the autoregressive term.[2] The analyses of the residuals showed that the errors were random and no spikes occurred in either the autocorrelations or the partial autocorrelations.

The best model was determined by calculating an F test for the increment to R^2 for the addition of variables into the model, when possible, and by comparing the adjusted R^2, the mean square error and the press statistic across equations. The final models shown in Table 1 are significantly different from more parsimonious models and the adjusted R^2s are higher while the mean square errors and press statistics are lower.

The final models for the newspaper (see Table 1, panel A) indicated that mentions of health consequences are significantly related to increases in sales of bottled water. Also, mentions of people buying bottled water significantly increase sales. Further, there was a significant interaction between mentions concerning the taste of tap water and proximity of the salt water wedge. This interaction indicated that mentions concerning taste significantly increased sales of bottled water only before the wedge arrived. Mentions in the newspaper of salt and toxin levels in the tap water had no effect on sales.

When the models for health, buying water and taste were combined in one equation, the model was significant but none of the variables were. This result was probably due to multicollinearity since the variables were significantly intercorrelated. Also, these topics tended to be mentioned on the same day. The variance explained by combining the models was not significantly greater than the variance explained by the separate models. Further, the standardized regression coefficients indicated that no individual media term was more important than the other terms.

The results were different for the television (see Table 1, panel B). Mentions concerning the taste of tap water on the previous day significantly increased sales and sales were significantly (.10 level) greater before the wedge arrived. Mentions of people buying water on the previous day's newscast significantly increased sales and sales were significantly (.10 level) greater before the wedge arrived. There was a significant interaction between proximity and mentions of health consequenc-

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[2] This use of the lag of the dependent variable is demonstrated in the SAS applications manual, SAS System for Forecasting Time Series.

es. Mentions of health consequences significantly increased sales only before the wedge arrived.

The model for mentions of salt indicated that mentions of salt in the tap water on the previous day nonsignificantly increased sales while such mentions two days previously significantly decreased sales. This model suggests that more water than expected by the trend was purchased the day after the story; thus sales fell the second day after the newcast. When most of the stories concerning salt contamination of the drinking water occurred, the sales of bottled water were increasing. Thus, the newscasts would have had to increase sales dramatically to have a significant positive effect, but the decrease in sales two days after the newscast would not have to be as large for the effect to be significant. Thus, the significant negative effect two days after the newscasts probably represents a recovery in the sales series following a day when the level was higher than expected by the trend in sales. Mentions of toxins were unrelated to sales.

When the models for taste, buying water, health and salt were combined in one equation, the model was significant but none of the variables were. This result was probably due to multicollinearity since the variables were significantly intercorrelated. The topics were usually mentioned on the same day. The variance explained by combining the models was not significantly greater than the variance explained by each topic separately. However, the standardized coefficients indicated that the terms for the health model were more important than the other media terms.

To examine furter the effects of the independent variables on sales, we analyzed the tone of the mentions of toxins, taste, health and salt. These mentions were coded as certain that the consequence would occur, uncertain that the consequence would occur, and not likely that the consequence would occur. The latter mentions were those that diminished the probability of the consequence. For the newspaper data, the most frequent tone for the variables that affected sales was diminishment. For the television data, the most frequent tone for the variables that affected sales was certainty.

To test the hypothesis that the tone of the mentions is important, three new series were created: certainty, uncertainty, and diminishment. Mentions that were certain about the consequence were summed for each day for each medium. Similarly, mentions that were uncertain were summed as were mentions that diminished the probability of the consequence. We regressed sales on the three variables for each medium using the seven equations that were used previously.

The regression results supported the idea that the tone of

the mentions is important. Newspaper mentions that diminish the consequence significantly increase sales of bottled water (see Table 2, panel A). Newspaper mentions that are certain or uncertain about the consequence did not affect sales. Television mentions that are certain that the consequence will occur were related to sales the next day (see Table 2, panel B). The effect of these mentions interacted with proximity indicating that these mentions significantly increased sales before the wedge arrived. Television mentions of the hazards that were uncertain or that diminished the probability of the consequence did not affect sales of bottled water.

To test the hypothesis that the effect of mentions of salt, health, taste, toxins and buying water did not vary by the place of the mention, three series were created for each medium: New Orleans mentions, Plaquemines parish mentions, and mentions elsewhere (Southeastern and Northern Louisiana and places outside the state). For each day, the mentions concerning New Orleans were summed. Similarly, the mentions concerning Plaquemines parish were summed as were the mentions concerning other places. The sales series was regressed on these three independent series for each medium using the same seven equations.

The results supported the hypothesis that the effect of the mentions did not depend on the place of the mention. For the newspaper data, all three series affected sales (see Table 3, panel A). There was a significant interaction between proximity and mentions concerning New Orleans. Mentions concerning the New Orleans area significantly increased sales of bottled water only before the wedge arrived. The results were similar for mentions concerning Plaquemines parish. Mentions concerning places outside Southeastern Louisiana significantly increased sales both before and after the wedge arrived.

For the television data, the effects were statistically significant at the .10 level (see Table 6, panel B). Mentions concerning the New Orleans area increased sales of bottled water the next day. Also, in the model for New Orleans mentions, proximity indicated that sales were greater before the wedge arrived. Further, mentions concerning Plaquemines parish increased sales the next day.

We hypothesized that people more readily respond to reports that cite personally relevant consequences. The news stories included discussions of consequences that affected business, such as equipment damage, and collective responses to the salt water wedge, such as barging water, dredging the river, building or adding to a levee. Three new series were created: mentions of barging water, mentions of business consequences, and mentions of other collective responses. Contrary to the hypothesis, mentions of these topics also affected sales (see Table 4). For the newspaper data, mentions of barging water significantly interact-

ed with proximity and sales of bottled water (see Table 4, panel A). Mentions of barging water significantly increased sales before the wedge arrived. The interaction between mentions of other responses and proximity was significant at the .10 level: thus these mentions had a stronger positive effect on sales before the wedge arrived.

When the models for barging water and other responses were combined into one equation, no individual media term was significantly related to sales, although the model was significant. This result was probably due to multicollinearity. The variance explained by the combined equation was not significantly greater than the variance explained for each topic separately. However, the standardized coefficients indicated that barging water was more important than other responses.

For the television data, mentions of barging water, business consequences and other responses to the salt water wedge affected sales of bottled water (see Table 4, panel B). There was a significant interaction between proximity and mentions of barging water. Mentions of barging water on the previous day's newscast significantly increased sales before the wedge arrived. Mentions of business consequences the previous day nonsignificantly increased sales while mentions two days previously significantly decreased sales. Mentions of other responses the previous day nonsignificantly increased sales while mentions two days previously significantly decreased sales. These two models are similar to the model for television mentions concerning salt and suggest that more water than expected by the trend in sales was purchased the day after the story; thus sales fell the second day after the newscast. Again, most of these stories occurred when sales were increasing; thus the explanation for the nonsignificant increase the day after the broadcast and the significant decrease two days after the broadcast is the same as that presented earlier.

When the separate models for barging water, business consequences and other responses were combined into one equation, barging water significantly affected sales while business consequences and other responses did not (see Table 5). Mentions of barging water on the previous day's television newscasts significantly increased sales of bottled water before the wedge arrived in New Orleans. The variance explained by the combined equation was not significantly greater than the variance explained by each separate model.

It is possible that business consequences, barging water, and other responses to the salt water wedge were significantly related to sales because they are significantly correlated with personal consequences and responses. Mentions of these eight topics were highly intercorrelated and tended to occur on the same days. Further the presence or absence of mentions of these

topics were highly interrelated.

To determine the effect of each topic net of the other topics, the significant models were combined for each medium separately. For the newspaper data, the sales series was regressed on the models for health, taste, buying water, barging water and other responses. No individual term for mentions was significant. This was probably due to the intercorrelation among these topics, which was discussed earlier. This combined model explained a significantly greater proportion of the variance in sales than did the models for buying water, barging water or other responses. The variance explained by the combined model was not significantly greater than the variance explained by the separate models for health and taste. This result suggests that health and taste are the most important topics for affecting sales of bottled water for the newspaper.

The analogous analysis could not be completed for the television data. When the separate models for taste, buying water, health, salt, barging water, business consequences and other responses were combined into one equation, the interaction of proximity and barging water was a linear combination of health, barging water, and the interaction of proximity and health. For the television data, health was the most important of the more personally relevant topics and barging water was the most important of the less personally relevant topics. Barging water is more personally relevant than are business consequences and other responses; thus it appears that personal hazards and consequences have a greater affect on sales of bottled water as hypothesized.

DISCUSSION

The results of our analysis are admittedly complex, so this discussion will center around the extent to which the results support or fail to support the conceptual model offered above.

In our model of response behavior, we assumed that media reporting would often be complex and ambiguous. When people lacked personal experience with the hazard event, this ambiguity would lead to people to react quicker and more actively as compared to when they did have such personal experience. In the present case, this would mean that retail sales of bottled water would be higher before the salt water wedge arrived at New Orleans (July 6th) than after it arrived. Several findings support this expectation. First, with only one exception, the significant breaks in retails sales before arrival were all increases, while those occurring after were all decreases. In addition, retail sales peaked on July 6th representing a large, but nonsignificant increase from July 5th to July 6th. Since there were three significant increases in retail sales in the

four days prior to this last increase, it would had to have been a huge increase to be significant. The exception was an increase between July 25th-July 26th. The data we have do not allow us to assess the reason for this anomaly. Further, in four of the specific models, proximity indicated that sales of bottled water were greater before the wedge arrived.

This provides indirect support for the model. Before the arrival of the wedge, most residents did not have direct, personal experience with a salt water intrusion and the data indicate that they responded by buying bottled water. However, after its arrival, the decreases in sales suggest that, on the basis of their direct experience, people did not assess the hazard to be sufficiently serious or threatening to warrant buying water. Of course our data do not allow us to directly examine whether this was due to changes in the level of anxiety created by the condition of personal experience.

The model also conceptualized responses to a hazard event to be a function of how people selectively attended to media reports of that event. This selectivity was hypothesized to operate in one or more of several directions. First, the more serious or threatening the hazard and its consequences, the more likely people would respond. This hypothesis was partially supported. The order of seriousness of the hazards and consequences was: toxins, health, salt, taste and business. Toxins were expected to be the most important topic, but it was never related to sales. Toxins in the water has been a long standing salient issue in New Orleans. It is possible that people have become desensitized to toxins as a hazard; therefore, they failed to respond to this threat while they responded to less serious threats. The health, salt, taste and business consequences were new threats and their newness may have provoked the response. Further, the results show that health was one of the two most important topics for both media and business consequences were among the least important. Thus, the results suggest that people respond more readily to more serious threats if these threats are new. Also, it is worth noting that purchasing bottled water has become a common response to the long standing problem of toxins. The results suggest that people used the same response in the face of the new hazard.

Second, people were hypothesized to respond more readily to reports that cited personally relevant consequences of the hazard than less relevant consequences. The results provide support for this part of the model. Although business consequences and collective responses were related to retail sales, the topic most strongly and consistently related was health consequences. This was one of the two most important topics for both media. For the newspaper, the second topic was also a personal consequence, taste. For the television, the second topic was a collective response, barging water. Although barging water is less personal

than health, taste, toxins, and salt, it is more personally relevant than business consequences and the other collective responses.

Further, the model suggested that in the absence of prior experience with the hazard, people will not discriminate as much between personally relevant consequences and less relevant consequences. Since the New Orleans area had not had a salt water intrusion of this magnitude since 1937, prior experience with this hazard was limited. Thus, we would expect people to be less discriminating concerning the personal relevance of the consequence. The results that business consequences and mentions of collective responses affected sales of bottled water supports the idea that, when prior experience is limited, people are less discriminating about the personal relevance of the consequence, especially since these topics tended to affect sales only before the wedge arrived.

Third, the model predicted that responses to media reporting would be a function of the relevance of responses mentioned in the reports. If social actors examine others' responses in order to help define ambiguous situations, then mentions of people buying bottled water would effect retail sales. The results support this prediction; in both media, mentions of people buying bottled water was a significant predictor of retail sales. However, mentions of barging water (categorized as a collective response) was also a significant predictor. If buying bottled water is a more personally relevant response than the barging of water, the results only provide partial support for this aspect of the model. On the other hand, since the water was barged to help freshen community, as well as business, water supplies, people may have interpreted these two types of responses in much the same way: as information relevant to the issue of personal water supplies. While our data do not allow us to directly test this hypothesis, the results do show that barging water had by far the greatest effect among all the less personal responses.

Fourth, people were hypothesized to more readily respond to reports which stressed the likelihood of the event or its consequences, especially if they had prior experience with the hazard. Our results concerning the tone of the stories produce mixed support for the model. For the television reports, mentions of personally relevant consequences and responses that stressed the certainty of the salt wedge and its consequences had a significant effect on sales. On the other hand, for the newspaper stories, mentions of such topics that diminished the hazard was a significant predictor of sales.

Finally, the model hypothesized that these aspects of selectivity in attending and responding to media reports would vary in their effects dependent upon whether people had direct, personal experience with the hazard event. The results provide

mixed, though strong, support for the model. For some topics, there were significant interactions between the mentions and proximity indicating that mentions of these topics increased sales only before people had direct experience with the hazard. These interactions occurred for taste (newspaper), health (television), barging water (both media) and other responses (newspaper). Further, proximity was important in three other models: taste, buying water, and business consequences (all television).

The results that most non-personal consequences and responses significantly increase sales only before the wedge arrived supports a final aspect of the model: in the face of uncertainty, people will not discriminate between personal and non-personal consequences and responses; since both necessarily mention the hazard and/or its effects, either would serve as an impetus for buying water. However, after the wedge arrived, from personal experience most people would have been able to assess the lack of a personal effect, and would thereby have been more selective in their attention and responses. This is especially likely in the case of barging water, since while we categorized this as a non-personal, and therefore less relevant, response, people may have attended and reacted to this aspect of media reports more readily before the wedge arrived. In fact, that barging water is the single most important predictor of sales among the nonpersonal variables provides additional, though indirect, support for the model. However, mentions of business consequences in the television reports continued to affect sales after the wedge arrived. As mentioned above, this may be due to these nonpersonal consequences often occurring in the same stories as personal consequences. However, we were not able to test this hypothesis since we cannot separate their individual effects on sales.

CONCLUSION

We have intended this paper as a both a theoretical and methodological contribution to the empirical study of the effects of media reports of natural hazards on human responses. We took as a basic postulate that people respond to a hazard primarily on the basis of information gleaned from the media. Further, we also postulate that media reporting undergoes changes during the course of the hazard event. On the basis of these two assumptions, the most adequate way to assess the effects of media reporting on response behaviors would be a research design that followed this relationship over the course of a whole hazard event. We incorporated this idea into our research by collecting data on the media reports as well as response behaviors over the course of the salt water intrusion. Further, we used a time series analysis to examine the effects of the former over time.

In addition, we used an intensive analysis of the media reports to generate our independent variables. A common tradition

in the study of media effects is a content analysis in which a small number of attributes of stories are identified and then summed. Our use of a detailed qualitative analysis allowed us to generate a much richer and elaborate picture of the contours of the media stories. In turn, this allowed us to examine a far greater number of attributes of these stories than would have otherwise been the case.

Despite the methodological advantages of our research, several improvements are suggested. While our conceptual model stresses the importance of ambiguity and uncertainty as well as selectivity, our data did not allow us to directly test this aspect of our model. Future research which utilized survey or questionnaire data during the course of the hazard event would be able to develop measures of and directly assess the role of these social psychological processes in responses. Obviously this is no small task, as it requires some degree of planning and a certain rapidity in order to collect the questionnaire data during the course of the hazard event.

It would be beneficial if self-reports of bottled water purchases, as well as other responses, were included in the data. Our use of bottled water sales as an aggregate measure of responses was appropriate, but it seems reasonable to argue that people in the New Orleans area responded in other ways, even when they interpreted the media reports in the same way as the people who bought bottled water.

There seems a relative lack of attention in the literature on natural hazards to developing general models of response behaviors, although Nigg's (1982) research provides a significant exception to this trend. Not only should attention be paid to developing models that are generalizable enough to apply to various types of hazards under various conditions, but these models should may relevant to this area. For example, some recent conceptual schemes are beginning to make use of work in cognitive social psychology. Further, research and theory in the areas of urban ecology, political systems, communication and sociolinguistics can contribute to research and conceptual development in the area of natural hazards and human responses. Responses to hazards can be examined both at a social psychological and social level, further conceptual development in this field would seem to depend on greater use of extant knowledge in sociological research and theory at both of these levels of analysis.

Table 1.
Regression Analyses[a] of the Effect of the Type of Media Mentions on Sales of Bottled Water.

Dependent Variable: Natural Logarithm of the Gallons Sold Daily

A. Newspaper

Independent Variable: Health	B	beta
Lagsales	.800*	.798*
Health	.130*	.211*
Constant	1.829	
R^2	.806*	
Adjusted R^2	.798*	
Durbin-Watson	1.799	
First-order autocorrelation	.095	

Independent Variable: Buying Water	B	beta
Lagsales	.840*	.838*
Buying Water	.052*	.151*
Constant	1.479	
R^2	.788*	
Adjusted R^2	.781*	
Durbin-Watson	1.870	
First-order autocorrelation	.060	

Independent Variable: Taste	B	beta
Lagsales	.817*	.814*
Proximity	-.080	-.064
Taste	.367*	.505*
Proximity * Taste	-.308*	-.404*
Constant	1.742	
R^2	.810*	
Adjusted R^2	.795*	
Durbin-Watson	1.879	
First-order autocorrelation	.051	

B. Television

Independent Variable: Taste	B	beta
Lagsales	.805*	.803*
Lagtaste	.071*	.160*
Proximity	-.139[b]	-.111[b]
Constant	1.883	
R^2	.796*	
Adjusted R^2	.785*	
Durbin-Watson	1.731	
First-order autocorrelation	.123	

Independent Variable: Buying Water	B	beta
Lagsales	.808*	.806*
Lagbuying water	.169*	.187*
Proximity	-.131[c]	-.105[c]
Constant	1.864	
R^2	.806*	
Adjusted R^2	.795*	
Durbin-Watson	1.778	
First-order autocorrelation	.098	

Note: Lagsales is the lag of the dependent variable, proximity is the dummy variable coded 0 before the salt water wedge arrived and 1 after the wedge arrived, lagtaste is the previous day's mentions of taste and lagbuying water is the previous day's mentions of people buying bottled water.

* $p<.05$.

a. The analyses were corrected for first-order autocorrelation (AR1).

b. $p=.0805$. The F test for the increment due to proximity was 3.98 while an F of 4.08 is needed for significance at the .05 level.

c. $p=.0896$. The F test for the increment due to proximity was 2.98 while an F of 4.08 is needed for significance at the .05 level.

Table 1 continued.
Regression Analyses[a] of the Effect of the Type of Media Mentions on Sales of Bottled Wat

Dependent Variable: Natural Logarithm of the Gallons Sold Daily					
B. Television					
Independent Variable: Health			Independent Variable: Salt		
	B	beta		B	beta
Lagsales	.856*	.854*	Lagsales	.903*	.904*
Proximity	-.084	-.067	Lagsalt	.030[d]	.178[d]
Laghealth	.637*	.560*	Lag2salt	-.041*	-.240*
Proximity*laghealth	-.629*	-.541*			
Constant	1.397		Constant	.928	
R^2	.795*		R^2	.797*	
Adjusted R^2	.779*		Adjusted R^2	.786*	
Durbin-Watson	1.922		Durbin-Watson	1.840	
First-order autocorrelation	.030		First-order autocorrelation	.078	

Note: Lagsales is the lag of the dependent variable, proximity is the dummy varia coded 0 before the salt water wedge arrived and 1 after the wedge arrived, laghealth is previous day's mentions of health consequences, lagsalt is the previous day's mentions salt, and lag2salt is the mentions of salt 2 days previously.

* $p<.05$

a. The analyses were corrected for first-order autocorrelation (AR1).

d. $p=.0600$.

Table 2.
Regression Analyses[a] of the Effect of the Tone of Media Mentions on Sales of Bottled Water.

Dependent Variable: Natural Logarithm of the Gallons Sold Daily		
A. Newspaper		
Independent Variable: Diminish		
	B	beta
Lagsales	.807*	.805*
Diminish	.041*	.157*
Constant	1.761	
R^2	.787*	
Adjusted R^2	.779*	
Durbin-Watson	1.764	
First-order autocorrelation	.114	
B. Television		
Independent Variable: Certain		
	B	beta
Lagsales	.801*	.799*
Lagcertain	.101*	.592*
Proximity	-.107	-.085
Proximity * Lagcertain	-.082*	-.472*
Constant	1.899	
R^2	.807*	
Adjusted R^2	.792*	
Durbin-Watson	1.797	
First-order autocorrelation	.091	

Note: Lagsales is the lag of the dependent variable, proximity is the dummy variable coded 0 before the salt water wedge arrived and 1 after the wedge arrived, diminish is the number of mentions that attempt to diminish the hazard or consequence (health, taste, toxins, and salt), and lagcertain is the number of mentions the previous day that claim that the hazard or consequence will occur. Uncertain mentions in the newspaper or television news did not affect sales of bottled water, certain mentions in the newspaper did not affect sales and mentions that diminish the hazard or consequence in the television news did not affect sales; therefore, no models are shown for these series.

* $p<.05$.

a. The analyses were corrected for first-order autocorrelation (AR1).

Table 3.
Regression Analyses[a] of the Effect of the Place in the Media Mentions on Sales of Bott Water.

Dependent Variable: Natural Logarithm of the Gallons Sold Daily

A. Newspaper

Independent Variable: New Orleans	B	beta
Lagsales	.834*	.832*
N.O.	.086*	.428*
Proximity	-.067	-.054
Proximity * N.O.	-.075*	-.352*
Constant	1.570	
R^2	.807*	
Adjusted R^2	.792*	
Durbin-Watson	1.864	
First-order autocorrelation	.060	

Independent Variable: Plaquemines	B	beta
Lagsales	.852*	.849*
Plaq.	.093*	.428*
Proximity	-.042	-.034
Proximity * Plaq.	-.091[b]	-.411[b]
Constant	1.396	
R^2	.793*	
Adjusted R^2	.777*	
Durbin-Watson	1.855	
First-order autocorrelation	.066	

Independent Variable: Other Places	B	beta
Lagsales	.785*	.783*
Other Places	.028*	.198*
Constant	1.960	
R^2	.797*	
Adjusted R^2	.790*	
Durbin-Watson	1.768	
First-order autocorrelation	.111	

B. Television

Independent Variable: New Orleans	B	beta
Lagsales	.790*	.788*
LagNewOrleans	.028[c]	.152[c]
Proximity	-.161[c]	-.129[c]
Constant	2.042	
R^2	.791*	
Adjusted R^2	.779*	
Durbin-Watson	1.638	
First-order autocorrelation	.168	

Independent Variable: Plaquemines	B	beta
Lagsales	.833*	.831*
LagPlaquemines	.045[d]	.129[d]
Constant	1.539	
R^2	.782*	
Adjusted R^2	.774*	
Durbin-Watson	1.713	
First-order autocorrelation	.138	

Note: Lagsales is the lag of the dependent variable, proximity is a dummy varia coded 0 before and 1 after the wedge arrived, other places is mentions concerning perso hazards and consequences (health, taste, toxins, and salt) in Southeastern and North Louisiana and outside of the state, lagNewOrleans is the previous day's mentions concern New Orleans, and lagPlaquemines is the previous day's mentions concerning Plaquemines Pari

* $p<.05$.

a. The analyses were corrected for first-order autocorrelation (AR1).

b. $p=.057$. The F test for the increment due to proximity and the interaction 3.01 while an F of 3.23 is needed for significance at the .05 level.

c. $p<.057$. The F test for the increment due to lagNewOrleans and proximity was 3 while an F of 3.23 is needed for significance at the .05 level.

d. $p=.063$. The F test for the increment due to lagPlaquemines was 3.69 while of 4.08 is needed for significance at the .05 level.

Table 4.
Regression Analyses[a] of the Effect of Media Mentions of Business Consequences and Responses to the Salt Water Intrusion on Sales of Bottled Water.

Dependent Variable: Natural Logarithm of the Gallons Sold Daily

A. Newspaper

Independent Variable: Barging Water

	B	beta
Lagsales	.872*	.870*
Barge	.146*	.372*
Proximity	-.032	-.026
Proximity * barge	-.160*	-.387*
Constant	1.203	
R^2	.797*	
Adjusted R^2	.782*	
Durbin-Watson	1.907	
First-order autocorrelation	.040	

Independent Variable: Other Responses

	B	beta
Lagsales	.925*	.922*
Resp.	.019	.207
Proximity	.009	.007
Proximity * Resp.	-.028[b]	-.273[b]
Constant	.685	
R^2	.789*	
Adjusted R^2	.773*	
Durbin-Watson	1.827	
First-order autocorrelation	.076	

B. Television

Independent Variable: Barging Water

	B	beta
Lagsales	.838*	.836*
Lagbarge	.646*	1.478*
Proximity	-.099	-.079
Prox. * lagbarge	-.609*	-1.391*
Constant	1.562	
R^2	.802*	
Adjusted R^2	.787*	
Durbin-Watson	1.884	
First-order autocorrelation	.048	

Independent Variable: Business Effects

	B	beta
Lagsales	.871*	.871*
Lagbusiness	.030[c]	.141[c]
Proximity	-.162[d]	-.127[d]
Lag2business	-.035*	-.181*
Constant	1.338	
R^2	.798*	
Adjusted R^2	.782*	
Durbin-Watson	1.736	
First-order autocorrelation	.113	

Independent Variable: Other Responses

	B	beta
Lagsales	.906*	.906*
Lagresponse	.017	.127
Lag2response	-.027*	-.198*
Constant	.901	
R^2	.792*	
Adjusted R^2	.779*	
Durbin-Watson	1.789	
First-order autocorrelation	.104	

Note: Lagsales is the lag of the dependent variable, proximity is a dummy variable coded 0 before and 1 after the wedge arrived, barge is mentions of barging water, resp. is mentions of other responses to the wedge, lagbarge is the previous day's mentions of barging water, lagbusiness is the previous day's mentions of business consequences, lag2business is mentions of business consequences 2 days previously, lagresponse is the previous day's mentions of responses to the wedge, and lag2response is mentions of responses 2 days before.

* $p<.05$.

a. The analyses were corrected for first-order autocorrelation (AR1).

b. $p=.0784$.

c. $p=.0952$.

d. $p=.0585$. The F test for the increment due to proximity was 3.84 while an F of 4.08 is needed for significance at the .05 level. Including proximity in the model causes lag2business to become statistically significant.

Table 5.
Regression Analyses[a] of the Combined Effect of Media Mentions Concerning Busi Consequences, Barging Water and Other Responses on Sales of Bottled Water.

Dependent Variable: Natural Logarithm of the Gallons Sold Daily		
A. Television		
Independent Variables: Barging Water, Business Consequences, and Other Responses		
	B	beta
Lagsales	.831*	.831*
Proximity	-.133	-.105
Lagbarge	.594*	1.365*
Prox. * lagbarge	-.569*	-1.306*
Lagbusiness	.008	.038
Lag2business	-.013	-.067
Lagresponse	.019	.139
Lag2response	-.017	-.127
Constant	1.670	
R^2	.825*	
Adjusted R^2	.795*	
Durbin-Watson	1.901	
First-order autocorrelation	.040	

Note: Lagsales is the lag of the dependent variable, proximity is a dummy varia coded 0 before and 1 after the wedge arrived, lagbarge is the previous day's mentions barging water, lagbusiness is the previous day's mentions of business consequenc lag2business is mentions of business consequences 2 days previously, lagresponse is previous day's mentions of responses to the wedge, and lag2response is mentions of respor 2 days previously.

* p<.05.

a. The analyses were corrected for first-order autocorrelation (AR1).

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