AN EVALUATION OF THE PROTECTIVE ACTION DECISION MODEL USING DATA FROM A TRAIN DERAILMENT IN CASSELTON, NORTH DAKOTA

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ABSTRACT

This study was designed to answer the questions: a) What factors affected peoples' decision to evacuate or not evacuate after a train derailment and explosion in Casselton, ND; and b) What factors affected the amount of time people took to evacuate? A survey was designed using criteria from literature on the Protective Action Decision Model, and administered by telephone. Results of the survey were examined with correlation analysis. Nine factors were found to be significantly correlated with the decision to evacuate and two variables were found to be significantly correlated with evacuation time. Implications of these findings are discussed.

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DEDICATION

I would like to dedicate this thesis to Dr. Lawrence E. Burnett, who helped me develop the patience and perseverance necessary to complete a project like this one.

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CHAPTER ONE: INTRODUCTION

People everywhere are threatened by hazards – be they natural, technological or willful. An important element of community response to hazard events is protective action – that is, action taken to limit exposure to the event (National Resource Council, 2006). The most frequently undertaken form of protective action is evacuation, and most of the research on protective action focuses on evacuation (National Resource Council, 2006), although other types of protective action, including sheltering in place, may be more appropriate for certain hazards (e.g. Cova et al., 2009).

Understanding how people respond to warnings, how they process warning information, and why they decide to take the response actions they do are therefore important for those responsible for issuing warnings and protective action orders or recommendations. Although studies have yielded models of warning response and evacuation behavior, emergency management literature suffers generally from a failure to confirm or reject existing findings (Tierney, Lindell & Perry, 2001). This study will consider models of warning receipt and evacuation behavior in response to evacuation recommendations following a train derailment and explosion in Casselton, North Dakota.

Background

On December 30, 2013, at 2:11 PM Central Time, a westbound grain train derailed 13 cars at milepost 28.5 outside of Casselton, ND. Less than a minute later, an eastbound train carrying petroleum crude oil from the Bakken oil fields collided with the derailed grain train, causing a large explosion. Although the explosion occurred outside of town, concerns about the chemical content of the smoke from the explosion and changes in weather conditions led Casselton and Cass County authorities to recommend, first that Casselton residents stay inside at approximately 4:30 PM, and later that all Casselton residents evacuate the city at approximately 7:00 PM.

Residents received messages about the explosion and the subsequent evacuation recommendation through a variety of media, both official and unofficial. These included, but were not limited to: email listservs, social media (including Twitter and Facebook), CodeRED text messages sent by Cass County Emergency Management authorities, television news, and in-person communications with Casselton police officers. The National Transportation Safety Board (NTSB) estimates that approximately 1,400 of Casselton's 2,400 residents evacuated (or approximately 58.3%), and 1,000 stayed in their homes for the duration of the recommended evacuation (National Transportation Safety Board, 2014).

Although the Casselton explosion was a high-profile and dramatic event, drawing attention to safety concerns related to Bakken oil transportation, it was relatively small in scale, did not directly threaten any lives when it occurred, and Casselton and Cass County officials were prepared for and trained to manage it. Moreover, Casselton is a small, tight-knit community, where residents exhibit a large degree of trust and confidence in local law enforcement and emergency responders. These characteristics likely contributed to the success of the subsequent emergency response, while also reducing the number of factors that could confound this analysis. The Casselton explosion therefore represents an excellent opportunity to test existing models of warning receipt and protective action decision-making.

CHAPTER TWO: LITERATURE REVIEW

Explanations for why people chose how to respond to hazard events have evolved significantly since disaster research began. It was, for example, commonly assumed that people behaved irrationally during disasters – panicking, looting and abandoning their responsibilities (National Research Council, 2006). More recently, research into human behavior in disaster situations has revealed that people do in fact make rational decisions. The primary model developed to explain how people make decisions in response to hazard situations is the Protective Action Decision Model (PADM).

The Protective Action Decision Model

The PADM was generated through a combination of emergent norm theory (Turner & Killian, 1987) and general systems theory (Tierney, Lindell & Perry, 2001). The model is composed of a number of stages, as defined by Lindell and Perry (2012), although these stages vary somewhat across the literature (see for example: Tierney, Lindell & Perry, 2001). These stages are environmental and social context, psychological processes, situational impediments and facilitators, and feedback. These stages are moreover broken up in the following way. Within environmental and social context are sub-stages, including: environmental cues, social cues, information sources, channel access and preference, warning messages, and receiver characteristics; and within psychological processes: predecision processes (exposure, attention and comprehension), perceptional processes (of the environmental threat, alternative protective actions, and social stakeholders), and protective action decision making processes. (Lindell and Perry, 2012). See Figure 1 for a visual representation of the PADM. Each of these component sub-stages will be discussed in detail below.

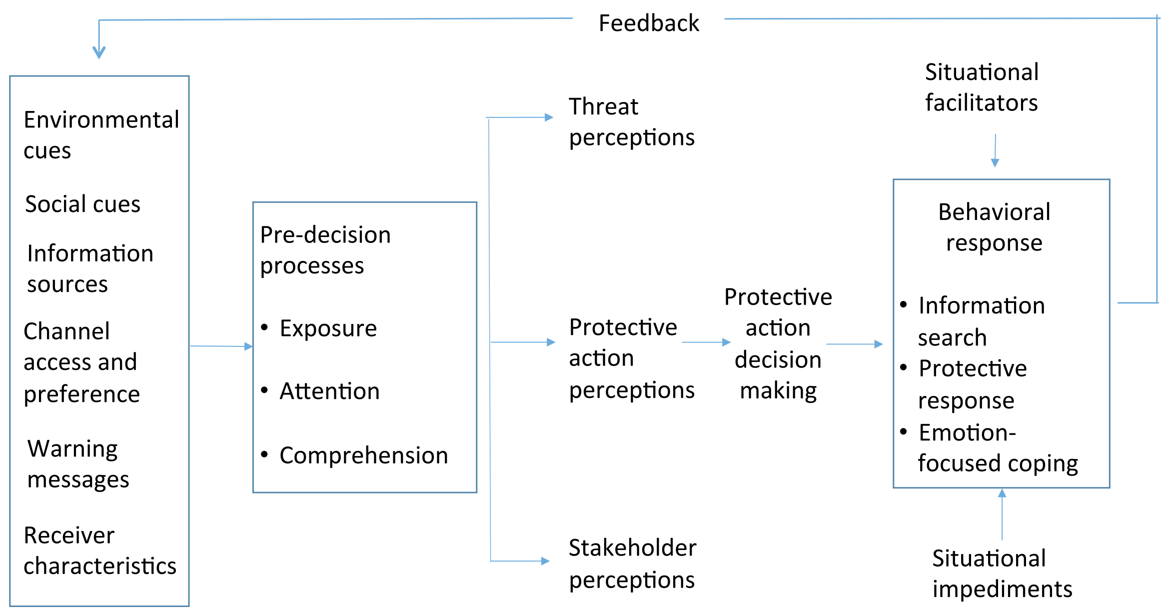

Figure 1. A visualization of the Protective Action Decision Model, modified from Lindell & Perry, 2012.

Environmental Cues

Environmental cues are "sights, smells, or sounds that signal the onset of a threat" (Lindell & Perry, 2012, p. 617). The absence of environmental cues or knowledge of environmental cues, even in the presence of warnings, may prevent people from taking appropriate action (Aguirre, 1988).

Social Cues

Social cues "arise from observations of others' behavior" (Lindell & Perry, 2012, p. 617). For example, if neighbors are seen evacuating, this information may be instructive to observers, and can signal that evacuation is the appropriate response to a threat.

Information Sources

Information sources may include authorities, news media, or peers (Lindell & Perry, 2012). “An original source can transmit a message by means of a broadcast process directly to ultimate receivers (e.g., households) and also by means of a diffusion process through intermediate sources who, in turn, relay messages to ultimate receivers” (Lindell & Perry, 2012, p. 618; Rogers & Sorensen, 1988; Aguirre, 1988). They play an important role in the warning process, as media (and household characteristics) may have a greater effect on evacuation than does the message content (Dash & Gladwin, 2007; Dow & Cutter, 1998). It should also be noted, “informal notification plays an important role in the warning dissemination in most emergencies” (Sorensen, 2000, p. 122).

Reliable or credible sources may allow people to skip confirmatory steps in the PADM (Lindell & Perry, 2012, p. 617). On the other hand, “[i]f individuals do not believe warnings are valid or the risk real, then the likelihood of response is decreased” (Dash & Gladwin, 2007, p. 70).

Channel Access and Preference

Channels may include “print (newspapers, magazines, and brochures), electronic (commercial radio and television, telephone, route alert (broadcast from a moving vehicle), tone alert radio, siren, and Internet), and face-to-face (dyadic conversation or group presentation)” (Lindell & Perry, 2012, p. 618). “Channels differ in characteristics such as dissemination rate and precision, penetration of normal activities, message specificity/distortion, sender and receiver requirements for specialized equipment, and feedback/receipt verification… Each channel has advantages and disadvantages, with channels that provide the fastest dissemination often providing the least information” (Lindell & Perry, 2012, p. 618). “People differ in their channel access and preference. For example, tornado warnings broadcast over an English-language radio station missed the population of Saragosa, Texas that routinely listened to Spanish-language stations" (Lindell & Perry, 2012, p. 618; Aguirre, 1988). Lindell et al. (2005) found that residents primarily use news media for information, but that evacuation was more closely correlated with having received information from peers and local authorities. "One important general finding is that a single warning concept will not equally serve the requirements of all hazards" (Sorensen, 2000, p. 120; Mileti & Sorensen, 1990).

On-site warnings are often an important channel for information dissemination. In the case of a tornado in Saragosa, Texas, "[t]here were no on-site emergency warning system or sirens. Moreover, there were no communications of the danger to the neighbors of Saragosa by public officials or community leaders" (Aguirre, 1988, p. 70). Different on-site warning technologies have various strengths and weaknesses: people do not know what sirens mean or do not pay attention to them, electronic media is variable in effectiveness depending on time of day, and route alert is constrained by number of available emergency personnel and size of area to be warned (Sorensen, 2000, p. 120).

Other warning technologies include: tone alert radio (TAR), which is reliable, highly personalized, and used by the NWS; and Emergency Alert System, which replaced the Emergency Broadcast System, requires participation of commercial broadcast stations and cable companies, and is flexible with respect to how the warning is broadcast and under what conditions it is deployed. Telephones may be deployed using computer technologies enabling rapid sequential auto dialing and switching equipment enabling simultaneous dialing. There are also systems available for people with hearing impairments (Sorensen, 2000, p. 120).

Warning Messages

"Warnings are messages that are transmitted from a source via a channel to a receiver, resulting in effects that depend on receivers' characteristics" (Lindell & Perry, 2012, p. 617). Peers may transmit information as informal warnings, or their behavior may act as a social cue for protective action (Lindell & Perry, 2012, p. 618; Baker, 1991).

There are a number of characteristics that are desirable in formal warnings. For example, formal warnings should include information that is relevant to recipients of the message. In the case of the Saragosa tornado, this did not occur: "The broad geographical locations used in the emergency weather announcements were difficult to interpret by the people of Saragosa. The emergency weather announcements could have been more effective if they had included the names of towns in the sublocalities at risk" (Aguirre, 1988, p. 70). Moreover, "the more specific, and less vague the warning, the more likely adaptive response occurs (Mileti et al. 1975). If warnings were heard and ultimately believed, then evacuation would be the end result" (Dash & Gladwin, 2007, p. 69). In addition, "Five specific topics that are important to include in assembling the actual content of a public warning message are the nature, location, guidance, time, and source of the hazard or risk. The style aspects that are important to include are message specificity, consistency, accuracy, certainty, and clarity" (Sorensen, 2000, p. 121).

In addition to a communicated message about risk, warnings are a social process that is affected by characteristics of the individual and community and relevant activities (Dash & Gladwin, 2007; Mileti et al., 1975; Nigg, 1993). It is important that warnings be integrated, that is, designed so that scientific monitoring and detection are melded "with an emergency organization that utilizes warning technologies coupled with social design factors to rapidly issue an alert and notification to the public at risk" (Sorensen, 2000, p. 120). Integration will necessarily vary with the type of hazard faced by a community.

Mileti and O'Brien note that "public response to communicated risk information is a direct consequence of perceived risk (understanding, belief and personalization), the warning information received (specificity, consistency, certainty, accuracy, clarity, channel, frequency, source), and personal characteristics of the warning recipient (demographics, knowledge, experience, resources, social network, cognition); and perceived risk is a direct function of both the warning information and personal characteristics of the warning recipient" (Mileti & O'Brien, 1992, p. 42). Understanding the context associated with the warning message as well as the necessary elements of a warning message are critical for developing effective emergency messaging.

Receiver Characteristics

Receiver characteristics "include … physical (e.g., strength), psychomotor (e.g., vision and hearing), and cognitive (e.g. primary and secondary languages as well as their mental models/schemas) abilities as well as their economic (money and vehicles) and social (friends, relatives, neighbors, and co-workers) resources" (Lindell & Perry, 2012, p. 617). In his discussion of receiver characteristics, White includes a socioeconomic dimension, including race, income, and age; a decision-maker dimension, including ability to process and understand information, and is broadly psychological in nature; and an environmental dimension, including knowledge of magnitude, frequency, duration and location of a hazard (Dash & Gladwin, 2007; White, 1994).

It is important to understand how individuals hear, understand, believe, personalize, confirm, and respond to warnings as one approach to warning evaluation (Dash & Gladwin, 2007; Mileti et al., 1975; Mileti & O'Brien, 1992; Mileti & Beck, 1975; Nigg, 1993; Mileti & Sorensen, 1990).

Predecision Processes

Predecision processes are "largely automatic processes that take place outside of conscious processing" (Lindell & Perry, 2012, p. 619; Fiske & Taylor, 2008).

Dash and Gladwin argue that "more research needs to focus on … what types of information are consciously considered in the evacuation decision-making process" (Dash & Gladwin, 2007, p. 74) – moreover, "decision making is composed of a series of sub-decisions as people evaluate the threat, the risk to themselves, and what they can do about it, adding complexity to the social process of evacuation decision making (Perry and Lindell, 1991)" (Dash & Gladwin, 2007, p. 70).

Predecision Processes: Exposure

Exposure refers to whether or not people receive information about the hazard event. Among other things, exposure is affected by channel: "For example, in many places along the Oregon coast, mountains prevent people from receiving signals from National Oceanographic and Atmospheric Administration Weather Radio transmitters" (Lindell & Perry, 2012, p. 619; Lindell & Prater, 2010).

Predecision Processes: Attention

Attention refers to whether or not people heed information. Attention depends in part on peoples' "expectations, competing attention demands, and the intrusiveness of the information" (Lindell & Perry, 2012, p. 619; Tierney, 2001). Attention is also affected by age, but it is unknown whether it is affected by other demographic characteristics (Lindell & Perry, 2012; Mayhorn, 2005).

Predecision Processes: Comprehension

Comprehension refers to whether or not people understand information. Comprehension depends, in part, on "whether the message is conveyed in words [people] understand" (Lindell & Perry, 2012, p. 619). "A warning message cannot be comprehended if it uses esoteric terms that have no meaning for those at risk" (Lindell & Perry, 2012, p. 619).

Perceptual Objects

Perceptual objects:

> "can elicit either automatic or reflective judgments, depending on the degree to which an individual has schemas that provide readily accessible and coherent beliefs about these objects … When someone has a schema – a generic knowledge structure defined by instances, attributes that differentiate these instances, and interrelationships among these attributes – beliefs about objects encompassed by that schema are rapidly accessed to produce an overall judgment that is congruent with the available information about the situation" (Lindell & Perry, 2012, p. 619).

It is important to understand peoples' hazard-related schemas, because "people will differ from each other in the comprehensiveness of their schemas about these objects. That is, some people will have highly differentiated schemas whereas others have poorly differentiated schemas about an object" (Lindell & Perry, 2012, p. 619).

Perceptual Objects: Threat Perceptions

The essential attributes of threat perceptions are probability, consequences, and possibly also dread and unknown risks (Lindell & Perry, 2012). Perceived risk has been conceptualized in terms of people's expectations of personal impacts (Lindell & Perry, 2012; Mileti & Peek, 2000; Mileti & Sorensen, 1987). "Expected personal impacts include death, injury, property damage, and disruption to daily activities such as work, school, and shopping" (Lindell & Perry, 2012, p. 620; Lindell & Prater, 2000). Most research has found that risk perception predicts response activities as well as long-term hazard adjustments for a variety of hazards (Sorensen, 2000; Lindell, 2013; Mileti & Fitzpatrick, 1992; Dash & Gladwin, 2007; Terpstra & Gutteling, 2008; Perry & Lindell, 2008), but there has been some disagreement (Lindell & Prater, 2000; Perry & Lindell, 2008; Lindell & Whitney, 2000; Mileti & Darlington, 1997).

Hazard intrusiveness is another important element of threat perceptions, that is: "the frequency of 'thoughts generated by the distinctive hazard-relevant associations that people have with everyday events, informal hazard-relevant discussions with peers, and hazard-relevant information received passively from the media'" (Lindell & Perry, 2012, p. 620). "Hazard intrusiveness is correlated with the adoption of earthquake hazard adjustments (Lindell & Prater, 2000; Lindell & Whitney, 2000) and expectations of participating in hurricane mitigation incentive programs (Ge, Peacock & Lindell, 2011)" (Lindell & Perry, 2012, p. 620). Both expected personal impacts and hazard intrusiveness are related to hazard experience, including recency, frequency and severity, all of which are in turn correlated with proximity to hazard source (Lindell & Perry, 2012, p. 620; Lindell & Prater, 2010; Ge, Peacock & Lindell, 2011). The effects of intrusiveness on response activities have not been studied to the extent that probability, consequences and dread have been.

Risk perception may be accurate or inaccurate (Lindell & Perry, 2012; Lindell & Earle, 1983; Arlikatti, Lindell, Prater & Zhang, 2006; Zhang, Prater & Lindell, 2004).
"Information from environmental cues and social warnings, together with prior beliefs about the hazard agent, produces a situational perception of personal risk that is characterized by beliefs about the ways in which environmental conditions will produce specific personal impacts"

(Lindell & Perry, 2012, p. 620; Baker, 1991; Dash & Gladwin, 2007). Hazard events are highly uncertain, and people have a difficult time estimating associated probabilities and understanding what options are available to them (Dash & Gladwin, 2007; Slovic et al., 1974).

Perceptual Objects: Protective Action Perceptions

Lindell and Perry (2012) conceptualize protective action perceptions using the Theory of Reasoned Action (TRA): "One's attitude toward an object (e.g., seismic hazard) is less predictive of behavior than one's attitude toward an act (seismic hazard adjustments) relevant to that object" (Lindell & Perry, 2012, p. 620; Fishbein & Ajzen, 2010). They can be summarized as actions having hazard-related or resource-related attributes (Lindell & Perry, 1992; Lindell & Perry, 2003; Lindell & Perry, 2000, Lindell, Arlikatti & Prater, 2009). Protective action perceptions are affected by perceived effectiveness (Mulilis & Duval, 1995), cost (Kunreuther, 1978), required knowledge (Davis, 1989), and utility for other purposes (Russell, Goltz & Borque, 1995). Hazard-related attributes strongly positively correlated with adoption intention and actual adoption (Lindell & Whitney, 2000; Lindell & Prater, 2002; Terpstra & Lindell, 2013) Resource-related attributes negatively correlated with adoption and intended adoption (i.e., as cost increases, adoption decreases) (Lindell, Arlikatti & Prater, 2009).

Perceptual Objects: Stakeholder Perceptions

Stakeholders include "authorities (federal, state, and local government), evaluators (scientists, medical professionals, universities), watchdogs (news media, citizens' and environmental groups), industry/employers, and households" (Lindell & Perry, 2012, p. 620; Drabek, 1986; Pijawka & Mushkatel, 1991; Lang & Hallman, 2005).

Some stakeholders have power to influence other stakeholders. There are six bases of this power: reward, coercive, expert, information, referent, legitimate power (Raven, 1964; Raven, 1993).

Reward and coercive bases of power consist of regulatory approaches, and require constant "surveillance to ensure rewards are received only for compliance and that punishment will inevitably follow noncompliance" (Lindell & Perry, 2012, p. 621; Raven, 1993). Expert power requires understanding cause and effect relationships in the environment. Information power requires knowledge about states of the environment. Referent power is defined by a person's sense of shared identity with another, related to that person's trustworthiness (Eagly & Chaiken, 1993). Trust power includes fairness, unbiasedness, willingness to tell the whole story, and accuracy (Meyer, 1988). Legitimate power consists of rights and responsibilities associated with each role in a social network (French & Raven, 1959).

Protective Action Decision-making

As discussed above, "Contrary to widespread belief, panic rarely occurs. Instead, protective action decision-making is often a reflective process that assesses the available information about the threat, alternative protective actions, and social stakeholders to choose a behavioral response. The research literature suggests that inappropriate disaster responses are more frequently due to inadequate information than to defective cognitive processing" (Lindell & Perry, 2012, p. 619; Tierney, 2001). Response varies with warning source, content, warning belief, sender characteristics and receiver characteristics (Dash & Gladwin, 2007; Mileti et al., 1975; Sorensen & Vogt-Sorensen, 2006).

Protective Action Decision-making: Risk Identification

In order for people to begin the protective action decision-making process, they must decide the environmental conditions are abnormal, but they tend not to do this even in the face of evidence that it is (Janis & Mann, 1977; Mileti, 1975; Perry, 1979; Drabek, 1986). Response increases as threat belief increases in a number of different hazard types (Perry, Lindell &

Greene, 1981; Mileti, 1975; Perry & Greene, 1983; Perry & Hirose, 1991; Lindell & Perry, 1992; Baker, 1991; Blanchard-Boehm, 1998; Houts, Cleary & Hu, 2010; Perry, 1983).

Protective Action Decision-making: Risk Assessment

Risk assessment is: "The process of determining expected personal impacts that a disaster could cause" (Perry & Lindell, 2012, p. 621; Mileti & Sorensen, 1987; Perry, 1979). Entailed in risk assessment is the process of assessing personal relevance (Lindell & Perry, 2012; Eagly & Chaiken, 1993). This process may result in motivation to take disaster response or long-term hazard adjustment (Lindell & Perry, 2012; Fritz & Marks, 1954; Perry, 1983b). Time associated with the risk, in the immediacy of the risk, the amount of time associated with forewarning, and the amount of time between warning or detection and disaster onset, is an important factor that may either encourage or discourage action (Perry & Lindell, 2012). Longer forewarning results in more information seeking and expedient property protection (Lindell & Perry, 2012; Perry, Lindell & Greene, 1981; Lindell, Lu & Prater, 2005). However, "the time people spend in responding to a warning depends on the perceived urgency of the threat" (Sorensen, 2000, p. 122). Although immediacy tends to increase protective action, there is an inherent tradeoff between the ability to confirm information or take property protection and the ability to take appropriate personal protective actions (Lindell & Perry, 2012; Lindell & Prater, 2005).

Risk perception is another important factor associated with protective action. Risk perception is characterized by the probability of events and magnitude of their consequences (Kasperson et al., 1988); by its social meaning, including dread, angst, concern or anxiety (Jaeger et al., 2001); or by a social concept, including context, culture and interpretations of danger (Dash & Gladwin, 2007; Turner, 1979; Tierney, 1994; White, 1994).

Personalization of risk is also an important factor. Dash (2002) personalized risk index questions: 1. "As it approached, how dangerous did Hurricane Georges seem to you then, in terms of death and serious injury?" and 2. "How concerned were you about damage or destruction to your home when Georges approached?" Gender may affect personalization of risk (Bateman & Edwards, 2002). The "crying wolf" phenomenon is largely absent from evacuation decision-making (Dow & Cutter, 1998; Morrow & Gladwin, 2005), and generally, risk perception has a more pronounced effect than personal experience (Dow & Cutter, 1998; Dash & Morrow, 2000)

Protective Action Decision-making: Protective Action Search

Protective action search "involves retrieving one or more feasible protective actions from memory or obtaining information about them from others" (Lindell & Perry, 2012, p. 622). It may involve personal knowledge of the hazard, observing social cues, vicarious experience, disaster warnings and hazard awareness programs – which, if well designed, include guidance. Many warning messages, however, contain inadequate guidance (Mileti & Sorensen, 1987).

Protective Action Decision-making: Protective Action Assessment

Protective action assessment "involves examining alternative actions, evaluating them in comparison to the consequences of continuing normal activities, and determining which of them is the most suitable response to the situation" (Lindell & Perry, 2012, p. 622). The end result of protective action assessment is an adaptive plan. Adaptive plans are sometimes vague and sometimes highly detailed (Lindell & Perry, 2012; Lindell, Kang & Prater, 2011).

Protective Action Decision-making: Protective Action Implementation

Protective action implementation occurs after all questions about risk reduction have been answered satisfactorily (Lindell & Prater, 2012). The tendency for people to procrastinate raises questions about whether it is possible to delay protective action without sacrificing effectiveness (Lindell & Prater, 2012).

Protective Action Decision-making: Information Needs Assessment

Information needs assessment occurs when time is perceived to be available and when information needs are perceived to have not been met sufficiently (Lindell & Perry, 2012; Perry, Lindell & Greene, 1981; Perry & Greene, 1983; Southern California Earthquake Center, 2011). Information that may be necessary include risk certainty, risk severity, risk immediacy, logistical support for protective actions including evacuation routes, destinations, modes of transportations, and arrangements for pets and family members with major medical needs (Lindell & Perry, 2012, p. 623).

Protective Action Decision-making: Communication Action Assessment

Communication action assessment involves "information source selection and information channel selection … [constituting] an information search plan." Information sources may be unavailable for disaster-related reasons (Lindell & Perry, 2012, p. 623; Drabek, 1969; Lindell & Perry, 1993).

Protective Action Decision-making: Communication Action Implementation

If information is needed immediately, people will seek information through most appropriate channel (Lindell & Perry, 2012; Drabek, 1969; Drabek & Stephenson, 1971). Information seeking depends on location specificity and time specificity of threat (Lindell & Perry, 2012).

Situational Facilitators

Situational facilitators are any factors that make an individual more likely to take protective action. Situational facilitators are less common than situational impediments (Lindell & Perry, 2012).

Situational Impediments

Situational impediments may be conceptualized as the cause or causes of lack of correspondence between intentions and behavior (Lindell & Perry, 2012). Examples of situational impediments include: lack safe space to evacuate or safe route to evacuate, lack access to a personal vehicle, lack of personal mobility due to physical disabilities (Heath, Kass, Beck & Glickman, 2001; Van Willigen, Edwards, Edwards & Hessee, 2002, Lindell & Perry, 2012).

Behavioral Response: Information Search

Information response refers to "Receipt of specific information about what to do to get ready was the most important information in predicting action. The most significant information that creates uncertainty may not be information about risk, but rather information that helps to clarify ambiguity about subsequent action" (Mileti & Darlington, 1997).

Mileti and Darlington describe Turner and Killian's work, writing "searching is characteristic of people caught up in uncertainty which blocks meaningful action. Searching results in "milling" with others, which leads to new definitions of risks. Milling allows time for interpreting symbols and substitutes meaning for ambiguity" (Mileti & Darlington, 1997, p. 89).

An important element of information search is disaster culture, which Mileti and Darlington (1997) describe in the following way:

"cultural defenses developed to cope with recurrent dangers… includes "those adjustments, actual and potential, social, psychological, and physical, which are used by residents of such areas to cope with disasters which have struck or which tradition indicates may strike in the future" (Moore 1964:195). It also includes norms, values, beliefs, knowledge, technology, and legends about disasters" (Mileti & Darlington, 1997, p. 91), information received ("elicits problem solving behavior when it: provides guidance about what to do (Drabek and Boggs, 1968; Greene et al., 1981; Mileti and O'Brien, 1992; Quarantelli, 1984); is distributed over multiple communication channels (Rogers, 1985; Turner et al., 1981); is consistent and received over multiple messages (Demerath, 1957; Keeney & von Winterfeldt, 1986; Mileti & Beck, 1975); and is confirmed by cues such as seeing others getting ready (Farley et al., 1993; Mileti & Fitzpatrick 1992, 1993)" (Mileti & Darlington, 1997, p. 91), information search, risk (both perceived and objective risk, and concern), motives ("to "reestablish meaning and to restore the flow of interaction that had been interrupted or put into question" (Spector & Kisuse, 1987, p. 92)" (Mileti & Darlington, 1997, p. 92), social position ("membership in social categories [e.g. race, gender, and age] might foster selective information gathering during interaction" (Mileti & Darlington, 1997, p. 93).

Behavioral Response: Protective Response

Protective response refers to the actual protective action taken (Kuligowski, 2013). It is the outcome the PADM seeks to explain.

Behavioral Response: Emotion-focused Coping

Emotion-focused coping may manifest in a number of ways, and may negatively influence the decision to take protective action. "Emotion-focused coping strategies, including threat denial, wishful thinking, and fatalism, can impede the adoption of hazard adjustments, such as hazard mitigation, emergency preparedness, and hazard insurance purchase (Grothmann & Reusswig, 2006; Rochford & Blocker, 1991)" (Lindell & Hwang, 2008).

Feedback

After the protective action decision-making process has been undertaken, or while it takes place, feedback occurs when additional information about the hazard event is acquired, causing the individual to go through the steps of the PADM again (Kuligowski, 2011). This element of the model is a result of the non-linear and complex nature of the protective action decision-making process.

Additional Components of the Protective Action Decision Process

In addition to the stages as defined above, Tierney, Lindell and Perry (2001), whose model is based on Lindell and Perry (1992), identify a number of additional variables, most of which are demographic, which affect the protective action decision process. In this version of the model, Recipient Characteristics, including prior beliefs, experience, education, adaptive plan, personality traits, and personal resources; and Social Context, including family contact, kin relations, community involvement, ethnicity, age and socioeconomic status, are also included (Tierney, Lindell & Perry, 2001).

How Do People Decide to Take Protective Action?

Research has identified a number of factors that affect peoples' decision to take or fail to take protective action. Lindell (1994) found that "perceived impact characteristics mediated the relationship between characteristics of the hazard agent characteristics and expected personal impacts." (Lindell & Perry, 2012, p. 626). Huang, Lindell and Prater (2012) found that "perceived storm characteristics (local landfall, major intensity, and rapid onset) partially mediated the effects of coastal proximity and hurricane experience on expected personal impacts (surge damage, inland flood damage, storm wind damage, and casualties), which, in turn, had a direct effect on evacuation decisions" (Lindell & Perry, 2012, p. 626). Previous experience (Hutton, 1976; Baker, 1979; Perry & Greene, 1982; Sorensen et al., 1987) and geographic location (Simpson & Riel, 1981) have also been shown to influence evacuation decision-making (Dash & Gladwin, 2007).

In addition, demographic factors have been found to have an effect on protective action decision-making:

> "Historically, factors such as age of the decision maker (Mileti et al. 1975; Gruntfest et al., 1978; Perry, 1979), presence of children or elderly in the household (Carter et al., 1983; Gladwin & Peacock, 1997), gender (Bolin et al., 1996; Fothergill, 1996; Bateman & Edwards, 2002), disability (Van Willigen et al., 2002), race and ethnicity (Drabek & Boggs, 1968; Perry et al., 1982; Perry & Mushkatel, 1986), and income (Schaffer & Cook, 1972; Sorensen et al., 1987; Bolin, 1986) have all been shown to influence evacuation outcomes" (Dash & Gladwin, 2007, p. 72).

Emergent norm theory, the idea that "development of situational norms and expectations that arise as a function of some crisis or change in the social or physical environment that renders traditional norms inappropriate" (Perry et al., 1981, p. 27), also affects protective action decision-making. Variables associated with emergent norm theory that might influence evacuation decision-making include: threat seen as real, level of perceived risk, having an adaptive plan, and having all family members accounted for (Perry et al., 1981). There is, however, some question about the degree to which decision-making is a social process, and how, as a social process, it should be measured (Perry et al., 1981; Gladwin & Peacock, 1997).

Gladwin and Peacock (1997) found that predictors of evacuation were: being in an evacuation zone, having demographic factors associated with small households, not having elders, having children, and not living in a single-family dwelling; but they did not include measures of risk perception (Dash & Gladwin, 2007). They also found that evacuation was influenced by length of residence in hazard area, household income, and race (Gladwin & Peacock, 1997).

Whitehead et al. (2000) considered objective and perceived risk, as well as social, economic, and risk variables (including income, gender, race and the presence of a pet in the household). Dash (2002) found that prioritizing doing what was best for them even if authorities said otherwise decreased evacuation likelihood, knowing an evacuation order had been issued increased likelihood of evacuation, having evacuated for an earlier hurricane increased evacuation likelihood, having an evacuation plan increased evacuation likelihood, large family size decreased evacuation likelihood, and having small children increased evacuation likelihood.

Lindell and Perry (1992) developed a four-stage process of decision-making: risk identification, risk assessment, risk reduction, protective response. In contrast, Mileti and Sorensen (1990) developed a sequential process model of decision-making: hear warning, understand contents of warning message, believe warning credible and accurate, personalization, confirmation that warning is true and others are acting, response with protective action.

With respect to the PADM generally, it should be noted that "if risk area residents have only very diffuse conceptions of seismic threat, then a global construct such as concern might be a more accurate characterization of their beliefs than the specific dimensions assumed by PADM" (Lindell & Perry, 2012, p. 626).

Protective Action in Technological Disasters

Most of the studies evaluating the protective action decision-making process concern natural disasters (e.g. hurricanes, floods). A smaller body of literature concerns protective action decision-making following technological, or manmade, hazard events. These types of events have been found to occur more frequently where there is a greater concentration of hazards (including, for example, railroad miles, chemical plants and hazardous waste facilities) (Cutter & Minhe, 1997), and to occur increasingly in conjunction with natural hazards (Sengul et al., 2012). Studies on technological hazards have also found that governments tend not to utilize lessons learned in earlier events (Sylves & Comfort, 2012), and not to employ an adequate number of mitigating tools to avoid some of the risks associated with technological hazards (Osland, 2013).

Many of the variables in studies considering technological hazards are similar to the variables described in the Protective Action Decision Model (Lindell, 2000; Mileti & Peek, 2000), including threat perceptions (Zeigler et al., 1981; Johnson, 1985), content of warning messages (Zeigler et al., 1981), information sources (Zeigler et al., 1981), social cues (Zeigler et al., 1981), and situational impediments (Zeigler et al., 1981; Johnson, 1985). Some of these studies also include novel variables, which arguably do not fit within the Protective Action Decision Model. These variables include attitudes toward the threat generally (e.g. nuclear power) (Zeigler et al., 1981; Johnson, 1985), warnings issued from utility companies and other organizations involved in the technological hazard event (Zeigler et al., 1981), and the location of home with respect to the event (Johnson, 1985). Other studies also describe the conditions necessary for officials to issue an evacuation order or recommendation following a technological hazard event (Lindell, 2000; Sorensen, Shumpert & Vogt, 2004).

Evacuation Timing

Previous research has also considered how people choose to time their evacuations. Fewer factors have been linked to this decision-making process than to the process of deciding which protective action to take, however, and there is no model for this process like the PADM. Sorensen (1991) found that the only factor that was significantly related to warning time is the personalization of the warning message received. Other researchers have found that the seriousness of the threat and the urgency of the situation are significantly related to evacuation timing decisions (Sorensen and Mileti 1989). Previous research has also found that there is a great deal of variability in evacuation timing for a single event (Burton 1981; Rogers and Sorensen 1989).

Summary and Research Objectives

In light of the findings of previous researchers, this study was designed to address two questions. First, which variables are related to the decision to evacuate or not to evacuate? Second, which variables are related to the amount of time required to decide to evacuate? The next chapter will discuss the methods used to answer these questions.

CHAPTER THREE: RESEARCH METHODS

In order to address the research objectives described in Chapter Two, this chapter describes the research tools and methodologies that were used. The first section describes how the sample was selected. The second section describes how data were collected. The third section describes how the survey was designed. The final section describes how data were analyzed.

Population and Sampling

The population for this study was all households in Casselton, North Dakota. This study was a census of all households in Casselton, ND with a publicly listed telephone number. The process of identifying these households involved examining the Fargo-Moorhead area telephone directory and locating all the residential (i.e. non-business) phone numbers in Casselton. A total of 409 phone numbers were located.

Data Collection

The method of data collection for this study was a telephone survey. This was a cross-sectional survey, meaning that the information was collected at one point in time for each respondent, instead of over a period of time (Creswell, 2003). Using a survey (as opposed to a qualitative interviewing method) provides quantitative data with respect to trends, attitudes or opinions of a population by studying a sample of that population (Babbie, 1990; Creswell, 2003, p. 153). In general, surveys may be conducted via telephone, mail or internet.

The data for this study were collected using a telephone survey. Based on the study population, using an internet survey methodology was deemed inappropriate, because a comprehensive, or even representative, list of email addresses for potential respondents was not available. In spite of some of the methodological problems associated with conducting a telephone survey (discussed below), this method was chosen over a mail survey because of the relatively greater speed with which responses can be collected.

There are a number of disadvantages associated with conducting a telephone survey. Telephone numbers may be hard to collect because many households do not have a landline telephone, or do not publicly list their telephone number. In this case, 409 phone numbers were available in the telephone directory, representing approximately 47% of the 874 households in Casselton identified in the 2010 U.S. Census (U.S. Census Bureau). In addition, Dillman et al. (2009) discuss new cultural difficulties associated with the rise of telemarketers and the Do Not Call Rule (Dillman et al., 2009, pp. 7-10). In addition to the fact that fewer potential respondents may be reached through a telephone survey, the individuals available for surveying may introduce bias into the sample, because characteristics associated with having a landline phone and listing it in the telephone directory may be associated with other characteristics that may be related to survey responses. In spite of these difficulties, a telephone survey remained the most efficient and straightforward method of data collection.

Before seeking the approval of the Institutional Review Board (IRB), the survey was pre-tested with two Casselton residents who qualified for participation in the study to ensure that the survey instrument was free of error, omission, grammatical problems, vague or confusing wording, missing options, offensive or biased wording, and other problems.

Feedback from the pre-tested Casselton residents prompted a few changes to the survey instrument. To avoid the potential issue of interviewers accidentally skipping questions inappropriately, the survey was transferred to an online format using SurveyMonkey.com, which automates skipping questions using programmed logic for specific responses to certain questions. Some questions, including a question about information sources used, were rewritten so that respondents were read a list of options, instead of volunteering open-ended responses. Finally, one of the pre-test respondents noted that some members of their household had evacuated but others had not. A series of questions was added to allow this response to the evacuation question. After these adjustments were made, an IRB protocol was submitted to the IRB at NDSU and approval was received. See Appendix A for a copy of the IRB approval letter for this study.

In order to assist in data collection, two undergraduate emergency management students were hired to make telephone calls. These students took IRB training before they began making calls. Casselton residents were called on weekdays between 11 AM and 3 PM, and 7 PM and 9 PM; on Saturdays between 11 AM and 5 PM; and on Sundays between noon and 5 PM. Potential respondents were called for approximately two weeks, until all available phone numbers had been called at least once, and up to twice if no one had answered on the first attempt, although due to time constraints, the majority of phone numbers were only called once.

Data collection ended on March 16, 2015. As of that date, 102 people declined to take the survey, 74 numbers were disconnected, 183 people were never successfully reached, and 50 people were surveyed, resulting in a 14.9% participation rate (50 out of 335).

Privacy and Confidentiality

All respondents were promised confidentiality. The researchers were the only individuals with access to information obtained from the survey. For the potential use of this data for future work, identification numbers were randomly assigned to each potential respondent, which corresponded to a name, phone number and address. It is hoped that this data could be used to understand the relationship between the decision to evacuate and actual (rather than perceived) distance from the incident site. This information, however, was not used in data analysis. No additional personally identifying information was collected about survey participants during the survey. Following the completion of data analysis (including calculating the actual distance between respondent's home location and the incident site) and the development of a report of the research findings, all personally identifying information was destroyed.

Survey Design

The survey instrument was designed using Dillman et al.'s (2009) guidelines for choosing words and writing questions for surveys, and with the ultimate goal of doing correlation analysis in mind. In order to conduct correlation analysis, it is necessary to formulate questions so that they may be answered numerically and at an appropriate level of measurement. The following guidelines for writing good survey questions, from Dillman et al. (2009), are designed to improve comprehension and accuracy in responses:

- Make sure the question applies to the respondent
- Make sure the question is technically accurate
- Ask one question at a time
- Use simple and familiar words
- Use specific and concrete words to specify the concepts clearly
- Use as few words as possible to pose the question
- Use complete sentences with complete sentence structures
- Make sure "yes" means yes and "no" means no
- Be sure the question specifies the response task (Dillman et al., 2009, pp. 79-89)

The measures in this study are presented below, and have been designed to follow these guidelines. Each of the following categories represents a component of the Protective Action Decision Model that survey questions were designed to address. A copy of the survey, as it appeared on SurveyMonkey.com, is available as Appendix B.

Environmental Cues

To address whether or not survey respondents had used environmental cues in their process of protective action decision-making, participants were asked, "Did you see, hear or smell any evidence of the train incident in person?"

Social Cues

To determine whether or not survey respondents had used social cues in their process of protective action decision-making, participants were asked, "Did you see people behaving in a way that made you think there had been a serious incident?"

Information Sources

To determine which information sources survey respondents had used, participants were read a list of sources and which ones they used. The information sources listed were: television news, radio news, Facebook, Twitter, other forms of social media, local news websites, information from family and friends, and communications from local authorities. Participants were also asked if they had used any other information sources. For each information source used, participants were asked how much they trusted that source on a scale from 1 to 5, with 1 being "did not trust at all" and 5 being "trusted completely."

Channel Access and Preference

In order to understand whether or not participants had access to the information channels they most preferred, they were asked to identify any information sources they wanted to get information about the incident from, but could not. Channel access was also measured with the question, "Did local authorities contact you or a member of your household face to face to inform you about the incident?"

Warning Messages

The researcher was interested in a few questions related to warning messaging for this incident. First, did Casselton residents receive the warning? If so, how many warning messages did they receive? If more than one message was received, participants were asked if the messages conflicted or were consistent. They were also asked whether the content of the warning messages was clear, if it was specific, and if it made them think the threat from the incident was likely to affect them personally.

Receiver Characteristics

Participants were asked a number of questions about themselves in terms of traditional and extended demographic variables. With respect to traditional demographic variables, participants were asked about the gender and age compositions of their households, the highest level of education anyone in their household had achieved, and how long they had lived in or near Casselton. Participants were also asked a number of other, less traditional demographic questions. These included, “Do you own any pets, and if so, how many and what kinds?”, “About how far, in miles, do you live from where the incident occurred?”, “Did you have access to a vehicle at the time of the incident?”, and “Do you or does anyone in your household have any physical, vision, hearing or cognitive impediments?”

Exposure and Attention

For the purposes of this study, and based on the nature of the event itself, the researcher assumed that levels of exposure and attention to the incident among participants were high.

Comprehension

In order to assess comprehension of the threat to them, specifically with respect to the warning messages they heard (if they did receive a warning message), participants were asked, “Based on the warning message or messages you received, did you know what the threat from the incident was?” They were also asked, “Based on the warning message or messages, did you know what actions you were being asked to take?” Participants were also asked to describe the actions the warning messages told them to take, and their responses were compared to the official warning to determine whether they had understood the messages accurately.

Threat Perceptions

Participants were asked a number of questions designed to address their perceptions of the threat from the train derailment. Respondents were asked whether they had heard of a train-related hazardous materials incident like the one that happened in Casselton happening somewhere else. Respondents were also asked to identify their level of concern on a 5-point Likert scale, with a value of 1 corresponding to “not at all concerned” and a value of 5 corresponding to “extremely concerned,” about the possibility of an incident like the one that occurred happening near them, and about the possibility of an incident like the one that occurred impacting them personally. Respondents were also asked whether they had taken any precautions to protect themselves from an incident like the one that occurred. Finally, participants were asked how far their home is from where the incident occurred. For the purposes of this study, the reported distance was not compared to the actual distance, but future work could compare the two distances to determine whether there is a relationship between the accuracy of participants’ responses (or, more precisely, the direction of inaccuracy: that is, whether participants believed they lived closer to or farther from the incident than they actually did) and the decision to evacuate.

Protective Action Perceptions

Based on the nature of this incident, and the nature of the available protective actions (either evacuate or shelter in place), questions about protective action perceptions were not asked explicitly of participants.

Stakeholder Perceptions

In order to determine how participants perceived local authorities, they were asked, to rate, on a scale from 1 to 5, where 1 is "not at all" and 5 is "completely," how much they trusted the authorities who issued warnings and evacuation recommendations. Participants were asked the same question if they responded that they had gotten information about the incident from local emergency authorities.

Risk Identification and Assessment

With respect to the risks related to the incident, participants were asked both about what the risks they believed they faced were, and how dangerous those risks were. Participants who reported having received warning messages were asked if they knew, based on the warning message, what the threat from the train derailment was. All participants were also asked to rate how dangerous the incident seemed to them personally, on a scale of 1 to 5 where 1 is "not dangerous at all" and 5 is "extremely dangerous," after the incident occurred.

Protective Action Search

Participants were asked a number of questions to determine how they sought out information about determining appropriate protective action. If participants reported having received a warning message, they were asked, "Did the warnings you received tell you what actions to take?" and if they responded affirmatively, they were also asked what actions the warning messages told them to take. Participants were also asked if they knew what they would do if a hazardous materials incident occurred near them, and if they had participated in any hazard education programs to help them determine what actions to take in the event of a serious incident, before it occurred. These questions was designed to help the researchers determine whether the participants had done a protective action search prior to the incident.

Information Needs Assessment

In order to address what information participants felt they needed but did not receive from warnings, they were asked, “What information, if any, did you look for that was not included in the warning or warnings?”

Communication Action Assessment and Implementation, and Information Search

In order to determine how and whether participants took action to communicate with others about the incident, and the source or sources they used to do this, they were asked, “Did friends, family members or neighbors tell you what to do, or did you discuss what to do with them, following the incident?” If they responded affirmatively, they were then asked what they were told to do. Participants were also asked if they engaged in a similar, but passive, type of communication action: “Did you pay attention to what [family members or neighbors] did following the explosion?” Again, if they responded affirmatively, they were asked what the participants saw them doing.

Situational Facilitators and Inhibitors

Participants were asked several questions in order to determine whether specific facilitating or inhibiting factors were part of their protective action decision-making process. Two of these questions (“Do you or does anyone in your household have any visual, hearing, cognitive or physical disabilities?” and “Did you have access to a vehicle at the time of the incident?") overlap with receiver characteristics. Finally, if participants indicated that they had wanted to evacuate but had not evacuated, they were asked why they had not evacuated.

Protective Action Decision

Participants were asked a number of questions about their protective action decision. First, they were asked whether everyone in their household evacuated. If the participant responded that everyone had evacuated, they were then asked how long it had taken them to decide to evacuate after receiving the evacuation recommendation (0-1 hours, 1-2 hours, 2-3 hours, or more than 3 hours), and where they had evacuated to (the designated evacuation location, Discovery Middle School; a friend or family member's house; a motel or hotel; or another location). If the respondent reported that everyone in their household had not evacuated, they were asked if anyone in their household evacuated. If respondents reported that some, but not all, members of their household evacuated, they were asked which members of their household evacuated, and why the members who evacuated had done so.

Statistical Analysis

Due to the preliminary nature of the data collected in this research, and the dichotomous nature of the primary dependent variable, evacuation decision, correlation testing was deemed the most appropriate type of statistical analysis. An inter-correlation matrix was also created and is included as Appendix D. After the correlation analyses were run, the variables that were significantly correlated to decision to evacuate were analyzed using stepwise regression.

Reliability

To the extent that multiple variables were designed to measure the same component of the Protective Action Decision Model, they were indexed and tested with Cronbach's Alpha. Cronbach's Alpha measures the level of internal consistency (or reliability) for scores among three or more equivalent items (Wright, 1979, p. 47). Higher consistency among variables will result in a higher Cronbach's Alpha. Values for Cronbach's Alpha range between 0 and 1 (Green & Salkind, 2011, pp. 325-327). All variables which were grouped together theoretically (as discussed in Chapter Three) were tested for internal consistency. There were no cases in which three or more variables had a Cronbach's Alpha score greater than .7 and enough observations to draw meaningful conclusions. One pairs of variables were recoded, however, based on their correlation. This pair was General Concern Pre-Incident and Personal Concern Pre-Incident, which had a correlation of .810, which was significant at the $p < .001$ level. These variables were combined to create the variable Concern Pre-Incident.

CHAPTER 4: DESCRIPTIVE STATISTICS

This chapter describes the data collected in the Casselton survey. The first section describes the study's sample profile. The second section presents descriptive statistics of the variables associated with components of the Protective Action Decision Model. The final section describes the study population's responses to the derailment and evacuation recommendation. See Appendix C for frequency tables of all the variables included in this analysis.

Sample Profile

The majority of respondents to this survey were female (54%). Respondents were members of households with an average of 2.46 members, ranging from one member to eight members (SD = 1.61). The survey did not ask for an exact age, but respondents reported ages ranging from 20-29 to over 70. Thirteen households had children under 18, representing 26% of the respondent households. Twelve households had children under 12, representing 24% of respondent households. Eight households had children under 5, representing 16% of respondent households. A majority of respondents, 60%, reported that their household did not have a pet at the time of the incident. The average number of pets in pet-owning households was 1.56 (*SD* = .71). Regarding the highest level of education achieved by a member of the household, 10% had some high school education, 20% had some college or technical school education, 18% had graduated technical school, and the majority, 52% of participants, had a Bachelor's degree or higher. See Table 2 for a comparison of the survey sample to census data for Casselton in 2010.

Table 1. Comparisons of sample characteristics to census characteristics (US Census, 2010)

Characteristic	*Sample N*	*Sample Percentage*	*Census N*	*Census Percentage*
Sex (Female)	27	54	1,133	48.6
Age (20-29)	1	2	200	8.4
Age (30-39)	5	10	346	14.9
Age (40-49)	19	34	372	16.0
Age (50-59)	12	24	282	12.2
Age (60-69)	9	18	173	7.4
Age (Over 70)	4	8	173	7.4
Had child under 18 years old	18	36	812	34.9

Elements of the Protective Action Decision Model

This section describes the extent to which survey respondents experienced the various phases of the Protective Action Decision Model as described in Chapter 2.

Environmental Cues

A majority of respondents reported having seen, heard, or smelled evidence of the train incident in person (62%). Of those who reported having been in Casselton (68% of the respondents), the proportion of respondents was even higher, at 76.5%. Of those who reported not having been in Casselton, only 31.3% reported having seen, heard or smelled evidence of the train incident in person.

Social Cues

A greater percentage of respondents (70%) reported having seen people behaving in a way that made them think there had been a serious incident. Of those who reported having been in Casselton, 82.4% reported having seen people behaving in a way that made them think there had been a serious incident, whereas of those who reported not having been in Casselton, it was 43.8%.

Information Sources

Respondents were asked whether or not they had looked for information about the train incident from the following sources: TV news, radio news, Facebook, Twitter, any other type of social media, family or friends, communications from local authorities, and local news websites. If they reported using an information source, they were also asked how much they trusted that source on a scale of 1 to 5, with 1 being "do not trust at all" and 5 being "trust completely." The most frequently reported information source used was TV news, which 82.9% of people reported using, and the most highly trusted source was local news websites (M= 4.46, SD = 1.10). A more detailed description of this data is presented in Table 2. Local news websites were used by 24 participants (48%), family and friends were used as an information source by 23 participants (46%), radio news was used by 16 people (32%), local authorities were used by 15 participants (30%), and Facebook, the least frequently used information source, was used by 10 participants (20%). See Table 2 for the central tendencies for level of trust in each of these sources.

Table 2. Central tendencies for information sources level of trust

Information Source	*Mean*	*SD*	*Skewness*	*Kurtosis*
Local news website	4.46	1.10	-2.12	3.84
TV news	4.26	1.14	-1.74	2.53
Local authorities	4.13	1.19	-1.47	2.09
Family and friends	4.04	1.15	-1.28	1.08
Radio news	3.63	1.15	-0.96	0.46
Facebook	2.80	1.48	0.43	-1.07

Channel Access and Preference

No respondents reported not having been able to get information from a particular source that they wanted to use. Channel access was also measured with the question, "Did local authorities contact you or a member of your household face to face to inform you about the incident?" A minority of respondents (20%) reported that local authorities did contact their household personally, but trends among those respondents who did not report being contacted by local authorities will be discussed in later chapters.

Warning Messages

A minority of participants reported having received the warning (22%). A total of 20%, or 10 participants, reported having received two warning messages. All participants who received more than one message reported that the messages they received were consistent. All participants who received a warning message or messages reported that warning messages were clear and a majority reported they were specific (100%). A majority of these participants (81.8%) also reported that the warning message made them think the threat from the incident was likely to affect them personally.

Receiver Characteristics

In addition to the information described about household and participant characteristics in "Sample Profile," some additional information about survey respondents was collected which is relevant to this analysis. The average distance respondents reported living from where the derailment occurred was 4.41 miles (*SD* = 2.93). On average, respondents had lived in or near Casselton, ND for 20.37 years (*SD* = 17.68).

Comprehension

Most of the participants who reported having received at least one warning message also reported having understood the threat from the train derailment (80.8% of those who received a warning message). Almost all participants who received a warning message also reported having understood what actions the warning message asked them to take (90.9% of those who received a warning message). The actions participants reported that the warning message instructed them to take were generally close to the actual instructions and recommendations in the warning messages, although there were some participants whose descriptions of the instructions were more detailed than others. For example, some participants reported simply that they were told to evacuate or stay in their homes, while others described specific procedures they were asked to follow, including closing windows, making sure air flow was cut off and to go into an interior room with no windows.

Threat Perceptions

Survey participants were asked a number of questions about their perception of the potential threat of a hazardous materials train incident. A majority of participants (74%) had heard of a train-related hazardous materials incident like the one that happened in Casselton happening somewhere else. Respondents were asked to identify their level of concern on a 5-point Likert scale, with a value of 1 corresponding to "not at all concerned" and a value of 5 corresponding to "extremely concerned," about the possibility of an incident like the one that occurred happening near them, and about the possibility of an incident like the one that occurred impacting them personally. Concern for both scenarios was rated low (happening near them: M = 1.72, SD = .73; impacting them personally: M = 1.60, SD = .67). Few respondents reported having taken any precautions to protect themselves from a train-related hazardous materials incident before it occurred (12%), further highlighting the low level of pre-event perceived threat.

Stakeholder Perceptions

Participants reported high levels of trust in local authorities, rating their level of trust at 4.73 (SD = .47) on a 5-point Likert scale with values ranging from 1 to 5 where 1 is "not at all" and 5 is "completely." Participants who reported that they had gotten information from local authorities were asked the same question, and reported an average level of trust at 4.13 (SD =

1.19). Note that only 11 participants, however, reported having received a warning, whereas 15 participants reported having gotten information from local authorities.

Risk Identification and Assessment

A majority of participants who reported having received warning messages (80.8%) reported that they knew, based on the warning message, what the threat from the train derailment was. On average, participants reported that the incident was quite dangerous to them personally, using a 5-point Likert scale of 1 to 5 where 1 is “not dangerous at all” and 5 is “extremely dangerous” ($M = 3.98$, $SD = 1.15$).

Protective Action Search

Participants who reported having received a warning message and that the warning message had recommended a particular action ($N = 10$) listed two protective actions that they reported having been asked to take. These protective actions included: evacuation, staying indoors, providing information to others, and variations of these actions, including ventilation procedures for sheltering in place. Analysis revealed that 28% of participants claimed they knew what they would do if a hazardous materials incident occurred near them, and 28% reported they had participated in any hazard education programs to help them determine what actions to take in the event of a serious incident, before it occurred..

Information Needs Assessment

Three participants (27.3% of those who received a warning message) reported that they looked for information that was not included in the warning message. Two participants reported that the warning message had not told them how far a safe distance from the incident was, and one wanted to know where the most dangerous location was.

Communication Action Assessment and Implementation, and Information Search

Analysis revealed that 32% of respondents talked to friends, family members or neighbors about what to do following the incident. These respondents reported discussing various types of protective action, including staying in place (three respondents, or 18.8% of those who talked to friends, family members or neighbors), evacuating (ten respondents, or 62.5%), and a few other specific actions, including looking after elderly neighbors, and taping up windows and other protocols for sheltering in place. Additionally, 16% of participants reported having paid attention to what friends, family members and neighbors did following the incident. These respondents reported witnessing various types of protective action, including evacuating (50% of respondents), staying in place (12.5% of respondents), and a combination of these (37.5% of respondents).

Situational Facilitators and Inhibitors

This survey measured two variables that may have facilitated or inhibited evacuation. These were having access to a vehicle at the time of the incident; and having a household member with a physical, vision, hearing or cognitive impediment. The vast majority of survey respondents had access to a vehicle (96%). Few respondents reported having a household member with a physical, vision, hearing or cognitive impediment (7%).

Protective Action Decision

Ultimately, 60% of respondents reported that their whole household evacuated Casselton following the official evacuation recommendation. An additional 6% reported that at least one member of their household, but not every member of the household, chose to evacuate. Of those respondents who evacuated, 70% evacuated within one hour of the evacuation recommendation, 23.3% evacuated 1-2 hours after the evacuation recommendation, 3.3% evacuated 2-3 hours after the evacuation recommendation, and 3.3% evacuated more than 3 hours after the evacuation recommendation. Of those who evacuated, the majority (56.7%) evacuated to a friend or family member's house, 36.7% evacuated to a hotel; and 2% reported evacuating to another location. No one evacuated to Discovery Middle School, the official evacuation location.

In addition to those who evacuated, 6% of participants reported wanting to evacuate, but not evacuating. There were a number of reasons for which people did not evacuate when they wanted to, which will be explored in the Discussion chapter.

CHAPTER 5: CORRELATION TESTING

There were 42 independent variables analyzed for this research, and two dependent variables: whether or not the household had evacuated, and how long the decision to evacuate took. Before doing correlation analysis for the dependent variables, an inter-item correlation matrix was created and analyzed. This inter-item correlation matrix revealed that 12% of the variables in this research were correlated at the $p < .05$ level, indicating that the experimental error rate is not a plausible explanation for the research's empirical support. See Appendix D for the inter-item correlation matrix.

Evacuation Decision Correlations

Several variables were correlated with decision to evacuate at the $p < .05$ level. Whether participants had heard of a similar incident before the Casselton derailment occurred, how highly participants rated their trust in information from television, whether participants used the radio as an information source, whether participants used Facebook as an information source, whether participants used family, friends or neighbors as an information source, the level of danger participants associated with the incident, whether participants had had any hazards education prior to the event, and the highest level of education within the participant's household all had a significantly positive relationship with the decision to evacuate. Years lived in or near Casselton and age of respondent both had significantly negative relationships with the decision to evacuate. See Table 3 for all correlations between independent variables and the decision to evacuate.

Table 3. Correlations between independent variables and evacuation decision

		Likelihood
In Casselton	Pearson's Correlation	-.035
	Sig. (1-tailed)	.405
Heard of previous incident	Pearson's Correlation	.261*
	Sig. (1-tailed)	.034
Environmental cues	Pearson's Correlation	.202
	Sig. (1-tailed)	.080
Social cues	Pearson's Correlation	.178
	Sig. (1-tailed)	.108
TV news trust	Pearson's Correlation	.316
	Sig. (1-tailed)	.034*
TV use	Pearson's Correlation	-.123
	Sig. (1-tailed)	.198
Radio trust	Pearson's Correlation	.137
	Sig. (1-tailed)	.307
Radio use	Pearson's Correlation	.421**
	Sig. (1-tailed)	.009
Facebook trust	Pearson's Correlation	.530
	Sig. (1-tailed)	.058
Facebook use	Pearson's Correlation	.331*
	Sig. (1-tailed)	.037
Family/ friends trust	Pearson's Correlation	.190
	Sig. (1-tailed)	.192
Family/ friends use	Pearson's Correlation	.358*
	Sig. (1-tailed)	.026
Local authorities trust	Pearson's Correlation	-.109
	Sig. (1-tailed)	.350
Local authorities use	Pearson's Correlation	.038
	Sig. (1-tailed)	.422
News website trust	Pearson's Correlation	.010
	Sig. (1-tailed)	.482
News website use	Pearson's Correlation	.198
	Sig. (1-tailed)	.124
Number of sources used	Pearson's Correlation	-.028
	Sig. (1-tailed)	.423
Face-to-face with local authorities	Pearson's Correlation	-.102
	Sig. (1-tailed)	.240
Received official warning(s)	Pearson's Correlation	-.059
	Sig. (1-tailed)	.342
Specificity of warning message(s)	Pearson's Correlation	.043
	Sig. (1-tailed)	.450
Warning made think incident would affect them	Pearson's Correlation	.516
	Sig. (1-tailed)	.052

Table 3. Correlations between independent variables and evacuation decision (continued)

		Likelihood
Understood threat from warning	Pearson's Correlation	-.430
	Sig. (1-tailed)	.093
Knew what actions to take from warning	Pearson's Correlation	.346
	Sig. (1-tailed)	.148
Warning trust	Pearson's Correlation	-.149
	Sig. (1-tailed)	.331
How dangerous incident seemed	Pearson's Correlation	.344**
	Sig. (1-tailed)	.007
Hazard education	Pearson's Correlation	.236*
	Sig. (1-tailed)	.049
Knew what to do pre-event	Pearson's Correlation	.145
	Sig. (1-tailed)	.157
Observed friends/family	Pearson's Correlation	-.195
	Sig. (1-tailed)	.090
Talked to friends/family	Pearson's Correlation	.035
	Sig. (1-tailed)	.405
Household size	Pearson's Correlation	.031
	Sig. (1-tailed)	.416
Had a child under 5	Pearson's Correlation	.022
	Sig. (1-tailed)	.439
Had a child under 12	Pearson's Correlation	.076
	Sig. (1-tailed)	.299
Had a child under 18	Pearson's Correlation	.019
	Sig. (1-tailed)	.449
Had pets	Pearson's Correlation	.083
	Sig. (1-tailed)	.283
Number of pets	Pearson's Correlation	.148
	Sig. (1-tailed)	.279
Distance from incident	Pearson's Correlation	.118
	Sig. (1-tailed)	.215
Household member(s) with impediment(s)	Pearson's Correlation	-.141
	Sig. (1-tailed)	.164
Vehicle access	Pearson's Correlation	.042
	Sig. (1-tailed)	.387
Years lived in or near Casselton	Pearson's Correlation	-.287*
	Sig. (1-tailed)	.025
Level of education	Pearson's Correlation	.360**
	Sig. (1-tailed)	.005
Age of respondent	Pearson's Correlation	-.314*
	Sig. (1-tailed)	.013
Sex of respondent	Pearson's Correlation	.016
	Sig. (1-tailed)	.455

Note: * $p < .05$, ** $p < .01$

Evacuation Time Correlations

One variable, household size, was positively correlated with the time it took to evacuate after the evacuation recommendation had been made at the $p < .05$ level. One variable, warning specificity, was negatively correlated with the time it took to evacuate at the $p < .05$ level, but this finding should be interpreted with caution because there were so few observations of this variable, and little variation in the responses. See Table 4 for all correlations between independent variables and evacuation time.

Table 4. Correlations between independent variables and evacuation time

		Likelihood
In Casselton	Pearson's Correlation	-.099
	Sig. (1-tailed)	.301
Heard of previous incident	Pearson's Correlation	.000
	Sig. (1-tailed)	.500
Level of concern, pre-incident	Pearson's Correlation	-.097
	Sig. (1-tailed)	.305
Had taken precautions	Pearson's Correlation	-.150
	Sig. (1-tailed)	.214
Environmental cues	Pearson's Correlation	.164
	Sig. (1-tailed)	.194
Social cues	Pearson's Correlation	.199
	Sig. (1-tailed)	.146
TV news trust	Pearson's Correlation	.127
	Sig. (1-tailed)	.302
TV use	Pearson's Correlation	-.058
	Sig. (1-tailed)	.380
Radio trust	Pearson's Correlation	-.073
	Sig. (1-tailed)	.415
Radio use	Pearson's Correlation	.240
	Sig. (1-tailed)	.194
Facebook trust	Pearson's Correlation	.098
	Sig. (1-tailed)	.417
Facebook use	Pearson's Correlation	-.260
	Sig. (1-tailed)	.185
Family/ friends trust	Pearson's Correlation	.244
	Sig. (1-tailed)	.210

Table 4. Correlations between independent variables and evacuation time (continued)

		Likelihood
Family/ friends use	Pearson's Correlation	.168
	Sig. (1-tailed)	.283
Local authorities trust	Pearson's Correlation	-.367
	Sig. (1-tailed)	.209
Local authorities use	Pearson's Correlation	.225
	Sig. (1-tailed)	.230
News website trust	Pearson's Correlation	-.244
	Sig. (1-tailed)	.191
News website use	Pearson's Correlation	-.200
	Sig. (1-tailed)	.199
Number of sources used	Pearson's Correlation	.109
	Sig. (1-tailed)	.282
Face-to-face with local authorities	Pearson's Correlation	-.251
	Sig. (1-tailed)	.090
Received official warning(s)	Pearson's Correlation	-.164
	Sig. (1-tailed)	.193
Specificity of warning message(s)	Pearson's Correlation	-1.00**
	Sig. (1-tailed)	.000
Warning made think incident would affect them	Pearson's Correlation	-
	Sig. (1-tailed)	.000
Understood threat from warning	Pearson's Correlation	.316
	Sig. (1-tailed)	.271
Knew what actions to take from warning	Pearson's Correlation	-
	Sig. (1-tailed)	.000
Warning trust	Pearson's Correlation	.316
	Sig. (1-tailed)	.271
How dangerous incident seemed	Pearson's Correlation	-.125
	Sig. (1-tailed)	.255
Hazard education	Pearson's Correlation	-.136
	Sig. (1-tailed)	.237
Knew what to do pre-event	Pearson's Correlation	.000
	Sig. (1-tailed)	.500
Observed friends/family	Pearson's Correlation	-.198
	Sig. (1-tailed)	.151
Talked to friends/family	Pearson's Correlation	-.198
	Sig. (1-tailed)	.151
Household size	Pearson's Correlation	.398*
	Sig. (1-tailed)	.015
Had a child under 5	Pearson's Correlation	-.126
	Sig. (1-tailed)	.254
Had a child under 12	Pearson's Correlation	.191
	Sig. (1-tailed)	.156

Table 4. Correlations between independent variables and evacuation time (continued)

		Likelihood
Had a child under 18	Pearson's Correlation	.191
	Sig. (1-tailed)	.156
Had pets	Pearson's Correlation	.265
	Sig. (1-tailed)	.079
Number of pets	Pearson's Correlation	-.033
	Sig. (1-tailed)	.462
Distance from incident	Pearson's Correlation	.074
	Sig. (1-tailed)	.349
Household member(s) with impediment(s)	Pearson's Correlation	.125
	Sig. (1-tailed)	.255
Vehicle access	Pearson's Correlation	.104
	Sig. (1-tailed)	.292
Years lived in or near Casselton	Pearson's Correlation	-.171
	Sig. (1-tailed)	.197
Level of education	Pearson's Correlation	-.199
	Sig. (1-tailed)	.146
Age of respondent	Pearson's Correlation	-.133
	Sig. (1-tailed)	.242
Sex of respondent	Pearson's Correlation	-.150
	Sig. (1-tailed)	.214

Note: * $p < .05$, ** $p < .01$

Regression Results

The nine variables that were found to be significantly correlated with evacuation decision-making were tested for their influence on evacuation decision-making using step-wise regression analysis. The results of this regression analysis are presented in Table 5 below.

Table 5. Regression results for variables significantly correlated with evacuation decision

Model	1	2	3	4	5	6	7	8	9	10
	β	β	β	β	β	β	β	β	β	β
Heard of	.143	.223	.168	.120	.116	.425	.385	.516*	.500	.514
TV trust		.093	.128	.166	.189	.223*	.212*	.170	.169	.170
Radio use			.296	.231	.175	.099	.156	.109	.112	.287
Facebook use				.347	.279	.081	.069	.039	.027	-.036
Family/friends use					.285	.447	.495	.432	.432	.003
How dangerous						.223*	.189	.145	.144	.075
Years in Casselton							-.007	-.003	-.001	-.007
Education								.457*	.452	.199
Age									-.021	-.105
										-.114
F	.373	.680	.994	1.243	1.201	2.115	1.964	2.831	2.316	1.590
R^2	.019	.070	.149	.237	.286	.475	.514	.654	.655	.799

Note: * $p < .05$, ** $p < .01$, β represents the unstandardized beta coefficient (the effect of an independent on the dependent variable, net of the effects of the other independent variables).

Conclusion

This chapter identified the significant correlations with respect to the dependent variables, evacuation decision and evacuation timing. The next chapter will discuss the significance of these correlations, as well as some of the significant correlations in the inter-item correlation matrix (Appendix D).

CHAPTER 6: DISCUSSION AND CONCLUSION

The goal of this research was to better understand how people made the decision to evacuate or not to evacuate following a train derailment and explosion, using the Protective Action Decision Model. This study attempted to do what few other studies have done: to examine holistically the factors described by the Protective Action Decision Model in order to determine their significance. Two major problems arose in conducting this study. First, from a methodological perspective, the number of potential participants was lower than statistically and theoretically desirable. Although there did not appear to be a large amount of bias in the data, the small study population and relatively low response rate obviously limit the predictive and statistical power of the results. In addition, the timing of the study, more than a year after the event took place, may have limited the accuracy and completeness of the data collected. Second, from a more theoretical perspective, this event was a technological event, in contrast with most of the Protective Action Decision Model research, which tends to be of natural events (e.g. hurricanes). The extent to which all of the elements of the model apply to technological events is therefore worth considering.

Relationships Between Independent and Dependent Variables

Seven variables were significantly positively correlated with the decision to evacuate: whether participants had heard of a similar incident before the Casselton derailment occurred, how highly participants rated their trust of information from television, whether participants used the radio as an information source, whether participants used Facebook as an information source, whether participants used family, friends or neighbors as an information source, the level of danger participants associated with the incident, and the highest level of education within the participant's household. Two variables were significantly negatively correlated with the decision to evacuate: years lived in or near Casselton and age of respondent.

These relationships are all logically reasonable, theoretically consistent with the PADM or both. Having heard of an incident like the one that occurred in Casselton beforehand was designed to be a proxy for threat perception, and it is reasonable that people with higher threat perceptions would be more likely to evacuate than those with lower threat perceptions. Interestingly, the other variable associated with threat perception, level of concern pre-event, did not have a significant relationship with decision to evacuate. Moreover, these two variables were not significantly correlated with each other (see Appendix D, the inter-item correlation matrix for this data), which suggests that they were measuring somewhat different concepts, or that having heard of a similar incident did not necessarily make respondents more concerned that such an incident would occur near them.

The next four variables – trust in information from television, use of the radio as an information source, use of Facebook as an information source, and use of family, friends or neighbors as an information source – were also all significantly positively correlated with evacuation decision-making. One possible explanation for these findings is that use of these information sources required somewhat more active engagement from participants than either communications from local authorities, which in turn suggests that participants who used these information sources were more concerned about the incident than those who did not. This hypothesis who also suggest that there would be a relationship between the number of information sources used and the decision to evacuate, but there is not a significant relationship between these two variables.

The relationship between decision to evacuate and how dangerous the incident seemed to participants is probably the most easily understood. How dangerous the incident seemed was designed to be a measure of risk perception, and it is consistent with the PADM and with logic that the higher one's risk perception, the more likely one is to evacuate. Interestingly, level of education, the final variable with a significantly positive correlation with decision to evacuate, is also significantly positively correlated with how dangerous the incident seemed to participants. It is less clear why higher levels of education would make participants more likely to evacuate. One possible hypothesis is that participants with more education perceived the risk associated with the incident more accurately, or at least that they perceived the risk as being greater than participants with less education.

There are two possible explanations for the significant correlation between decision to evacuate and having had hazards education. One is that individuals who had taken courses in hazards education had more knowledge about how to respond to a hazard event than other members of the sample. An alternative explanation is that the individuals who had more hazards education were more engaged and interested in hazard response, and this engagement was responsible for both the decision to evacuate and the decision to learn about hazards.

The final two variables with significant correlations with evacuation decision were age of respondent and years lived in Casselton. The first relationship is somewhat troubling, because it suggests that older (and therefore more vulnerable) members of the community were not able (or willing) to take the recommended protective action. There is furthermore no significant relationship between age of respondent and how dangerous the incident seemed to participants, which suggests that this finding was not due to the fact that these older participants did not think the risk from the derailment was lower than did other participants. This finding suggests actions local authorities should take with respect to these older segments of the population, which will be discussed later in this chapter.

The final variable with a significant correlation to evacuation decision, years lived in Casselton, is harder to explain. In general, literature associated with the PADM and evacuation decision-making overall, has come to two different conclusions regarding how long participants have lived in a place and their decision to evacuate or not evacuate. Some researchers have found that people who have lived in a place for a long time, and have therefore experienced a hazard more than once (or many times) are more likely to evacuate, because they understand that it is the best response to that hazard (see for example: Dow & Cutter, 1997). Other researchers have found that participants who have lived in a place for a long time are less likely to evacuate because they have adapted to the hazard, or because previous experience with the hazard has made them believe they do not have to worry about its impacts on them personally (see for example: Gladwin & Peacock, 1997). In this case, however, neither explanation is particularly relevant, because none of the participants in this study had ever experienced an incident like this one before it occurred. Although one possible explanation is that participants who have lived in Casselton for the longest are also its oldest residents, and were therefore less likely to evacuate for the same reasons, there is not a significant relationship between years lived in or near Casselton and respondent age.

Performing step-wise regression analysis in order to measure the relationship between these significantly correlated variables does not return any particularly useful results. Although some of the variables within some of the models tested were significant, none of the F-statistics, and therefore none of the models, were statistically significant.

In addition to the factors explaining evacuation itself, two factors had significant relationships with evacuation timing: household size, and specificity of warning message(s). The first relationship was positive in nature, meaning the larger the household size, the longer evacuation took. This finding is intuitively sensible because, for example, it may take longer to coordinate an evacuation for a larger number of people, or some members of the household may want to wait for other household members to all be in the same place. As noted in the correlation analysis chapter, the second relationship, between evacuation timing and warning specificity (specifically, participants who reported that the warning message or messages they received were specific evacuated more quickly than participants who reported the warning message or messages were not specific) should be interpreted with caution, because there were few observations and little variance among responses.

It is also worth noting that there were three participants who expressed that they wanted to evacuate but did not do so. Two of these reported that they felt leaving their homes was too dangerous, and even though they were concerned about the threat from the incident, they believed leaving their homes would have exposed them to greater danger than staying inside. The other participant reported that they did not have access to their vehicle at that time and so were not able to evacuate, even though they wanted to.

Relationships Between Independent Variables

In addition to the significant correlations between independent and dependent variables discussed above, there were other significant relationships in the data that are worth noting. Variables measuring the trust respondents had in the various information sources they used are highly correlated, and were in fact considered for indexing, but because people did not consistently use the same sources, there were too few valid cases to combine these variables in a theoretically meaningful way. In spite of this, it seems that there were significant, positive relationships between trust in one information source and trust in other information sources, suggesting that respondents had either a trusting or less trusting orientation to their information sources, rather than distinguishing differing levels of trustworthiness among various information sources.

There were a number of interesting correlations between whether a participant had taken precautions to protect themselves from an incident like this one, and other variables. For example, people who reported having taken precautions reported lower levels of trust in all the information sources for which there was a significant correlation (including TV news, radio news, and news websites). These participants also reported using a greater number of information sources, were more likely to have received an official warning or warnings, and reported higher levels of prior knowledge about hazards. This suggests participants who were more engaged and discerning about the information they received about the incident were the members of the community who were most likely to have prepared for such an incident.

Perceived distance from where the incident occurred had several significant correlations with other variables. People who reported living closer to the event reported that the incident seemed more dangerous, but also were less likely to have spoken with local authorities face to face, and to have received warning messages. It is important to keep in mind that distances for each participant from the site of the incident were not confirmed by the researcher (although future research could accomplish this, because all participants have ID numbers with associated addresses), and are therefore referred to here as "perceived distance." This variable is therefore likely a function of both the actual distance from the participant's home to the incident and the participant's perceptions of the danger associated with the incident. There are therefore two possible explanations for the relationship between this variable and how dangerous the incident seemed: participants who lived closer to where the incident occurred believed they were at greater risk because they were closer to the danger, and how dangerous the incident seemed influenced how far they reported living from the incident.

The second two variables with significant correlations to perceived distance may also possibly be related to perceived risk. Both whether participants had face to face interactions with local authorities, and whether they had received an official warning were negatively correlated with perceived distance from the incident. This may be because participants who reported living closer to the incident evacuated before they could receive a warning or speak to authorities in person. This hypothesis is questionable, however, because distance from incident is not significantly correlated with evacuation timing.

There were also some counter-intuitive findings. For example, the researcher hypothesized that participants with children (coded as “Had children under 5,” “Had children under 12,” and “Had children under 18”) would be more likely to perceive that the level of danger associated with the incident was high, more likely to trust warning messages, and more likely to evacuate than other participants. In fact, having children had a significantly negative correlation with how dangerous the incident seemed, a significantly negative correlation with trust in warnings, and did not impact evacuation likelihood.

Limitations of Study and Data

There are a number of limitations associated with this research and data. The relatively small number of people surveyed (50) created some problems for data analysis, and a larger number of participants may have been necessary to draw more significant conclusions about evacuation decision-making. In addition, data collection took place more than a year after the incident took place, so participants' memories about their decision-making process may have been more limited than they would have been had data been collected closer to the incident, temporally.

The majority of factors measured in this research did not return a significant relationship with either of the dependent variables. There are several immediately apparent possible explanations for this. The first two are described in the introductory paragraph to this chapter: there is not enough data, and this incident is so different from other hazard events that the same theoretical factors do not apply to it.

To expand upon this second possibility, there are a few ways in which a technological incident is different from a natural incident. First, the speed of onset is often different: in a natural disaster like a hurricane, affected individuals likely have time to gather information and make decisions before the incident occurs. In contrast, in a technological incident, affected individuals may have to decide what to do after the incident has occurred, as was the case in Casselton.

Second, technological disasters and incidents occur less frequently than natural disasters, or they occur infrequently in the same geographical area. Many natural hazards are quite common in certain areas and uncommon in others. For example, hurricanes have affected the East coast of the United States on a regular basis, tornadoes occur many times a year in the regions of the country known as "Tornado Alleys," and earthquakes are a relatively common occurrence in California. In contrast, a train derailment may occur anywhere there is railroad track, and an incident involving the combustion of Bakken oil may occur anywhere Bakken oil travels through. Moreover, although possible, an incident is unlikely to affect the same place more than once. Finally, although there have been other, similar incidents involving derailments and explosions of trains carrying Bakken oil specifically, these incidents have been relatively rare (although high profile), especially in the period before the Casselton derailment.

For these reasons, it seems likely that there are important theoretical differences between peoples' response to natural and technological incidents, especially incidents involving Bakken oil train derailments.

Directions for Future Research

The two major issues with the data in this study – that is, the amount of data collected and the theoretical limitations of the PADM for this event – point to two new directions for research on this event. First, in order to collect more data, future researchers could use mail surveys instead of telephone surveys. Although more time consuming and expensive, mail surveys have a few advantages over telephone surveys that would improve data quality. First, the sample population is larger with a mail survey, because, through the United States Postal Service's Delivery Sequence File (DSF), every address to which the USPS delivers mail can be surveyed (Dillman et al., 2009, pp. 46-47). Second, unlike a telephone survey, which takes place at a discrete point in time determined by the researcher, a mail survey can be completed at a convenient time for the respondent. These advantages make mail surveys an appealing alternative to telephone surveys for this research.

Second, with respect to the potential theoretical problems associated with this data, two complementary approaches could be taken. First, the results from this survey, or a similar survey of Casselton residents regarding this incident, could be compared to the results of surveys of residents of other evacuated communities. These communities should ideally have experienced a mix of technological and natural hazard events. This approach would have two major advantages: first, it would allow researchers to examine the components of the Protective Action

Decision Model in a more holistic way than has been done before. With enough data, various elements of the model could be assessed for their relative importance on protective action decision-making. In addition, this approach could help researchers tease apart the differences between protective action decision-making for natural hazard events and technological hazard events. Understanding how people respond differently to different kinds of events could help authorities determine how to tailor warning messages and recommendations or orders to members of their communities.

In contrast to future research looking at between-group differences, a second approach to research on this subject could involve within-group differences. That is, future research could consider decision-making processes among people who had experienced technological hazard events, as opposed to a mix of technological and natural hazard events. There are a number of possible directions for this research to take. First, new theoretical factors could be developed and tested, or expanded upon. Other elements of the Protective Action Decision Model might also be eliminated if they are deemed inappropriate in the context of technological hazard events. Second, elements of a PADM for technological hazards might be studied in a broadly longitudinal fashion. For example, to determine how threat perceptions change over time, responses of participants who have experienced a technological disaster before many similar events have occurred (like the Casselton residents in this study) could be compared to those of participants who have experienced a technological disaster after such events have occurred more often. Finally, if a large enough population were available, combinations of surveys could be administered to different members of the population. These different surveys might include questionnaires that adhere closely to the PADM, questionnaires that have a new set of theoretical elements applicable to technological events, and questionnaires with a mix of question types.

Recommendations for Policymakers and Local Authorities

Although there are few robust and statistically significant conclusions to be drawn from this data, there are some obvious takeaways for local authorities and policymakers. First, a relatively small number of survey participants reported having received an official warning message (11 respondents, or 22%). It is possible that some of these participants did in fact receive an official warning message or messages, but did not know they were official warning messages or do not remember receiving them. Even so, it would likely be beneficial for Cass County emergency management personnel to consider how to disseminate warning messages more effectively and to more people.

Second, the finding that older participants were less likely to evacuate than younger participants suggests that more efforts should be made to reach out to these older members of the community in order to encourage them to evacuate in higher numbers. It appears from the data that older participants were receiving warning messages and contact from local authorities at the same rate as other community members (or possibly at a slightly higher rate), so efforts should be made to tailor warning messages and other communication to these residents.

Finally, although people generally reported high levels of trust in information from local authorities, the correlation between level of trust in communications from local authorities and having children was significant and negative. It is not clear why this relationship exists, or whether the participants surveyed for this study are simply outliers, but police and emergency managers should investigate whether there it would be possible to increase the level of trust this group has in their communications, possibly by tailoring their messages to these people, or by including specific information about children in warnings.

Conclusion

This study, although limited in several ways, advances research into evacuation decision-making in several ways. First, it helps address one of the problems associated with much of the literature in emergency management, the failure to re-test findings, in this case, findings related to the Protective Action Decision Model. Second, it contributes to the currently small body of literature addressing evacuation decision-making following technological, rather than natural, hazard events. Although this paper considered the extent to which elements of the Protective Action Decision Model are relevant to technological hazard events, future research must continue to test this, as well as look at other variables that are potentially unique to technological events. Finally, it addresses some of the ways that local authorities responsible for issuing warnings and evacuation recommendations or orders could tailor their messages and communication channels in order to reach the members of their communities with unique needs or preferences. As the number of technological hazard events increases, especially events related to Bakken oil train derailments, this research and other research on this topic will only become more important.

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APPENDIX A: IRB APPROVAL

NDSU NORTH DAKOTA STATE UNIVERSITY

February 6, 2015

Daniel J. Klenow
Emergency Management

Re: IRB Certification of Exempt Human Subjects Research:
Protocol #HS15165, "Casselton, ND Train Derailment: Evaculation Survey"

Co-investigator(s) and research team: Amanda Savitt

Certification Date: 2/6/15 Expiration Date: 2/5/18
Study site(s): NDSU/Casselton
Sponsor: n/a

The above referenced human subjects research project has been certified as exempt (category # 2) in accordance with federal regulations (Code of Federal Regulations, Title 45, Part 46, Protection of Human Subjects). This determination is based on the original protocol submission (received 2/4/15).

Please also note the following:

- If you wish to continue the research after the expiration, submit a request for recertification several weeks prior to the expiration.
- The study must be conducted as described in the approved protocol. Changes to this protocol must be approved prior to initiating, unless the changes are necessary to eliminate an immediate hazard to subjects.
- Notify the IRB promptly of any adverse events, complaints, or unanticipated problems involving risks to subjects or others related to this project.
- Report any significant new findings that may affect the risks and benefits to the participants and the IRB.

Research records may be subject to a random or directed audit at any time to verify compliance with IRB standard operating procedures.

Thank you for your cooperation with NDSU IRB procedures. Best wishes for a successful study.
Sincerely,

Kristy Shirley, CIP, Research Compliance Administrator

For more information regarding IRB Office submissions and guidelines, please consult www.ndsu.edu/irb. This Institution has an approved FederalWide Assurance with the Department of Health and Human Services: FWA00002439.

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APPENDIX B: QUESTIONNAIRE FROM SURVEYMONKEY.COM

Welcome to My Survey

Hello, my name is _________ and I'm calling from the Emergency Management Department at North Dakota State University. We are conducting a survey about the train derailment that occurred in Casselton in December 2013. We want to learn more about what factors had an impact on peoples' response to the incident. We are interviewing persons 18 years of age or older who have lived in Casselton since before December 30, 2013. Your participation is completely voluntary, and any information you provide will be kept confidential. If you have any questions about the survey, or would like my contact information, the contact information of the researchers, or the contact information for NDSU's Human Research Protection Program, please stop me at any time. [If participant wants contact information: Amanda Savitt: amanda.savitt@ndsu.edu or (339) 225-2281; Daniel Klenow: daniel.klenow@ndsu.edu or (701) 239-8925; Human Research Protection Program: ndsu.irb@ndsu.edu, (701) 231-8908 or toll free at (855) 800-6717.] The survey will take about 7-10 minutes – may I begin?

1. *Respondent's ID #*

2. Which of the following best describes where you were when the Casselton train derailment happened?

- At home in Casselton
- At work in Casselton
- At work outside of Casselton
- Other

Other (please specify)

3. Did you return to Casselton on the day of the derailment?

- Yes
- No

Page 2

4. Why not?

Page 3

5. Had you ever heard about a train-related hazardous materials incident like the one in Casselton happening somewhere else?

- Yes
- No

6. On a scale of 1 to 5, with 1 being "not concerned at all" and 5 being "extremely concerned," how concerned were you before December 30, 2013, that a train-related hazardous materials incident would occur near you?

1	2	3	4	5
○	○	○	○	○

7. On a scale of 1 to 5, with 1 being "not at all concerned" and 5 being "extremely concerned," how concerned were you before December 30, 2013, that a train-related hazardous-materials incident would impact you personally?

1	2	3	4	5
○	○	○	○	○

8. Had you taken any precautions to protect yourself from a train-related hazardous-materials incident before it occurred?

- Yes
- No

9. Did you see, hear or smell any evidence of the train incident in person?

- Yes
- No

10. Did you see people behaving in a way that made you think there had been a serious incident?

- Yes
- No

11. Now I'm going to ask you about how you learned about the train derailment. I'm going to read out a list of information sources. Please tell me if you used this information source to learn about the derailment. If you did, I will also ask you how much you trust that source on a scale from 1 to 5, where 1 is "not at all" and 5 is "completely."

	Did not use	1	2	3	4	5
TV news	○	○	○	○	○	○
Radio news	○	○	○	○	○	○
Facebook	○	○	○	○	○	○
Twitter	○	○	○	○	○	○
Other form of social media	○	○	○	○	○	○
Family or friends	○	○	○	○	○	○
Communications from local authorities, like police or emergency manager	○	○	○	○	○	○

Did you use any other sources not listed here?

12. Were there any sources you wanted to get information from but could not?

- ○ Yes
- ○ No

13. What were those sources?

14. Did local authorities contact you or a member of your household face-to-face to inform you about the incident?

- ○ Yes
- ○ No

15. Did you receive any official warnings about the incident?

- ○ Yes
- ○ No

16. From what source or sources did you receive the warnings?

Source 1

Source 2

Source 3

Source 4

Source 5

Source 6

Source 7

Source 8

Source 9

Source 10

17. ONLY ASK IF MULTIPLE SOURCES GIVEN: Were all the warnings consistent, or did they conflict in any way?

- Consistent
- Conflicted
- Multiple sources not given

18. Was the content of the warning or warnings clear?

- Yes
- No

19. Was the content of the warning or warnings specific?

- Yes
- No

20. Did the warning message or messages make you think that the incident was going to affect you?

- Yes
- No

21. Based on the warning message or messages, did you know what the threat from the train derailment was?

- Yes
- No

22. Based on the warning message or messages, did you know what actions you were being asked to take?

- Yes
- No

23. On a scale from 1 to 5, where 1 is "not at all" and 5 is "completely," how much did you trust the authorities who issued warnings and evacuation recommendations?

1	2	3	4	5
○	○	○	○	○

24. Did the warnings you received tell you what actions to take?

- Yes
- No

25. What actions did the warnings tell you to take?

26. What information, if any, did you look for that was not included in the warning or warnings?

27. On a scale from 1 to 5, with 1 being "not dangerous at all" and 5 being "extremely dangerous," how dangerous did the incident seem to you personally, after it occurred?

1	2	3	4	5
○	○	○	○	○

28. Before December 30, 2013, did you know what you would do if a hazardous materials incident occurred near you?

- Yes
- No

29. Did friends, family members or neighbors tell you what to do, or did you discuss what to do with them, after the incident?

- Yes
- No

30. What did they tell you to do?

31. Did you pay attention to what they did following the explosion?

- Yes
- No

32. What did you observe them doing?

33. Prior to the incident, had you ever participated in any hazard education programs that helped you determine what action to take?

- Yes
- No

34. Did everyone in your household evacuate Casselton because of this incident?

- Yes
- No

35. Did it take you less than an hour, between one and two hours, between two and three hours, or more than three hours to decide to evacuate after the evacuation order was issued?

- 0-1 hours
- 1-2 hours
- 2-3 hours
- 3+ hours

36. Which of the following best describes the destination you evacuated to: Discovery Middle School, the designated evacuation location; a friend or family member's house; a hotel; or other?

- Discovery Middle School, the designated evacuation location
- A friend or family member's house
- A hotel
- Other

Please specify

37. Did anyone in your household evacuate Casselton because of this incident?

- Yes
- No

38. Who in your household evacuated?

39. Why did they evacuate?

40. Did you want to evacuate?

- Yes
- No

41. Why didn't you evacuate?

42. How many people lived in your home at the time of the incident?

43. What are the ages, in years, of all members of your household, excluding yourself?

Member 1:

Member 2:

Member 3:

Member 4:

Member 5:

Member 6:

Member 7:

Member 8:

Member 9:

Member 10:

44. What are the genders of all the members of your household, excluding yourself?

	Gender
Member 1:	
Member 2:	
Member 3:	
Member 4:	
Member 5:	
Member 6:	
Member 7:	
Member 8:	
Member 9:	
Member 10:	

45. Did you have any pets at the time of the incident?

- ◯ Yes
- ◯ No

46. What kinds of pets did you have?

Pet 1: ________

Pet 2: ________

Pet 3: ________

Pet 4: ________

Pet 5: ________

Pet 6: ________

Pet 7: ________

Pet 8: ________

Pet 9: ________

Pet 10: ________

47. To the best of your knowledge, how far, in miles, is your home from where the incident occurred?

____

48. Do you, or does anyone in your household, have any physical, vision, hearing or cognitive impediments?

- ◯ Yes
- ◯ No

49. Did you have access to a vehicle at the time of the incident?

- ◯ Yes
- ◯ No

50. How many years have you lived in or near Casselton?

____

51. Which of the following best describes the highest amount of education someone in your household has achieved?

- Some high school
- High school graduate
- Some college or technical school
- Technical school graduate
- College graduate or higher

52. Which of the following best contains your age?

- Under 20
- 20-29
- 30-39
- 40-49
- 50-59
- 60-69
- Over 70

53. ***Code gender based on voice.***

APPENDIX C: FREQUENCY TABLES FOR ALL VARIABLES

Table C1. Frequency table, "Which of the following best describes where you were when the Casselton train derailment happened?"

	Frequency	*Percent*
At home in Casselton	26	52
At work in Casselton	8	16
At work outside of Casselton	9	18
Other	7	14
Total	50	100

Table C2. Frequency table, was respondent in Casselton at the time of the derailment?

	Frequency	*Percent*
No	16	32
Yes	34	68
Total	50	100

Table C3. Frequency table, "Had you ever heard about a train-related hazardous materials incident like the one in Casselton happening somewhere else?"

	Frequency	*Percent*
No	13	26
Yes	37	74
Total	50	100

Table C4. Frequency table, Pre-incident concern index

	Frequency	*Percent*
1.0	21	42
1.5	3	6
2.0	20	40
2.5	2	4
3.0	3	6
3.5	1	2
Total	50	100

Table C5. Frequency table, "Had you taken any precautions to protect yourself from a train-related hazardous materials incident before it occurred?"

	Frequency	*Percent*
No	44	88
Yes	6	12
Total	50	100

Table C6. Frequency table, "Did you see, hear or smell any evidence of the train incident in person?"

	Frequency	*Percent*
No	19	38
Yes	31	62
Total	50	100

Table C7. Frequency table, "Did you see people behaving in a way that made you think there had been a serious incident?"

	Frequency	*Percent*
No	15	30
Yes	35	70
Total	50	100

Table C8. Frequency table, Used TV news as an information source

	Frequency	*Percent*
No	16	32
Yes	34	68
Total	50	100

Table C9. Frequency table, "On a scale of 1 to 5, where 1 is do not trust and 5 is trust completely, how much did you trust TV news?"

	Frequency	*Percent*
1	2	5.9
2	1	2.9
3	3	8.8
4	8	23.5
5	20	58.8
Total	34	100

Table C10. Frequency table, Used radio as an information source

	Frequency	*Percent*
No	15	48.4
Yes	16	51.6
Total	31	100

Table C11. Frequency table, "On a scale of 1 to 5, where 1 is do not trust and 5 is trust completely, how much did you trust the radio?"

	Frequency	*Percent*
1	1	6.3
2	2	12.5
3	2	12.5
4	8	50
5	3	18.8
Total	16	100

Table C12. Frequency table, Used Facebook as an information source

	Frequency	*Percent*
No	20	66.7
Yes	10	33.3
Total	30	100

Table C13. Frequency table, "On a scale of 1 to 5, where 1 is do not trust and 5 is trust completely, how much did you trust Facebook?"

	Frequency	*Percent*
1	2	20
2	3	30
3	2	20
4	1	10
5	2	20
Total	10	100

Table C14. Frequency table, Used friends and family as an information source

	Frequency	*Percent*
No	7	23.3
Yes	23	76.7
Total	30	100

Table C15. Frequency table, "On a scale of 1 to 5, where 1 is do not trust and 5 is trust completely, how much did you trust information from friends and family?"

	Frequency	*Percent*
1	1	4.3
2	2	8.7
3	2	8.7
4	8	34.8
5	10	43.5
Total	23	100

Table C16. Frequency table, Used communications from local authorities as an information source

	Frequency	*Percent*
No	14	48.3
Yes	15	51.7
Total	29	100

Table C17. Frequency table, "On a scale of 1 to 5, where 1 is do not trust and 5 is trust completely, how much did you trust communications from local authorities?"

	Frequency	*Percent*
1	0	0
2	1	6.7
3	3	20
4	3	20
5	8	53.3
Total	15	100

Table C18. Frequency table, Used news websites as an information source

	Frequency	*Percent*
No	12	33.3
Yes	24	66.7
Total	36	100

Table C19. Frequency table, "On a scale of 1 to 5, where 1 is do not trust and 5 is trust completely, how much did you trust news websites?"

	Frequency	*Percent*
1	1	4.2
2	1	4.2
3	2	8.3
4	2	8.3
5	18	75
Total	24	100

Table C20. Frequency table, Total number of information sources used

	Frequency	*Percent*
1	16	32
2	14	28
3	7	14
4	6	12
5	6	12
6	1	2
Total	50	100

Table C21. Frequency table, “Were there any sources you tried to get information from but could not?”

	Frequency	*Percent*
No	50	100
Yes	0	0
Total	50	100

Table C22. Frequency table, “Did local authorities contact you or a member of your household face-to-face to inform you about the incident?”

	Frequency	*Percent*
No	40	80
Yes	10	20
Total	50	100

Table C23. Frequency table, “Did you receive any official warnings about the incident?”

	Frequency	*Percent*
No	39	78
Yes	11	22
Total	50	100

Table C24. Frequency table, "Were all the warnings consistent, or did they conflict in any way?"

	Frequency	*Percent*
Consistent	10	100
Conflicted	0	0
Total	10	100

Table C25. Frequency table, "Was the content of the warning or warnings clear?"

	Frequency	*Percent*
No	0	0
Yes	11	100
Total	11	100

Table C26. Frequency table, "Was the content of the warning or warnings specific?"

	Frequency	*Percent*
No	2	18.2
Yes	9	81.8
Total	11	100

Table C27. Frequency table, "Did the warning message or messages make you think that the incident was going to affect you?"

	Frequency	*Percent*
No	2	18.2
Yes	9	81.8
Total	11	100

Table C28. Frequency table, "Based on the warning message or messages, did you know what the threat from the train derailment was?"

	Frequency	*Percent*
No	2	18.2
Yes	9	81.8
Total	11	100

Table C29. Frequency table, "Based on the warning message or messages, did you know what actions you were being asked to take?"

	Frequency	*Percent*
No	1	9.1
Yes	10	91.9
Total	11	100

Table C30. Frequency table, "On a scale from 1 to 5, with 1 being did not trust and 5 being trusted completely, how much did you trust the warning message?"

	Frequency	*Percent*
1	0	0
2	0	0
3	0	0
4	3	27.3
5	8	72.7
Total	11	100

Table C31. Frequency table, "On a scale from 1 to 5, with 1 being not dangerous at all and 5 being extremely dangerous, how dangerous did the incident seem to you, after it occurred?"

	Frequency	*Percent*
1	1	2
2	6	12
3	9	18
4	11	22
5	23	46
Total	50	100

Table C32. Frequency table, Prior knowledge index (0 = responded no to all questions, .5 = responded no to one question and yes to one question, 1 = responded yes to both questions)

	Frequency	*Percent*
0	30	60
.5	12	24
1	8	16
Total	50	100

Table C33. Frequency table, Information search index (0 = responded no to all questions, .5 = responded no to one question and yes to one question, 1 = responded yes to both questions)

	Frequency	*Percent*
0	31	63.3
.5	12	24.5
1	6	12.2
Total	49	100

Table C34. Frequency table, “How many people lived in your home at the time of the incident?”

	Frequency	*Percent*
1	15	30
2	19	38
3	4	8
4	8	16
5	1	2
6	1	2
7	1	2
8	1	2
Total	50	100

Table C35. Frequency table, Had a child under 5

	Frequency	*Percent*
No	42	84
Yes	8	16
Total	50	100

Table C36. Frequency table, Had a child under 12

	Frequency	*Percent*
No	38	76
Yes	12	24
Total	50	100

Table C37. Frequency table, Had a child under 18

	Frequency	*Percent*
No	37	74
Yes	13	26
Total	50	100

Table C38. Frequency table, “Did you have any pets at the time of the incident?”

	Frequency	*Percent*
No	32	64
Yes	18	36
Total	50	100

Table C39. Frequency table, “How many pets did you have?”

	Frequency	*Percent*
1	10	55.6
2	6	33.3
3	2	11.1
Total	18	100

Table C40. Frequency table, “To the best of your knowledge, how far, in miles, is your home from where the incident occurred?”

	Frequency	*Percent*
1	8	17
2	5	10.7
3	7	14.9
4	4	8.5
5	11	23.4
6	4	8.5
7	1	2.1
8	1	2.1
10	5	10.7
12	1	2.1
Total	47	100

Table C41. Frequency table, “Do you, or does anyone in your household, have any physical, vision, hearing or cognitive impediments?”

	Frequency	*Percent*
No	43	86
Yes	7	14
Total	50	100

Table C42. Frequency table, “Did you have access to a vehicle at the time of the incident?”

	Frequency	*Percent*
No	2	4
Yes	48	96
Total	49	100

Table C43. Frequency table, “How many years have you lived in or near Casselton?”

	Frequency	*Percent*
1	1	2.1
2	2	4.3
3	3	6.4
4	2	4.3
6	3	6.4
7	2	4.3
8	1	2.1
10	3	6.4
13	2	4.3
14	2	4.3
15	5	10.6
16	1	2.1
17	1	2.1
19	1	2.1
20	2	4.3
23	1	2.1
24	1	2.1
25	2	4.3
30	2	4.3
33	1	2.1
40	4	8.5
48	1	2.1
50	1	2.1
57	1	2.1
60	1	2.1
80	1	2.1
Total	47	100

Table C44. Frequency table, "Which of the following best describes the highest amount of education someone in your household has achieved?"

	Frequency	*Percent*
Less than Bachelor’s Degree	24	48
Bachelor’s Degree or higher	26	52
Total	50	100

Table C45. Frequency table, “Which of the following best contains your age?”

	Frequency	*Percent*
20-29	1	2
30-39	5	10
40-49	19	38
50-59	12	24
60-69	9	18
Over 70	4	8
Total	50	100

Table C46. Frequency table, “Did everyone in your household evacuate Casselton because of this incident?”

	Frequency	*Percent*
No	20	40
Yes	30	60
Total	50	100

Table C47. Frequency table, "Which of the following best describes the destination you evacuated to?"

	Frequency	*Percent*
Discovery Middle School	0	0
A friend or family member’s house	17	56.7
A hotel	11	36.7
Other	2	6.7
Total	30	100

Table C48. Frequency table, “Did it take you less than an hour, between one and two hours, between two and three hours, or more than three hors to decide to evacuate after the evacuation recommendation was issued?”

	Frequency	*Percent*
0-1 hours	21	70
1-2 hours	7	23.3
2-3 hours	1	3.3
3+ hours	1	3.3
Total	30	100

Table C49. Frequency table, “Did anyone in your household evacuate Casselton because of this incident?”

	Frequency	*Percent*
No	3	15.8
Yes	16	84.2
Total	19	100

Table C50. Frequency table, “Did you want to evacuate?”

	Frequency	*Percent*
No	12	75
Yes	4	25
Total	16	100

APPENDIX D: INTER-ITEM CORRELATION MATRIX

		In Casselton	Heard of similar incident	Concern pre-event	Precautions	Env. evidence	Social evidence	TV news trust
In Casselton	Pearson's r							
	Sig (2-tail)							
	N	50						
Heard of similar incident	Pearson's r	.082						
	Sig (2-tail)	.571						
	N	50	50					
Concern pre-event	Pearson's r	.134	.109					
	Sig (2-tail)	.354	.450					
	N	50	50	50				
Precautions	Pearson's r	.121	.219	.284*				
	Sig (2-tail)	.401	.127	.046				
	N	50	50	50	50			
Env. evidence	Pearson's r	.435**	-.088	.034	.036			
	Sig (2-tail)	.002	.542	.816	.807			
	N	50	50	50	50	50		
Social evidence	Pearson's r	.393**	-.227	.093	-.027	.746**		
	Sig (2-tail)	.005	.522	.522	.853	.000		
	N	50	34	50	50	50	50	
TV news trust	Pearson's r	-.020	-.117	-.213	-.576**	-.138	-.173	
	Sig (2-tail)	.909	.511	.227	.000	.435	.327	
	N	34	34	34	34	34	34	34
TV news use	Pearson's r	.109	.044	.049	-029	-.075	-.149	-
	Sig (2-tail)	.499	.784	.763	.857	.435	.351	.000
	N	41	41	41	41	34	41	34
Radio news trust	Pearson's r	.203	-.065	-.549*	-.501*	.015	.213	.813**
	Sig (2-tail)	.450	.811	.028	.048	.956	.429	.001
	N	16	16	16	16	16	16	12

		In Casselton	Heard of similar incident	Concern pre-event	Precautions	Env. evidence	Social evidence	TV news trust
Radio news use	Pearson's r	-.193	.092	.105	.311	.091	.314	-.246
	Sig (2-tail)	.299	.624	.574	.089	.625	.085	.259
	N	31	31	31	31	31	31	23
Facebook trust	Pearson's r	-.408	.190	-.096	-.530	-.408	-.561	.568
	Sig (2-tail)	.242	.598	.791	.115	.242	.091	.142
	N	10	10	10	10	10	10	8
Facebook use	Pearson's r	-.100	.309	.268	.177	.000	.000	-.361
	Sig (2-tail)	.599	.097	.152	.350	1.00	1.000	.080
	N	30	30	30	30	30	30	22
Family or friends trust	Pearson's r	.194	-.153	-.344	-.222	-.134	-.167	.849**
	Sig (2-tail)	.375	.484	.119	.308	.541	.445	.000
	N	23	23	23	23	23	23	16
Family or friends use	Pearson's r	-.017	.155	-.117	-.118	.071	.202	-.374
	Sig (2-tail)	.928	.414	.351	.534	.710	.284	.086
	N	30	30	30	30	30	30	22
Local authorities trust	Pearson's r	-.575*	-.296	-.109	-.082	-.164	-.061	.755*
	Sig (2-tail)	.025	.283	.700	.771	.558	.828	.012
	N	15	15	15	15	15	15	10
Local authorities use	Pearson's r	-.051	.396*	-.035	.323	.098	.021	-.427
	Sig (2-tail)	.791	.033	.857	.087	.613	.913	.054
	N	29	29	29	29	29	29	21
News website trust	Pearson's r	.028	-.070	-.423*	-.511*	-.201	-.111	.841**
	Sig (2-tail)	.898	.746	.039	.011	.347	.604	.000
	N	24	24	24	24	24	24	14
News website use	Pearson's r	.047	-.213	.118	-.158	.327	.088	.180
	Sig (2-tail)	.784	.212	.495	.367	.051	.611	.411
	N	36	36	36	36	36	36	23

		In Casselton	Heard of similar incident	Concern pre-event	Precautions	Env. evidence	Social evidence	TV news trust
Number of sources used	Pearson's r	.059	.047	.189	.383**	.157	.166	-.609**
	Sig (2-tail)	.682	.744	.189	.006	.277	.249	.000
	N	50	50	50	50	50	50	34
Face-to-face with authorities	Pearson's r	.021	.068	-.008	.277	-.021	-.109	-.024
	Sig (2-tail)	.883	.637	.958	.052	.887	.451	.893
	N	50	50	50	50	50	50	34
Received official warning(s)	Pearson's r	.157	.095	.018	.547**	.217	.137	-.523**
	Sig (2-tail)	.275	.513	.904	.000	.130	.343	.002
	N	50	50	50	50	50	50	34
Belief threat affect them	Pearson's r	-.222	.389	.414	.430	.389	-.222	-.693
	Sig (2-tail)	.511	.237	.206	.186	.237	.511	.127
	N	11	11	11	11	11	11	6
Knew threat from incident	Pearson's r	-.222	-.222	.110	.430	-.222	.389	.000
	Sig (2-tail)	.511	.511	.747	.186	.511	.237	1.00
	N	11	11	11	11	11	11	6
Knew what actions	Pearson's r	-.149	-.149	.278	.289	.671*	-.149	-
	Sig (2-tail)	.662	.662	.409	.389	.024	.662	.000
	N	11	11	11	11	11	11	6
Warning trust	Pearson's r	-.289	-.289	-.119	-.261	-.289	.241	.258
	Sig (2-tail)	.389	.389	.726	.438	.389	.476	.621
	N	11	11	11	11	11	11	6
How dangerous post-event	Pearson's r	-.012	-.090	-.155	-.155	.239	.180	.243
	Sig (2-tail)	.934	.532	.281	.281	.094	.211	.166
	N	50	50	50	50	50	50	34
Prior knowledge index	Pearson's r	-.002	.259	.102	.461**	.145	.139	-.196
	Sig (2-tail)	.987	.069	.483	.001	.317	.335	.267
	N	50	50	50	50	50	50	34

		In Casselton	Heard of similar incident	Concern pre-event	Precautions	Env. evidence	Social evidence	TV news trust
Information search index	Pearson's r	.211	-.173	.213	.271	.137	.148	-.296
	Sig (2-tail)	.146	.235	.142	.060	.347	.311	.089
	N	49	49	49	49	49	49	34
Household size	Pearson's r	-.179	-.058	.054	.087	.201	.189	-.160
	Sig (2-tail)	.213	.689	.711	.549	.163	.188	.365
	N	50	50	50	50	50	50	34
Had child under 5	Pearson's r	-.051	.134	.308*	.175	.117	.048	-.385*
	Sig (2-tail)	.723	.352	.030	.225	.419	.743	.025
	N	50	50	50	50	50	50	34
Had child under 12	Pearson's r	-.317*	.120	.219	.225	-.042	-.041	-.317
	Sig (2-tail)	.025	.408	.127	.117	.770	.778	.068
	N	50	50	50	50	50	50	34
Had child under 18	Pearson's r	-.278	.040	.167	.202	-.006	-.010	-.261
	Sig (2-tail)	.051	.785	.245	.159	.969	.945	.136
	N	50	50	50	50	50	50	34
Had pets	Pearson's r	-.053	-.168	.081	.201	.219	.178	-.240
	Sig (2-tail)	.717	.245	.578	.162	.127	.216	.171
	N	50	50	50	50	50	50	34
Number of pets	Pearson's r	-.040	.057	.051	. -.043	.141	.043	-.283
	Sig (2-tail)	.874	.821	.841	.864	.577	.864	.349
	N	18	18	18	18	18	18	13
Distance from incident	Pearson's r	.097	.055	-.114	-.268	.058	.020	.359*
	Sig (2-tail)	.518	.711	.443	.068	.696	.895	.047
	N	47	47	47	47	47	47	31
Impediment in household	Pearson's r	.153	-.024	-.010	.206	.078	.138	-.041
	Sig (2-tail)	.288	.870	.942	.152	.589	.338	.820
	N	50	50	50	50	50	50	34

		In Casselton	Heard of similar incident	Concern pre-event	Precautions	Env. evidence	Social evidence	TV news trust
Vehicle access	Pearson's r	-.140	.112	-.105	.075	.050	-.134	.059
	Sig (2-tail)	.332	.440	.467	.603	.728	.355	.740
	N	50	50	50	50	50	50	34
Years in Casselton	Pearson's r	.278	.138	-.163	.156	-.144	.119	-.245
	Sig (2-tail)	.058	.354	.274	.295	.336	.426	.169
	N	47	47	47	47	47	47	33
Level of education	Pearson's r	-.230	-.204	-.131	-.138	-.010	-.017	.236
	Sig (2-tail)	.108	.154	.364	.339	.946	.904	.178
	N	50	50	50	50	50	50	34
Respondent age	Pearson's r	.117	-.035	.036	-.011	-.165	.019	-.005
	Sig (2-tail)	.418	.809	.802	.942	.251	.898	.976
	N	50	50	50	50	50	50	34
Respondent sex	Pearson's r	-.141	.090	-.102	-.094	-.104	.079	-.079
	Sig (2-tail)	.328	.536	.480	.517	.472	.586	.658
	N	50	50	50	50	50	50	50
Evacuation decision	Pearson's r	-.035	.261	.136	-.201	.202	.178	.316
	Sig (2-tail)	.809	.068	.345	.162	.160	.216	.069
	N	50	50	50	50	50	50	34
Evacuation time	Pearson's r	-.099	.000	-.097	-.150	.164	.199	.127
	Sig (2-tail)	.601	1.00	.611	.428	.388	.291	.604
	N	30	30	30	30	30	30	19

		TV news use	Radio trust	Radio use	Facebook trust	Facebook use	Family or friends trust	Family or friends use
TV news use	Pearson's r							
	Sig (2-tail)							
	N	41						
Radio news trust	Pearson's r	.188						
	Sig (2-tail)	.502						
	N	15	16					
Radio news use	Pearson's r	.079	-					
	Sig (2-tail)	.679	.000					
	N	30	16	31				
Facebook trust	Pearson's r	.461	.789	-.063				
	Sig (2-tail)	.212	.062	.873				
	N	9	6	9	10			
Facebook use	Pearson's r	.204	-.216	.247	-			
	Sig (2-tail)	.288	.458	.197	.000			
	N	29	14	29	10	30		
Family or friends trust	Pearson's r	-.132	.570*	.000	.720*	-.410		
	Sig (2-tail)	.558	.042	1.000	.029	.058		
	N	22	13	22	9	22	23	
Family or friends use	Pearson's r	-.130	-.151	.384*	-	.378*	-	
	Sig (2-tail)	.502	.606	.040	.000	.043	.000	
	N	29	14	29	9	29	23	30
Local authorities trust	Pearson's r	-.158	.846*	-.225	.149	-.095	.791**	-.296
	Sig (2-tail)	.590	.016	.420	.779	.737	.001	.283
	N	14	7	15	6	15	13	15
Local authorities use	Pearson's r	-.082	-.272	-.033	.125	.201	.000	.261
	Sig (2-tail)	.676	.347	.864	.749	.297	1.00	.171
	N	28	14	29	9	29	22	29

		TV news use	Radio trust	Radio use	Facebook trust	Facebook use	Family or friends trust	Family or friends use
News website trust	Pearson's r	.210	.983*	-.725**	.500	-.348	.742*	-.424
	Sig (2-tail)	.434	.017	.005	.667	.244	.035	.131
	N	16	4	13	3	13	8	14
News website use	Pearson's r	.079	-.574	-.359	.063	-.280	.178	-.338
	Sig (2-tail)	.697	.051	.078	.873	.175	.465	.050
	N	27	12	25	9	25	19	26
Number of sources used	Pearson's r	.105	-.446	.393*	-.135	.546**	-.116	.516**
	Sig (2-tail)	.512	.084	.029	.710	.002	.597	.004
	N	41	16	31	10	30	23	30
Face-to-face with authorities	Pearson's r	-.267	-.414	-.095	-.464	-.056	.065	.118
	Sig (2-tail)	.091	.111	.613	.176	.770	.767	.535
	N	41	16	31	10	30	23	30
Received official warning(s)	Pearson's r	-.229	-.320	.116	-.143	.250	.048	.223
	Sig (2-tail)	.149	.228	.535	.694	.183	.827	.236
	N	41	16	31	10	30	23	30
Belief threat affect them	Pearson's r	.189	-	.612	-	.500	-.478	-.167
	Sig (2-tail)	.626	.000	.060	.000	.141	.193	.645
	N	9	6	10	5	10	9	10
Knew threat from incident	Pearson's r	-.250	-	.408	-.885*	-.333	.040	-.111
	Sig (2-tail)	.516	.000	.242	.046	.347	.920	.760
	N	9	6	10	5	10	9	10
Knew what actions	Pearson's r	.500	-	.408	-	.333	-.316	-.111
	Sig (2-tail)	.179	.000	.242	.000	.347	.407	.760
	N	9	6	10	5	10	9	10
Warning trust	Pearson's r	-.500	-.175	-.089	-.542	-.218	-.078	-.327
	Sig (2-tail)	.170	.740	.807	.346	.545	.855	.356
	N	9	6	10	5	10	8	10

		TV news use	Radio trust	Radio use	Facebook trust	Facebook use	Family or friends trust	Family or friends use
How dangerous post-event	Pearson's r	.273	.288	.158	.483	.127	.168	-.156
	Sig (2-tail)	.084	.279	.395	.157	.504	.443	.411
	N	41	16	31	10	30	23	30
Prior knowledge index	Pearson's r	-.246	-.488	.339	-.513	.132	-.031	.021
	Sig (2-tail)	.121	.055	.062	.129	.488	.889	.913
	N	41		31	10	30	23	30
Information search index	Pearson's r	-.328*	-.273	.088	-.513	.076	.000	.248
	Sig (2-tail)	.039	.325	.644	.129	.697	1.00	.194
	N	40	15	30	10	29	22	29
Household size	Pearson's r	-.176	-.218	.112	.377	-.095	.116	.068
	Sig (2-tail)	.271	.418	.547	.282	.618	.597	.723
	N	41	16	31	10	30	23	30
Had child under 5	Pearson's r	-.104	-.195	-.019	.094	.053	-.376	-.024
	Sig (2-tail)	.519	.470	.919	.797	.780	.077	.901
	N	41	16	31	10	30	23	30
Had child under 12	Pearson's r	-.164	-.383	.178	.143	.196	-.349	.093
	Sig (2-tail)	.305	.143	.337	.694	.400	.103	.626
	N	41	16	31	10	40	23	30
Had child under 18	Pearson's r	-.136	-.383	.107	.143	.144	-.268	.129
	Sig (2-tail)	.398	.143	.567	.694	.477	.215	.498
	N	41	16	31	10	30	23	30
Had pets	Pearson's r	-.144	-.195	.354	-.571	-.047	-.201	.116
	Sig (2-tail)	.368	.470	.050	.084	.804	.359	.542
	N	41	16	31	10	30	23	30
Number of pets	Pearson's r	-.748**	-.283	-.046	-.839	-.363	.225	-.185
	Sig (2-tail)	.001	.429	.865	.076	273	.439	.766
	N	15	10	16	5	11	14	5

		TV news use	Radio trust	Radio use	Facebook trust	Facebook use	Family or friends trust	Family or friends use
Distance from incident	Pearson's r	.415**	.551*	.180	.456	.054	-.269	-.190
	Sig (2-tail)	.009	.027	.359	.217	.790	.225	.341
	N	38	16	28	9	27	22	27
Impediment in household	Pearson's r	.034	.325	.148	-.190	-.126	-.015	-.176
	Sig (2-tail)	.835	.220	.428	.598	.505	.946	.352
	N	41	16	31	10	30	23	30
Years in Casselton	Pearson's r	-.103	-.087	-.177	-	.131	.198	-.102
	Sig (2-tail)	.523	.748	.341	.000	.489	.364	.590
	N	41	16	31	10	30	23	30
Vehicle access	Pearson's r	-.317*	.234	-.006	-.201	-.176	.186	.194
	Sig (2-tail)	.046	.402	.975	.578	.351	.396	.305
	N	40	15	30	10	30	23	30
Level of education	Pearson's r	.054	.113	.100	.467	.189	.196	.042
	Sig (2-tail)	.738	.678	.591	.174	.317	.371	.825
	N	41	16	31	10	30	23	30
Respondent age	Pearson's r	-.250	.066	-.040	-.130	-.337	.145	.056
	Sig (2-tail)	.115	.808	.832	.720	.069	.508	.769
	N	41	16	31	10	30	23	30
Respondent sex	Pearson's r	.162	-.450	.033	.175	.094	-.122	.166
	Sig (2-tail)	.312	.080	.859	.629	.619	.578	.542
	N	41	16	31	10	30	23	30
Evacuation decision	Pearson's r	-.010	.137	.421*	.530	.331	.190	.358
	Sig (2-tail)	.953	.614	.018	.115	.074	.384	.052
	N	41	16	31	10	30	23	30
Evacuation time	Pearson's r	-.310	-.073	.240	.098	-.260	.244	.168
	Sig (2-tail)	.150	.830	.389	.835	.369	.421	.565
	N	23	11	11	7	14	13	14

		Local authorities trust	Local authorities use	News website trust	News website use	Number of sources	Face-to-face with authorities	Received official warning(s)
Local authorities trust	Pearson’s r							
	Sig (2-tail)							
	N	15						
Local authorities use	Pearson’s r	-						
	Sig (2-tail)	.000						
	N	15	29					
News website trust	Pearson’s r	.971**	-.129					
	Sig (2-tail)	.000	.675					
	N	7	13	24				
News website use	Pearson’s r	.111	.206	-				
	Sig (2-tail)	.744	.322	.000				
	N	11	25	24	36			
Number of sources used	Pearson’s r	-.050	.524**	-.543**	-.260			
	Sig (2-tail)	.859	.004	.006	.126			
	N	15	29	24	36	50		
Face-to-face with authorities	Pearson’s r	.041	.222	-.277	-.248	.035		
	Sig (2-tail)	.884	.246	.290	.144	.812		
	N	15	29	24	36	50	50	
Received official warning(s)	Pearson’s r	.109	.411*	-.408	-.136	.451**	.338*	
	Sig (2-tail)	.700	.027	.048	.429	.001	.106	
	N	15	29	24	36	50	50	50
Belief threat affect them	Pearson’s r	-.342	.375	-	.395	.509	-.043	-
	Sig (2-tail)	.407	.286	.000	.292	.110	.900	.000
	N	8	10	5	9	11	11	11
Knew threat from incident	Pearson’s r	.114	-.167	-.491	-.478	.214	.430	-
	Sig (2-tail)	.788	.645	.401	.193	.527	.186	.000
	N	8	10	5	9	11	11	11

		Local authorities trust	Local authorities use	News website trust	News website use	Number of sources	Face-to-face with authorities	Received official warning(s)
Knew what actions	Pearson's r	-.342	-.167	-	-	.341	.289	-
	Sig (2-tail)	.407	.645	.000	.000	.304	.389	.000
	N	8	10	5	9	11	11	11
Warning trust	Pearson's r	-.078	-.327	.055	-.158	-.487	.559	-
	Sig (2-tail)	.855	.356	.931	.685	.129	.074	.000
	N	8	10	5	9	11	11	11
How dangerous post-event	Pearson's r	-.036	-.011	.300	.652**	-.358*	-.298*	-.118
	Sig (2-tail)	.899	.955	.154	.000	.011	.035	.415
	N	15	29	24	36	50	50	50
Prior knowledge index	Pearson's r	.028	.355	-.448*	.108	.165	.292*	.553
	Sig (2-tail)	.921	.059	.028	.530	.251	.039	.078
	N	15	29	24	36	50	50	11
Information search index	Pearson's r	.107	.280	-.174	.000	.303*	.439**	.251
	Sig (2-tail)	.716	.149	.417	1.00	.034	.002	.082
	N	14	28	24	36	49	49	49
Household size	Pearson's r	-.296	.178	-.153	-.107	.378**	-.145	.120
	Sig (2-tail)	.285	.357	.474	.533	.007	.316	.408
	N	15	29	24	36	50	50	50
Had child under 5	Pearson's r	-.333	-.021	-.397	-.099	.264	-.218	.032
	Sig (2-tail)	.225	.913	.055	.565	.064	.128	.828
	N	15	29	24	36	50	50	50
Had child under 12	Pearson's r	-.575*	.186	-.397	-.272	.324*	-.164	.041
	Sig (2-tail)	.025	.333	.055	.108	.022	.255	.779
	N	15	29	24	36	50	50	50
Had child under 18	Pearson's r	-.575*	.111	-.397	-.351*	.300*	-.068	.125
	Sig (2-tail)	.025	.566	.055	.036	.035	.637	.385
	N	15	29	24	36	50	50	50

		Local authorities trust	Local authorities use	News website trust	News website use	Number of sources	Face-to-face with authorities	Received official warning(s)
Had pets	Pearson's r	-.575*	-.177	-.409*	-.120	.311*	.000	.158
	Sig (2-tail)	.025	.358	.047	.487	.028	1.00	.274
	N	15	29	24	36	50	50	50
Number of pets	Pearson's r	-.185	-.044	-.498	.038	.057	-.145	-.322
	Sig (2-tail)	.766	.880	.173	.893	.821	.566	.193
	N	5	14	9	15	18	18	18
Distance from incident	Pearson's r	-.436	-.326	.428	.089	-.440**	-.320*	-.344*
	Sig (2-tail)	.119	.104	.053	.623	.002	.028	.022
	N	14	26	21	33	47	47	47
Impediment in household	Pearson's r	.378	.076	.190	-.057	.100	.086	.064
	Sig (2-tail)	.165	.697	.375	.742	.491	.550	.659
	N	15	29	24	36	50	50	50
Vehicle access	Pearson's r	-	.196	.282	.086	.000	.102	.108
	Sig (2-tail)	.000	.309	.182	.619	1.00	.481	.454
	N	15	29	24	36	50	50	50
Years in Casselton	Pearson's r	.406	.123	-.137	-.447**	.062	.308*	.370*
	Sig (2-tail)	.133	.524	.542	.008	.678	.035	.010
	N	15	29	22	34	47	47	47
Level of education	Pearson's r	-.214	-.100	.193	.079	-.111	.080	.027
	Sig (2-tail)	.445	.604	.366	.648	.444	.580	.852
	N	15	29	24	36	50	50	50
Respondent age	Pearson's r	.404	.035	.191	-.078	-.254	.256	-.029
	Sig (2-tail)	.135	.856	.370	.653	.075	.072	.842
	N	15	29	24	36	50	50	50
Respondent sex	Pearson's r	-.451	-.243	-.158	-.118	.153	.040	-.006
	Sig (2-tail)	.092	.204	.460	.494	.290	.782	.968
	N	15	29	24	36	50	50	50

		Local authorities trust	Local authorities use	News website trust	News website use	Number of sources	Face-to-face with authorities	Received official warning(s)
Evacuation decision	Pearson’s r	-.109	.038	.010	.198	-.028	-.102	-.059
	Sig (2-tail)	.700	.844	.963	.248	.846	.481	.683
	N	15	29	24	36	50	50	50
Evacuation time	Pearson’s r	-.367	.225	-.244	-.200	.109	-.251	-.164
	Sig (2-tail)	.418	.459	.381	.398	.565	.180	.387
	N	7	13	15	20	30	30	30

		Belief threat affect them	Knew threat from incident	Knew what actions	Warning trust	How dangerous post-event	Prior knowledge index	Information search index
Belief threat affect them	Pearson's r							
	Sig (2-tail)							
	N	11						
Knew threat from incident	Pearson's r	-.222						
	Sig (2-tail)	.511						
	N	11	11					
Knew what actions	Pearson's r	.671*	-.149					
	Sig (2-tail)	.024	.662					
	N	11	11	11				
Warning trust	Pearson's r	-.289	.241	-.194				
	Sig (2-tail)	.389	.476	.568				
	N	11	11	11	11			
How dangerous post-event	Pearson's r	.389	-.422	-.100	-.430			
	Sig (2-tail)	.226	.196	.770	.186			
	N	11	11	11	11	50		
Prior knowledge index	Pearson's r	.553	.553	.371	.000	.060		
	Sig (2-tail)	.078	.078	.262	1.00	.681		
	N	11	11	11	11	50	50	
Information search index	Pearson's r	.463	.180	.311	.111	-.164	.259	
	Sig (2-tail)	.152	.596	.353	.744	.260	.072	
	N	11	11	11	11	49	49	49
Household size	Pearson's r	-.056	.056	.169	-.608*	-.238	.119	.014
	Sig (2-tail)	.870	.870	.618	.047	.097	.410	.924
	N	11	11	11	11	50	50	49
Had child under 5	Pearson's r	.222	-.389	.149	-.770**	-.375**	.110	.006
	Sig (2-tail)	.511	.237	.662	.006	.007	.446	.965
	N	11	11	11	11	50	50	49

		Belief threat affect them	Knew threat from incident	Knew what actions	Warning trust	How dangerous post-event	Prior knowledge index	Information search index
Had child under 12	Pearson's r	.289	-.241	.194	-.542	-.360*	.080	-.027
	Sig (2-tail)	.389	.476	.568	.085	.010	.582	.854
	N	11	11	11	11	50	50	49
Had child under 18	Pearson's r	-.134	-.134	.239	-.386	-.430**	.044	-.059
	Sig (2-tail)	.695	.695	.479	.241	.002	.764	.686
	N	11	11	11	11	50	50	49
Had pets	Pearson's r	.043	.516	.346	.261	-.272	.043	.160
	Sig (2-tail)	.900	.104	.297	.438	.056	.765	.271
	N	11	11	11	11	50	50	49
Number of pets	Pearson's r	.250	-	-	.250	-.427	.236	.047
	Sig (2-tail)	.685	.000	.000	.685	.077	.346	.852
	N	5	5	5	5	18	18	18
Distance from incident	Pearson's r	.207	-.642*	.199	.192	.417**	-.288*	-.332*
	Sig (2-tail)	.541	.033	.558	.572	.004	.049	.024
	N	11	11	11	11	47	47	46
Impediment in household	Pearson's r	.222	.222	.149	-.241	.007	.159	.130
	Sig (2-tail)	.511	.511	.662	.476	.961	.269	.372
	N	11	11	11	11	50	50	49
Vehicle access	Pearson's r	-	-	-	-	-.004	.016	-.003
	Sig (2-tail)	.000	.000	.000	.000	.980	.911	.984
	N	11	11	11	11	50	50	49
Years in Casselton	Pearson's r	-.380	.129	-.744**	.163	-.239	.043	.146
	Sig (2-tail)	.249	.705	.009	.632	.106	.773	.332
	N	11	11	11	11	47	47	46
Level of education	Pearson's r	.043	-.430	.346	-.149	.299*	.130	.044
	Sig (2-tail)	.900	.186	.297	.662	.035	.369	.765
	N	11	11	11	11	50	50	49

		Belief threat affect them	Knew threat from incident	Knew what actions	Warning trust	How dangerous post-event	Prior knowledge index	Information search index
Respondent age	Pearson's r	-.273	.043	-.500	.261	-.049	-.173	.243
	Sig (2-tail)	.417	.900	.117	.438	.733	.231	.093
	N	11	11	11	11	50	50	49
Respondent sex	Pearson's r	-.516	.430	-.346	.559	-.089	-.047	-.132
	Sig (2-tail)	.104	.186	.297	.074	.537	.746	.367
	N	11	11	11	11	50	50	49
Evacuation decision	Pearson's r	.516	-.430	.346	-.149	.344*	.228	-.071
	Sig (2-tail)	.104	.186	.297	.662	.015	.112	.627
	N	11	11	11	11	50	50	49
Evacuation time	Pearson's r	-	.316	-	.316	-.125	-.084	-.212
	Sig (2-tail)	.000	.541	.000	.541	.509	.659	.268
	N	6	6	6	6	30	30	29

		Household size	Had child under 5	Had child under 12	Had child under 18	Had pets	Number of pets	Distance from incident
Household size	Pearson's r							
	Sig (2-tail)							
	N	50						
Had child under 5	Pearson's r	.560**						
	Sig (2-tail)	.000						
	N	50	50					
Had child under 12	Pearson's r	.750**	.777**					
	Sig (2-tail)	.000	.000					
	N	50	50	50				
Had child under 18	Pearson's r	.775**	.736**	.948**				
	Sig (2-tail)	.000	.000	.000				
	N	50	50	50	50			
Had pets	Pearson's r	.303*	.312*	.306*	.354*			
	Sig (2-tail)	.032	.028	.031	.012			
	N	50	50	50	50	50		
Number of pets	Pearson's r	.095	.459	.351	.254	-		
	Sig (2-tail)	.708	.055	.153	.309	.000		
	N	18	18	18	18	18	18	
Distance from incident	Pearson's r	-.333*	-.269	-.158	-.194	-.013	-.239	
	Sig (2-tail)	.022	.068	.288	.192	.930	.373	
	N	47	47	47	47	47	16	47
Impediment in household	Pearson's r	.101	-.019	-.092	-.108	-.094	-.029	-.147
	Sig (2-tail)	.486	.897	.526	.456	.516	.910	.325
	N	50	50	50	50	50	18	47
Vehicle access	Pearson's r	.059	.089	.115	.121	.167	-	-.043
	Sig (2-tail)	.684	.538	.428	.403	.247	.000	.775
	N	50	50	50	50	50	18	47

		Household size	Had child under 5	Had child under 12	Had child under 18	Had pets	Number of pets	Distance from incident
Years in Casselton	Pearson's r	-.213	-.220	-.262	-.265	-.276	.025	-.135
	Sig (2-tail)	.151	.137	.075	.072	.061	.927	.382
	N	47	47	47	47	47	16	44
Level of education	Pearson's r	.253	-.017	.165	.204	.049	-.162	.083
	Sig (2-tail)	.077	.904	.252	.154	.735	.520	.578
	N	50	50	50	50	50	18	47
Respondent age	Pearson's r	-.399**	-.354*	-.416**	-.432**	-.384**	.077	.024
	Sig (2-tail)	.004	.012	.003	.002	.006	.761	.875
	N	50	50	50	50	50	18	47
Respondent sex	Pearson's r	-.116	-.074	-.049	.002	.147	-.185	-.215
	Sig (2-tail)	.424	.607	.736	.990	.307	.463	.146
	N	50	50	50	50	50	18	47
Evacuation decision	Pearson's r	.031	.022	.076	.019	.083	.148	.118
	Sig (2-tail)	.832	.878	.598	.898	.565	.558	.431
	N	50	50	50	50	50	18	47
Evacuation time	Pearson's r	.398*	-.126	.191	.191	.265	-.033	.074
	Sig (2-tail)	.029	.508	.313	.313	.158	.924	.697
	N	30	30	30	30	30	11	30

		Impediment in household	Years in Casselton	Vehicle access	Level of education	Respondent age	Respondent sex	Evacuation decision
Impediment in household	Pearson's r							
	Sig (2-tail)							
	N	50						
Years in Casselton	Pearson's r	-.212						
	Sig (2-tail)	.140						
	N	50	50					
Vehicle access	Pearson's r	.135	-.182					
	Sig (2-tail)	.367	.220					
	N	47	47	47				
Level of education	Pearson's r	-.189	.212	-.240				
	Sig (2-tail)	.188	.139	.105				
	N	50	50	47	47			
Respondent age	Pearson's r	.251	-.140	.659**	-.280*			
	Sig (2-tail)	.079	.334	.000	.049			
	N	50	50	47	50	50		
Respondent sex	Pearson's r	-.257	.188	.002	-.077	-.106		
	Sig (2-tail)	.072	.190	.990	.595	.463		
	N	50	50	47	50	50	50	
Evacuation decision	Pearson's r	-.141	.042	-.287	.360*	-.314*	.016	
	Sig (2-tail)	.328	.774	.051	.010	.026	.910	
	N	50	50	47	50	50	50	50
Evacuation time	Pearson's r	.125	.104	-.171	-.199	-.133	-.150	-
	Sig (2-tail)	.511	.583	.394	.293	.484	.428	.000
	N	30	30	27	30	30	30	30