ABSTRACT

Title of Dissertation: NUCLEAR REACTIONS: TESTING A MESSAGE-CENTERED EXTENSION OF ENDURING PREDICTIONS ABOUT EXPERT AND LAY PERSON PERCEPTIONS OF AND REACTIONS TO RISK

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The purpose of this dissertation was to critically examine differences in risk perceptions among experts and lay people. In particular, this project aimed to address inconsistent definitions of "expert" found in the existing literature and to test the predictions of the psychometric paradigm in the context of communication. To examine the effect of message features and expertise on risk perceptions and evaluations of risk characteristics, this dissertation employed a 2 (*emotional appeal*: fear, anger) x 2 (*message topic*: nuclear energy, traffic accidents) x 4 (*expertise*: general risk assessors, traffic safety experts, nuclear energy experts, lay people) between-participants design.

The results replicated some findings of the existing research. First, in the main, experts reported lower risk perceptions than lay people. Second, expressed fear led to increased risk perceptions compared to expressed anger. This study also advanced theory regarding risk perception and risk communication in two critical ways. First, differences were found not only between experts and lay people but also among the various expert groups, and, even in the expert groups, these differences were influenced in meaningful ways by the messages viewed. Second, this study demonstrated the potential for messages to affect not only risk perceptions but also the evaluation of risk characteristics, a possibility not previously tested. Specifically, the findings indicated that emotional appeals and message topic can affect evaluations of risk characteristics for risks both related to the message and unrelated to the message. The messages' effects on evaluations of risk characteristics were, in fact, more pronounced than the effects of the messages on general risk perceptions. The results suggest the factors argued to be predictive of risk perception (dread risk and knowledge risk), presented previously as characteristics inherent to risks rather than as targets for influence, can be altered through strategic communication. Both theoretical and applied implications of these results are discussed, and recommendations for future research are provided.

NUCLEAR REACTIONS: TESTING A MESSAGE-CENTERED EXTENSION OF ENDURING PREDICTIONS ABOUT EXPERT AND LAY PERSON PERCEPTIONS OF AND REACTIONS TO RISK

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Dedication

To my parents, Bruce and Susan, who have always made my dreams their own.

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Lastly, I must thank my dear friends, who listened to my horror stories, assured me I could make it through, and reminded me that there was life outside of graduate school. Thank you for your tireless efforts to help me recruit the participants I needed for this project so I could join you again on the outside! I am also very grateful for an uber talented and supportive graduate student family. Thank you for pushing me to be better and reminding me I wasn't alone. My company and coworkers have been tremendously supportive as well, granting me the flexible schedule needed to finish as well as offering general encouragement and advice. The flood of emails before and after my defense was touching.

I hope that this work is something in which you can all take pride, as you have all contributed greatly to its completion.

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Chapter 1: Introduction

In risk communication research, much attention has been given to the discrepancy between expert and lay individual judgments of risk (Flynn, Slovic, & Mertz, 1993; Hansen et al., 2003; Kraus, Malmfors, & Slovic, 1992; Lazo et al., 2000; Salvadori et al., 2004; Slovic, Fischhoff, & Lichtenstein, 1979; Slovic, 1987). This incongruity in judgments between experts and lay people may stem from the nature of risk communication requiring a transition from the technical to the public "sphere of argument" (Goodnight, 1982). That is due to the scientific nature of risk, which requires risk assessment to be taken from the technical sphere in which professionals (i.e., risk assessors, risk managers) communicate through scientific jargon and strict(er) rules to the public sphere in which messages about risk must be simple, clear, understandable, and accessible to lay people. The ability of the risk communicator to transition from the technical sphere to the public sphere is essential to widespread understanding and informed risk decision-making (Marzec, 2009). Such a transition, however, is certainly not simple in practice.

The challenge of transitioning from the technical to the public sphere is demonstrated by lay risk perceptions that are not aligned with, and sometimes in opposition to, expert risk assessments. In some cases, risks that experts deem to be relatively small can cause anger and fear in the public. For example, the detection of trace amounts of tritium in groundwater near nuclear power plants (e.g. Braidwood Generating Station) caused anger and fear in the local communities (EPA, 2006). In the case of Braidwood, although the Environmental Protection Agency (EPA) asserted the public was not at risk, community members nonetheless expressed fear and even refused to drink the groundwater ("Braidwood Tritium Project," 2010).

On the other end of the risk perception spectrum, attempts to bring attention to the relatively large risk of traffic accidents seem futile. According to National Highway Traffic Safety Administration's (NHTSA) Fatality Analysis Reporting System (FARS), for each of the past 15 years, more than 40 thousand Americans have died in fatal traffic accidents (NHTSA, 2009). A sense of risk or threat, however, escapes the public when it comes to traffic safety and driving behaviors (AAAFTS, 2009; Slovic, 1987). For example, within the 30 days prior to completing the AAA Foundation for Traffic Safety's Traffic Safety Culture Index, over half of drivers interviewed had used their cell phones while driving, and two in five had driven 15 miles per hour over the speed limit at least once (AAAFTS, 2009).

Though the existence of a gap between expert and lay individual risk evaluations has been well-established (Flynn, 1993; Kraus, Malmfors, & Lazo, Kinnell, & Fisher, 2000; Salvadori, Savio, Nacotra, Rumiati, Finucane, & Slovic, 2004; Slovic, 1987; Slovic, 1992); in this dissertation I argue that a satisfactory explanation as to why the discrepancy exists, and under what conditions it may be more or less pronounced, is incomplete. In order for risk communicators to overcome the challenge of successfully transitioning from the technical to public sphere and thereby ensuring lay people have the knowledge and tools necessary to make sound decisions regarding risks, the underlying cause of the discrepancy between expert and lay person risk perceptions must be better understood. This dissertation will specifically examine contexts in which the expert-lay risk perception gap is more or less pronounced.

Significant contributions to this area of research have been made by Paul Slovic and Baruch Fischhoff (Fischhoff, Slovic, Lichtenstein, Read & Combs, 1978; Slovic, 1987; Slovic, Fischhoff, & Lichtenstein, 1979) via what is now called the psychometric paradigm. Research in the area of the psychometric paradigm indicates lay people evaluate risk on multiple factors. Rather than using a single indicator or scale, such as estimated frequency of deaths caused by a risk, lay people tend to evaluate risk on several of the factors identified by the psychometric paradigm—novelty, severity of consequences, extent to which the risk is known to those exposed, scientific knowledge, voluntariness, number of people likely to be killed in an accident (catastrophic potential), control over the risk, immediacy of effects, and dread potential (Siegrist, Keller, & Kiers, 2005; Slovic, 1987). Such a multi-dimensional approach to risk has been used to explain the discrepancy between expert and lay person risk assessments. Generally, lay person risk estimates tend not to match probabilistic risk—with some risks being overestimated and some underestimated. More specifically, the psychometric paradigm predicts lay person evaluations of risks will be influenced by affective and subjective components (dimensions) of risk, and experts will evaluate risks probabilistically, based on an estimated frequency of deaths caused by each risk.

There are several methodological artifacts represented in this literature, however, that warrant further exploration of the discrepancy between expert and lay assessments. First, the term “expert” has not been consistently defined. In the original research on this topic (Slovic, Fischhoff, & Lichtenstein, 1979), experts were chosen for their professional involvement with risk assessment and came from varying areas of domain expertise. In more recent studies domain expertise has taken priority, making conclusions across studies and generalizations difficult. Second, extant literature on the psychometric paradigm assessed risk perceptions in the absence of communication. The dimensions of the psychometric paradigm are presented as a guide to risk "personality profiles" rather than as features that might be externally influenced or determined (Barnett & Breakwell, 2001). Specifically, the role of discrete emotion in risk perception, which is well established in other areas of the risk perception literature, is ignored by the psychometric paradigm. Though the psychometric paradigm accounts for affect-related characteristics inherent to individual risks, it does not take into account the discrete experienced emotion within the individual person making judgments about the risk. Of particular interest to communication scholars is how communication shapes and reinforces such risk perceptions.

The purpose of this dissertation is to extend the psychometric paradigm to include not only dread and knowledge characteristics of risks but also message-induced emotions experienced by the individuals evaluating the risks. The following sections provide an overview of the importance of risk perception to risk communication as well as the foundational research that led to the psychometric paradigm. Gaps in this research will be identified, followed by an argument that the literature on emotion and risk perception provide insight as to the direction research on the psychometric paradigm and risk communication should take. The dissertation will continue with a study to test the proposed effects of messages on the risk characteristics identified by the psychometric paradigm and conclude with results and a discussion of implications and directions for future risk communication research.

Chapter 2: Theoretical Foundations

Risk communication: What is it and why does it matter?

Risk communication can be described as involving the exchange of information regarding the significance, magnitude, and control of a risk (Reynolds & Seeger, 2005). More specifically it is the exchange of information "among risk assessors, risk managers, other stakeholders, and the public about levels of risk, the significance and meaning of those risks, and the decisions, actions, or policies aimed at managing or controlling the risks" (USDA, 2001, p. 6). The goal of such communication can be to inform, to engage people in the decision-making process regarding risk (Trettin & Musham, 2000) through a two-way process in which the general public not only receives information but also provides feedback (Slovic, 1986; Tanaka, 1998), or to influence and/or change behavior (Rohrmann, 1998).

It is important to note that several purposes are identified in these definitions. Risk communication may be persuasive in nature (influencing or changing attitudes and behavior), but it may also aim to inform or engage. In the latter instances, risk communication assists people in better understanding a risk so they can come to their own decisions about the appropriate response or behavior (Renn, 1998). In this way, risk communication can equip members of the public with the knowledge and tools necessary to make informed decisions for themselves as well as others (e.g. parents making decisions for family members). To do so successfully, it is imperative that risk communicators understand how people come to understand risks and the contextual factors that cause individuals to perceive risks differently.

To come to such an understanding, the concept of risk itself needs further explanation. Each component of the definition provided for risk communication references risk as if it is a self-explanatory variable. Risk, however, is a complex concept that is defined and treated differently across disciplines and contexts. Researchers in decision theory equate risk in terms of certainty of outcomes with higher uncertainty indicating higher risk (Kahneman, & Tversky, 1979). The hard sciences (i.e. chemistry, biology, and physics) tend to define risk in a manner that utilizes the probability of negative outcomes (Freudenburg, 1988; Henley & Kumamoto, 1996; Solomon, Giesy, & Jones, 2000). Risk, in this way, is "probabilistic" (Solomon, Giesy, & Jones, 2000) or "objective" risk (Lipkus, Rimer, & Strigo, 1996). The term "objective" can be misleading, however, as even statistically based risk estimates are influenced by researcher subjectivity—perhaps in choice of sampling method, or risk assessment model applied for example (Rohrmann, 1998). Nonetheless, probabilistic risk of this type is sometimes equated with true or, real risk (Freudenburg, 1988).

Embracing the role of subjectivity in assessments of risk, on the other hand, are those scholars who place emphasis on risk as a social perception rather than a true, or objective reality (Mirel, 1994). Social science researchers, for example, take into account qualitative factors (in addition to quantitative factors) when defining risk. Research in the area of the psychometric paradigm indicates lay people evaluate risk on multiple levels. Rather than using a single indicator, such as estimated frequency of deaths caused by a risk (or probability of negative outcomes), lay people tend to evaluate a risk on several factors. In his discussion of the psychometric paradigm, Slovic (1987) wrote:

> The concept “risk" means different things to different people. When experts judge risk, their responses correlate highly with technical estimates of annual fatalities. Lay people can assess annual fatalities if they are asked to (and produce estimates somewhat like the technical estimates). However, their judgments of "risk" are related more to other hazard characteristics (for example, catastrophic potential, threat to future generations) and, as a result, tend to differ from their own (and experts') estimates of annual fatalities. (p. 283)

These other characteristics to which Slovic referred address people’s perceptions, and risk defined in such a manner is often referred to as “perceived risk” (Freudenburg, 1988; Slovic, 1987; Slovic, Fischhoff, Lichtenstein, 1979). Such a multi-dimensional approach to perceived risk has been used to explain the discrepancy between expert and lay person evaluations of risk (Slovic, 1987; Slovic, Fischhoff, Lichtenstein, 1979) and provides a potential opportunity to influence risk perceptions. It is this type of perceived risk that is of interest in this dissertation.

The important challenge facing risk communicators is to understand when and why a gap between expert and lay person evaluations of risk exists so that message receivers’ behavior is not negatively impacted by an incomplete or misguided understanding of the risks. Importantly, it has been argued that the most common theoretical influencer of risk communication scholarship is the psychometric paradigm (Abraham, 2009). This claim has been supported by empirical evidence as well. A systematic analysis of the literature revealed that Slovic and Fischhoff are the predominant authors in the field of risk communication, cited 254 and 118 times respectively, compared to 34 times for the next most cited author (Gurabardhi, Gutteling,

& Kuttschreuter, 2004). The dominance of the psychometric paradigm in the area of risk communication and its limitations that have yet to be explained, or even thoroughly empirically investigated, make this theory an essential topic for further research.

Current literature on the influence of the dimensions of the psychometric paradigm and emotion on risk perceptions both provide the groundwork for this study and reveal important gaps in the extant literature warranting further empirical inquiry. The following sections provide an overview of this prior research focusing first on the early research identifying differences between expert and lay person risk perceptions and leading into an explanation of the psychometric paradigm which is currently heavily relied upon in risk communication. Areas in need of further inquiry will be identified and will lead into discussion of the role of message-induced emotion in risk evaluations (which is not considered in current psychometric paradigm literature).

Early Research: Identifying Differences in Expert and Lay Judgments of Risk

In their pioneering research examining differences between expert and lay person risk perceptions, Slovic, Fischhoff, and Lichtenstein (1979) asserted that there is a subjective component to risk assessment, and the manner in which judgments are often biased must be understood before the public can be educated about risks. For this reason, the researchers sought to understand how lay and expert risk evaluations might differ systematically. In the initial study, Slovic's team compared three groups of lay people (League of Women Voters, college students, and business and professional members of the Active Club) with a group of experts. Experts were selected on the basis of professional involvement in risk assessment. All participants considered 30 risks and were asked to consider the risk of dying as a consequence of each. They were then asked to rank the risks from least risky to most risky. Similarities were seen across the three groups of lay individuals, but, there were statistically significant differences between overall lay person risk perceptions and expert risk perceptions. Slovic's team posited that the differences in risk perceptions resulted from different approaches to risk, arguing that:

> The experts' judgments of risk were so closely related to the statistical or calculated frequencies that it seems reasonable to conclude that they both knew what the technical estimates were and viewed the risk of an activity or technology as synonymous with them. The risk judgments of lay people, however, were only moderately related to annual death rates, raising the possibility that, for them, risk may not be synonymous with fatalities. (p. 191)

The possibility that lay people were just inaccurate in predicting frequencies of deaths per year was considered but not supported by the data. When asked specifically to estimate frequencies of deaths caused by each risk per year, lay people provided estimates that did not correspond to their estimates of the "riskiness" of an activity or technology, indicating that lay people were not simply inaccurate in judging frequencies but rather were using different or additional information when judging risks. For example, lay people rated nuclear power as the highest risk but as causing the lowest number of fatalities—which could be explained by lay persons' consideration of a disaster potential.

Slovic's team asked participants to estimate the number of deaths they would expect if this year was particularly disastrous. Nuclear power produced a mean disaster multiplier of 100 (high potential for disaster). However, most risks showed little potential for disaster, with estimates of deaths during a particularly disastrous year deviating little from estimates for a typical year. Given disaster potential was not seen for risks other than nuclear energy, this characteristic could only partially explain why lay perceptions differed from those of experts (Slovic, Fischhoff, & Lichtenstein, 1979).

In an attempt to provide a more complete theoretical explanation of the data, Slovic's team also examined nine qualitative characteristics of risk. These factors were measured using seven-point Likert scales instructing participants to rate the extent to which risks were voluntarily undertaken, the extent to which death occurred immediately or the effects were delayed, the extent to which the risks were known precisely by the person who was exposed to those risks, the extent that the risks were known to science, the level of control participants perceived they had if they were exposed to the risk, the extent to which a risk kills people one at a time (chronic risk) or a large number of people at once (catastrophic risk), the extent to which the risk was one that people have learned to live with and can think about calmly, or was one for which people have great dread, and how likely it was that the consequence will be fatal if the risk was realized (Fischhoff, Slovic, Lichtenstein, Read, & Combs, 1978).

Across all 30 risks, ratings of perceived dread and perceived severity of consequences were closely related to lay evaluations of risk (Slovic, Fischhoff, & Lichtenstein, 1979). Expert judgments, however, were not related to any of the nine factors. Slovic et al. concluded that lay individuals approached the evaluation of risk more holistically, and experts evaluated risks based on estimated fatalities. This research program ultimately became what is now known as the psychometric paradigm (Slovic, Fischhoff, & Lichtenstein, 1979).

The Psychometric Paradigm

As indicated previously, lay people tend to evaluate a risk by considering the factors identified by the psychometric paradigm. The psychometric paradigm predicts that factors of dread, newness, and potential for catastrophic effects vary across risks in measurable and predictable ways (Slovic, 1987). According to this paradigm, the factors predicting risk perception are newness, severity of consequences, knowledge about the risk possessed by those exposed, scientific knowledge, voluntariness, number of people killed in an accident, control over risk, immediacy, and dread potential (Siegrist, Keller, & Kiers, 2005).

Factor analysis revealed that the factors discussed above can be grouped into two main components for psychometric analysis (Slovic, 1987). Dread risk is the extent to which the consequences evoke fear (Taylor-Gooby & Zinn, 2006) and is highly correlated with rating scales of perceived lack of control, dread potential, and fatal consequences (Siegrist, Keller, & Kiers, 2005). Knowledge risk (Boholm, 1998), i.e. unknown risk, is the extent to which risk is seen as controllable or uncertain (Taylor-Gooby & Zinn, 2006) and is highly correlated with the rating scales of perceived newness, perceived scientific knowledge, and delay of effects (Siegrist, Keller, & Kiers, 2005).

Participants in studies investigating the psychometric paradigm are typically asked to answer seven-point Likert-type questions measuring these factors (Fischhoff, Slovic, Lichtenstein, Read & Combs, 1978). For example, to measure common-dread, participants in a study conducted by Fischhoff, Slovic, Lichtenstein, Read and Combs (1978) rated whether a hypothetical risk is one people have learned to live with and can think about calmly, or whether it is a risk for which people have great dread (i.e. it causes anxiety and worry and perhaps even panic). Consider, for example, nuclear energy which is a risk that Slovic and colleagues (Fischhoff, Slovic, Lichtenstein, Read & Combs, 1978; Slovic, Fischhoff, & Lichtenstein, 1979) found a large discrepancy between expert and lay individual perceptions of risk.

In the Fischhoff et al. study, lay participants rated nuclear power as highly dreadful (*M* = 6.42 with 1 being "common" and 7 being "dreadful"). For the remaining eight factors mean ratings for nuclear power were: voluntariness (*M* = 6.51), immediacy (*M* = 5.08), known to those exposed (*M* = 5.85), known to science (*M* = 4.83), controllability (*M* = 1.36), newness (*M* = 1.35), chronic-catastrophic (*M* = 6.43), and severity of consequences (*M* = 5.98). These data suggest that lay participants felt nuclear power wasn't voluntary, wasn't immediate, wasn't known to the exposed or to science, can't be controlled, is still new, is catastrophic, and has risks fairly certain to be fatal (Fischhoff, Slovic, Lichtenstein, Read & Combs, 1978).

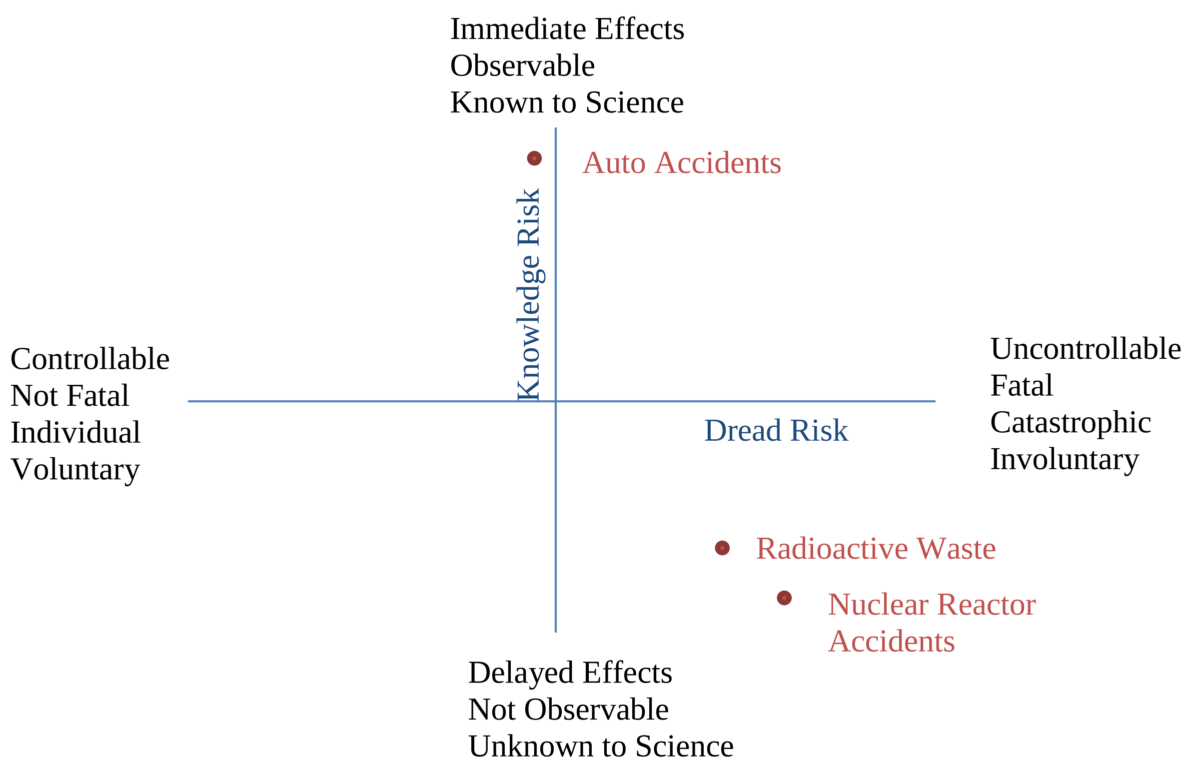
Experts, however, ranked nuclear energy 20th of 30 risks, from most risky to least risky, while the League of Women Voter and college student groups ranked nuclear energy as the most risky of 30 risks. Interestingly, nuclear power tends to be judged high on both the dread and unknown factors by lay people in other studies also (Peters, Burraston, & Mertz, 2004). Regarding lay perceptions, Boholm (1998) wrote that nuclear power is "perceived to be unknown, dreadful, uncontrollable, catastrophic and having delayed adverse effects on future generations" (Boholm, 1998, p. 139). Particularly interesting, however, is how much these public risk perceptions differ from expert perceptions despite the fact that Slovic argues the psychometric paradigm factors have been replicated with both expert and lay person samples (Slovic, 1987). The question then remains: Why are experts not as influenced by the dreadful, uncontrollable, and potentially catastrophic nature of risks (relative to lay people)? And, are there contexts in which this expert effect would diminish?

Although some risks (e.g., nuclear) are over-estimated, other risks lead to lay person evaluations of low risk when the risk is actually higher (an optimistic bias). Some of the fundamental research on layperson risk assessment and decision-making determined that people evaluate traffic accidents as only somewhat dreadful and less voluntary and easily reduced than the risks associated with transportation via bicycle or motorcycle (Slovic, 1987). It seems that people see traffic accidents as a risk that is not only more likely to affect other people but also only likely to affect them personally at the fault of other drivers (AAA Foundation, 2009). In this dissertation, I will compare nuclear energy and traffic risks because they lay on opposite ends of the risk perception continuum with one risk being overestimated and the other underestimated.

The aforementioned evaluation demonstrates the *perceived* involuntary nature of the traffic risks and an optimistic bias that can make risk communication particularly difficult for experts who understand automobile accidents pose a statistically serious risk. These two different risks (traffic accidents and nuclear energy) are clear examples of the gap existing between objective and perceived risk perceptions—one of overestimation and one of underestimation. Figure 1 visually demonstrates the differences between traffic and nuclear energy risks according to the psychometric paradigm's factors of dread risk and unknown risk (Slovic, 1987). The qualitative aspects of risk that make up the factors of dread risk and knowledge risk are widely thought to explain the pattern of risk perceptions observed (Barnett, & Breakwell, 2001; Fife-Schaw & Rowe, 2000; Marris, Langford, & Riordan, 1998; Slovic, 1987), and this dissertation assumes the existence of such factors.

In the years following the initial Slovic study, multiple researchers have collected data supporting the pattern of experts and lay people differing in their formations of risk perceptions across a wide range of topics including food-related risks (Hanson, Holm,

Figure 1. *Visual representation of how traffic accident risks and nuclear energy risks differ in terms of Slovic's (1987) risk characteristics*



Frewer, Robinson, & Sandoe, 2003), ecosystem risks (Lazo, Kinnell, & Fisher, 2000), global climate change (Lazo, Kinnell, & Fisher, 2000), chemical (Kraus, Malmfors, & Slovic, 1992), biotechnology (Salvadori, Savio, Nacotra, Rumiati, Finucane, & Slovic, 2004), and radioactive waste disposal (Flynn, 1993). Similar results are expected in the present study.

H_1: There will be a main effect of expertise, such that experts will report lower risk perceptions than lay people.

Though this general prediction that came out of the psychometric paradigm work is expected to be replicated, there are several limitations of the psychometric paradigm research that should be addressed as they could provide insight regarding under what circumstances this difference between experts and lay people will persist.

Limitations of the Psychometric Paradigm

Perhaps because it makes intuitive sense, articles challenging the notion that experts and lay people evaluate risks differently are scarce (but see Rowe & Wright, 2001). There are, however, both theoretical and methodological concerns that should be improved upon in future risk communication research involving the psychometric paradigm. First, theoretically, the psychometric paradigm is simply a descriptive tool and may be too broad in scope. Although the explanation of risk perceptions being affected by the amount of dread and knowledge helps explain why some risks are perceived as more dangerous than others, there are not clear predictions regarding how each quadrant of the factor space (see Figure 1) might function differently. The factor space is presented as though it is based on internal characteristics of risk that are unchanging without consideration of potential influencers that may change evaluations of these characteristics (Barnett & Breakwell, 2001).

Inconsistent definitions of expert

Further, methodological issues need to be addressed. A meta-analysis took issue with how the expert sample in the original sample was defined and as a result argued that no conclusions could presently (p. 356) be drawn regarding differences in risk perceptions between experts and lay people (Rowe & Wright, 2001). In the original psychometric paradigm research (Slovic, Fischhoff, & Lichtenstein, 1979), experts were chosen for their professional involvement with risk assessment and came from varying areas of domain expertise (i.e. geography, economics, biology, and law). In more recent studies domain expertise has been employed as the operationalization of expert, making generalizable conclusions across studies difficult. Rowe and Wright (2001) called for researchers to be more precise in defining their sample because “expert” had been operationalized differently across the studies reviewed making it difficult if not impossible to draw firm conclusions.

Scholars continue to design studies stemming from Slovic’s original argument, however, and no one has conducted a study examining the potential impacts of variations in the term “expert.” In other words, one type of expert may be those with a background in risk assessment (e.g. Slovic, Ficshhoff, & Lichtenstein, 1979), while another type of expert, may be those with a specific level of training in the specific threat (e.g. a nuclear scientist). Table 1 shows various definitions of the term expert used in the current risk perception literature. An unanswered question, then, is whether two distinct groups of domain experts (in this case traffic and nuclear) would rate domain specific risks similarly.

Expert-lay person conceptualizations of risk

Some scholars have asserted that the notion that experts do not consider qualitative factors of risk when making evaluations, could be misleading. It is taken for granted in the psychometric paradigm research that experts base risk assessments on more objective information—such a procedure for expert evaluations is presented as self-evident. It seems clear, however, that any person making a risk assessment has a choice in terms of the type of information to employ in their assessment. Slovic (1987) touches on this argument in explaining that lay people can be influenced to "objectively" rate frequencies of death, but the possibility that experts might choose to (or be influenced to) evaluate risks on the more qualitative and emotional aspects of the risk is ignored in the literature.

Research on emotion management, however, is particularly interesting when considered in this context. In general, organizations are positioned as rational entities, and emotion management is argued to be critical to organizational success (Kersten, 2005). Furthermore, public relations managers are presented as dealing with and managing public emotion—in such a way to minimize the effect of emotion on decision-making. There is also neurological evidence that emotion affects decision-making (Berns et al., 2006; Davidson, 2003; Murphy, Nimmo-Smith, & Lawrence, 2003). Such emotional processing at the neurological level demonstrates the pervasive effect of

Table 1. *Definition of "Expert" Across Existing Studies*

Definitions of Expert Across Existing Studies				
Study	**Operationalization of Expert**	**Type of Risk**	**Expert Evaluating Risk in Own Domain?**	**Difference between Expert and lay risk perceptions?**
Slovic, Fischhoff, and Lichtenstein (1985)	Involvement in professional risk assessment (wide range including geographer, layer, economist, biologist)	Various	No	Yes
Kraus, Malmfors, and Slovic (1992)	Members of Society of Toxicology	Toxicology	Yes	Yes
Flynn, Slovic, and Mertz (1993)	Members of American Nuclear Society	Nuclear Waste	Yes	Yes
Barke and Jenkins-Smith (1993)	American Association for the Advancement of Science	Nuclear Waste	No	Mixed Results
Slovic *et al.* (1995)	Members of the Canadian Society of Toxicology	Toxicology	Yes	Yes
McDaniels, Axelrod, Cavanagh, and Slovic (1997)	Professionals in aquatic science	Water Environments	Yes	Yes
Lazo, Kinnell, and Fisher (2000)	Professors/researchers in ecological sciences and employees of the U.S. Environmental Protection Agency (EPA)	Global Climate change risks and non-global climate change risks	Mixed	Mixed Results
Salvadori (2004)	Professors/Ph.D students of biology	Biotechnology	Yes	Yes

emotion at the human level, not by type of training or profession (Naqvi, Shiv, & Bechara, 2006). Furthermore, there is literature providing advice on managing emotions in order to better perform in certain areas, such as investing. In the context of this research, experts are not presented as immune to emotion but rather as actively controlling the influence of emotion on their decisions (Lucey & Dowling, 2005; Seo & Barrett, 2007; Waldman, 1996; Zinn, 2008).

Given this evidence, perhaps it is not that experts broadly use different information than lay people when judging a risk but that certain experts are trained to make evaluations in a particular manner in specific contexts. That is, a nuclear energy expert would be trained to suppress emotion when dealing with the risk of nuclear energy, but would not necessarily or automatically apply such training in the context of evaluating risks in other domains.

A test of this idea will require a more carefully formulated definition of expert. Specifically a distinction between risk assessment expertise and domain expertise should be made. It is expected that depending on the specific area of expertise, risk perceptions will be affected differently.

H_{1b}: There were be a main effect of expertise such that experts who evaluate a risk within their domain of expertise will have more accurate risk perceptions than lay people and experts for whom the risk is outside of their domain.

In the case of traffic safety, for which an optimistic bias is expected in the general public assessments, traffic safety expert risk perceptions are expected to be higher than those of other expertise groups. On the other hand, in the case of nuclear energy, nuclear energy experts are expected to have lower risk perceptions than other expertise groups.

Lack of control for biological sex

Furthermore, important demographic characteristics were not controlled for in the original psychometric paradigm research (Slovic, 1987). Namely, the gender composition of the different groups was not considered. The expert group, which was small (n = 15), was almost entirely male (only three women) while the League of Women Voters lay group was not surprisingly primarily female (68 percent female—Slovic, Fischhoff, & Lichtenstein, 1979). This is an essential limitation as more recent research has shown that risk perceptions vary along biological sex lines.

Specifically, men tend to evaluate potential threats as less risky than women (the same pattern seen between the expert and lay groups in the Slovic study). In fact, even when comparing male and female scientists, significant differences in risk perceptions are found. For example, Barke et al. (1997) found that female scientists (from the "hard" sciences) evaluated the risk of nuclear technologies higher their male counterparts ($p < 0.05$). Similarly, Slovic et al. (1995) found that female toxicologists were more likely than male toxicologists to judge risks as moderate or high threats. Such a pattern is often referred to as the "white male effect" (Finucane et al., 2000).

Furthermore, societal factors have historically led to fewer women than men going into technical and scientific fields (Alper, 1993) making it imperative to control for biological sex to truly statistically establish that the differences that lie between expert and lay individual judgments about risks (if they in fact exist) are not due to the gender compositions of those groups. It is therefore expected that biological sex will be a significant predictor of risk assessments such that:

H_{2a}: Women's risk perceptions will be higher than men's risk perceptions regardless of expertise.

H_{2b}: The relationship between expertise and risk perceptions will be attenuated when controlling for biological sex.

Absence of a communication context

A final limitation is that extant research on the psychometric paradigm measures individuals risk perceptions as if they were stable and not influenced by external communication. Yet, research is clear that the vast majority of individuals co-create their risk perceptions with the influence of external messages. In fact, some scholars have gone so far as to argue communication is the only way to initiate responses to risk, and, further, that risks would lack meaning completely in the absence of communication. Luhmann (1986) argues that:

> Fish may die or human beings; drinking water or swimming in rivers or lakes may cause diseases; we may run out of oil; the global temperature may rise or fall; all these effects will not cause any societal effects unless society communicates about it… Society observes nature and environment through communication. Communicating meaning is the only means for initiating responses: therefore it can regulate communication only by other forms of communication. In essence, it is society which poses a threat to its survival, not the environment. (p. 63; translation by and in Renn, 1991)

Through social interaction and communication, perceptions of risks can be amplified and attenuated (Kasperson, Renn, Slovic, Brown, Emel, Goble, Kasperson, & Ratick., 1988; Kasperson & Kasperson, 1996; Renn, 1991; Renn, Burns, Kasperson, & Kasperson, 1992). As it was defined in the first section of this dissertation, risk communication can inform or even persuade—that is, change risk perceptions. It would be particularly useful to know if risk perceptions existing in one quadrant are more difficult to change, with a risk message, than risk perceptions in another quadrant. Likewise, it would be useful to know if one quadrant is more important in terms of public policy or risk interventions (e.g. risks that currently (pre-communication) are underestimated by the public leading to insufficient preventative action (e.g., risk of obesity)). The psychometric paradigm does not provide guidance as to how the qualitative factors of risks might be influenced, particularly through communication, and if such communication could in fact move a risk into a quadrant that may be more easily targeted in a public health campaign.

The extant literature on the psychometric paradigm and the expert-lay person risk perception discrepancy has tested risk perceptions in a vacuum—in the context of no risk communication. Not only does this affect the feasibility of extending predictions from the psychometric paradigm to practical contexts for risk communicators, but it also fails to address whether or not a risk can move in the factor space—and more specifically, whether a perceived risk's placement in the factor structure is dependent upon the type of risk message received. In fact, as the subsequent section will demonstrate, research has shown that discrete emotions, as induced by risk messages, affect individuals' risk perceptions.

Emotion and Risk Perception

Only since the 1980's have judgment and decision researchers begun to incorporate affect into their decision models (see Lerner & Keltner, 2000, 2001; Loewenstein, Weber, Hsee, & Welch, 2001). Moreover, most of those studies that did integrate affect into their risk predictions only examined affect and ignored the effects of discrete emotions (Johnson & Tversky, 1983).

The seminal study demonstrating the effect of affect on risk perception was conducted by Johnson and Tversky (1983) who experimentally manipulated affect using newspaper articles. Johnson and Tversky conducted four experiments. In the first two experiments, participants either read a mundane news story (i.e. a "people in the news" column, p. 23) or a story about a tragic event ("the death of a single person," p. 23) written to induce negative affect. The data from both of these experiments indicated that when participants experienced negative affect there were global increases in risk perceptions. In the third experiment, Johnson and Tversky asked participants to read news stories that either communicated a tragic event or elicited positive affect. Experiment four showed that participants who experienced negative affect rated their perceptions of risks higher than those who experienced positive affect (as a result of a story about a young man who is accepted to medical school and succeeds on a difficult exam).

Two important findings were illuminated by this research. First, Johnson and Tversky's data indicated that the negative affect caused by the leukemia story affected participants' perceptions of their risk for leukemia. Second, participants who experienced negative affect rated their perceptions of the other risks (e.g., fire, floods, terrorism) higher than those who experienced positive affect prior to completing the risk perception survey. In other words, the negative affect aroused by the leukemia story affected judgments which were both related (integral) and unrelated (incidental) to leukemia. Incidental emotions are feelings that are unrelated to the judgment at hand; integral emotions, on the other hand, are related to the judgment in consideration (Lerner, Han, & Keltner, 2007). Such findings demonstrated the pervasive influence of affect in evaluating everyday risks and also raised an important methodological point as positive and negative affect were induced experimentally through the presentation of messages. Based on this research, and other studies following in their footsteps, consensus in the literature was that positively valenced emotions resulted in lower perceived risk and negatively valenced emotions resulted in increased perceived risk (Forgas, 1995; Kavanagh & Bower, 1985; Wright & Bower, 1992).

The importance of affective responses to risk perceptions and judgments continued to be supported in subsequent research. Sjoberg (1998) argued that to understand risk perception we cannot focus our attention solely on cognition but must consider the crucial role of affect. Epstein (1994) explained that the judgment process involves evaluation of evidence in two ways—the first “intuitive, automatic, natural, nonverbal, narrative, and experiential, and the other analytical, deliberative, verbal, and rational” (p. 710). Experiential processing tends to be a quicker, easier, and more efficient way to come to judgments about risks which are often complex and laden with uncertainty (Epstein, 1994). Specific to the role of emotion in experiential processing, Epstein (1994) noted the following:

> The experiential system is assumed to be intimately associated with the experience of affect … which refer[s] to subtle feelings of which people are often unaware … the experiential system automatically searches its memory banks for related events, including their emotional accompaniments … If the activated feelings are pleasant, they motivate actions and thoughts anticipated to reproduce the feelings. If the feelings are unpleasant, they motivate actions and thoughts anticipated to avoid the feelings. (p. 716)

In this way affect plays a role in coming to judgments about risks and serves as an indicator of, or cue for, forming risk perceptions. These cues are utilized in an effort to cognitively simplify risk judgments. Such use of affect as a cognitive shortcut to evaluate complex risks led Finucane, Alhakami, Slovic, and Johnson (2000) to propose the "affect heuristic."

Affect Heuristic

The affect heuristic is a cue for judgment based on an affective state produced by a particular object or event. Affect is a state that people experience resulting from positive and negative associations with a particular object or event. As people come to associate objects or events with positive or negative affect, their affective reactions can serve as a cue for judgment. For example, an unpleasant affective response can increase judged probabilities of risks and lead to actions to avoid these feelings (Finucane, Alhakami, Slovic, & Johnson, 2000). Particularly for lay people, the actual probability of a risk occurring is less important than the perception of potential consequences and the feelings these potential consequences produce.

To test this idea, studies have been conducted measuring both cognitive and affective aspects of risks (Bargh, 1984; LeDoux, 1996; Sundblad, Biel, & Garling, 2007; Zajonc, 1980, 1984a, 1984b). Cognitive aspects of risk judgments include knowledge of cause and negative consequences related to the risk while affective aspects relate to the anticipated affect evoked by the risk. Anticipatory affect may not be experienced while presently thinking about a risk but is expected to be experienced in the future in conjunction with or as a result of the risk (Sundblad, Biel, & Garling, 2007). When both cognitive and affective components of risks have been measured, affect influenced judgments significantly more than cognitive components (Sundblad, Biel, & Garling, 2007). This may be due in part to the fact that affective responses have been shown to occur more quickly than cognitive evaluations (Zajonc, 1980, 1984a, 1984b; Bargh, 1984; LeDoux, 1996).

Similarly, Loewenstein et al. (2001) proposed a "risk-as-feelings" hypothesis. Like Finucane et al. (2000), Loewenstein et al. (2001) predicted that there are both cognitive and affective aspects of risk judgments. According to their hypothesis, attention is given to the anticipated negative affect evoked by threats (also similar to the application of the affect heuristic).

Both cognitive risk perception and anticipated affective response function as antecedents to decisions and behavioral intentions; moreover, the two concepts influence each other. In fact, in cases where affective reactions to risks and cognitive assessment of risk do not mesh well, affective reactions (opposed to cognitive evaluations) often drive behavior (Loewenstein, et al., 2001). For example, when emotional responses and cognitive evaluations of a risk diverge, the emotional reaction can lead to a behavior that does not seem to match the cognitive severity of the risk (Nesse & Klaas, 1994). Loewenstein and colleagues explained:

> Fear causes us to slam on the brakes instead of steering into the skid, immobilizes us when we have greatest need for strength, causes sexual dysfunction, insomnia, ulcers, and gives us dry mouth and jitters at the very moment when there is the greatest premium on clarity and eloquence. (p. 5)

As I stated earlier, early consensus in the literature was that positively valenced emotions, such as happiness, resulted in decreased perceived risk and negatively valenced emotions, like fear or anger, resulted in increased risk perceptions (Forgas, 1995; Kavanagh & Bower, 1985; Wright & Bower, 1992), and some scholars continue to make this argument. The affect heuristic plays a vital role in explaining the differences in judgments between lay people and experts. The argument here is that lay people apply the affect heuristic to their risk judgments and experts do not (Finucane, Alhakami, Slovic, & Johnson, 2000). Problematically, though, studies of this kind present all negative affective states as equivalent (as well as all positive states). Yet, Nabi (1999) as well as Lerner and Keltner (2001) have argued that valence is not the primary driver of risk perception, and that discrete emotions need to be studied.

Nabi (2010) explained the potential implications of ignoring discrete emotions:

> …if the discrete emotion perspective allows for more precise prediction of actions in accordance with emotional arousal, we are better prepared to enact interventions responsive to those emotional experiences. Not only would we use different words to calm a person in an angry, sad, or fearful state, but the

underlying appraisals resulting in those affects suggest how we might accomplish this task. (p. 155)

Based on an appraisal-based emotion paradigm (e.g. Lazarus, 1994) Lerner and Keltner (2001) argued that emotion leads individuals to appraise their immediate environment and these appraisals guide subsequent evaluations. Specifically, Lerner and Keltner proposed that certainty appraisals were the primary driver of the relationship between emotions and risk perceptions. Two similarly valenced emotions, such as anger and fear, can elicit opposite outcomes on risk perceptions because they vary with regard to certainty and control appraisals. It is important to note that the psychometric paradigm has never been tested an outcome of emotional risk messages. I will subsequently make the case that discrete emotional appeals will affect people's dread and knowledge perceptions.

Emotion Appraisals: Appraisal Tendency Framework

Appraisal theories of emotion date back to the 1960s. The basic premise is that emotion is caused by some sort of evaluation of an event—be it interpersonal, intrapersonal, or mass-mediated. Arnold (1960) argued that appraisal is the process by which individuals assess the personal relevance of an event. Further, he explained that "to arouse an emotion, the object must be appraised as affecting me in some way, affecting me personally as an individual with my particular experience and my particular aims" (p. 171). The basic idea is that a message or event triggers a particular predominant emotion which in turn affects the response to the stimulus. These responses differ along physiological, behavioral, and cognitive lines (Frijda, 1986; Levenson, 1994; Oatley & Johnson-Laird, 1996).

Appraisal theorists maintain that all emotions are initiated by an individual's appraisal of events in the environment as they relate to personal well-being and the things that are most cared about, and that these appraisals also affect the consequences of emotions (Parrot, 2004). Smith and Ellsworth (1985) identified six cognitive dimensions that could be combined to distinguish among discrete emotions: pleasantness (i.e., valence), attentional activity, anticipated effort, control, certainty and responsibility. Table 2 shows the distinctions among emotions based on these appraisals.

Table 2. *Emotions Mapped onto Smith and Ellsworth's Dimensions*

	Valence	Effort	Certainty	Attention	Control	Responsibility
Fear	Unpleasant	High	Uncertain	High	Situational	Either[1]
Anger	Unpleasant	High	Certain	High	Human	Other
Guilt	Unpleasant	High	Certain	Low	Human	Self
Hope	Pleasant	Low	Uncertain	High	Situational	Either[1]
Pride	Pleasant	Low	Certain	High	Human	Self

Note.
[1]Fear and Hope were at the mid-point for attribution of responsibility to self or others

Of particular interest to risk communication researchers are the dimensions of certainty and control. To clarify, certainty is the degree to which future events seem predictable and comprehensible; control is the degree to which events seem brought about by individual agency versus situational agency; and responsibility is the degree to which someone or something other than oneself is believed to be responsible for the events. According to Lerner and Keltner (2000), these dimensions map directly onto the two cognitive meta-factors discussed in the risk-psychometrics literature: unknown risk and "dread" risk (Slovic, 1987).

Two commonly experienced emotions in risk-related situations, anger and fear, are clearly differentiated by these two dimensions. Anger arises from appraisals of negative events as being predictable (i.e. high certainty) and intentionally brought about by others (i.e. other-responsibility and control). Fear, on the other hand, arises from perceptions of negative events as unpredictable (i.e. low certainty) and under situational control. Lerner and Keltner (2001) found that these two distinct emotions influenced individual risk judgments: whereas fearful people expressed pessimistic risk estimates and risk-averse choices, angry people expressed optimistic risk estimates and risk-seeking choices. Similarly, Lerner, Gonzalez, Small, and Fischhoff (2003) induced participants to either feel fear or anger regarding terrorism and then asked participants to complete a battery of risk perceptions about both terrorism and non-terrorism related risks (e.g., disease). Their data indicated that anger led to optimistic risk perceptions and fear led to pessimistic perceptions of risk.

Shortly after the September 11, 2001 terrorist attacks, a field experiment was conducted to test the framework. Rather than inducing emotion solely through an article or past experience, Lerner et al. (2003) studied a national representative sample of people on their emotional responses to the attack and perceptions of the risk of additional attacks and more common risks such as homicide and the flu. Though anger and fear were prevalent after the attacks, the researchers strengthened the target emotion by having participants write brief essays on why they felt either angry or fearful. Even in this more natural setting (compared to college students in a lab setting), higher levels of anger led to lower, more optimistic perceptions of future risks (both terrorism specific and general) compared to higher levels of fear which led to more pessimistic and elevated perceptions of risk (Lerner et al., 2003).

A similar pattern is expected to be reproduced here:

H_3: There will be a main effect of emotional appeal, such that participants who read the message targeting fear will report higher risk perceptions than those who read the message targeting anger.

Additionally, given the research explained previously on emotion management and the operationalization issues with regard to the term expert, it is also expected that emotion will affect people differently based on the type of expertise and the type of risk being evaluated, such that:

H_{4a}: There will be a main effect for expertise on expressed fear such that lay people will report more fear than experts.

H_{4b}: There will be a main effect for expertise on expressed anger such that lay people will report more anger than experts.

H4, as a whole, makes the case that lay people will express more emotion relative to experts regardless of domain topic, expert domain, or emotional appeal type. Regardless of this predicted main effect, the three predictor variables of interest in this dissertation are still expected to interact:

H_5: There will be a 2-way interaction of risk domain (nuclear, traffic) and expertise (lay people, traffic experts, nuclear experts, general risk assessors) such that experts reading an emotional appeal regarding a risk *outside of their domain* will report higher levels of the intended emotion (i.e., fear for the fear appeal) relative to experts evaluating a risk within their domain.

It further seems reasonable that emotional appeals could affect the evaluation of risk characteristics as well as risk perceptions. These effects could present themselves in a similar pattern to those seen when evaluating general risk perceptions, but because the psychometric paradigm has not yet been tested in the context of communication specifically, research questions are posed. Furthermore, Slovic (1987) states that the factor space has been replicated with expert and lay person groups, so differences due to expertise are not expected with regard to evaluations of the psychometric paradigm dimensions.

RQ_1: Will there be a main effect of emotional appeal on dread risk and knowledge risk?

RQ_2: Will there be a main effect of message topic on dread risk and knowledge risk?

RQ_3: Will there be an interaction of emotional appeal and message topic such that varying combinations of emotional induction and message topic type yield different dread risk and knowledge risk?

To date the effects of discrete emotions that vary along certainty and control appraisals (anger and fear) on risk perceptions have been examined (Lerner & Keltner, 2001), and risk perceptions regarding risks that vary along the psychometric paradigm's dread and knowledge factors have been studied (Seigrist, Keller, & Kiers, 2005; Slovic, Fischhoff, & Lichtenstein, 1979; Slovic, 1897), but the potential interaction of experienced emotions and affect-related characteristics of the risks themselves has not been explored. Furthermore the research on experts and lay people (Hanson et al., 2003; Kraus, Malmfors, & Slovic, 1992; Lazo, Kinnel, & Fisher, 2003; Slovic, 1987) has not considered the effect of induced emotion, and the research on induced emotion (Lerner & Keltner, 2001) has not compared experts and lay people.

Certainly existing literature on the psychometric paradigm and emotion makes a strong argument that expertise, the psychological space in which a risk exists, and induced emotion influence risk perception. The relationship between these variables, however, is unknown—yet essential to successful risk communication efforts. Through an influence on the factors of the psychometric paradigm, messages have the potential to influence the position of a risk in the psychometric paradigm's factor space, ultimately increasing or decreasing risk perceptions in the process. Such a finding would substantially extend the original theory and situate the psychometric paradigm as a communication theory providing practical direction for the development of successful risk communication messages.

In summary, this study will test the following hypotheses and research questions:

Table 3. *Summary of Hypotheses and Research Questions*

Summary of Hypotheses and Research Questions	
Hypothesis/Research Question	Replication?
H_{1a}: There will be a main effect of expertise, such that experts will report lower risk perceptions than lay people.	Yes
H_{1b}: There were be a main effect of expertise such that experts who evaluate a risk within their domain of expertise will have more accurate risk perceptions that lay people and experts for whom the risk is outside of their domain.	No
H_{2a}: Women's risk perceptions will be higher than men's risk perceptions regardless of expertise.	Yes

H_{2b}:	The relationship between expertise and risk perceptions will be attenuated when controlling for biological sex.	No
H_3:	There will be a main effect of emotional appeal, such that participants who read the message targeting fear will report higher risk perceptions than those who read the message targeting anger.	Yes
H_{4a}:	There will be a main effect for expertise on expressed fear such that lay people will report more fear than experts.	No
H_{4b}:	There will be a main effect for expertise on expressed anger such that lay people will report more anger than experts.	
H_5:	There will be a 2-way interaction of risk domain (nuclear, traffic) and expertise (lay people, traffic experts, nuclear experts, general risk assessors) such that experts reading an emotional appeal regarding a risk *outside of their domain* will report higher levels of the intended emotion (i.e., fear for the fear appeal) relative to experts evaluating a risk within their domain.	No
RQ_1:	Will there be a main effect of emotional appeal on dread risk and knowledge risk?	No
RQ_2:	Will there be a main effect of message topic on dread risk and knowledge risk?	No
RQ_3:	Will there be an interaction of emotional appeal and message topic such that varying combinations of emotional induction and message topic type yield different dread risk and knowledge risk?	No

Chapter 3: Methodology

In the third chapter of this dissertation, the method of the study is described, including the participants, study design, procedures, and instrumentation.

Participants

A sample of 560 people was recruited, targeting three types of expertise—traffic safety, nuclear energy, risk assessment—and lay people. The sample consisted of 22 percent traffic safety experts (n = 124), 23 percent nuclear energy experts (n = 129), 13 percent risk assessment experts (n = 70), and 42 percent lay people (n = 237). Fifty-one percent of the total sample were male (n = 285), 26 percent were female (n = 145), and 23 percent (n = 130) chose not to disclose their biological sex. The mean age fell in the 40-49 years old group (15%; n = 84), with ages ranging from 18 to 60 years of age [18-20 years old (1%), 21-29 years old (18%), 30-39 years old (10%), 50-59 years old (19%) and 60 and older (7%)]. Sixty-eight percent of the participants were white (n = 382), one percent black or African American (n = 4), one percent Asian (n = 3), less than one percent Native Hawaiian or Pacific Islander (n = 1), and the remaining participants (30%; n = 167) did not respond to this demographic question. Time in field ranged from less than one year to 20 years or more, with a mean of 15-19 years in field. Education ranged from high school or equivalent to graduate degree with most participants holding a bachelor's degree (n = 169). No incentive was provided for participation.

A snowball sampling technique was utilized to obtain each type of expertise in this difficult to reach population. Snow ball sampling, i.e., network sampling, is a recruitment technique that utilizes an initial group of participants' social networks to gain access to difficult to reach populations (Browne, 2005). For the lay sample, the initial participant group consisted of personal contacts of the authors' (*n* = 20). Each participant was asked to both participate in the study and forward the invitation to contacts in their own networks, targeting people with as little overlap as possible among their contacts (i.e. only one person from a baseball team, or one coworker, rather than five contacts from a single common activity)—both requesting participation and asking these contacts to forward the invitation as well.

The expert sample was recruited through a slightly different method given that specific expertise was sought. First, personal contacts in each of the expertise groups (nuclear, traffic, and general risk assessors) were contacted via email with an invitation to participate in the study. Again, these participants were asked to pass along the invitation letter to others in their field that might be willing to participate by simply forwarding the electronic invitation. Second, professional organizations and societies (Table 4) in each area of expertise were contacted via electronic mail. Contacts at these organizations were invited to participate as well as asked to use their listserv(s) and/or personal contacts to distribute the invitation further. Each contact in this initial group of people was asked to forward the survey electronically to other people in his or her particular area of expertise. Most of the organizations agreeing to forward the study invitation did not or would not disclose how many people were on their listserv. Further, many of the organizations did not provide an indication of whether or not they were willing to distribute the invitations. Therefore, it is impossible to know with accuracy how many people received the invitation to participate in the study.

Table 4 contains a list of groups contacted for each area of expertise and the response received.

Table 4: *Professional Organizations Contracted for Study Recruitment*

Organization	Response
Nuclear Energy	
Nuclear Energy Institute	Directed to contacts at other organizations.
Women in Nuclear	No response.
Dominion Nuclear	Agreed to distribute.
Traffic Safety	
AAA Foundation for Traffic Safety	Agreed to distribute.
National Highway Transportation Safety Board	No response.
Department of Transportation, Traffic Operations-Traffic Safety	Agreed to distribute.
American Association of State Highway and Transportation Officers	No response.
Federal Highway Administration	Agreed to distribute.
Network of Employers for Traffic Safety	No response.
American Road and Transportation Builders Association	No response.
Risk Assessment	
Society for Risk Analysis	No response.
UMD center	Agreed to distribute.
Harvard Center for Risk Analysis	No response.
Professional Risk Managers' International Association	Agreed to distribute.
Toxicology Excellence for Risk Assessment	No response.
Environmental Protection Agency	No response.
CHEMRISK	No response.
UVA Center for Risk Management	Agreed to distribute.

Risk Assessment and Policy Association	No response.
Global Association of Risk Professionals	No response.

Experimental Design

A 4 (*Type of expertise*: risk assessor, nuclear energy expert, traffic safety expert, lay person) x 2 (*Type of risk*: nuclear energy, automobile accident) x 2 (*Type of emotional appeal*: fear, anger) independent groups design was employed (Table 5). Participants were randomly assigned to the emotional appeal condition and the topic domain condition. The domain expertise is a quasi-experimental factor. The resulting conditions are as depicted in Table 5:

Table 5: *A Visual Depiction of Experimental Groups*

		Message Characteristics			
		Nuclear Energy		**Automobile Accidents**	
		Fear	**Anger**	**Fear**	**Anger**
Type of Expertise	**Risk Assessors**	Risk Assessor/Fear Nuclear Energy Message	Risk Assessor/Anger Nuclear Energy Message	Risk Assessor/Fear Automobile Accident Message	Risk Assessor/Anger Automobile Accident Message
	Nuclear Energy Experts	Nuclear Energy Expert/Fear Nuclear Energy Message	Nuclear Energy Expert/Anger Nuclear Energy Message	Nuclear Energy Expert/Fear Automobile Accident Message	Nuclear Energy Expert/Anger Automobile Accident Message
	Traffic Safety Experts	Traffic Safety Expert/Fear Nuclear Energy Message	Traffic Safety Expert/Anger Nuclear Energy Message	Traffic Safety Expert/Fear Automobile Accident Message	Traffic Safety Expert/Anger Automobile Accident Message
	Lay People	Lay Person/Fear Nuclear Energy Message	Lay Person/Anger Nuclear Energy Message	Lay Person/Fear Traffic Accident Message	Lay Person/Anger Traffic Accident Message

Procedure

The experiment was created with the Survey Monkey tool (see www.surveymonkey.com) and distributed electronically. Potential participants were invited to participate in the study via email. Upon following the link to the study, participants first completed the consent form and indicated they wished to participate in the study. They were first asked questions about the profession in which they work so that they could be grouped by profession (traffic safety, nuclear energy, risk assessment, or other) to be randomly assigned to condition. This grouping assured a relatively even distribution across conditions for each type of expert.

Participants were randomly assigned to message condition by the month in which they were born (e.g., people born in May were assigned to experimental condition nuclear energy, fear). Next, participants read the emotional message corresponding to their condition—either a traffic safety message targeting anger, a traffic safety message targeting fear, a nuclear energy message targeting anger, or a nuclear energy message targeting fear. Manipulation checks for these conditions will be described in the results chapter of this dissertation.

Participants were prompted to “click continue” to indicate they were finished reading the message, and were subsequently taken to a page asking them to write a brief essay or statement regarding their emotional reaction to the risk targeted in their condition, either traffic safety or nuclear energy. It has been shown that asking participants to write about a particular emotion further induces the emotion (Lerner & Keltner, 2001; Turner et al., 2010) justifying the use of this procedure. Participants in the anger conditions were asked to write about an aspect of the risk in question that made them angry, specifically:

> The article you just read addressed a risk associated with [nuclear energy or traffic accidents]. [Nuclear energy or Traffic accidents] evokes a lot of emotions in Americans. We'd like to get a sense of how [nuclear energy or traffic accidents] makes you feel. We are particularly interested in what makes you most angry about [nuclear energy or traffic accidents]. Please describe in detail what angers you about [nuclear energy or traffic accidents], or perhaps what angers you about how people communicate about [nuclear energy or traffic accidents]. If you can, write the description so that someone reading it might even feel angry from learning about the situation. What aspect of nuclear energy makes you the most angry? Why does it make you so angry?

Participants in the fear conditions were asked to describe an aspect of the risk that made them scared, using the same instructions as above only substituting the word "scared" for "angry."[1]

Next, participants in all conditions were asked to continue completing the questionnaire which assessed evaluations of the subjective "riskiness" of 30 activities and technologies (Slovic, 1987). The survey continued with more specific questions regarding risk characteristics related to the dimensions of the psychometric paradigm. The questionnaire concluded with questions to assess demographics. The entire procedure took approximately fifteen minutes.

[1] These instructions were used in Lerner et al. (2003) and were replicated by this author in a previous study (Turner, Evans, & Boudewyns, 2010).

Stimulus Materials

Four mock news articles were used—one for each condition, to induce emotion and topic domain. The articles varied first in the emotional induction, with two articles targeting an anger response and two articles targeting a fear response. The articles also varied in topic, with two articles focusing on a nuclear energy risk and two articles focusing on a traffic safety risk. The aesthetic layout of the articles was the same for all four conditions, and the content remained similar for the pair of articles for each risk with the elements of certainty and control (identified by Smith & Ellsworth as crucial in distinguishing fear and anger) highlighted in the articles differing to produce the targeted emotion. The stimulus materials can be found in Appendix A.

Measures

Expertise

Expertise was measured by self-reported selection of specialized knowledge. Participants were first instructed to indicate whether or not they were considered an expert in their field. They were then asked to indicate the field in which they work: nuclear energy, traffic safety, risk assessment, or other area (e.g. nursing, marketing, or teaching). Participants also had the option to choose "other" and describe their area of expertise. Those who did not indicate expertise in traffic safety, nuclear energy, or risk assessment were all considered lay people for this dissertation.

Emotional response

To ensure the emotional inductions were successful, participants in all conditions evaluated their experience of the two basic emotions of interest here, fear and anger. Emotional response items were rated on a seven-point Likert-type scale with the anchors

(1) "none of this feeling" and (7) "a great deal of this feeling." Anger was measured with three items: angry, mad, and enraged. These three items were submitted to a principal components analysis with varimax rotation. The results showed a one-factor solution explaining 78% of the variance, but the enraged item had a much weaker loading than the other two items (0.80 compared to > 0.90). The principal components analysis was adjusted to include only angry and mad. The results indicated a one-factor solution explaining 92% of the variance (both factor loadings > 0.95). Therefore, these two items were averaged to form an index for expressed anger (Cronbach's $\alpha = 0.91$).

Fear was assessed with three items: frightened, scared, and fearful. These three items were submitted to a principal components analysis with varimax rotation. The results showed a one-factor solution explaining 86% of the variance, (all factor loadings > 0.91). Therefore, these three items were averaged to form an index for expressed fear (Cronbach's $\alpha = 0.91$).

Risk Perceptions

Based on Johnson and Tversky (1983) general subjective risk perceptions were measured regarding 19 distinct risks: breast cancer, skin cancer, lung cancer, leukemia, heart disease stroke, fire, electrocution, airplane accidents, traffic accidents, nuclear accidents, toxic chemical spills, climate change, tornadoes, floods, accidental falls, war, homicide, and terrorism. Notably, these risks vary with regard to Slovic's (1987) hazard dimensions of dread and knowledge and include the two risks utilized in the message stimuli. Using a seven-point Likert scale, participants were asked to "estimate your level of worry or concern about the following risks" (1 = not worried at all, 7 = very worried).

Dread and Knowledge Risk

The questions published in the original psychometric paradigm article Slovic, Ficshhoff, & Lichtenstein, 1979) were used to assess voluntariness, novelty, dread, extent known to science, extent known to those exposed, extent the effects are delayed, potential for catastrophic consequences, and likelihood the consequences are fatal [the factors]. These were 7-point Likert-type scales. Since this hypothesis was based on the original research conducted on the psychometric paradigm, the methods employed in that study to create the factors were replicated as closely as possible, based on personal communication with Slovic (2011).

First, correlations were calculated across risks, and this correlation matrix was factor analyzed. Slovic (personal communication, 2011) specified that the factors be orthogonal (un-correlated). Based on this direction, confirmatory factor analyses were conducted for both knowledge and dread risk. The following criteria were used to assess model fit: nonsignificant chi-squared (Ong & Van Dulmen, 2007), IFI greater than 0.90 (Hoyle & Panter, 1995), RMSEA lower than 0.08 (Browne & Cudeck, 1992), and SRMR lower than 0.08 (Joreskog & Sorbom, 1996).

For knowledge risk, the overall model was found to be a very poor fit with these data ($\chi^2 = 42.42$, $p < 0.01$; IFI = 0.76, RMSEA = 0.00; SRMR = 0.14). Based on the parameter estimates and standard error for each item, it was determined that the "known to exposed" items should be dropped as the *z* scores were well below the 1.96 cutoff (Suhr, 2006) for significance at $p < 0.05$ ($z_{\text{nuclear energy}} = 0.16$ and $z_{\text{traffic accident}} = 0.73$ respectively). This revised model was an acceptable fit ($\chi^2 = 3.36$, $p = 0.95$; IFI = 0.89, RMSEA = 0.00; SRMR = 0.08). When a scale was created, the scale was found to have poor reliability both for traffic accidents ($\alpha = 0.078$) and nuclear energy ($\alpha = 0.003$). It was therefore decided that a scale should not be created for knowledge risk, and each individual item (i.e., question in the scale) would be analyzed separately for the research questions that dealt with knowledge and dread risk.

A second confirmatory factor analysis was conducted for dread risk, and this model was found to be a poor fit with these data as well ($\chi^2 = 58.19$, $p < 0.01$; IFI = 0.69, RMSEA = 0.00; SRMR=0.16). After examining parameter estimates and standard error values for each item, the voluntary variables were first dropped from the model ($z_{\text{nuclear energy}} = 0.19$ and $z_{\text{traffic accident}} = 0.11$ respectively). Though this improved the fit of the model, it still did not produce an acceptable fit. Again based on the parameter estimates and standard error values for each item, the dread variables were dropped from the model ($z_{\text{nuclear energy}} = 1.21$ and $z_{\text{traffic accident}} = 0.34$ respectively). This produced an acceptable fit ($\chi^2=2.35$, $p = 0.98$; IFI = 0.92, RMSEA = 0.00; SRMR = 0.07). However, the scale creation revealed that dread risk had poor reliability both for traffic accidents ($\alpha = 0.11$) and nuclear energy ($\alpha = 0.16$). A scale was not created for dread risk, and each item will be analyzed individually for the research questions that dealt with knowledge and dread risk.

Chapter 4: Results

In this chapter the results of the study are presented. The chapter begins with a description of the manipulation checks for fear and anger. The results for the hypotheses and research questions are then detailed. All hypotheses were one-tailed, and the results reflect one-tailed significance testing throughout.

Manipulation Checks

Manipulation Check: Fear

An independent samples *t*-test was performed to ascertain the effect of the fear induction on experienced fear. Emotion condition was used as the independent variable, and experienced fear was used as the dependent variable (the experienced fear scale included fearful, scared, and frightened as stated in the explanation of measures in Chapter 3). The results indicated that the effect of the fear induction was statistically significant, $t(423) = 9.98$, $p < 0.01$. The individuals in the fear condition experienced more fear ($M = 1.83$; $SD = 1.16$) than individuals in the anger condition ($M = 1.53$; $SD = 0.97$). Based on these results it was concluded that the effect of the fear induction on experienced fear was successful.

Manipulation Check: Anger

An independent samples *t*-test was performed to ascertain the effect of the anger induction on experienced anger. Emotion condition was used as the independent variable, and experienced anger was used as the dependent variable (the experienced anger scale included anger and mad as stated in the explanation of measures in Chapter 3). The results indicated that the effect of the anger induction was statistically significant, $t(464) = 5.45$, $p < 0.05$. The individuals in the anger condition experienced more anger (*M* = 1.91; *SD* = 1.42) than individuals in the fear condition (*M* = 1.70; *SD* = 1.18). Based on these results it was concluded that the effect of the anger induction on experienced anger was successful.

Hypothesis Testing

Hypothesis 1

The first hypothesis predicted the well-cited finding of a main effect of expertise such that experts would report lower risk perceptions than lay people. To test this hypothesis, an independent samples *t*-test was conducted to explore the differences between all experts (across domains) in the sample and all lay people. These data indicated that in the case of three particular risks, climate change $t(466) = -1.83$, $p < 0.001$, nuclear energy $t(466) = -2.80$, $p < 0.001$, and homicide $t(465) = -1.51$, $p < 0.01$, expert and lay person risk perceptions differed in the expected direction. Differences between expert and lay person risk perceptions were not statistically significant when evaluating the remaining risks (Table 7). Hypothesis 1 is partially supported by these data.

Because the results were not as clear cut as would be expected from the psychometric paradigm literature, a selection of cases was chosen to most closely replicate the original Slovic study (Slovic, 1987) upon which the assumption of this hypothesis has developed. For this test, only risk assessment experts were chosen as “experts” and only female lay people were used for the lay group (to mimic the League of Women Voters group used as the lay group in the initial Slovic study). An independent samples *t*-test revealed a similar pattern found as when the entire sample was analyzed: expert and lay person risk perceptions differed in the expected manner for some risks—

war $t(184) = -2.00$, $p < 0.001$, leukemia $t(185) = -0.56$, $p < 0.05$, homicide $t(185) = -0.51$, $p < 0.01$, and electrocution $t(184) = 2.82$, $p < 0.01$ but not others. Oddly, for electrocution, experts ($M = 1.98$, $SD = 1.24$) actually displayed higher risk perceptions than lay people ($M = 1.55$, $SD = 0.83$). These results can be found in Table 8.

Differences between the experts with a particular domain expertise, the general risk assessors, and lay people were explored next. Here, it was expected that those with domain expertise would have the lowest risk perceptions (when assessing the risk within their domain) relative to others. First, a univariate ANOVA was conducted with perception of nuclear energy risk as a function of domain expertise ($F(3, 464) = 7.02$, $p < 0.001$). In the case of nuclear energy, nuclear energy experts reported lower risk perceptions ($M = 1.54$, $SD = 0.69$) than the other three groups, traffic experts ($M = 1.82$, $SD = 1.17$), risk assessors ($M = 2.22$, $SD = 1.35$), and lay people ($M = 2.12$, $SD = 1.39$), which did not significantly differ from each other.

This procedure was repeated for traffic accident risk ($F(3, 462) = 4.25$, $p < 0.01$). For traffic accidents the differences lied between traffic experts ($M = 4.14$, $SD = 1.62$) and nuclear experts ($M = 3.55$, $SD = 1.58$) and between traffic experts and lay people ($M = 3.46$, $SD = 1.55$), with traffic experts demonstrating higher risk perceptions than the other two groups.

When the dependent variable consisted of out of domain risks the results were mixed. Results from the univariate ANOVA, along with post-hoc (Scheffe's) tests, revealed that for climate change the differences lied between lay people ($F(3, 464) = 4.13$, $p < 0.01$; $M = 2.58$, $SD = 1.73$) and nuclear energy experts as well as between risk assessors ($M = 2.79$; $SD = 1.71$) and nuclear energy experts ($M = 2.05$; $SD = 1.25$), with nuclear energy experts displaying lower risk perceptions than the other two groups. Heart disease risk perceptions varied between the risk assessors and the other three groups $F(3, 465) = 3.40$, $p < 0.01$. Risk assessors ($M = 3.65$, $SD = 1.71$) reported higher risk perceptions than nuclear energy experts ($M = 3.15$, $SD = 1.57$), traffic experts ($M = 2.79$, $SD = 1.55$), and lay people ($M = 3.15$, $SD = 1.74$). The difference between traffic experts and lay people as well as nuclear energy experts was also statistically significant.

When evaluating electrocution risks, the difference was between traffic experts and lay people compared to nuclear energy experts and risk assessors, $F(3, 463) = 4.48$, $p < 0.01$. Traffic experts ($M = 1.61$, $SD = 0.92$) and lay people ($M = 1.61$, $SD = 0.92$) reported lower risk perceptions than nuclear energy experts ($M = 1.97$, $SD = 1.16$) and risk assessors ($M = 1.98$, $SD = 1.24$). Finally, when considering accidental falls, risk assessors ($M = 2.87$, $SD = 1.49$) reported higher risk perceptions than lay people ($M = 2.25$, $SD = 1.41$) and traffic experts ($M = 2.30$, $SD = 1.40$) who did not differ significantly from each other $F(3, 463) = 3.73$, $p < 0.01$. The results further indicated that different types of experts display different risk perceptions depending on the topic of the risk evaluation.

Hypothesis 2

This two part hypothesis explored the effect of biological sex on risk perceptions. First, it was expected that the risk perceptions of women would be higher than the risk perceptions of men regardless of expertise domain or message topic domain. An independent samples *t*-test revealed that women did report higher risk perceptions than men for most risks: climate change $t(426) = 2.01$, $p < 0.05$, terrorism $t(423) = 3.56$, $p < 0.05$, was $t(425) = 3.98$, $p < 0.05$, tornadoes $t(425) = 2.41$, $p < 0.05$, fire $t(425) = 2.28$, p

< 0.01, airplane $t(427) = 3.47$, $p < 0.001$, nuclear $t(426) = 3.81$, $p < 0.001$, chemical spills $t(425) = 2.07$, $p < 0.05$, heart disease $t(427) = 0.86$, $p < 0.05$, leukemia $t(426) = 1.80$, $p <$ 0.01, stroke $t(423) = -2.06$, $p < 0.01$, homicide $t(425) = -2/59$, $p < 0.001$, electrocution $t(425) = 2.83$ $p < 0.01$. The difference was in the expected direction except for in the case of electrocution for which men reported higher risk perceptions than women. Differences for accidental falls, lung cancer, stomach cancer, and traffic accidents, and floods were not statistically significant. Means and standard deviations for all risks are reported in Table 10.

Next, it was expected that biological sex would attenuate the relationship between expertise and risk perceptions. Separate ANCOVAs were conducted for each of the risks. Here, the independent variable was domain expertise, the covariate was biological sex, and the dependent variable was the risk assessed. A statistically significant main effect of expertise was consistent with the data for all risk types. For all of these risks measured in this dissertation, adding biological sex to the ANOVA model reduced the effect of expertise on risk perceptions. For climate change the effect was attenuated but remained statistically significant, $F(3, 420) = 7.38$, $p < 0.05$ (compared to $p < 0.01$ without controlling for biological sex). For the other risks for which an effect was initially found, the effect was no longer statistically significant when controlling for sex. For risks that did not differ by expertise before controlling for biological sex, the effect of expertise remained nonsignificant. Means and significance levels for all risks can be found in Table 11.

Hypothesis 3

The third hypothesis explored the effect of emotional appeal on risk perceptions.

A main effect of emotional appeal was expected such that participants who read the message targeting fear would report higher risk perceptions than those who read the message targeting anger. An independent samples *t*-test revealed that statistical differences in the expected direction *approached* statistical significance for fire and stroke risks, with participants reading the fear-inducing message (M_{fire} = 2.59, SD_{fire} = 1.54; M_{stroke} = 2.78, SD_{stroke} = 1.66 respectively) reporting higher risk perceptions than participants reading the anger-inducing message (M_{fire} = 2.41, SD_{fire} = 1.39; M_{stroke} = 2.64, SD_{stroke} = 1.51). Emotional appeal had no effect on the other risks (Table 12).

Correlations between each of the judged risks and expressed emotion were also examined. Fear was positively correlated with each of the judged risks such that more fear led to high risk perceptions. Anger was also positively correlated for all but two risks (war and terrorism) such that more anger led to higher risk perceptions. The differences between these correlations were also tested. For terrorism, war, fire, airplane accidents, nuclear energy, chemical spills, leukemia, and lung cancer, the positive relationship between fear and risk perceptions was statistically stronger than that of the anger and risk perception relationship. For the other risks, the difference between the correlation was not statistically significant but was observed in the expected direction. The full correlation matrix can be reviewed in Table 13.

Hypothesis 4

The two parts of Hypothesis 4 considered the relationship between expertise and expressed emotion. First it was predicted that there would be a main effect for expertise on expressed fear such that lay people would report a greater amount of fear than experts, overall. An independent samples *t*-test supported this hypothesis with experts (*M* = 1.56, *SD* = 0.96) reported less fear than lay people (*M* = 1.80, *SD* = 1.19), $t(423) = 2.34$, $p < 0.01$). A univariate ANOVA indicated that the relationship between expertise and expressed fear was significant $F(3, 421) = 2.55$, $p < 0.05$. Lay people did demonstrate the highest level of fear (*M* = 1.80, *SD* = 1.19), but this group did not differ significantly from the traffic expert group (*M* = 1.71, *SD* = 1.12). Together these two groups were significantly higher than the nuclear energy expert group (*M* = 1.47, *SD* = 0.86) and the risk assessor group (*M* = 1.53, *SD* = 0.92), which did not differ significantly from each other.

Similarly it was expected that there would be a main effect for expertise on expressed anger such that lay people would report a greater amount of anger than experts. An independent samples *t*-test indicated that there was not a significant difference between the expert (*M* = 1.83, *SD* = 1.33) and lay person (*M* = 1.80, *SD* = 1.31) groups $t(464) = 0.02$, $p = 0.92$. When examining the differences for the various expert groups, a univariate ANOVA indicated that there was not a significant relationship between expertise and expressed anger $F(3, 462) = 0.85$, $p = 0.24$. See Table 14.

Because biological sex was found to be a significant predictor of risk perceptions, the effect of biological sex was considered here in light of the weak findings with regard to the relationship between expertise and expressed emotion. An independent samples *t*-test revealed that biological sex affected both expressed anger $t(419) = 0.54$, $p < 0.01$ and expressed fear $t(384) = 1.75$, $p < 0.001$. Women expressed more anger (*M* = 1.87, *SD* = 1.51) than men (*M* = 1.80, *SD* = 1.22), and women expressed more fear (*M* = 1.79, *SD* = 1.26) than men (*M* = 1.59, *SD* = 0.94).

Hypothesis 5

The final hypothesis predicted a two-way interaction of message topic (nuclear, traffic) and expertise (lay people, traffic experts, nuclear energy experts, and general risk assessors) on risk perceptions such that experts reading an emotional appeal regarding a risk *outside of their domain* would report higher levels of the message's intended emotion (i.e., fear for the fear appeal) relative to experts evaluating a risk within their domain. The predicted differences were consistent with these data, and a univariate ANOVA showed the effects to be statistically significant for anger $F(1, 139) = 2.49$, $p < 0.05$ and fear $F(1, 112) = 3.78$, $p < 0.05$.[2] Traffic experts who read an anger-inducing traffic message reported lower levels of anger ($M = 2.06$, $SD = 1.58$) than traffic experts who read an anger-inducing nuclear energy message ($M = 2.22$, $SD = 2.07$). Similarly, nuclear energy experts who read an anger-inducing traffic message ($M = 1.87$, $SD = 1.41$) reported higher levels of anger than nuclear energy experts who read an anger-inducing nuclear energy message ($M = 1.71$, $SD = 1.09$).

Traffic experts who received a fear-inducing traffic message reported less fear ($M = 1.50$, $SD = 0.99$) than traffic experts who viewed a fear-inducing nuclear message ($M = 2.04$, $SD = 1.36$). Similarly, nuclear energy experts who viewed a fear-inducing nuclear message reported less fear ($M = 1.41$, $SD = 0.91$) than nuclear energy experts who viewed a fear-inducing traffic message ($M = 1.65$, $SD = 1.06$). These results support the hypothesis.

[2] The results of additional regression analyses for each of the two dependent variables are displayed in Table 17.

Figure 2. *The interaction of domain expertise and message topic on expressed anger*

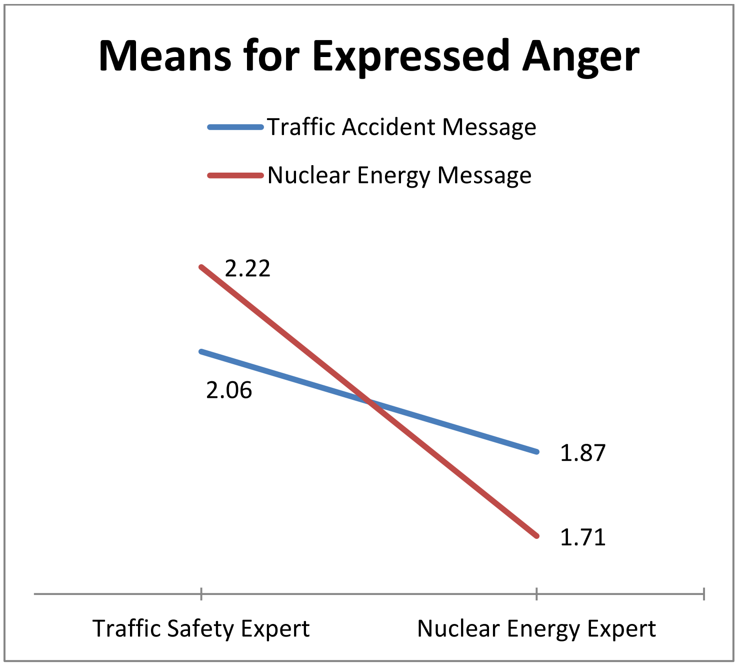
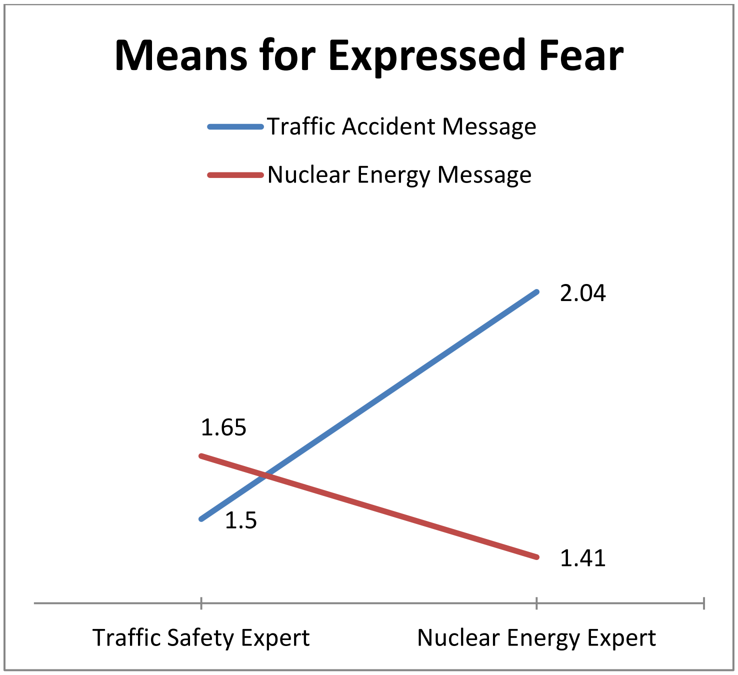


Figure 3. *The interaction of domain expertise and message topic on expressed fear*



Research Question 1

Research question one examined whether or not there would be a main effect of emotion on knowledge and dread risk. Because reliable scales could not be created for these factors as expected based on previous research, the individual measures of the psychometric paradigm were examined separately. An independent samples *t*-test indicated the emotion manipulation had a significant effect on some of the measures of the psychometric paradigm. For the extent to which a risk was judged to be known to science, participants who read a fear-inducing message judged traffic accidents to be less known to science (M = 5.02, SD = 1.8) than those who saw an anger-inducing message (M = 5.09, SD = 1.58), $t(424) = -0.48$, $p < 0.05$. For novelty, participants who viewed a fear message judged traffic accidents to be more novel (M = 2.35, SD = 1.40) than those who viewed an anger message (*M* = 2.16, *SD* = 1.28), $t(426) = 1.49$, $p < 0.05$. Emotion induction also had a statistically significant effect on the extent to which traffic accidents were judged to have catastrophic potential, $t(428) = 2.52$, $p < 0.05$, with participants who viewed fear messages judging traffic accidents as more potentially catastrophic (*M* = 3.92 *SD* = 1.90) than those who viewed anger messages (*M* = 3.49, *SD* = 1.67).

Research Question 2

Research question two examined whether or not there would be a main effect of message topic on knowledge and dread risk. Because reliable scales could not be created for these factors as expected based on previous research, the individual measures of the psychometric paradigm were examined separately. An independent samples *t*-test indicated the risk topic had a significant effect on some of the measures of the psychometric paradigm. Message topic had a statistically significant effect on the extent to which both nuclear energy, $t(428) = 2.66$, $p < 0.05$, and traffic accidents, $t(428) = -1.67$, $p < 0.05$, were judged to have catastrophic potential. For catastrophic potential of nuclear energy, participants who viewed a traffic accident message reported more catastrophic potential for nuclear energy (*M* = 4.79, *SD* = 1.85) than those who viewed a nuclear energy message (*M* = 4.30, *SD* = 1.98), $t(428) = 2.66$, $p < 0.05$. A similar pattern was seen for traffic accidents, with participants viewing a traffic accident message reporting lower catastrophic potential for traffic accidents (*M* = 3.56, *SD* = 1.69) than those viewing a nuclear energy message (*M* = 3.85, *SD* = 1.90), $t(428) = -1.67$, $p < 0.05$. For dread ratings for nuclear energy, participants who viewed a nuclear energy message reported higher perceived dread (*M* = 4.83, *SD* = 1.50) than those who viewed a traffic accident message (*M* = 4.50, *SD* = 1.77), $t(426) = -2.02$, $p < 0.01$.

Research Question 3

Research question three examined a potential interaction effect of message topic and emotional induction on knowledge and dread risk. Because reliable scales could not be created for these factors as expected based on previous research, the individual measures of the psychometric paradigm were examined separately. Separate univariate ANOVAs were conducted with each item examined as a dependent variable, and the interaction was shown to be statistically significant for the perceived immediacy of effects for nuclear energy, the perceived voluntariness of traffic accidents, the perceived extent to which nuclear energy is known to those exposed, the extent to which both nuclear energy and traffic accidents were judged to be known to science, the perceived catastrophic potential of both nuclear energy and traffic accidents, and the likelihood of fatal consequences for nuclear energy.[3]

First, a univariate ANOVA indicated that the interaction was statistically significant for the extent to which nuclear energy was judged to have immediate effects, $F(1, 424) = 6.56$, $p < 0.01$, with those in the nuclear energy, anger condition judging the effects of nuclear energy as more immediate ($M = 3.01$, $SD = 1.61$) than participants in the traffic accident, anger condition ($M = 3.57$, $SD = 1.56$), the nuclear energy, fear condition ($M = 3.66$, $SD = 1.63$) and the traffic accident, fear condition ($M = 3.41$, $SD = 1.74$).

Next, the interaction had a statistically significant effect on the perception of how voluntary traffic accidents are $F(1, 425) = 3.21$, $p < 0.05$. Participants who viewed a traffic accident message did not vary significantly by type of emotional appeal, but those

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[3] The results of additional regression analyses for each dependent variable are displayed in tables 22, 24, 26, 28, 30, 32, 34, 36, and 38.

who viewed a fear appeal judged traffic accidents to be less voluntary (*M* = 4.98, *SD* = 1.75) than those who viewed an anger appeal (*M* = 4.77, *SD* = 1.77). For participants who viewed a nuclear energy message, those in the anger condition perceived traffic accidents to be more voluntary (*M* = 5.26, *SD* = 1.56) than those in the fear condition (*M* = 4.81, *SD* = 1.90). Complete means and standard deviations for both nuclear energy and traffic accidents are shown in Table 21.

Figure 4. *The interaction of emotional appeal and message topic on extent to which the effects of nuclear energy are judged voluntary*

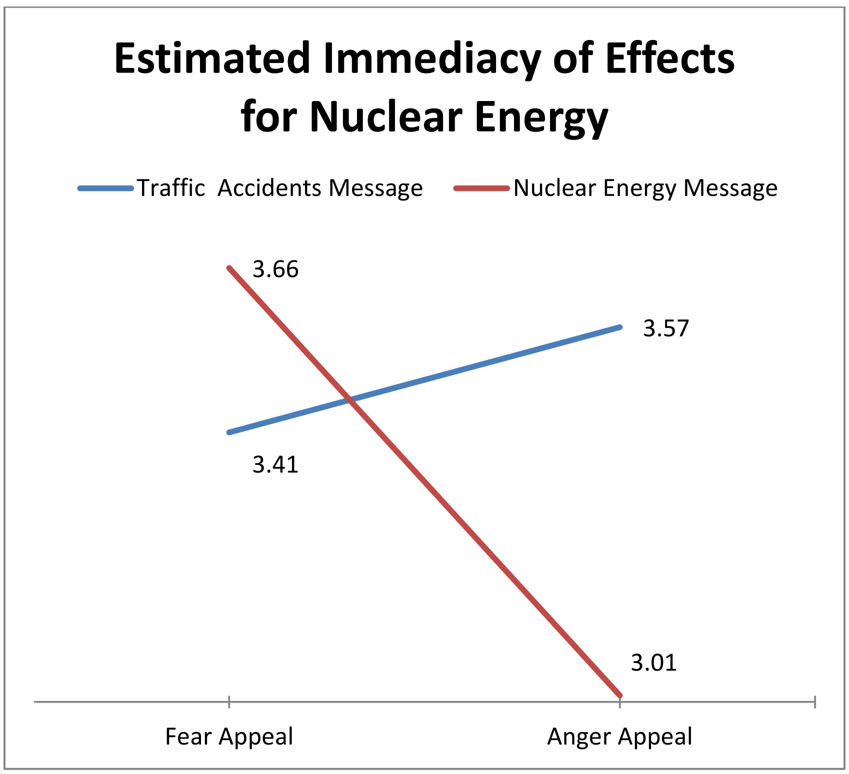
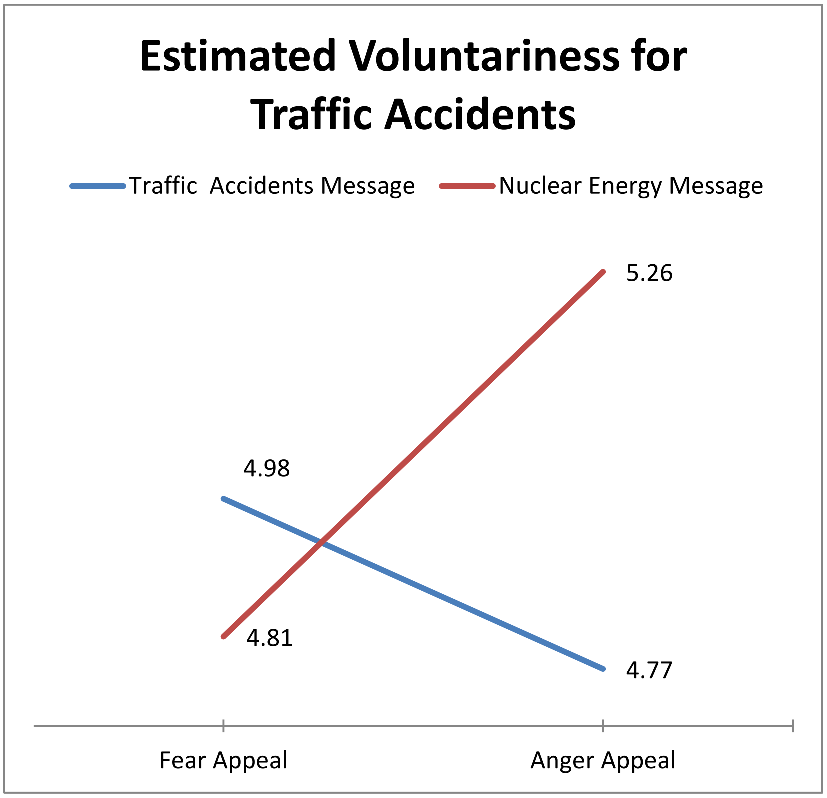


Figure 5. *The interaction of emotional appeal and message topic on extent to which the effects of traffic accidents are judged voluntary*



The effect of the interaction of message topic and emotional appeal on judgments of "known to exposed" was examined next. A univariate ANOVA indicated the effect was significant for nuclear energy $F(1, 425) = 2.53$, $p < 0.05$. For participants who viewed a nuclear energy message, those in the anger condition reporting higher perceptions of nuclear energy being known to those exposed ($M = 4.11$, $SD = 2.06$) than those in the fear condition ($M = 3.82$, $SD = 1.94$). The opposite was true for those who viewed traffic accident messages, with participants in the traffic accident, fear condition perceiving nuclear energy as more known to those exposed ($M = 4.06$, $SD = 1.86$) than those in the traffic accident, anger condition ($M = 3.74$, $SD = 1.97$). The interaction is displayed visually in Figure 6, and means for the extent to which traffic accidents were judged to be known to those exposed are displayed in Table 25.

The interaction was also found to effect evaluations of how known to science both nuclear energy and traffic accidents are. For nuclear energy $F(1, 424) = 2.31$, $p < 0.05$, those who viewed a traffic accident message evaluated nuclear energy as less known to science in the anger ($M = 5.51$, $SD = 1.22$) condition compared to the fear condition ($M = 5.74$, $SD = 1.22$). The opposite effect was found for those who viewed nuclear energy messages, with those in the fear condition ($M = 5.55$, $SD = 1.46$) evaluating nuclear energy as less known to science than those in the anger condition ($M = 5.70$, $SD = 1.31$). This interaction is displayed in Figure 7.

For the extent to which traffic accidents are judged to be known to science, $F(1, 422) = 12.60$, $p < 0.001$, the same pattern was observed. Participants who viewed a traffic accident message evaluated traffic accidents as more known to science when that message was a fear appeal ($M = 5.35$, $SD = 1.45$) than when that message was an anger appeal ($M = 4.92$, $SD = 1.63$). On the other hand, those who viewed a nuclear energy fear appeal evaluated traffic accidents as less known to science ($M = 4.70$, $SD = 2.04$) than those who viewed a nuclear energy anger appeal ($M = 5.44$, $SD = 1.44$). This interaction is shown in Figure 8, and complete results for both nuclear energy and traffic accidents are displayed in Table 27.

Figure 6. *The interaction of emotional appeal and message topic on extent to which the effects of nuclear energy are judged known to exposed*

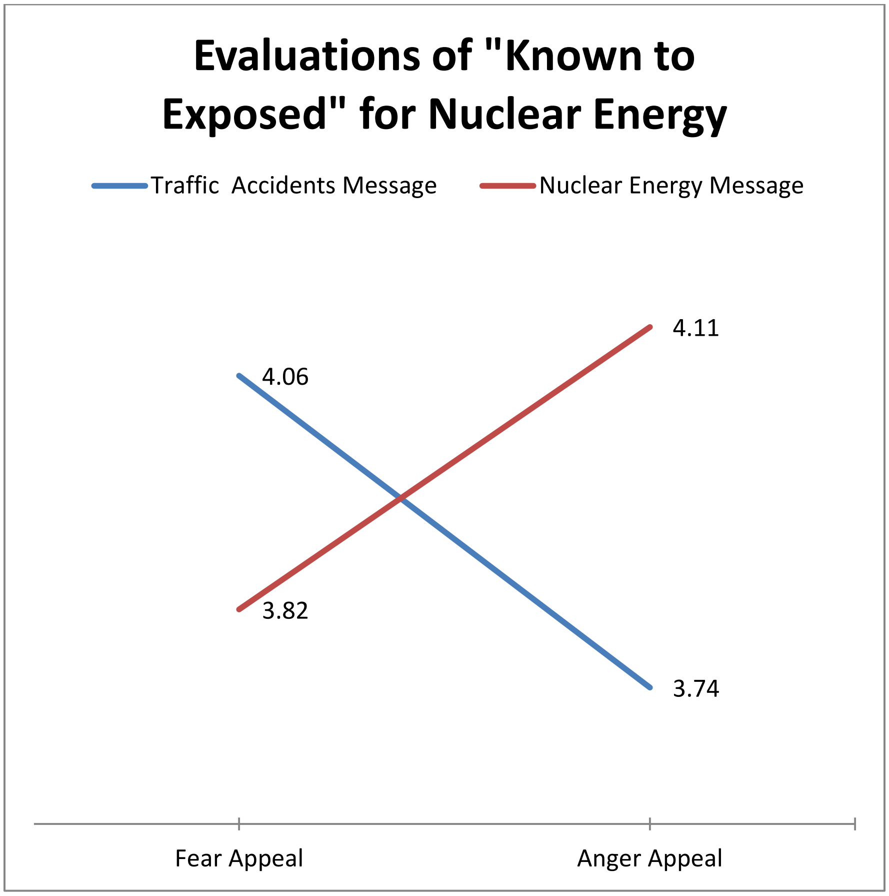


Figure 7. *The interaction of emotional appeal and message topic on extent to which the effects of nuclear energy are judged known to science*

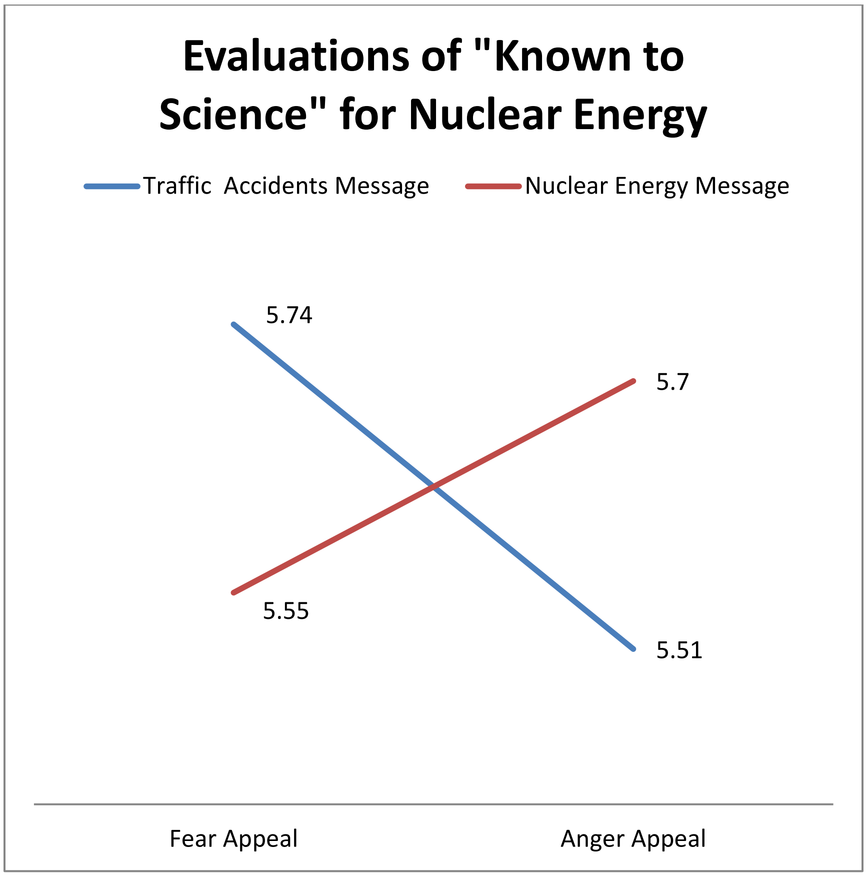
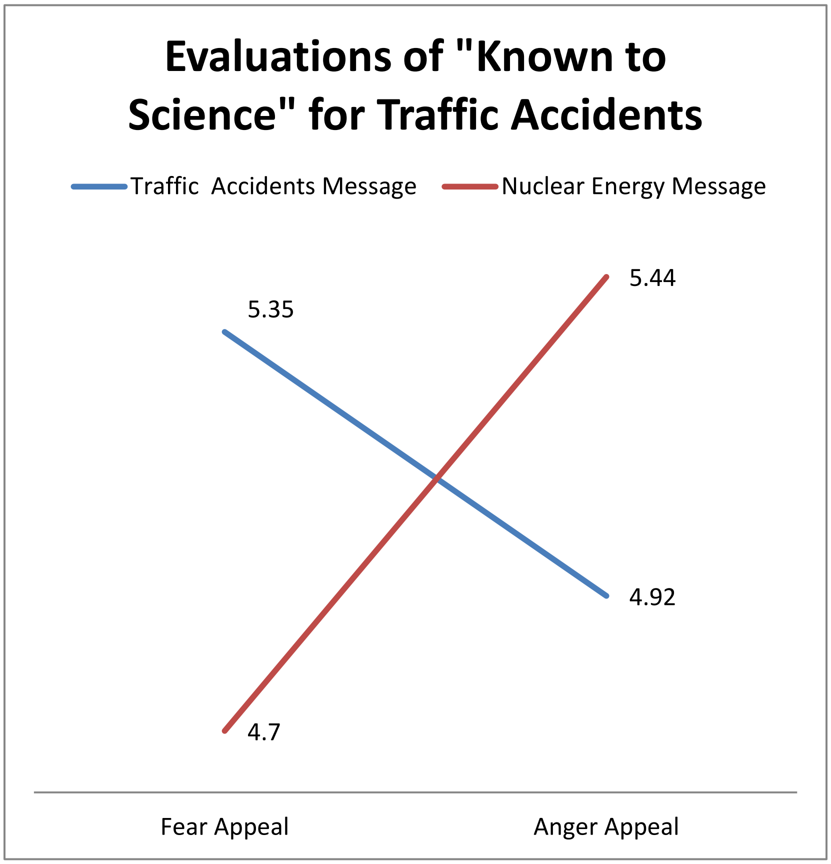
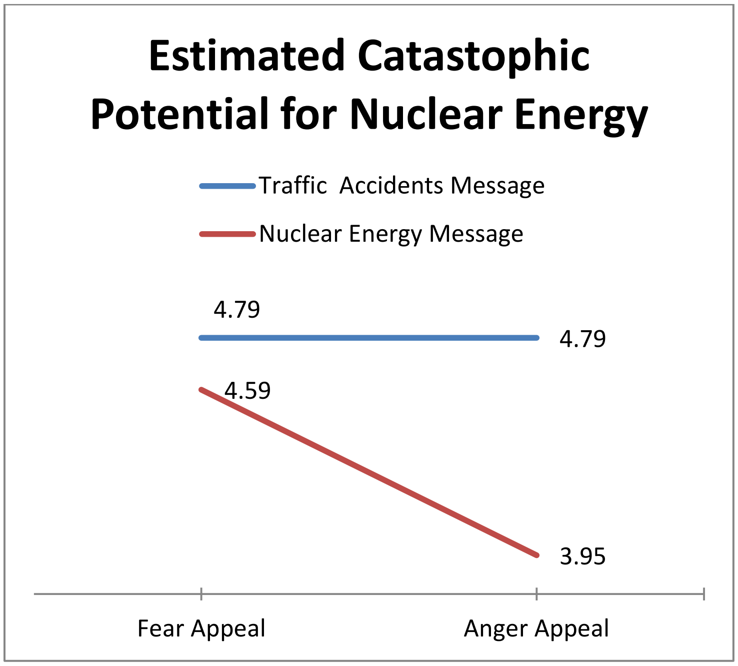


Figure 8. *The interaction of emotional appeal and message topic on extent to which the effects of traffic accidents are judged known to science*



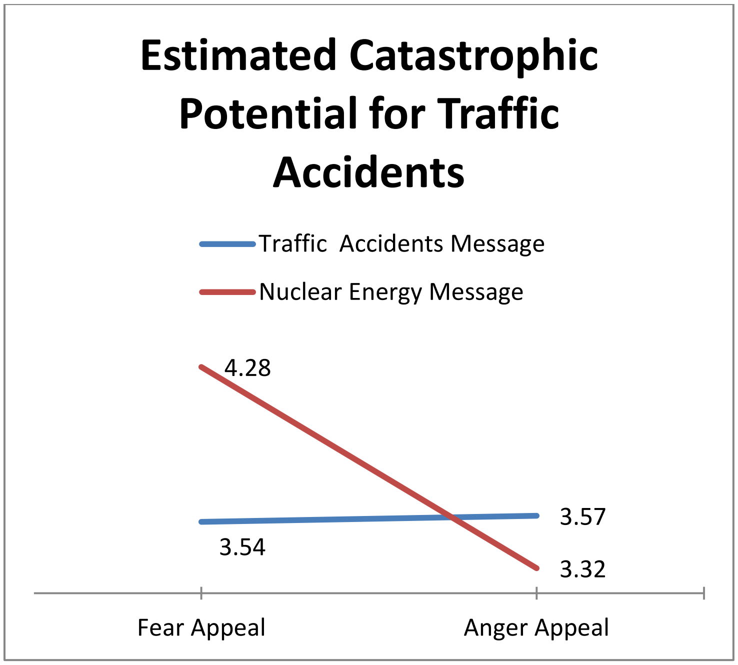
The interaction was also statistically significant for the judgment of the catastrophic potential of both nuclear energy and traffic accidents. A univariate ANOVA indicated that for nuclear energy $F(1, 426) = 2.86$, $p < 0.05$, those in the nuclear energy, anger condition judged the catastrophic potential as lower ($M = 3.95$, $SD = 1.88$) than those in the traffic accident, anger condition ($M = 4.79$, $SD = 1.80$), the nuclear energy, fear condition ($M = 4.59$, $SD = 2.02$) and the traffic accident, fear condition ($M = 4.79$, $SD = 1.93$).

Figure 9. *The interaction of emotional appeal and message topic on extent to which nuclear energy is judged to have catastrophic potential*



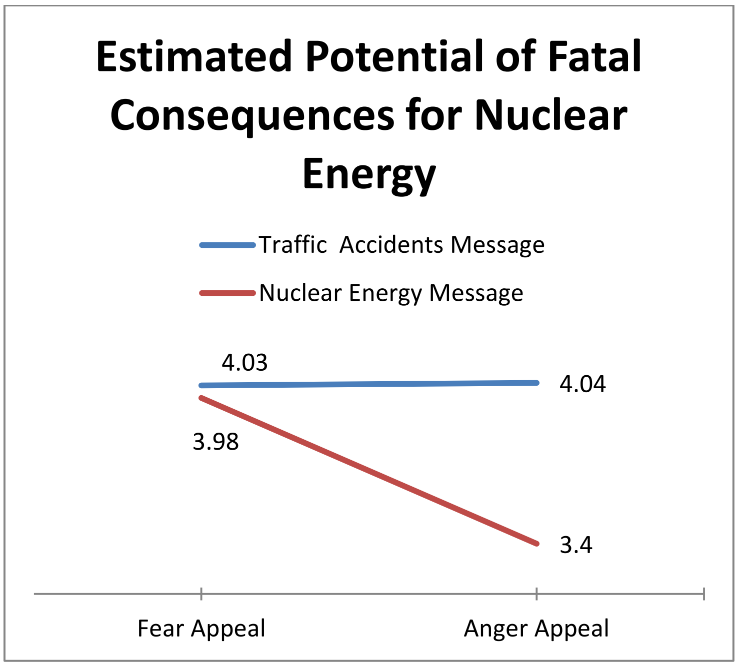
A univariate ANOVA indicated the interaction was also significant for the judgment of the catastrophic potential of traffic accidents, $F(1, 426) = 8.01$, $p < 0.01$, with participants in the nuclear energy, fear condition judging the catastrophic potential of traffic accidents to be higher ($M = 4.28$, $SD = 1.52$) than participants in the traffic accident, fear condition ($M = 3.54$, $SD = 1.28$), the nuclear energy, anger condition ($M = 3.32$, $SD = 1.24$) and the traffic accident, anger condition ($M = 3.57$, $SD = 1.30$).

Figure 10. *The interaction of emotional appeal and message topic on extent to which traffic accidents are judged to have catastrophic potential*



A similar pattern was seen for the judgment of fatal consequences for nuclear energy, $F(1, 424) = 2.52$, $p < 0.05$, with those in the nuclear energy, anger condition judging nuclear energy to be less likely to have fatal consequences ($M = 3.40$, $SD = 1.81$) than those in the traffic accident, anger condition ($M = 4.04$, $SD = 1.82$), the nuclear energy, fear condition ($M = 3.98$, $SD = 1.90$) and the traffic accident, fear condition ($M = 4.03$, $SD = 2.01$).

Figure 11. *The interaction of emotional appeal and message topic on extent to which nuclear energy is judged to have likely fatal consequences*



Chapter 5: Discussion

The purpose of this dissertation was to examine the differences in risk perceptions among experts and lay people. In particular, this project aimed to address inconsistent definitions of "expert" found in the existing literature and to test the predictions of the psychometric paradigm in the context of communication. To examine these questions, this dissertation tested the effects of emotional appeals (anger, fear), message topic (nuclear energy, traffic accidents), and expertise (nuclear energy expert, traffic safety expert, risk assessment expert, and lay people) on risk perceptions and evaluation of risk characteristics. The results replicated some findings of the existing research. First, in the main, experts reported lower risk perceptions than lay people. Further, expressed fear led to increased risk perceptions compared to expressed anger. Both of these findings were consistent with previous research and were expected.

This study also advanced theory of risk perception by documenting the varying effects of different types of expertise and by demonstrating the potential for message characteristics to affect both risk perceptions and the evaluation of risk characteristics, a possibility not previously tested. The findings indicated that emotional appeals (augmented by a response statement) and message topic can affect evaluations of risk characteristics for both risks related to the message and risks unrelated to the message. These effects for risk characteristics were in fact more prominent than the effects of message characteristics on general risk perceptions. The results suggest the factors argued to be predictive of risk perception (dread risk and knowledge risk) can be altered through strategic communication. Given the pervasive effect of emotion documented in previous research, this finding is not surprising though it is quite exciting given such an effect has not been previously demonstrated in the context of the psychometric paradigm. These results are further discussed below.

The first hypothesis tested the traditional expert-lay person risk perception predictions and confirmed that experts did perceive less risk than lay people, for risks that showed a statistically significant difference (climate change, nuclear energy, and homicide). The extended definition of expert was examined next, testing the differences between varying types of expertise and lay people. Statistically significant differences between groups were found for nuclear energy, traffic accidents, climate change, heart disease, electrocution, and accidental falls.

For the two risks that fell in the domain expertise of some of the experts (traffic accidents and nuclear energy), the expected differences were statistically significant. For nuclear energy, the nuclear energy experts reported the lowest risk perceptions while for traffic accidents the traffic experts reported the highest means (though not statistically different from risk assessors), demonstrating the optimistic bias that was expected with traffic accidents. These results were consistent with this dissertation's expectations, and provide empirical documentation that the definition of "expert" is influential in the effect found between expertise and risk perceptions. A blanket statement that experts perceive risks different than lay people has dominated the literature, but these results suggest more care is needed in determining precisely what differences are present between what type of expert when judging what type of risk.

For the risks that were out of domain for all experts, the typical patterns did not hold. For electrocution and accidental falls, risk assessors and nuclear energy experts reported higher risk perceptions than lay people and traffic safety experts. For climate change, nuclear energy experts demonstrated the lowest risk perceptions, and for heart disease, risk assessors demonstrated the highest risk perceptions. Overall, the specific type of expertise had varying effects on risk perceptions. Though these risks were not specifically within the domain of any of these experts, the tangential relationship may have been enough to drive differing risk perceptions.

For example, it seems plausible that nuclear energy experts would be more familiar with and aware of the risk associated with electrocution than other types of experts or lay people. Further, in terms of climate change, nuclear energy is often discussed in relation to climate change, and this association could have influenced the emergence of the same pattern for climate change as emerged for nuclear energy. In the case of heart disease, a risk clearly not in the domain of any certain type of expert and a very individual risk, the two types of domain experts and lay people underestimated the risk compared to risk assessors—again in line with existing research on optimistic bias. Overall, these results indicate that a broad definition of expert will produce the expected differences between experts and lay people, but that a more specific definition of expert will produce differences not only between experts and lay people but among the expert groups themselves.

These data suggest a more specific definition of "expert" is preferred. Specifically, expertise seems to be specialized knowledge in a subject area, acquired through professional training and education. With regard to risk, expertise is domain specific—an "expert" can only be defined as such when evaluating the specific topic in which his or her expertise lies. Expertise is not an inherent advantage certain people possess that guides their general evaluations but rather expertise is an acquired body of knowledge resulting from extensive experience in a particular domain.

Further examining the expert-lay person relationship, hypothesis two revealed differences in biological sex that first replicated findings in existing research by showing women generally have higher risk perceptions than men even in expert groups. These results also documented the strength of this relationship by demonstrating a statistically significant effect not only within groups but also between groups. That is, when controlling for the effect of biological sex, the effect of expertise was greatly attenuated—in most cases to the extent that the relationship between expertise and risk perceptions was no longer significant when controlling for biological sex. Though these data suggest a strong relationship between biological sex and risk perceptions, it should also be taken into consideration that the ethnicity of this study's sample was not diverse. From this data alone, it cannot be gleaned for certain if the effect is truly between males and females in general, or between white males and white females—an effect that may not have been as strong had there been greater diversity—particularly in the male sample (see discussion of the "white male effect" in Chapter 2 of this dissertation).

Next, the effects of emotional induction were examined in relation to both risk perceptions and evaluations of risk characteristics (the factors identified in the psychometric paradigm research). Surprisingly, the emotional induction conditions did not have a statistically significant effect on risk perceptions. In fact, the effect only approached statistical significance in two cases (fire and stroke). In these cases, the difference was in the expected direction, with those in the fear condition reporting higher risk perceptions than those in the anger conditions. Even when considering the potential interaction of domain expertise and emotion, the effect on risk perceptions was not statistically significant. It is possible that the mean differences between the fear and anger conditions were not large enough to produce the expected results. Though the procedure was pilot-tested, the mean emotion scores were very low. This will be discussed further in the limitations section of this chapter.

The effect of emotion as not completely absent, however, as demonstrated by the analysis of expressed emotion. Expressed emotion, compared to emotional induction, was examined with hypotheses three and four. The interaction effect of expertise and message topic was statistically significant on *expressed* emotion. It was predicted that experts reading an emotional appeal regarding a risk *outside of their domain* would report higher levels of the message's intended emotion (i.e., fear for the fear appeal) relative to experts evaluating a risk *within their domain*. The expected differences were statistically significant for both expressed anger and expressed fear. This finding supports the notion that experts are selectively suppressing the effect of emotion on risk judgments when faced with evaluating a risk with which they have training. Furthermore, this finding opens the door to the possibility that lay people are also capable of learning to evaluate risks differently, should the motivation to do so exist. This is also further evidence that experts and lay people do not *generally* evaluate risks differently but rather the choice of different information to apply to a risk evaluation depends on the type of background of the individual and the type of risk at hand.

Further, expertise and biological sex were found to be statistically significant predictors of expressed emotion such that for fear, lay people demonstrated the greatest level of fear compared to the other expertise groups, and females demonstrated greater fear and greater anger than men. Expertise did not affect expressed anger. Correlations revealed that risk perceptions increased with expressed emotion in general and increased with higher *expressed* fear to a greater extent than they increased with higher *expressed* anger. This suggests that although the message manipulations had weaker effects than expected, the expected differences between fear and anger were present even with low means reported for both. Such a finding supports the previous research that different discrete emotions have differing effects on risk perceptions. With the trend for increased emotion to correlate with increased risk perceptions, it is plausible that stronger emotional appeals that produced stronger means overall would have had the expected effect for emotional condition in addition to the expected effect for expressed emotion.

Additional evidence that these emotional inductions were effective is shown in the examination of the effects on the evaluations of the psychometric paradigm items. Though the expected effect of emotional induction was not found for general risk perceptions, the emotional inductions were found to have a main effect on several of the psychometric paradigm factors. The fear induction produced judgments of risk characteristics that were less known to science, more novel, and more potentially catastrophic compared to the anger induction. This finding is consistent with the existing emotion research on risk perceptions as in this case fear produced more highly negative evaluations of risk characteristics.

A main effect for message topic was also found for some of the factors of the psychometric paradigm. Specifically, reading a message about a particular risk lowered the judgment of that risk's catastrophic potential compared to reading a message about another risk. This relationship held true for both traffic accidents and nuclear energy such that participants who read a nuclear energy message evaluated the catastrophic potential of nuclear energy to be lower than those who read a traffic accident message, and participants who read a traffic accident message evaluated the catastrophic potential of traffic accidents to be lower than those who read a nuclear energy message. On the other hand, participants who viewed a nuclear energy message evaluated nuclear energy as more dreadful than participants who read a traffic accident message. It is interesting that the type of risk would have opposite effects on two items that have been predicted to belong to a single factor—dread risk. This could be related to the way the psychometric paradigm measures dread. The item assessing dread does not address personal feelings of dread but rather addressed how dreadful "people" find the risk. It could be that reading a message about a risk reduces personal risk perceptions but an assumption remains that *other* people remain worried. Future additions to the scale to include both personal and the perception of others' risk perceptions would aid in clarifying this issue. For risk communicators of traditional dreadful risks especially, though, it is promising that personal judgments of the dangers of a risk can be reduced through communication.

The interaction between emotional appeal and message topic was also found to be statistically significant for most of the items addressing the psychometric paradigm. Participants in the nuclear energy, anger condition judged nuclear energy to have less immediate effects, to have lower catastrophic potential, and to be less likely to have fatal consequence than participants in the other three conditions. In terms of the extent to which nuclear energy is known to exposed, both nuclear energy and traffic accidents are known to science, and traffic accidents are voluntary, participants who viewed a nuclear energy message reported lower evaluations when the message was a fear appeal than when the message was an anger appeal, with the opposite true for those who viewed a traffic safety message. For the catastrophic potential of traffic accidents, participants in the nuclear energy, fear condition judged the catastrophic potential of traffic accidents to be greater than any of the other three conditions.

These results are quite interesting for two reasons. First, the expected difference between anger and fear is further demonstrated, to a large extent for message topics that address the risk being evaluated. Second, this effect is shown to hold for unrelated risks, which is consistent with the emotion research on general risk perceptions. These findings may suggest that comparative risk messages could be successful in increasing risk perceptions for typically low dread risks, such as traffic safety.

Implications

This study has several important implications for future research directions. Although much research has examined the differences in risk perceptions between experts and lay people, the definition has been broad, and the underlying factors that are thought to explain such a difference have not been reproduced. The results of this study indicate the now common-sense prediction, that expert and lay-person risk perceptions differ, is not as free of complication as has been previously presented in existing research.

The predictions of the psychometric paradigm have endured for 30 years, and because they are so strongly established, were assumed by this dissertation to exist. Surprisingly, confirmatory factor analysis could not reproduce the expected factor groupings, and scale reliabilities further suggested that the factors could not be combined as predicted. Attempts to replicate the original factor analysis results were made with the entire sample, with expertise coded as yes or no as in the original psychometric paradigm studies, and with only lay people. In all of these subsets of the data, a three factor solution was found, with different items than expected grouping together. With advancements in technology and changes in political environments, it seems plausible that this factor space could have evolved over time. It is also noteworthy that though the factors identified in the early psychometric paradigm research are often cited both in research and practical guides on risk communication, these factors, and specifically the factor space they are thought to create, have not been replicated precisely. Other authors who have explored the factors of dread risk and knowledge risk have called the factors by the same name but have arrived at them differently.

For example, instead of measuring all of the qualitative characteristics proposed in the initial psychometric paradigm work, subsequent research has measures dread risk and knowledge risk with one item each (Barnett & Breakwell, 2001), or has stated simply that the factors found are "similar" to those reported by Slovic (1987) without clear explanation of the analysis that took place or the items that produced the similar factors (Fife-Schaw & Rowe, 2000). The data presented in this dissertation suggest a more careful exploration and replication of the factors themselves is called for. Given the factors of knowledge risk and dread risk are the underlying explanatory function behind the differences between expert and lay person risk perceptions, it will be essential that future research re-examine the factors presented in the early psychometric paradigm research and re-establish the relationships among them.

A clearer understanding of how the factor space currently functions, coupled with extended knowledge of how communication can influence these factors, has the potential to greatly improve risk communication theory. The results of this study suggest further inquiry into the effects of message features on evaluations of risk characteristics is warranted. Emotional appeals, message topic, and the interaction of emotional appeal and message topic all affected evaluations of risk characteristics. It would be useful to test whether these results could be replicated across all of the risks upon which the factor space was originally developed. Theoretically, the findings of this study suggest it may be possible to move a risk in the factor space, and thus change the risk perceptions that are thought to be influenced by the space the risk occupies. In addition to being an exciting theoretical possibility, these results would be obviously relevant to practitioners in risk communication and message design. Should a reliable pattern emerge regarding message features and the evaluation of risk characteristics, the current theory could move from a common-sense explanation to a prescriptive theory from which specific recommendations could be developed to identify action steps for targeting risk perception change.

Specifically, these data indicate appeals to emotion can influence evaluations of risk characteristics—and that the most effective emotion in altering these evaluations depends on the type of risk in question. In terms of the type of risk, both the message topic and the evaluation topic are shown to be of importance. For a risk that does not inherently produce an emotional response (as in the case of traffic accidents), a comparative approach in risk communication may be most effective. Message topic affected evaluations of both message-relevant and message-irrelevant risks, and more mundane risks may be able to harness more dreadful risks' power to engage audiences (as nuclear energy affected perceptions of traffic accidents in this project). For historically emotionally-charged risks, such as nuclear energy, topic-relevant messages targeting reduction in uncertainty and fear were effective in lowering perceptions of catastrophic potential and likelihood of fatal consequences—certainly promising evidence for risk communicators.

Limitations

There are a few limitations of this dissertation. First, the emotional inductions produced weak means for expressed anger and expressed fear. Though emotion has been shown to be difficult to produce in a single message, especially out of the context of crisis (Lerner et al, 2003 reported a mean level of fear of terrorism of 3.46 for data collected two weeks after the September 11 attacks), these means were lower than expected given the procedures were pilot tested. The topic of the messages could have played a role as these two risks in particular were not pre-tested; however, theoretically nuclear energy should have produced greater emotional responses than any of the other topics tested. Nonetheless, effects for emotion condition were still found, suggesting stronger inductions could produce additional effects. Furthermore, it is important to note that the emotional induction included both a message and a brief essay or statement. While this procedure has been shown to be effective and, in some cases, necessary, in producing measurable emotion in an experimental setting, the combination approach also makes it impossible to say whether the message itself or the induction as a whole produced the observed effects.

Second, there were limitations to the sample that could hopefully be improved upon in a larger (and most likely funded) effort to extend this research. First, a snowball sample was utilized rather than a probability sample, and while this technique was a necessity for this project, it is not ideal due to the bias potentially introduced. Although the sample successfully branched out from the typical college student sample, it nonetheless had weaknesses in demographic composition. The sample did have a fairly normal distribution of age and education and was nearly evenly split between males and females, but it was predominantly white. Oversampling techniques may need to be utilized in future research to ensure differences between groups are not overly affected by the "white male effect."

Furthermore, participants self-selected into the study, and it is reasonable to think that people who were willing to participate may be different than those individuals who received an invitation but did not choose to participate. Thinking about the differing types of experts in particular, traffic safety and nuclear energy experts struggle with the issue addressed in this project—expert and lay person differences—and several people in these groups expressed interest in the results. They may have been more willing to participate because although there were no direct incentives for participation, the potential knowledge to be gained from the successful completion of the project had the potential to benefit them more directly than the general risk assessor and lay person groups.

Additionally, the missing data, particularly with regard to the demographic questions, indicated there could have been a fatigue effect. However, participants with missing data did not differ significantly from those without missing data on the any of the key dependent variables in this project. Though the demographic questions did appear at the end of the survey, they consisted of only four multiple choice items that could have been quickly answered. It may have been more that participants saw the demographic questions as too personal, or that they simply did not want to reveal that information about themselves.

Finally, the message feature variations were limited due to the scope of this dissertation. Future research should examine the effects of additional emotions, in particular to include positive emotions. Limited research exists on positive emotions in general and even less exists on the potential interaction of emotion and expertise. Further, only two topics were used in this dissertation. Though it is encouraging that similar patterns seen across more than one topic and risk, it will be necessary to examine additional topics that fall in all quadrants of the psychometric paradigm space (whatever that space may look like after the factors are first re-examined).

In conclusion, this study was a successful attempt at examining the effects of message characteristics (emotional appeal and topic) on risk perceptions and evaluations of risk characteristics. The results replicated the findings of existing research on expert and lay person differences (as well as extended the understanding of the effects of expertise definition). To a limited extent, the data replicated the expected difference between fear and anger inductions, though most of the evidence in this data lies in expressed fear and expressed anger. In addition, this study advanced the theory of risk perception by examining the effect of communication, and specifically message features, on risk perceptions and evaluations of risk characteristics. In sum, the present study is important for both theorists and practitioners of risk communication and risk perceptions. Further research is needed, however, to continue examination of the psychometric paradigm factors themselves. Additionally the generalizability of the findings of these data to a wider range of message topics and to additional message features shown to be important in other areas of persuasion research should be explored.

Table 6. *Means, Standard Deviations, and Test Statistics for Emotion Inductions*

	emotion	Mean	*SD*	*df*	*t*	*p*
expressed anger	fear	1.70	1.18			
	anger	1.91	1.42	464	5.45	< 0.05
expressed fear	fear	1.83	1.16			
	anger	1.53	0.97	423	9.98	< 0.01

Table 7. *Means, Standard Deviations, and Test Statistics for Expertise on Risk Perceptions*

	Expertise	Mean	*SD*	*df*	*t*	*p*
Climate change	expert	2.31	1.48			
	lay	2.58	1.73	466	-1.83	< 0.001*
terrorism	expert	3.14	1.62			
	lay	3.20	1.68	463	-0.36	0.29
war	expert	2.91	1.55			
	lay	2.96	1.67	465	-0.34	0.19
tornadoes	expert	2.21	1.35			
	lay	2.05	1.27	465	1.29	0.09
floods	expert	2.15	1.36			
	lay	2.29	1.41	466	-1.03	0.33
fire	expert	2.47	1.42			
	lay	2.54	1.52	464	-0.50	0.32
Airplane Accidents	expert	2.12	1.35			
	lay	2.27	1.38	467	-1.13	0.42
Traffic Accidents	expert	3.81	1.61			
	lay	3.46	1.55	464	2.35	0.38
Nuclear Energy	expert	1.80	1.08			
	lay	2.12	1.39	466	-2.80	<0.001**
Chemical spills	expert	1.99	1.28			
	lay	1.90	1.22	465	0.76	0.95
Heart Disease	expert	3.14	1.63			
	lay	3.15	1.74	467	-0.06	0.28
leukemia	expert	1.94	1.19			
	lay	2.06	1.35	466	-0.94	0.07
Stomach Caner	expert	1.97	1.24			
	lay	2.03	1.34	464	-0.43	0.39
Lung Cancer	expert	2.14	1.36			
	lay	2.22	1.47	463	-0.59	0.37
stroke	expert	2.73	1.60			
	lay	2.66	1.56	463	0.49	0.85
homicide	expert	1.92	1.17			
	lay	2.10	1.45	465	-1.51	< 0.01*
Electrocution	expert	1.84	1.11			
	lay	1.61	0.92	465	2.36	0.09
Accidental Falls	expert	2.55	1.47			
	lay	2.25	1.41	465	2.25	0.14

* $p < 0.01$

** $p < 0.001$

Table 8. *Means, Standard Deviations, and Test Statistics for Risk Assessors versus Female Lay People on Risk Perceptions*

	expertise	Mean	*SD*	*df*	*t*	*p*
climate	risk assess	2.79	1.71			
	lay	2.55	1.67	185	0.94	0.93
terrorism	risk assess	2.89	1.47			
	lay	3.61	1.76	183	-2.78	0.06
war	risk assess	2.90	1.35			
	lay	3.40	1.71	184	-2.00	<0.001***
tornadoes	risk assess	2.19	1.38			
	lay	2.36	1.38	185	-0.81	0.69
floods	risk assess	2.22	1.35			
	lay	2.39	1.44	185	-0.76	0.50
fire	risk assess	2.89	1.46			
	lay	2.75	1.69	183	0.54	0.12
airplane	risk assess	2.37	1.44			
	lay	2.48	1.46	185	-0.53	0.92
traffic	risk assess	3.79	1.60			
	lay	3.86	1.65	184	-0.29	0.69
Nuclear Energy	risk assess	2.22	1.35			
	lay	2.23	1.49	185	-0.02	0.42
Chemical spills	risk assess	2.30	1.38			
	lay	2.10	1.43	185	0.90	0.65
Heart disease	risk assess	3.65	1.71			
	lay	3.19	1.81	185	1.66	0.57
leukemia	risk assess	2.05	1.28			
	lay	2.17	1.47	185	-0.56	<0.05*
Stomach Cancer	risk assess	2.02	1.34			
	lay	2.05	1.40	184	-0.15	0.42
Lung Cancer	risk assess	2.42	1.44			
	lay	2.26	1.52	184	0.69	0.96
stroke	risk assess	3.03	1.62			
	lay	2.92	1.78	184	0.42	0.06
homicide	risk assess	2.11	1.17			
	lay	2.23	1.60	185	-0.51	<0.01**
electrocution	risk assess	1.98	1.24			
	lay	1.55	0.83	184	2.82	<0.01**
Accidental Falls	risk assess	2.87	1.49			
	lay	2.20	1.50	184	2.89	0.96

* < 0.05
* *p* < 0.01
** *p* < .001

Table 9. *Means, Standard Deviations, and Test Statistics for Domain Expertise on Risk Perceptions*

		Mean	*SD*	*df*	*F*	*p*
climate	traffic	2.29	1.49			
	nuclear energy	2.05	1.25			
	risk assessment	2.79	1.71			
	other (lay)	2.58	1.73			
	Total	2.42	1.59	3, 464	4.130	< 0.01**
terrorism	traffic	3.07	1.59			
	nuclear energy	3.35	1.71			
	risk assessment	2.89	1.47			
	other (lay)	3.20	1.68			
	Total	3.17	1.64	3, 461	1.172	0.16
war	traffic	2.74	1.63			
	nuclear energy	3.05	1.58			
	risk assessment	2.90	1.35			
	other (lay)	2.96	1.67			
	Total	2.93	1.60	3, 463	.694	0.28
tornadoes	traffic	2.16	1.41			
	nuclear energy	2.27	1.28			
	risk assessment	2.19	1.38			
	other (lay)	2.05	1.27			
	Total	2.14	1.31	3, 463	.677	0.28
floods	traffic	2.08	1.45			
	nuclear energy	2.18	1.29			
	risk assessment	2.22	1.35			
	other (lay)	2.29	1.41			
	Total	2.21	1.38	3, 464	.501	0.34
fire	traffic	2.33	1.40			
	nuclear energy	2.35	1.39			
	risk assessment	2.89	1.46			
	other (lay)	2.54	1.52			
	Total	2.50	1.46	3, 462	2.263	p<0.05*
airplane	traffic	2.03	1.33			
	nuclear energy	2.06	1.30			
	risk assessment	2.37	1.44			
	other (lay)	2.27	1.38			
	Total	2.18	1.36	3, 465	1.321	0.13
traffic	traffic	4.14	1.62			
	nuclear energy	3.55	1.58			
	risk assessment	3.79	1.60			
	other (lay)	3.46	1.55			
	Total	3.67	1.60	3, 462	4.254	< 0.01**
nuclear	traffic	1.82	1.17			

	nuclear energy	1.54	0.69			
	risk assessment	2.22	1.35			
	other (lay)	2.12	1.39			
	Total	1.93	1.23	3, 464	7.021	< 0.001***
Chemical spills	traffic	1.87	1.27			
	nuclear energy	1.92	1.23			
	risk assessment	2.30	1.38			
	other (lay)	1.90	1.22			
	Total	1.96	1.26	3, 463	1.880	0.066
Heart disease	traffic	2.79	1.55			
	nuclear energy	3.15	1.57			
	risk assessment	3.65	1.71			
	other (lay)	3.15	1.74			
	Total	3.14	1.67	3, 465	3.397	<0.01**
leukemia	traffic	1.96	1.20			
	nuclear energy	1.88	1.13			
	risk assessment	2.05	1.28			
	other (lay)	2.06	1.35			
	Total	1.99	1.26	3, 464	.553	0.32
Stomach cancer	traffic	1.97	1.19			
	nuclear energy	1.96	1.23			
	risk assessment	2.02	1.34			
	other (lay)	2.03	1.34			
	Total	2.00	1.28	3, 462	.092	0.48
Lung cancer	traffic	1.92	1.26			
	nuclear energy	2.17	1.38			
	risk assessment	2.42	1.44			
	other (lay)	2.22	1.47			
	Total	2.17	1.41	3, 461	1.761	0.077
stroke	traffic	2.54	1.58			
	nuclear energy	2.72	1.60			
	risk assessment	3.03	1.62			
	other (lay)	2.66	1.56			
	Total	2.70	1.58	3, 461	1.289	0.14
homicide	traffic	1.75	1.18			
	nuclear energy	1.96	1.17			
	risk assessment	2.11	1.17			
	other (lay)	2.10	1.45			
	Total	2.00	1.30	3, 463	1.799	0.073
electrocution	traffic	1.61	0.92			
	nuclear energy	1.96	1.16			
	risk assessment	1.98	1.24			
	other (lay)	1.61	0.92			
	Total	1.75	1.04	3, 463	4.480	<0.01**
Accidental falls	traffic	2.30	1.40			
	nuclear energy	2.58	1.49			
	risk assessment	2.87	1.49			
	other (lay)	2.25	1.41			
	Total	2.42	1.45	3, 463	3.725	<0.01**

* $p < 0.05$
** $p < 0.01$
*** $p < 0.001$

Table 10. *Means, Standard Deviations, and Test Statistics for Biological Sex on Risk Perceptions*

	sex	Mean	*SD*	*df*	*t*	*p*
climate	male	2.30	1.47			
	female	2.62	1.71	426	2.01	<0.05*
terrorism	male	2.93	1.49			
	female	3.51	1.74	423	3.56	<0.05*
war	male	2.69	1.47			
	female	3.31	1.67	425	3.98	<0.05*
tornadoes	male	2.02	1.26			
	female	2.34	1.38	425	2.41	<0.05*
floods	male	2.15	1.33			
	female	2.34	1.44	426	1.38	0.14
fire	male	2.34	1.33			
	female	2.76	1.63	425	2.82	<0.01**
airplane	male	2.03	1.28			
	female	2.51	1.49	427	3.47	<0.001***
traffic	male	3.52	1.51			
	female	3.92	1.69	425	2.44	0.43
nuclear	male	1.76	0.98			
	female	2.21	1.49	426	3.81	<0.001***
Chemical spills	male	1.87	1.14			
	female	2.13	1.42	425	2.07	<0.05*
Heart disease	male	3.11	1.57			
	female	3.26	1.81	427	0.86	<0.05*
leukemia	male	1.91	1.17			
	female	2.14	1.43	426	1.80	<0.01**
Stomach cancer	male	1.97	1.21			
	female	2.01	1.35	425	-0.30	0.36
Lung cancer	male	2.12	1.34			
	female	2.26	1.51	423	-0.96	0.17
stroke	male	2.60	1.50			
	female	2.94	1.77	423	-2.06	<0.01**
homicide	male	1.89	1.13			
	female	2.21	1.55	425	-2.49	<0.001***
electrocution	male	1.85	1.13			
	female	1.55	0.82	425	2.83	<0.01**
Accidental falls	male	2.49	1.41			
	female	2.32	1.52	425	1.18	0.45

* $p < 0.05$
** $p < 0.01$
*** $p < 0.001$

Table 11. *Means, Standard Deviations, and Test Statistics for Domain Expertise on Risk Perceptions, Controlling for Biological Sex*

		Mean	*SD*	*df*	*F*	*p*
climate	traffic	2.31	1.44			
	nuclear energy	2.06	1.25			
	risk assessment	2.71	1.71			
	other (lay)	2.58	1.71			
	Total	2.41	1.56	3, 420	7.38	< 0.05*
terrorism	traffic	3.04	1.50			
	nuclear energy	3.29	1.65			
	risk assessment	2.85	1.52			
	other (lay)	3.15	1.64			
	Total	3.13	1.60	3, 417	0.95	0.26
war	traffic	2.67	1.52			
	nuclear energy	3.04	1.52			
	risk assessment	2.86	1.39			
	other (lay)	2.93	1.66			
	Total	2.90	1.57	3, 419	.74	0.30
tornadoes	traffic	2.22	1.44			
	nuclear energy	2.25	1.28			
	risk assessment	2.11	1.38			
	other (lay)	2.02	1.24			
	Total	2.13	1.31	3, 419	1.83	0.16
floods	traffic	2.08	1.42			
	nuclear energy	2.18	1.27			
	risk assessment	2.16	1.32			
	other (lay)	2.32	1.42			
	Total	2.22	1.37	3, 420	1.10	0.24
fire	traffic	2.37	1.45			
	nuclear energy	2.33	1.33			
	risk assessment	2.84	1.45			
	other (lay)	2.53	1.52			
	Total	2.48	1.45	3, 419	0.71	0.31
airplane	traffic	2.07	1.39			
	nuclear energy	2.06	1.31			
	risk assessment	2.36	1.51			
	other (lay)	2.28	1.35			
	Total	2.19	1.37	3, 421	0.78	0.28
traffic	traffic	4.25	1.58			
	nuclear energy	3.52	1.54			
	risk assessment	3.66	1.59			
	other (lay)	3.46	1.55			
	Total	3.66	1.59	3, 419	3.17	0.10
nuclear	traffic	1.82	1.13			
	nuclear energy	1.55	.70			
	risk assessment	2.14	1.32			
	other (lay)	2.10	1.36			
	Total	1.91	1.20	3, 420	3.21	.09

Chemical spills	traffic	1.82	1.12			
	nuclear energy	1.93	1.22			
	risk assessment	2.36	1.43			
	other (lay)	1.92	1.24			
	Total	1.96	1.25	3, 419	1.87	.16
Heart disease	traffic	2.89	1.60			
	nuclear energy	3.16	1.58			
	risk assessment	3.59	1.68			
	other (lay)	3.15	1.71			
	Total	3.16	1.66	3, 465	2.09	.14
leukemia	traffic	2.00	1.23			
	nuclear energy	1.86	1.13			
	risk assessment	2.09	1.32			
	other (lay)	2.03	1.35			
	Total	1.99	1.27	3, 464	.26	0.43
Stomach cancer	traffic	1.96	1.17			
	nuclear energy	1.96	1.22			
	risk assessment	2.00	1.34			
	other (lay)	1.99	1.30			
	Total	1.98	1.26	3, 419	.011	0.48
Lung cancer	traffic	1.92	1.28			
	nuclear energy	2.17	1.38			
	risk assessment	2.40	1.42			
	other (lay)	2.21	1.46			
	Total	2.16	1.40	3, 461	1.53	0.19
stroke	traffic	2.64	1.62			
	nuclear energy	2.74	1.61			
	risk assessment	2.95	1.61			
	other (lay)	2.66	1.59			
	Total	2.72	1.60	3, 417	.36	0.39
homicide	traffic	1.77	1.19			
	nuclear energy	1.94	1.11			
	risk assessment	2.09	1.18			
	other (lay)	2.11	1.46			
	Total	2.00	1.29	3, 419	2.81	0.11
electrocution	traffic	1.65	.96			
	nuclear energy	1.98	1.17			
	risk assessment	1.89	1.22			
	other (lay)	1.60	.91			
	Total	1.75	1.04	3, 419	3.02	.10
Accidental falls	traffic	2.38	1.45			
	nuclear energy	2.58	1.48			
	risk assessment	2.77	1.43			
	other (lay)	2.27	1.42			
	Total	2.44	1.45	3, 419	3.32	.09

* $p < 0.05$

Table 12. *Means, Standard Deviations, and Test Statistics for Emotional Appeal on Risk Perceptions*

	emotion	Mean	*SD*	*df*	*t*	*p*
climate	fear	2.3146	1.55394			
	anger	2.5098	1.61407	466	1.325	.515
terrorism	fear	3.2311	1.67739			
	anger	3.1146	1.61550	463	.761	.607
war	fear	2.9194	1.61191			
	anger	2.9375	1.59041	465	.121	.504
tornadoes	fear	2.0708	1.36985			
	anger	2.2039	1.26646	465	1.090	.851
floods	fear	2.1038	1.31293			
	anger	2.2969	1.42998	466	1.509	.171
fire	fear	2.5877	1.53550			
	anger	2.4196	1.39473	464	1.237	.064
airplane	fear	2.2629	1.34809			
	anger	2.1133	1.36872	467	1.187	.544
traffic	fear	3.7773	1.66552			
	anger	3.5725	1.53234	464	1.380	.240
nuclear	fear	1.9953	1.31572			
	anger	1.8784	1.14883	466	1.026	.365
Chemical spills	fear	1.9292	1.25048			
	anger	1.9765	1.26407	465	.404	.475
Heart disease	fear	3.1362	1.67818			
	anger	3.1484	1.67140	467	.079	.951
leukemia	fear	2.0329	1.32603			
	anger	1.9569	1.19797	466	.651	.302
Stomach cancer	fear	1.9762	1.35350			
	anger	2.0117	1.21585	464	-.298	.419
Lung cancer	fear	2.1374	1.46550			
	anger	2.1969	1.35739	463	-.453	.517
stroke	fear	2.7725	1.66345			
	anger	2.6378	1.51498	463	.913	.077
homicide	fear	1.9671	1.31172			
	anger	2.0197	1.28675	465	.436	.694
electrocution	fear	1.7109	.98408			
	anger	1.7773	1.08521	465	.687	.349
Accidental falls	fear	2.4057	1.40263			
	anger	2.4392	1.49646	465	.248	.383

Table 13. *Correlations for Expressed Emotion and Risk Perceptions*

	r_{ANGER}	r_{FEAR}	z
Climate	.096*	.196***	-1.51
Terrorism	.071	.202***	-1.97*
War	.059	.171***	-1.67*
Tornadoes	.130**	.232***	-1.56
Floods	.115**	.192***	-1.16
Fire	.096*	.230***	-2.03*
Airplane Accident	.150***	.288***	-2.14**
Traffic Accident	.261***	.268***	-0.11
Nuclear Energy	.163***	.296***	-2.07*
Chemical Spill	.133**	.267***	-2.06*
Heart disease	.127**	.171***	-0.66
Leukemia	.163***	.302***	-2.17*
Stomach Cancer	.151***	.230***	-1.21
Lung cancer	.105**	.215***	-1.66*
Stroke	.139***	.188***	-0.74
Homicide	.171***	.241***	-1.08
Electrocution	.158***	.200***	-0.64
Accidental Falls	.121**	.126*	-0.07

* $p < 0.05$
** $p < 0.01$
*** $p < 0.001$

Table 14. *Means, Standard Deviations, and Test Statistics for Expertise on Expressed Emotion*

	Expertise	Mean	*SD*	*df*	*t*	*p*
expressed anger	expert	1.83	1.33			
	lay	1.80	1.31	464	0.2	0.92
expressed fear	expert	1.56	0.96			
	lay	1.80	1.19	423	2.34	<0.01

	Expertise	Mean	*SD*	*df*	*F*	*p*
Expressed anger	traffic	1.96	1.51			
	nuclear energy	1.68	1.14			
	risk assessment	1.89	1.32			
	other (lay)	1.80	1.31	3, 462	0.85	0.24
Expressed fear	traffic	1.71	1.12			
	nuclear energy	1.47	0.86			
	risk assessment	1.53	0.92			
	other (lay)	1.80	1.19	3, 421	2.55	<0.05

Table 15. *Means, Standard Deviations, and Test Statistics for Biological Sex on Expressed Emotion*

	sex	Mean	*SD*	*df*	*t*	*p*
expressed anger	male	1.80	1.22			
	female	1.87	1.51	419	0.54	< 0.01
expressed fear	male	1.59	0.94			
	female	1.79	1.26	384	1.75	< 0.001

Table 16. *Means, Standard Deviations, and Test Statistics for the Interaction of Message Topic and Expertise on Expressed Anger*

topic	expertise	Mean	*SD*	*df*	*F*	*p*
traffic	traffic	2.06	1.58			
	nuclear	1.87	1.41			
nuclear energy	traffic	2.22	2.07			
	nuclear	1.71	1.09	1, 139	2.49	< 0.05

Table 17. *Means, Standard Deviations, and Test Statistics for the Interaction of Message Topic and Expertise on Expressed Fear*

topic	expertise	Mean	*SD*	*df*	*F*	*p*
traffic	traffic	1.5	0.99			
	nuclear	1.65	1.06			
nuclear energy	traffic	2.04	1.36			
	nuclear	1.41	0.91	1, 112	3.78	< 0.05

Table 18. *Regression Results for the Interaction of Expertise and Message Topic on Expressed Emotion*

Anger				
	Model A		Model B	
Independent Variables	*β*	t-statistic	*β*	t-statistic
Expertise	-.11	-1.01	-.29*	-1.97
Message Topic	-.064	-.061	.11	.78
Expertise*Message Topic	--	--	-.31*	-1.76
R^2	0.016		0.049[a]	
Fear				
Expertise	-.029	.44	.26*	-1.59
Message Topic	-.042	-.64	.22*	1.91
Expertise*Message Topic	--	--	-.41*	-2.01
R^2	0.002		0.02[b]	

* $p < 0.05$
a. R^2 change was statistically significant, $F(1, 112) = 3.09$, $p < 0.05$
b. R^2 change was statistically significant, $F(1, 139) = 4.05$, $p < 0.01$

Table 19. *Means, Standard Deviations, and Test Statistics for Emotional Appeal on Psychometric Paradigm Measures*

	emotion	Mean	SD	df	t	p
nuclear voluntary	fear	3.63	1.69			
	anger	3.83	1.76	427	1.17	0.58
nuclear immediate effects	fear	3.54	1.69			
	anger	3.38	1.60	426	1.01	0.28
nuclear known to exposed	fear	3.94	1.90			
	anger	3.87	2.01	427	0.37	0.11
nuclear known to science	fear	5.64	1.34			
	anger	5.57	1.25	426	0.54	0.86
nuclear personal control	fear	3.37	1.76			
	anger	3.30	1.69	428	0.44	0.28
nuclear novel	fear	3.12	1.61			
	anger	3.16	1.50	427	0.26	0.18
nuclear catastrophic potential	fear	4.69	1.98			
	anger	4.50	1.87	428	1.00	0.46
nuclear dread	fear	4.70	1.60			
	anger	4.58	1.73	426	0.71	0.15
traffic voluntary	fear	4.89	1.82			
	anger	4.94	1.71	427	0.26	0.14
traffic immediacy of effects	fear	5.87	1.20			
	anger	5.90	1.23	428	0.26	0.72
traffic known to exposed	fear	4.52	1.70			
	anger	4.22	1.66	427	1.84	0.55
traffic known to science	fear	5.02	1.80			
	anger	5.09	1.58	424	-0.48	<0.05*
traffic personal control	fear	4.39	1.68			
	anger	4.44	1.60	428	0.30	0.36
traffic novel	fear	2.35	1.40			
	anger	2.16	1.28	426	1.49	<0.05*
traffic catastrophic potential	fear	3.92	1.90			
	anger	3.49	1.67	428	2.52	<0.05*
traffic dread	fear	3.67	1.71			
	anger	3.50	1.68	394	1.01	0.94
traffic fatal	fear	5.44	1.41			
	anger	5.57	1.24	395	-.99	0.07

* $p < 0.05$

Table 20. *Means, Standard Deviations, and Test Statistics for Message Topic on Psychometric Paradigm Measures*

	topic	Mean	*SD*	*df*	*t*	*p*
nuclear voluntary	traffic	3.67	1.72	427	-0.97	0.55
	nuclear	3.84	1.73			
nuclear immediate effects	traffic	3.51	1.63	426	0.88	0.88
	nuclear	3.37	1.65			
nuclear known to exposed	traffic	3.86	1.93	427	-0.45	0.36
	nuclear	3.95	2.00			
nuclear known to science	traffic	5.60	1.22	426	-0.17	0.41
	nuclear	5.62	1.39			
nuclear personal control	traffic	3.16	1.66	428	-2.51	0.09
	nuclear	3.58	1.78			
nuclear novel	traffic	3.20	1.52	427	0.86	0.48
	nuclear	3.07	1.59			
nuclear catastrophic potential	traffic	4.79	1.85	428	2.66	<0.05*
	nuclear	4.30	1.98			
nuclear dread	traffic	4.50	1.77	426	-2.02	<0.01**
	nuclear	4.83	1.50			
traffic voluntary	traffic	4.85	1.76	427	-0.95	0.65
	nuclear	5.01	1.76			
traffic immediacy of effects	traffic	5.86	1.19	428	-0.65	0.59
	nuclear	5.93	1.25			
traffic known to exposed	traffic	4.19	1.64	427	-2.40	0.52
	nuclear	4.58	1.73			
traffic known to science	traffic	5.08	1.57	424	0.32	<0.05*
	nuclear	5.03	1.83			
traffic personal control	traffic	4.30	1.61	428	-1.87	0.73
	nuclear	4.59	1.66			
traffic novel	traffic	2.24	1.29	426	-0.15	0.21
	nuclear	2.26	1.40			
traffic catastrophic potential	traffic	3.56	1.69	428	-1.67	<0.05*
	nuclear	3.85	1.90			
traffic dread	traffic	3.62	1.70	394	0.76	0.98
	nuclear	3.49	1.69			
traffic fatal	traffic	5.49	1.24	395	-0.45	0.26
	nuclear	5.55	1.43			

* $p < 0.05$

** $p < 0.01$

Table 21. *Means, Standard Deviations, and Test Statistics for the Interaction of Emotional Appeal and Message Topic on Perceived Voluntariness*

Nuclear Energy						
topic	emotion	Mean	*SD*	*df*	*F*	*p*
traffic	fear	3.61	1.68			
	anger	3.71	1.76			
nuclear energy	fear	3.66	1.70			
	anger	4.05	1.75	1	0.69	0.21
Traffic Accidents						
topic	emotion	Mean	*SD*	*df*	*F*	*p*
traffic	fear	4.98	1.75			
	anger	4.77	1.77			
nuclear energy	fear	4.81	1.90			
	anger	5.26	1.56	1, 425	3.21	<0.05

Table 22. *Regression Results for the Interaction of Emotional Appeal and Message Topic on Perceived Voluntariness*

Nuclear Energy				
	Model A		Model B	
Independent Variables	*β*	t-statistic	*β*	t-statistic
Emotional Appeal	-.065	-1.34	-.113	-1.50
Message Topic	-.057	-1.17	-.096	-1.42
Emotional Appeal*Message Topic	--	--	.069	.83
R^2	0.006		0.008	
Traffic Accidents				
Emotional Appeal	-.021	-.42	-.13*	-1.72
Message Topic	-.049	-1.00	-.14*	-2.04
Emotional Appeal*Message Topic	--	--	.16*	1.91
R^2	0.002		0.011[a]	

* $p < 0.05$

a. R^2 change was statistically significant, $F(1, 425) = 3.64$, $p < 0.05$

Table 23. *Means, Standard Deviations, and Test Statistics for the Interaction of Emotional Appeal and Message Topic on Perceived Immediacy of Effects*

Nuclear Energy						
topic	emotion	Mean	*SD*	*df*	*F*	*p*
traffic	fear	3.41	1.74			
	anger	3.57	1.56			
nuclear energy	fear	3.66	1.63			
	anger	3.01	1.61	1, 424	6.56	<0.01
Traffic Accidents						
topic	emotion	Mean	*SD*	*df*	*F*	*p*
traffic	fear	5.85	1.16			
	anger	5.86	1.21			
nuclear energy	fear	5.89	1.24			
	anger	5.99	1.27	1, 424	0.16	0.35

Table 24. *Regression Results for the Interaction of Emotional Appeal and Message Topic on Perceived Immediacy of Effects*

Nuclear Energy				
	Model A		Model B	
Independent Variables	*β*	t-statistic	*β*	t-statistic
Emotional Appeal	0.057	1.16	.20*	2.66
Message Topic	0.052	1.05	.17*	2.50
Emotional Appeal*Message Topic	--	--	-.21*	-2.51
R^2	0.005		0.02[a]	
Traffic Accidents				
Emotional Appeal	-.018	-.70	-.040	-.54
Message Topic	-.034	.-.37	-.053	-.78
Emotional Appeal*Message Topic	--	--	.033	.40
R^2	0.001		0.002	

* $p < 0.01$

a. R^2 change was statistically significant, F(1, 424) = 6.29, p < 0.01

Table 25. *Means, Standard Deviations, and Test Statistics for the Interaction of Emotional Appeal and Message Topic on Perceived Extent Known to Exposed*

Nuclear Energy						
topic	emotion	Mean	*SD*	*df*	*F*	*p*
traffic	fear	4.06	1.86			
	anger	3.74	1.97			
nuclear energy	fear	3.82	1.94			
	anger	4.11	2.06	1, 425	2.53	<0.05*
Traffic Accidents						
topic	emotion	Mean	*SD*	*df*	*F*	*p*
traffic	fear	4.30	1.64			
	anger	4.12	1.64			
nuclear energy	fear	4.73	1.75			
	anger	4.40	1.71	1, 425	0.17	0.34

Table 26. *Regression Results for the Interaction of Emotional Appeal and Message Topic on Perceived Extent Known to Exposed*

Nuclear Energy				
	Model A		Model B	
Independent Variables	*β*	t-statistic	*β*	t-statistic
Emotional Appeal	0.015	.31	-.075	-1.002
Message Topic	-.019	-.39	-.094	-1.38
Emotional Appeal*Message Topic	--	--	.13*	1.59
R^2	0.001		0.007[a]	
Traffic Accidents				
Emotional Appeal	.072	1.47	.095	1.27
Message Topic	-.10*	-2.135	-.085	-1.26
Emotional Appeal*Message Topic	--	--	-.033	-.41
R^2	0.018		0.019	

* $p < 0.05$

a. R^2 change was statistically significant, F(1, 425) = 2.53, p < 0.05

Table 27. *Means, Standard Deviations, and Test Statistics for the Interaction of Emotional Appeal and Message Topic on Perceived Known to Science*

Nuclear Energy						
topic	emotion	Mean	*SD*	*df*	*F*	*p*
traffic	fear	5.74	1.22			
	anger	5.51	1.22			
nuclear energy	fear	5.55	1.46			
	anger	5.70	1.31	1, 424	2.31	<0.05
Traffic Accidents						
topic	emotion	Mean	*SD*	*df*	*F*	*p*
traffic	fear	5.35	1.45			
	anger	4.92	1.63			
nuclear energy	fear	4.70	2.04			
	anger	5.44	1.44	1, 422	12.60	<0.001

Table 28. *Regression Results for the Interaction of Emotional Appeal and Message Topic on Perceived Known to Science*

Nuclear Energy				
	Model A		Model B	
Independent Variables	*β*	t-statistic	*β*	t-statistic
Emotional Appeal	0.026	1.33	-.061	-.81
Message Topic	-.004	1.93	-.075	-1.11
Emotional Appeal*Message Topic	--	--	.13*	1.51
R^2	0.001		0.006[a]	
Traffic Accidents				
Emotional Appeal	-.021	-.43	-.22*	-2.97
Message Topic	.012	.24	-.16*	-2.29
Emotional Appeal*Message Topic	--	--	.29**	3.55
R^2	0.001		0.03[b]	

* $p < 0.05$
** $p < 0.001$
a. R^2 change was statistically significant, F(1, 424) = 2.31, p < 0.05
b. R^2 change was statistically significant, F(1, 422) = 12.60, p < 0.001

Table 29. *Means, Standard Deviations, and Test Statistics for the Interaction of Emotional Appeal and Message Topic on Perceived Personal Control*

Nuclear Energy						
topic	emotion	Mean	*SD*	*df*	*F*	*p*
traffic	fear	3.23	1.73			
	anger	3.11	1.62			
nuclear energy	fear	3.51	1.78			
	anger	3.66	1.78	1, 424	0.66	0.21
Traffic Accidents						
topic	emotion	Mean	*SD*	*df*	*F*	*p*
traffic	fear	4.33	1.55			
	anger	4.27	1.65			
nuclear energy	fear	4.45	1.80			
	anger	4.77	1.46	1, 424	1.32	0.13

Table 30. *Regression Results for the Interaction of Emotional Appeal and Message Topic on Perceived Personal Control*

Nuclear Energy				
	Model A		Model B	
Independent Variables	*β*	t-statistic	*β*	t-statistic
Emotional Appeal	0.002	.042	-0.044	-.59
Message Topic	-.12*	-2.47	-.16*	-2.34
Emotional Appeal*Message Topic	--	--	.068	.81
R^2	0.014		0.016	
Traffic Accidents				
Emotional Appeal	-.03	-.62	-.095	-1.27
Message Topic	-.095*	-1.95	-.15*	-2.20
Emotional Appeal*Message Topic	--	--	.095	1.15
R^2	0.009		0.012	

* $p < 0.05$

Table 31. *Means, Standard Deviations, and Test Statistics for the Interaction of Emotional Appeal and Message Topic on Perceived Novelty*

Nuclear Energy						
topic	emotion	Mean	*SD*	*df*	*F*	*p*
traffic	fear	3.14	1.59			
	anger	3.23	1.48			
nuclear energy	fear	3.10	1.63			
	anger	3.03	1.55	1, 424	0.28	0.30
Traffic Accidents						
topic	emotion	Mean	*SD*	*df*	*F*	*p*
traffic	fear	2.32	1.28			
	anger	2.19	1.30			
nuclear energy	fear	2.38	1.52			
	anger	2.10	1.24	1, 424	0.35	0.28

Table 32. *Regression Results for the Interaction of Emotional Appeal and Message Topic on Perceived Novelty*

Nuclear Energy				
	Model A		Model B	
Independent Variables	*β*	t-statistic	*β*	t-statistic
Emotional Appeal	-.006	-.12	0.025	.33
Message Topic	.041	.83	.066	-.96
Emotional Appeal*Message Topic	--	--	-0.045	-.53
R^2	0.002		0.002	
Traffic Accidents				
Emotional Appeal	.073	1.48	.11	1.41
Message Topic	.01	.10	.033	.48
Emotional Appeal*Message Topic	--	--	-.049	-.59
R^2	0.005		0.006	

Table 33. *Means, Standard Deviations, and Test Statistics for the Interaction of Emotional Appeal and Message Topic on Perceived Catastrophic Potential*

Nuclear Energy						
topic	emotion	Mean	*SD*	*df*	*F*	*p*
traffic	fear	4.79	1.93			
	anger	4.79	1.80			
nuclear energy	fear	4.59	2.02			
	anger	3.95	1.88	1, 426	2.86	<0.05
Traffic Accidents						
topic	emotion	Mean	*SD*	*df*	*F*	*p*
traffic	fear	3.54	1.28			
	anger	3.57	1.30			
nuclear energy	fear	4.28	1.52			
	anger	3.32	1.24	1, 426	8.01	<0.01

Table 34. *Regression Results for the Interaction of Emotional Appeal and Message Topic on Perceived Catastrophic Potential*

Nuclear Energy				
	Model A		Model B	
Independent Variables	β	t-statistic	β	t-statistic
Emotional Appeal	0.070	1.45	0.17*	2.23
Message Topic	.14*	2.86	.22**	3.24
Emotional Appeal*Message Topic	--	--	-0.14*	-1.69
R^2	0.021		0.028[a]	
Traffic Accidents				
Emotional Appeal	.11*	2.28	.27**	3.65
Message Topic	-.062	-1.28	.069	1.04
Emotional Appeal*Message Topic	--	--	-.23**	-2.84
R^2	0.018		0.037[b]	

* $p < 0.05$
** $p < 0.01$

a. R^2 change was statistically significant, F(1, 426) = 2.86, p < 0.05
b. R^2 change was statistically significant, F(1, 426) = 8.08, p < 0.01

Table 35. *Means, Standard Deviations, and Test Statistics for the Interaction of Emotional Appeal and Message Topic on Perceived Dread*

Nuclear Energy						
topic	emotion	Mean	*SD*	*df*	*F*	*p*
traffic	fear	4.44	1.82			
	anger	4.53	1.75			
nuclear energy	fear	4.95	1.30			
	anger	4.68	1.71	1, 424	1.15	0.14
Traffic Accidents						
topic	emotion	Mean	*SD*	*df*	*F*	*p*
traffic	fear	3.71	1.75			
	anger	3.57	1.67			
nuclear energy	fear	3.62	1.67			
	anger	3.37	1.71	1, 424	0.091	0.38

Table 36. *Regression Results for the Interaction of Emotional Appeal and Message Topic on Perceived Dread*

Nuclear Energy				
	Model A		Model B	
Independent Variables	*β*	t-statistic	*β*	t-statistic
Emotional Appeal	0.02	1.33	0.08	1.07
Message Topic	-.094	1.93	-.044	-.65
Emotional Appeal*Message Topic	--	--	-0.089	-1.07
R^2	0.01		0.013	
Traffic Accidents				
Emotional Appeal	.054	1.07	.073	.92
Message Topic	.043	.85	.057	.83
Emotional Appeal*Message Topic	--	--	-.027	-.30
R^2	0.004		0.005	

Table 37. *Means, Standard Deviations, and Test Statistics for the Interaction of Emotional Appeal and Message Topic on Perceived Likelihood of Fatal Consequences*

Nuclear Energy						
topic	emotion	Mean	*SD*	*df*	*F*	*p*
traffic	fear	4.03	2.01			
	anger	4.04	1.82			
nuclear energy	fear	3.98	1.90			
	anger	3.40	1.81	1, 424	2.52	<0.05
Traffic Accidents						
topic	emotion	Mean	*SD*	*df*	*F*	*p*
traffic	fear	5.47	1.31			
	anger	5.50	1.19			
nuclear energy	fear	5.40	1.52			
	anger	5.69	1.34	1, 424	0.87	0.18

Table 38. *Regression Results for the Interaction of Emotional Appeal and Message Topic on Perceived Likelihood of Fatal Consequences*

Nuclear Energy				
	Model A		Model B	
Independent Variables	*β*	t-statistic	*β*	t-statistic
Emotional Appeal	0.065	1.33	0.15*	2.07
Message Topic	0.094*	1.93	0.17**	2.49
Emotional Appeal*Message Topic	--	--	-0.13*	-1.59
R^2	0.011		0.017[a]	
Traffic Accidents				
Emotional Appeal	-.052	-1.03	-.11	-1.38
Message Topic	-.027	-.54	-0.07	-1.02
Emotional Appeal*Message Topic	--	--	0.083	0.93
R^2	0.003		0.005	

* $p < 0.05$
** $p < 0.01$
a. R^2 change was statistically significant, $F(1, 424) = 2.52$, $p < 0.05$

Appendix A: Message Inductions

Condition: nuclear energy, fear

VOLUME 12, ISSUE 2 PAGE 3

SPOTLIGHT ON PUBLIC HEALTH: QUESTIONS AND ANSWERS ON TRITIUM

Q: Is Tritium a public health concern?

A: In June 2011 the Associated Press reported that radioactive tritium has leaked from three-quarters of U.S. commercial nuclear power sites, often into groundwater from corroded, buried piping.

According to the report, leaks from at least 37 of those facilities contained concentrations exceeding the federal drinking water standard — sometimes at hundreds of times the limit. While most leaks have been found within plant boundaries, some have migrated offsite. But none is known to have reached public water supplies. In three cases, leaks have contaminated drinking wells of nearby homes, but not at levels violating the drinking water standard.

Q: What is Tritium?

A: Tritium is a radioactive isotope of hydrogen. Like non-radioactive hydrogen, tritium reacts with oxygen to form water. Tritiated water moves through the environment and the human body just as ordinary water does. It is produced naturally in the environment when cosmic rays interact with the atmosphere, and it also results from nuclear power operations. In addition to being commonly found in water, tritium is also found in non-harmful amounts in the food we eat. Many man-made items such as light-reflective road signs use tritium.

Q: What are the federal limits for Tritium in water?

A: The Environmental Protection Agency has established a safe drinking water limit of 20,000 picocuries per liter. For perspective, many industrial-grade "exit" signs contain 10 to 20 curies of tritium gas. If a person were to drink one liter of water containing the maximum amount of tritium allowed by EPA standards each day for one year, the total radiation exposure to this individual would be the same as from eating one banana per day for a year.

Q: What are the risks?

A: Since tritium is almost always found as water, it goes directly into the soft tissues and organs and increases the risk of developing cancer.

Q: Who is responsible?

A. The Environmental Protection Agency and the Nuclear Regulatory Commission monitor tritium levels in groundwater and strive to keep potential leakage from local nuclear power plants to a minimum. However, because tritium is produced naturally in the environment and is also found in non-harmful amounts in the food we eat, it is impossible to avoid completely. Some sources, including the National Academy of Sciences, point out that any exposure to radioactivity, no matter how slight, boosts cancer risk.

SOME SOURCES, INCLUDING THE NATIONAL ACADEMY OF SCIENCES, POINT OUT THAT ANY EXPOSURE TO RADIOACTIVITY, NO MATTER HOW SLIGHT, BOOSTS CANCER RISK.

Condition: nuclear energy, anger

SPOTLIGHT ON PUBLIC HEALTH: QUESTIONS AND ANSWERS ON TRITIUM

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A: In June 2011 the Associated Press reported that radioactive tritium has leaked from three-quarters of U.S. commercial nuclear power sites, often into groundwater from corroded, buried piping.

According to the report, leaks from at least 37 of those facilities contained concentrations exceeding the federal drinking water standard — sometimes at hundreds of times the limit. While most leaks have been found within plant boundaries, some have migrated offsite. But none is known to have reached public water supplies. In three cases, leaks have contaminated drinking wells of nearby homes, but not at levels violating the drinking water standard.

Q: What is Tritium?

A: Tritium is a radioactive isotope of hydrogen. Like non-radioactive hydrogen, tritium reacts with oxygen to form water. Tritiated water moves through the environment and the human body just as ordinary water does. It is produced naturally in the environment when cosmic rays interact with the atmosphere, and it also results from nuclear power operations. In addition to being commonly found in water, tritium is also found in non-harmful amounts in the food we eat. Many man-made items such as light-reflective road signs use tritium.

Q: What are the federal limits for Tritium in water?

A: The Environmental Protection Agency has established a safe drinking water limit of 20,000 picocuries per liter. For perspective, many industrial-grade "exit" signs contain 10 to 20 curies of tritium gas. If a person were to drink one liter of water containing the maximum amount of tritium allowed by EPA standards each day for one year, the total radiation exposure to this individual would be the same as from eating one banana per day for a year.

Q: What are the risks?

A: Since tritium is almost always found as water, it goes directly into the soft tissues and organs and increases the risk of developing cancer.

Q: Who is responsible?

A. The Environmental Protection Agency and the Nuclear Regulatory Commission monitor tritium levels in groundwater and strive to keep potential leakage from local nuclear power plants to a minimum. So far, federal and industry officials say, the tritium leaks pose no health threat. In fact, the Associated Press argues that the NRC and industry consider the leaks a public relations problem, not a public health or accident threat. Other sources, including the National Academy of Sciences, point out that any exposure to radioactivity, no matter how slight, boosts cancer risk.

THE ASSOCIATED PRESS ARGUES THAT THE NRC AND INDUSTRY CONSIDER THE [TRITIUM] LEAKS A PUBLIC RELATIONS PROBLEM, NOT A PUBLIC HEALTH OR ACCIDENT THREAT. OTHER SOURCES, INCLUDING THE NATIONAL ACADEMY OF SCIENCES, POINT OUT THAT ANY EXPOSURE TO RADIOACTIVITY, NO MATTER HOW SLIGHT, BOOSTS CANCER RISK

Condition: traffic accident, fear

VOLUME 12, ISSUE 2 PAGE 3

SPOTLIGHT ON PUBLIC HEALTH: QUESTIONS AND ANSWERS ON DISTRACTED DRIVING

Q: Is distracted driving a public health concern?

A. Absolutely. Each year over the past 15 years more than 40,000 Americans have died in car accidents (National Highway Traffic Safety Administration's Fatality Analysis Reporting System, 2010). Distractions are the leading cause of motor vehicle crashes and the number one distraction is cell phones.

The use of a cell phone while driving is a very high-risk behavior with significant impact on society because of the vast number of people engaging in the behavior and the cognitive distractions the driver experiences when engaged in a cell phone conversation. More than 50 peer-reviewed scientific studies have identified the risks associated with cell phone use while driving.

Q: What about hands free devices?

A. Hands-free devices cause the same amount of cognitive distraction (impairment to awareness, judgment and perception) as handheld devices, according to simulator studies conducted at the University of Utah.

Q: How does distracted driving compare to drunk driving?

A. One recent simulator study compared drivers using cell phones and drivers impaired by alcohol. Cell phone users had slower reaction times than drivers with .08 blood alcohol content (BAC).

Q: What are the risks?

A. According to studies linking crashes to cell phone records, people who use cell phones while driving are four times more likely to be involved in a crash.

Q: Who is responsible?

A. Distracted driving has been shown to be in many ways as dangerous as driving while intoxicated. But, because few people take the risk of distracted driving seriously, there is little demand for accountability and little hesitation when putting ourselves and others at risk by using cell phones while driving. States have begun enforcing distracted driving laws, but until drivers decide to avoid cell phone use while driving, we—and especially our nation's teenagers and young adults—are at a statistically high risk of being in potentially deadly traffic accidents.

BECAUSE FEW PEOPLE TAKE THE RISK OF DISTRACTED DRIVING SERIOUSLY, THERE IS LITTLE DEMAND FOR ACCOUNTABILITY AND LITTLE HESITATION WHEN PUTTING OURSELVES AND OTHERS AT RISK BY USING CELL PHONES WHILE DRIVING.

Condition: traffic accidents, anger

VOLUME 12, ISSUE 2

SPOTLIGHT ON PUBLIC HEALTH: QUESTIONS AND ANSWERS ON DISTRACTED DRIVING

Q: Is distracted driving a public health concern?

A. Absolutely. Each year over the past 15 years more than 40,000 Americans have died in car accidents (National Highway Traffic Safety Administration's Fatality Analysis Reporting System, 2010). Distractions are the leading cause of motor vehicle crashes and the number one distraction is cell phones.

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A. Hands-free devices cause the same amount of cognitive distraction (impairment to awareness, judgment and perception) as handheld devices, according to simulator studies conducted at the University of Utah.

Q: How does distracted driving compare to drunk driving?

A. One recent simulator study compared drivers using cell phones and drivers impaired by alcohol. Cell phone users had slower reaction times than drivers with .08 blood alcohol content (BAC).

Q: What are the risks?

A. According to studies linking crashes to cell phone records, people who use cell phones while driving are four times more likely to be involved in a crash.

Q: Who is responsible?

A. The danger distracted drivers pose to themselves and other motorists has been compared to the risk posed by drivers who operate motor vehicles while intoxicated. Distracted driving is a choice that is leading to a significant number of unnecessary deaths, especially among teenagers and young adults. Please hold yourself and those around you accountable.

> DISTRACTED DRIVING IS A CHOICE THAT IS LEADING TO A SIGNIFICANT NUMBER OF UNNECESSARY DEATHS, ESPECIALLY AMONG TEENAGERS AND YOUNG ADULTS.

Appendix B: Questionnaire

***2. Are you currently 18 years of age or older?**

- [ ] No
- [ ] Yes

For this study, we're interested in how the opinions of people in particular occupations differ. Before we begin, please answer a few questions about the work you do.

3. Would you say you are an expert in your field?

- ◯ Yes
- ◯ No

4. How long have you been working in your field?

- ◯ Less than one year.
- ◯ 1 to 2 years.
- ◯ 3 to 5 years.
- ◯ 6 to 9 years.
- ◯ 10 to 14 years.
- ◯ 15 to 19 years.
- ◯ 20 years or more.

5. Which of the following best describes the field in which you work?

- ◯ Traffic Safety
- ◯ Teaching
- ◯ Nuclear Energy
- ◯ Risk Assessment
- ◯ Nursing
- ◯ Marketing
- ◯ Other

Other (please specify)

*6. Please choose the month you were born in.

- ◯ January
- ◯ February
- ◯ March
- ◯ April
- ◯ May
- ◯ June
- ◯ July
- ◯ August
- ◯ September
- ◯ October
- ◯ November
- ◯ December

NF

14. The article you just read addressed a risk associated with nuclear energy. Nuclear energy evokes a lot of emotions in Americans. We'd like to get a sense of how nuclear energy makes you feel. We are particularly interested in what makes you most fearful about nuclear energy. Please describe in detail your concerns about nuclear energy. If you can, write the description so that someone reading it might even feel fearful from learning about the situation.

What aspect of nuclear energy makes you the most fearful or nervous?

Why does it make you so fearful or nervous?

*** 15. Please choose "continue" when you are ready to move on.**

○ Continue

NA

16. The article you just read addressed a risk associated with nuclear energy. Nuclear energy evokes a lot of emotions in Americans. We'd like to get a sense of how nuclear energy makes you feel. We are particularly interested in what makes you most angry about nuclear energy. Please describe in detail what angers you about nuclear energy, or perhaps what angers you about how people communicate about nuclear energy. If you can, write the description so that someone reading it might even feel angry from learning about the situation.

What aspect of nuclear energy makes you the most angry?

Why does it make you so angry?

*** 17. Please choose "continue" when you are ready to move on.**

○ Continue

TF

18. The article you just read addressed the risk of traffic accidents. Traffic accidents evoke a lot of emotions in Americans. We'd like to get a sense of how traffic accidents make you feel. We are particularly interested in what makes you most fearful about traffic accidents. Please describe in detail what scares you about traffic accidents. If you can, write the description so that someone reading it might even feel fearful from learning about the situation.

What aspect of traffic accidents makes you the most fearful?

Why does it make you so scared?

*** 19. Please choose "continue" when you are ready to move on.**

○ Continue

TA

20. The article you just read addressed the risk of traffic accidents. Traffic accidents evoke a lot of emotions in Americans. We'd like to get a sense of how traffic accidents make you feel. We are particularly interested in what makes you most angry about traffic accidents. Please describe in detail what angers you about traffic accidents, or perhaps what angers you about how people communicate about traffic accidents. If you can, write the description so that someone reading it might even feel angry from learning about the situation.

What aspect of traffic accidents makes you the most angry?

Why does it make you so angry?

***21. Please choose "continue" when you are ready to move on.**

○ Continue

Post

22. We are now interested in knowing how you currently feel more generally. Think about your current feelings (not your general disposition, but specifically what you feel just this moment). How much of each of the following emotions are you currently experiencing? Please answer on a 1 to 7 scale, where 1 means "none of this feeling" and 7 means "a great deal of this feeling."

Please rate the extent to which you are currently experiencing the following emotions:

	1-None of this feeling	-2-	-3-	-4-	-5-	-6-	7-A great deal of this feeling
Dismal	○	○	○	○	○	○	○
Frustrated	○	○	○	○	○	○	○
Accountable	○	○	○	○	○	○	○
Responsible	○	○	○	○	○	○	○
Sad	○	○	○	○	○	○	○
Enraged	○	○	○	○	○	○	○
Angry	○	○	○	○	○	○	○
Mad	○	○	○	○	○	○	○
Frightened	○	○	○	○	○	○	○
Skeptical	○	○	○	○	○	○	○
Optimistic	○	○	○	○	○	○	○
Fearful	○	○	○	○	○	○	○
Scared	○	○	○	○	○	○	○
Guilty	○	○	○	○	○	○	○
Bored	○	○	○	○	○	○	○
Content	○	○	○	○	○	○	○
Cheerful	○	○	○	○	○	○	○
Happy	○	○	○	○	○	○	○
Hopeful	○	○	○	○	○	○	○

23. Please estimate your level of worry or concern about the following risks on a 1 to 7 scale, where 1 is not at all worried, and 7 is extremely worried.

	1-Not at all worried	-2-	-3-	-4-	-5-	-6-	7-Extremely worried
Lung cancer							
Floods							
War							
Climate change							
Nuclear accidents							
Stomach cancer							
Fires							
Traffic accidents							
Toxic chemical spills							
Airplane accidents							
Leukemia							
Homicide							
Terrorism							
Tornados							
Accidental Falls							
Stroke							
Electrocution							
Heart disease							

24. Next, we'd like you to think about these risks in a slightly different way. Please estimate the number of deaths caused by each risk in a one-year period in the United States. We're not looking for exact answers; please just provide your gut estimations. Enter numbers only; no commas.

Stroke	
Electrocution	
Stomach cancer	
Homicide	
Lung cancer	
Automobile accident	
War	
Toxic chemical spills	
Leukemia	
Terrorism	
Floods	
Heart disease	
Accidental falls	
Nuclear energy	
Tornadoes	
Airplane accidents	
Fire	
Climate change	
Lightning strike	

For the set of questions on this page, please consider the risk of NUCLEAR ENERGY specifically.

25. Would you say nuclear energy poses risks that...

	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
Are new and novel (opposed to old and familiar).	○	○	○	○	○	○	○
People have a great deal of dread for (opposed to thinking about calmly).	○	○	○	○	○	○	○
Could kill a large number of people at one time (opposed to one at a time).	○	○	○	○	○	○	○
People face voluntarily.	○	○	○	○	○	○	○
Have immediate effects (opposed to effects that might occur some time later).	○	○	○	○	○	○	○
Are known to science.	○	○	○	○	○	○	○
Are known precisely by the people who are exposed to the risk(s).	○	○	○	○	○	○	○
Allow each individual to control his or her own personal risk.	○	○	○	○	○	○	○
Will have fatal consequences.	○	○	○	○	○	○	○

Copy of page:

For the set of questions on this page, please consider the risk of TRAFFIC ACCIDENTS specifically.

26. Would you say traffic accidents pose risks that...

	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
Are known precisely by the people who are exposed to the risk(s).	○	○	○	○	○	○	○
Are new and novel (opposed to old and familiar).	○	○	○	○	○	○	○
Could kill a large number of people at one time (opposed to one at a time).	○	○	○	○	○	○	○
People face voluntarily.	○	○	○	○	○	○	○
Have immediate effects (opposed to effects that might occur some time later).	○	○	○	○	○	○	○
Are known to science.	○	○	○	○	○	○	○
People have a great deal of dread for (opposed to thinking about calmly).	○	○	○	○	○	○	○
Allow each individual to control his or her own personal risk.	○	○	○	○	○	○	○
Will have fatal consequences.	○	○	○	○	○	○	○

Lastly, please tell us a little bit about yourself.

27. Are you male or female?

- ◯ Male
- ◯ Female

28. Which category below includes your age?

- ◯ 17 or younger
- ◯ 18-20
- ◯ 21-29
- ◯ 30-39
- ◯ 40-49
- ◯ 50-59
- ◯ 60 or older

29. What is the highest level of school you have completed or the highest degree you have received?

- ◯ Less than high school degree
- ◯ High school degree or equivalent (e.g., GED)
- ◯ Some college but no degree
- ◯ Associate degree
- ◯ Bachelor degree
- ◯ Graduate degree

30. Are you White, Black or African-American, American Indian or Alaskan Native, Asian, Native Hawaiian or other Pacific islander, or some other race?

- ◯ White
- ◯ Black or African-American
- ◯ American Indian or Alaskan Native
- ◯ Asian
- ◯ Native Hawaiian or other Pacific Islander
- ◯ From multiple races

Some other race (please specify)

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