

A Multi-Method, Multi-Hazard Approach to Explore the Uniqueness of Terrorism Risk Perceptions and Worry¹

JENNIFER E.C. LEE² AND

LOUISE LEMYRE

GAP-Santé Research Unit

*Institute of Population Health and School
of Psychology*

University of Ottawa

Ottawa, Ontario, Canada

DANIEL KREWSKI

McLaughlin Centre for Population Health

Risk Assessment

*Institute of Population Health and
Department of Epidemiology and*

Community Medicine

University of Ottawa

Ottawa, Ontario, Canada

Developing ways to manage terrorism effectively requires a better understanding of how the public perceives this threat. In the present study, Canadians' perceptions of terrorism risk and 4 other hazards were assessed using a word-association technique and rating scales reflecting key cognitive dimensions of risk (threat, uncertainty, control) and worry reactions. Data were collected in a national telephone survey. Canadians perceived terrorism as posing a lower threat, as more uncertain, and as less controllable, compared to the other hazards. Positive associations of perceived threat and of perceived uncertainty with worry about terrorism were observed. However, perceived control was unexpectedly positively associated with worry about terrorism. The findings also suggest that additional social contextual factors should be examined in future research.

Deemed "a new species of trouble" (Slovic, 2002b, p. 425), terrorism is known for its potential to evoke considerable fear, regardless of its low probability of occurrence. Indeed, numerous studies have stressed the fact that psychological and related behavioral responses to this threat, rather than physical damage or loss incurred, can have the most long-lasting effects (Hyams, Murphy, & Wessely, 2002; Kunreuther, 2002; Lemyre, Clément, Corneil, Craig et al., 2005; Lerner, Gonzalez, Small, & Fischhoff, 2003; Stein

¹This research was supported by a contribution agreement from Health Canada ("Public Perception and Acceptable Levels of Health Risk Among Canadians"), as well as the Social Sciences and Humanities Research Council (SSHRC) of Canada through a doctoral fellowship to the first author. The authors thank Kevin Brand, Louise Bouchard, Christine Dallaire, and Pierre Mercier for their help with the development of the survey questionnaire. The contributions of Graham M. Gaylord, Marie-Pierre L. Markon, and Michelle C. Turner are also acknowledged.

²Correspondence concerning this article should be addressed to Jennifer E. C. Lee (who is now at Defence Research and Development Canada), GAP-Santé Research Unit, Desmarais Hall, University of Ottawa, 55 Laurier Avenue East, Room 3217, Ottawa, Ontario K1N 6N5, Canada. E-mail: jeclee@alumni.uottawa.ca

et al., 2004). Contributing to the pervasiveness of such responses is the fact that behavior can be driven by perceptions of terrorism threat, regardless of whether it is actually present (Jenkin, 2006; Kasperson et al., 1988; Lemyre, Clément, Corneil, Lee et al., 2005; Slovic, 2002a, 2002b). Achieving a better understanding of the way individuals perceive this hazard is a pivotal first step in developing effective strategies to manage terrorism risk. The present study, therefore, aims to shed light on key dimensions of terrorism risk perceptions and worry in the Canadian context. In particular, the analysis is informed by key areas in the study of health risk perception.

Health Risk Perception

The body of research on health risk perception has grown tremendously over the past three decades, in parallel with the increasing number of articles using the term *risk* (Berry, 2004). Of all approaches used to study health risk perception (e.g., Morgan, Fischhoff, Bostrom, & Atman, 2001; Joffe, 2002a, 2002b; Steg & Sievers, 2000), there is no doubt that the psychometric approach of Fischhoff and his colleagues (Fischhoff, Slovic, Lichtenstein, Read, & Combs, 1978) is among the most influential. In this approach, respondents are asked to rate a list of hazards in terms of several dimensions such as (a) whether the hazards are novel, known to science, controllable, or evoke considerable dread; (b) whether exposure to the hazards is unknown or involuntary; and (c) whether the hazards' effects are immediate, catastrophic, or severe. Subsequently, these may be characterized by two underlying factors: *dread risk* (i.e., seriousness of the consequences of hazards) and *unknown risk* (i.e., a sense of uncertainty surrounding hazards; Sjöberg, 2000; Slovic, 2002a; Slovic, Fischhoff, Lichtenstein, & Roe, 1981). Hazards scoring high on both dread and unknown risk (e.g., pesticides, nuclear power) are typically among those found to raise the highest degree of concern among members of the public.

The psychometric approach has helped to establish that risk perceptions reflect several qualitative factors other than quantitative expert assessments of likelihood or degree of harm to health. While experts understand risk in terms of cause and effect relationships, as well as potential mortality or morbidity resulting from taking part in a given activity (Rogers, Amlôt, Rubin, Wessely, & Krieger, 2007), it is increasingly recognized that these more qualitative dreaded and unknown facets of risk have real consequences on individuals' feelings and behaviors that must be accounted for in risk-management frameworks (Lemyre, Clément, Corneil, Lee et al., 2005). Despite this important contribution, the psychometric approach is not free of shortcomings (Schütz, Wiedemann, & Gray, 2000; Siegrist, Keller, & Kiers,

2005; Sjöberg, 1996). First, the potential for these factors to account for individual differences in response to hazards has been called into question (Langford, Marris, McDonald, Goldstein, & O'Riordan, 1999; Schütz et al., 2000; Siegrist et al., 2005). As noted by Siegrist et al., the analytical strategy used by Fischhoff et al. (1978) identifies factors that distinguish different types of hazards based on their potential to generate concern, rather than describing the processes involved in one's development of concern over a particular hazard.

Also, related to Schütz et al.'s (2000) observation that risk perception is used to describe both "attitudes and intuitive judgments about risk . . . [and] more general evaluations of and reactions to risk" (p. 1), the dread factor consists of both cognitive dimensions (e.g., perceived controllability, voluntariness, catastrophic potential, fatality of consequences) and affective responses (e.g., dread; Fischhoff et al., 1978; Slovic, 1987, 2002a). Peters and Slovic (1996) noted that affect "can be viewed as constructed or interpreted through cognitive mediation, or reactive in a Darwinian sense and influential on the cognitive process itself" (p. 1450). Unfortunately, it is often (albeit not always) assumed that risk perceptions correspond to affect, where relationships of these cognitive factors with affective responses to hazards are not examined explicitly.

By contrast, the literature on models of health behavior not only sheds light on important cognitive dimensions predicting response to hazards; fear appeal models, in particular, also specify how these dimensions relate to affect (e.g., fear) as a separate response to hazards in order to predict health behavior. While a variety of models fall within this category (e.g., protection motivation theory, parallel response model, extended parallel process model; Leventhal, 1971; Rogers, 1975, 1983; Witte, 1998), there is considerable overlap among them. Reminiscent of the dread factor (Fischhoff et al., 1978), a common assumption is that fear drives response to a particular hazard and is driven by the extent to which individuals perceive this hazard as a serious and likely threat to health (perceived threat). In support of this, perceived threat has been associated with increased negative affect, such as worry or fear (Ruiter, Verplanken, Kok, & Werrij, 2003; Sjöberg, 1998; Takao, Motoyoshi, Sato, & Fukuzono, 2003). Additionally, many models of health behavior place importance on individuals' perceived level of control over the health hazard. Such perceptions are recognized as robust predictors of behaviors aimed at averting the threat and preserving health (Skinner, 1996).

Health Risk Perception: The Case of Terrorism

Drawing from this literature, as well as research applying the psychometric approach, examining terrorism risk perceptions in terms of dread (or

threat), unknown, and controllability dimensions, as well as their relationship with affect might thus serve as a good starting point to achieve a better understanding of response to this hazard. Since the events of September 11, 2001, a growing number of studies have contributed to a previously sparse literature on terrorism risk perceptions and (at times) related affective responses (Bergstrom & McCaul, 2004; Bleich, Gelkopf, & Solomon, 2003; Fischhoff, Bruine de Bruin, Perrin, & Downs, 2004; Fischhoff, Gonzalez, Small, & Lerner, 2003, 2005; Goodwin, Wilson, & Gaines, 2005; Klar, Zakay, & Sharvit, 2002; Lerner et al., 2003; Rubin, Brewin, Greenberg, Simpson, & Wessely, 2005; Sjöberg, 2002). Despite widespread recognition of the multidimensionality of risk perceptions, however, investigations have been limited to but a subset of cognitive dimensions at a time (i.e., mostly perceived threat dimensions of likelihood or severity, at times perceived control, but rarely the dimension of unknown risk). The majority point to a relationship between perceived threat and heightened worry, fear, or other types of anxiety-based affective reactions to terrorism (Bergstrom & McCaul, 2004; Bleich et al., 2003; Fischhoff et al., 2005; Klar et al., 2002; Lerner et al., 2003; Rubin et al., 2005). By contrast, studies examining the relationship between perceived control over terrorism and affect have been fewer in number and less conclusive (nonsignificant in Bleich et al., 2003; positive significance in Klar et al., 2002).

In addition to only having examined a subset of cognitive dimensions, much of the work in this area has been conducted in countries following specific attacks. Not surprisingly, the findings have pointed to terrorism as an important source of perceived health risk and concern. These results may not generalize to populations of other countries, particularly where no particular attack has been experienced. Accordingly, marked differences are observed in terrorism risk perceptions as a function of both timing relative to the occurrence of an event and national context. For example, one study revealed a tendency for Swedes to perceive the risks of various types of terrorism as low, relative to other hazards 9 months following the attacks of September 11, 2001. However, terrorism was identified as a significant source of perceived threat, worry, and fear in other Swedish studies conducted closer to the time of the attacks (Sjöberg, 2002). Also, in a cross-national study comparing Canadians and Americans, Canadian students perceived their likelihood of becoming seriously ill or dying from terrorism as lower than did American students. However, they perceived themselves as more likely to become seriously ill or die from serious acute respiratory syndrome (SARS), an outbreak of which had only recently occurred in Toronto at the time (Feigenson, Bailis, & Klein, 2004). The authors of that study further noted the importance of examining terrorism risk perceptions in multiple national contexts, given that terrorism risk management is likely to require

international cooperation (Feigenson et al., 2004). As their findings emphasize, it is also important to understand terrorism risk perceptions in relation to the various other health risks that may be present in a given national context.

Terrorism Risk in Canada

Canada is recognized as one of the safest countries in the world. Still, this country is no stranger to terrorist activity. Between the years of 1973 and 2003, Canada witnessed a number of events, including (at least) 6 hijackings; 2 airplane bombings; 73 disruptive hoaxes; 9 hostage takings or kidnappings; 4 letter bombs; 170 bombs, firebombs, and arson; 59 threats; 35 attacks on individuals; 45 acts of vandalism; 14 plots and foiled attacks; and 32 instances of support for terrorist activities (Leman-Langlois & Brodeur, 2005). Since the events of September 11, 2001, there has also been increased awareness of the need to improve terrorism preparedness among federal, provincial, and local governments. Nevertheless, evidence to date has suggested that Canadians do not share such concerns about terrorism (Gibson, Lemyre, Clément, Markon, & Lee, 2007). In line with research on health risk perception, this low level of worry about terrorism could be a function of various dimensions of the public's terrorism risk perceptions. Identifying and understanding key dimensions of terrorism risk perceptions might help to shed light on some of the processes involved.

In addition, it could help to understand perceptions of terrorism in relation to perceptions of other hazards. To this effect, a multi-hazard approach comparing terrorism risk perceptions to those surrounding other hazards could provide deeper, more contextualized insight into individuals' cognitive experiences of this threat. For instance, doing so could help to identify aspects of terrorism risk perceptions that are shared with other hazards, as well as aspects that are unique, which would enable the development of more appropriate terrorism risk communication frameworks (Rogers et al., 2007; Wray, Kreuter, Jacobsen, Clements, & Evans, 2004). Analyses of this nature would also result in a more ecologically valid portrayal of public perceptions of terrorism. Indeed, people are exposed to a number of health hazards at any given point in time—some deemed important, others not—and this entire array represents the context wherein their responses to health issues are based (Lemyre, Lee, Mercier, Bouchard, & Krewski, 2006).

Study Objectives

Using data from a previous national survey on health risk perception, the present study explores the nature of terrorism risk perceptions within the

Canadian context (Krewski et al., 2005, 2006), First, Canadians' most salient thoughts of terrorism, as well as four other hazards (i.e., motor vehicles, climate change, recreational physical activity, cellular phones) assessed by way of a word-association task are examined. This can help to determine how cognitive dimensions that characterize terrorism risk perceptions might differ from those characterizing other hazards, and thereby facilitate the identification of variables of potential interest in future studies.

Second, key dimensions of Canadians' risk perceptions and levels of worry surrounding terrorism as well as the other hazards are examined and compared. Worry related to various hazards has been found in previous studies to be associated with a number of sociodemographic factors (e.g., gender, age), as well as cognitive evaluations of the hazards (Houghton, Murray, & Ball, 1999; Tennfjord & Rundmo, 2007). Accordingly, sociodemographic and cognitive correlates of worry are examined for each hazard.

Drawing from research on the psychometric approach and on models of health behavior, cognitive dimensions of risk perceptions include (a) perceived threat; (b) perceived uncertainty (as an index of "unknown risk"), and (b) perceived control. The nature of relationships among these cognitive dimensions and worry is examined and compared across hazards in a last set of analyses. It is hypothesized that worry will be positively associated with perceptions of threat and uncertainty, and negatively associated with perceptions of control above and beyond any existing sociodemographic differences, although to varying degrees.

Method

Participants

Study participants were 1,503 Canadians (721 men, 782 women) who were interviewed by telephone. The sample was stratified to resemble the Canadian adult population in terms of province of residence, as well as age group (18–29 years, 30–34 years, 35–44 years, 45–54 years, and 55 years and over) and gender within province, according to 2001 Census data.

Materials

The content of the telephone survey was designed in part to follow up a previous similar survey conducted in 1992 (Slovic, Flynn, Mertz, & Mullican, 1993), and in part to investigate perceptions of the level of risk posed by a wider range of population health hazards to the health of Canadians

(Krewski et al., 2005, 2006). To develop the survey questionnaire, a series of group meetings was held throughout Summer and Fall 2003 among members of the project team. The questionnaire was first drafted in English and was translated into French by a professional English–French translator. The translated questionnaire was then verified by two bilingual individuals and a second professional English–French translator. Thus available in both official Canadian languages, the final version consists of multiple sections to assess different aspects of health risk perception and acceptability.³

For the purposes of the present analyses, questions were drawn from only one section of the full survey. This section assesses more detailed aspects of Canadians' perceptions of five health hazards: motor vehicles, climate change, recreational physical activity, cellular phones, and terrorism. The hazards were selected by members of the project team to reflect opposite spectrums of controllability, with motor vehicles, recreational physical activity, and cellular phones representing fairly controllable hazards; and climate change and terrorism representing relatively less controllable hazards. Some researchers have noted that distinguishing lifestyle (i.e., hazards that are under personal control and are subject to personal decisions) from environmental hazards (i.e., hazards that result from societal activities or natural processes) may be useful from a psychological perspective (Schütz et al., 2000). Hence, motor vehicles, recreational physical activity, and cellular phones may be conceptualized as lifestyle hazards, while climate change and terrorism may be conceptualized as environmental hazards.

Prior to assessing detailed aspects of respondents' perceptions of each hazard, a word-association task was employed to assess participants' general, unsolicited representations of each of them. Slovic and colleagues began using word-association tasks as a way to study processes involved in risk perception, arguing that the findings can provide insight into the content of people's representational systems (Benthin et al., 1995; Peters & Slovic, 1996; Slovic, Finucane, Peters, & MacGregor, 2003; Slovic, Kraus, Lappe, Letzel, & Malmfors, 1989). Indeed, word associations can provide insight into individuals' representations of a given object by shedding light on those concepts that are most readily accessible in memory when they think about the given object. Respondents were thus asked to provide the first word or image they had in mind while hearing about each of the hazards (i.e., "When you hear the term "health risks" from [motor vehicles, climate change, recreational physical activity, cellular phones, terrorism], what is the first word or image that comes to mind?").

³Descriptive results, as well as details regarding all sections of the survey have been presented in a report as a series of papers (for details about other sections of the survey, see Krewski et al., 2005, 2006, 2008, 2009).

Following the word-association task, respondents were asked to rate the five hazards on a number of dimensions (see Krewski et al., 2009), including the cognitive dimensions of (a) perceived threat (“To what extent is/are [motor vehicles, climate change, recreational physical activity, cellular phones, terrorism] a risk to your personal health?”); (b) perceived uncertainty (“What level of uncertainty do you think there is, in general, about [motor vehicle, climate change, recreational physical activity, cellular phone, terrorism] risks?”); (c) perceived control (“How much personal control do you have over [motor vehicle, climate change, recreational physical activity, cellular phone, terrorism] risks?”); and (d) worry (“To what extent do you worry about [motor vehicle, climate change, recreational physical activity, cellular phone, terrorism] risks?”). Participants rated their responses on a 5-point Likert-type scale ranging from 1 (*almost no/none*) to 4 (*high*), with a fifth response category to indicate that they did not know or had no answer (5 = *don’t know/no opinion*). Information was also gathered on education (*some/completed elementary school, some/completed high school, some/completed community college or CEGEP, some/completed university, some/completed graduate school*) and household income (*under \$19,999, \$20,000–\$29,999, \$30,000–\$39,999, \$40,000–\$49,999, . . . , and \$80,000 and up*), allowing for the control of background variables in the analyses.

Procedure

The survey was administered in Winter 2004 by a consulting firm. A random-digit-dialing method was applied to identify potential respondents, with a maximum of five callbacks in the case of unanswered calls. Once a household was contacted, the adult whose birthday was closest to the day of the call was asked to participate in the survey. A total of 26,223 numbers were dialed. Of these numbers, 21.4% were not valid and 18.9% were unanswered calls. Refusals to participate, callbacks, and elimination as a result of completed quotas represented 44.4%, 5.4%, and 4.2%, respectively, of all dialed numbers. The 1,503 interviews completed represent 5.7% of all dialed numbers. Calculated using the Performance Management and Recognition System method of calculation (Allen, Ambrose, Halpenny, & Simmie, 2003), the response rate was 12.7%.

Data were collected using computer-assisted telephone interviewing (CATI), which improves flow of survey administration and reduces errors in data entry. For survey items of interest to the present study, all items pertaining to the same hazard were presented sequentially, resulting in five sections (i.e., one for each hazard). Each section began with the word-association task. This was followed by items assessing the various dimensions

of respondents' perceptions, which were sequenced randomly in order to control for order effects. The order of presentation of sections on the different hazards was also sequenced randomly to control for order effects. Survey administration took approximately 30 min and was conducted in the official language of the respondents' choice.

Data Analyses

Content analyses. Word associations generated for each hazard were subjected to a content analysis. In a first step, word associations were grouped according to semantic meaning in order to facilitate screening for emerging concepts. For example, "collision" (as a word associated with motor vehicles) would have been placed in the same group as "car crash." In a second step, semantically grouped word associations were read and re-read to identify preliminary themes and categories for each hazard. When respondents provided more than one idea or image as a word association (e.g., "jogging and heart," "guns and fear"), only the first word was coded. It should be noted that word associations were typically quite short and rarely (i.e., roughly no more than 1%) included more than one idea or image.

Responses relevant to emerging categories were identified and examined using the method of constant comparison (Glaser & Strauss, 1967) in that each word association was compared with the rest to establish analytical categories. When necessary, categories were added to reflect as many nuances of the data as possible (Pope, Ziebland, & Mays, 2000). One researcher coded all the data, while a second independent rater coded a random sample of 10% of the word associations to each hazard in order to establish interrater reliability. The validity of the analytical categories was assessed in terms of kappa's interrater reliability coefficient.

Quantitative analyses. Design effects as a result of sample stratification were computed for a random subset of variables and were found to be close to 1 (i.e., 0.93–1.00), indicating that analyses of data using simple random-sample variances would be adequate, although slightly conservative. Prior to analyses, all variables were screened through various SPSS programs for accuracy of data entry and missing values. Entries of 5 (i.e., *don't know/no opinion*) were treated as missing values.

An examination of skewness and kurtosis revealed significant departure from normality of most variable distributions. Nevertheless, multiple linear regression analyses are robust to departures from normality in large samples (Tabachnick & Fidell, 2001). Therefore, the decision was made to perform sequential multiple linear regression analyses including perceived threat, perceived uncertainty, and perceived control as predictors of worry about each

health hazard (Step 2), controlling for effects related to demographic variables (Step 1). A p value of .05 was used as a criterion for all tests of significance.

Results

Content Analyses

A wide variety of word associations was provided for each hazard, with the number of emerging themes ranging from 17 for recreational physical activity to 23 for terrorism. Satisfactory agreement was observed for all items, ranging from a kappa coefficient of .77 for word associations to “risks from recreational physical activity” to a kappa coefficient of .90 for word associations to “risks from motor vehicles.”

Emerging themes could be classified loosely as those reflecting potential impacts of the hazard once its health risks are incurred (e.g., injury), descriptions of health risks associated with the hazard (e.g., whether the hazard is controllable, uncertain, high in risk, or low in risk), more specific examples of health risks associated with the hazard (e.g., a particular type of health risk or specific situation involving the health risk), individual behaviors (e.g., any preventative or risky individual behavior that may change the level of associated health risks), management issues (e.g., higher order, as opposed to individual actions or regulations that control the level of associated health risks), benefits associated with the hazard, specific populations (e.g., types of individuals, seemingly mentioned as examples of “vulnerable” groups, since the hazard is of relevance to them), sociopolitical factors (e.g., political or societal issues related to the hazard), and general images of the hazard (e.g., images that are a slight variation of the hazard itself).

Emerging categories of themes are presented in Table 1 for each hazard. For the sake of simplicity, the discussion of the results is organized according to the aforementioned broad categories for each hazard. The percentage of word associations coded under each category of themes across hazards is summarized in Table 2.

Risks from motor vehicles. The term “risks from motor vehicles” most frequently elicited thoughts or images reflecting examples of health risks associated with motor vehicles, including accidents (48.8%), pollutants (2.6%), driving conditions (2.1%), and the technical condition of the vehicle (1.0%). Relative to other hazards, respondents most frequently had thoughts or images that alluded to individual behaviors related to motor vehicles (e.g., 17.7% risky driving behaviors, 1.9% safe driving behaviors,

Table 1

Word-Association Themes by Categories of Themes Across Hazards

Theme category	Motor vehicles	Climate change	Recreational physical activity	Cellular phones	Terrorism
Examples	Accidents, pollutants, driving conditions, technical condition of the vehicle	Global warming, ozone depletion, environmental health, greenhouse effect	Types of activities, accidents, environmental risk	Accidents, radiation, related problems not directly affecting health, distraction, fire or explosive potential	Attacks (general or specific), types of terrorism or weapons
Impact	Environmental health impact, human health impact, level of emotional impact, cost	Weather, human health impact, endangerment, glacial melting, level of emotional impact, warm places, economic impact	Human health impact	Human health impact, general dislike, level of emotional impact	Human health impact, level of emotional impact, social impact, general dislike
Specific population	Other drivers	—	Athletes/participants, young people	—	Perpetrator characteristics, non-political groups, family and children
Description	Level of perceived risk	Level of perceived risk, debate surrounding risk, uncertainty, uncontrollable	Level of perceived risk, level of controllability, debate surrounding risk	Level of perceived risk, debate surrounding risk, uncertainty, acceptability	Level of perceived risk, debate surrounding risk, uncontrollable, uncertainty
General image	Type of motor vehicle	Changes not directly related to climate change, broader notion of change	Sporting environments	Telephone image	—
Benefit Management issues	Benefits Vehicle safety features, law	— —	Benefits Education and awareness, health care	Benefits Regulation and management	— Counter-terrorism policy
Sociopolitical	—	Political activism, industrialization	—	—	Political groups and leaders, conflict, countries or regions, information dissemination issues, current state and structure of society, government, peace
Individual behavior	Risky driving behaviors, safe driving behaviors, insurance	Adaptations, preventative action	Risky sport practices, safe sport practices, inactivity/availability of opportunity	Risk while driving, amount of use, preventative practices, don't have one	Preparedness and response

Table 2
Percentage of Word Associations Coded Under Each Category of Themes Across Hazards

Theme category	Motor vehicles	Climate change	Recreational physical activity	Cellular phones	Terrorism
Example	54.5	38.3	31.1	22.6	44.7
Impact	11.2	43.1	34.9	37.2	16.2
Specific population	5.1	—	1.2	—	4.8
Description	2.5	4.6	4.6	10.1	8.4
General image	2.3	3.0	1.4	1.3	—
Benefit	0.7	—	5.7	1	—
Management issues	1.9	—	1.3	0.5	1.7
Sociopolitical	—	1.6	—	—	17.8
Individual behavior	20.2	1.5	10.2	16.6	0.8

0.6% insurance), specific populations (e.g., 5.1% other drivers), and management issues (e.g., 1.7% vehicle safety features, 0.2% law). Relative to other hazards, it was also the least likely to elicit thoughts or images related to potential impacts of motor vehicle risks (e.g., 5.7% environmental health impact, 4.7% human health impact, 0.5% level of emotional impact, 0.3% cost). Aside from those who were unable to provide a word association (1.4%), or who provided word associations that did not relate to any main theme (0.3%), the remaining respondents either described associated health risks in term of their level (2.5%), mentioned a type of motor vehicle as a general image (2.3%), or benefits that might be derived from motor vehicles (0.7%).

Risks from climate change. The term “risks from climate change” most frequently elicited word associations reflecting potential impacts of climate change risks (e.g., 21.5% weather, 12.0% human health impact, 4.7% endangerment, 2.9% glacial melting, 1.5% level of emotional impact, 0.3% warm places, 0.2% economic impact). Many respondents provided examples of health risks associated with climate change (e.g., 16.8% global warming, 9.4% ozone depletion, 8.8% environmental health, 3.3% greenhouse effect), whereas others described the level of perceived risk (1.6%), the debate surrounding the risk (1.4%), uncertainty (0.9%), or its uncontrollable nature (0.7%).

As general images, some respondents made reference to other changes that are not directly related to climate change (e.g., 2.1% seasonal changes) or mentioned the broader notion of change (0.9%). With the exception of terrorism, climate change was the only hazard in relation to which respondents mentioned word associations reflecting sociopolitical factors (e.g., 1.1% political activism, 0.5% industrialization). It was also among the hazards in relation to which respondents mentioned the fewest word associations reflecting individual behaviors (e.g., 1.0% adaptations, 0.5% preventative action).

Risks from recreational physical activity. Although none referred to death, respondents most often referred to human health impact (34.9%) in relation to the phrase “risks from recreational physical activity.” As examples of health risks from recreational physical activity, respondents mentioned types of activities (21.6%), accidents (9.1%), as well as environmental risks (0.4%). As they did for motor vehicles and cellular phones, a relatively high proportion of respondents mentioned individual behaviors (e.g., 5.6% risky sport practices, 3.7% safe sport practices, 0.9% inactivity/availability of opportunity) or mentioned benefits that may be derived from recreational physical activity (5.7%). By comparison, fewer respondents mentioned management issues (e.g., 0.9% education and awareness, 0.4% health care). Others described health risks in terms of the level of perceived risk (3.3%),

level of controllability (0.7%), or debate surrounding them (0.6%). The remaining respondents either had sporting environments as a general image (1.4%) or mentioned specific populations (e.g., 0.9% athletes/participants, 0.3% young people).

Risks from cellular phones. Again, the majority of respondents mentioned potential impacts (e.g., 32.9% human health impact, 3.3% general dislike, 1.0% level of emotional impact). The proportion of respondents who thought of examples of health risks associated with cellular phones was also relatively high (e.g., 11.0% accidents, 6.6% radiation, 2.4% related problems not directly affecting health, 1.7% distraction, 0.9% fire or explosive potential), as was that of respondents who thought of individual behaviors (e.g., 11.6% risk while driving, 2.3% amount of use, 1.9% preventative practices, 0.8% don't have one). Others described health risks in terms of either level of perceived risk (4.7%), debate surrounding them (3.7%), uncertainty (1.3%), or acceptability (0.4%). The few remaining imagined an actual telephone as a general image (1.3%), mentioned the benefits of cellular phones (1.0%), or referred to their regulation and management (0.5%).

Risks from terrorism. The term "risks from terrorism" elicited the widest range of themes. As was the case with risks from motor vehicles, the majority of respondents first thought about examples of health risks. More specifically, they mentioned a specific attack or referred to an attack in general terms (25.2%). Others thought about different types of terrorism or weapons that might be used in an attack (19.5%). However, a distinguishing feature of these word associations was the prominence of themes reflecting sociopolitical factors. Indeed, respondents referred to political groups and leaders (7.2%), conflict (4.6%), various countries or regions (many of which are or have been involved in a conflict; 3.5%), information dissemination issues (1.0%), the current state and structure of society (0.7%), the government (0.6%), or peace (0.2%).

Also, terrorism was the only hazard in relation to which respondents mentioned management issues (1.7% counter-terrorism policy) more frequently than individual behaviors (0.8% preparedness and response). Although potential impacts were mentioned less frequently, many of these reflected death or intense emotion (e.g., 6.7% human health impact, 6.3% level of emotional impact, 1.7% social impact, 1.5% general dislike). Respondents described health risks associated with terrorism in terms of level of perceived risk (4.5%), debate surrounding them (2.3%), as well as uncontrollable (0.9%) or uncertain (0.7%) nature. Finally, word associations of the remainder of respondents related to specific populations (e.g., 2.6% perpetrator characteristics, 1.7% non-political groups, 0.4% family and children).

Quantitative Analyses

In order to compare perceptions of terrorism to those of other hazards on key cognitive dimensions and worry, analyses were performed on respondents' ratings of each hazard on these criteria. Table 3 presents the means and standard deviations of respondents' ratings of each hazard on the dimensions of perceived threat, uncertainty, and control, and in terms of worry. It was noted that items assessing perceived uncertainty generated a high proportion of *don't know/no opinion* responses (from 4.0% for terrorism to 6.4% for cellular phones), suggesting that this cognitive dimension may not have been clearly understood.

ANOVAs. To examine differences in ratings on the three dimensions (i.e., perceived threat, uncertainty, control), as well as in worry by type of hazard, a series of repeated-measures ANOVAs were performed, with listwise deletion of cases who answered with ratings of 5 (*don't know/no opinion*). Final sample sizes were as follows: analysis involving perceived threat, $N = 1,433$; analysis involving perceived uncertainty, $N = 1,297$; analysis involving perceived control, $N = 1,446$; and analysis involving worry, $N = 1,466$.

Investigation of Mauchly's tests reveals significant violation of the assumption of sphericity in all cases. Therefore, Huynh-Feldt adjustments were made to degrees of freedom. Significant differences were observed for perceived threat, $F(3.95, 5653.33) = 367.55$, $MSE = .73$, $p < .001$, $\eta^2_p = .20$; perceived uncertainty, $F(3.95, 5116.31) = 101.87$, $MSE = .67$, $p < .001$, $\eta^2_p = .07$; perceived control, $F(3.67, 5298.60) = 855.34$, $MSE = .99$, $p < .001$, $\eta^2_p = .37$; and worry, $F(3.98, 5831.19) = 221.85$, $MSE = .67$, $p < .001$, $\eta^2_p = .13$. Comparisons of ratings of terrorism with those of other hazards demonstrate that perceived threat of terrorism differed from that of all other hazards, with the exception of recreational physical activity (all significant p values $< .001$). However, perceived uncertainty and control of terrorism each differed from that of all other hazards (all significant p values $< .001$).

Sequential multiple linear regression analyses. Tables 4 and 5 present correlations among demographic variables (i.e., age, education, gender, income), as well as ratings of perceived threat, perceived uncertainty, perceived control, and worry for each hazard. Gender was coded such that the reference category was male. It was decided to include gender and age as covariates in the first step of each analysis since these variables were significantly associated with worry about most of the health hazards (i.e., at least three out of the five, as shown in Table 5), and these variables have repeatedly been found to be associated with concern about health risk.

Cases with missing values on variables included in each analysis were deleted listwise, resulting in the following sample sizes: motor vehicles, $N = 1,411$; climate change, $N = 1,413$; recreational physical activity,

Table 3
Mean Ratings of Perceived Threat, Perceived Uncertainty, Perceived Control, and Worry by Hazard

Variable	Motor vehicles		Climate change		Recreational physical activity		Cellular phones		Terrorism	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Perceived threat	2.64 _a	0.91	2.37 _b	1.01	1.81 _e	0.87	1.65 _d	0.92	1.77 _e	0.90
Perceived uncertainty	2.74 _a	0.88	2.73 _b	0.93	2.32 _c	0.88	2.53 _d	0.98	2.91 _e	0.92
Perceived control	2.65 _a	1.00	1.81 _b	1.00	3.18 _c	1.06	2.82 _d	1.29	1.43 _c	0.83
Worry	2.50 _a	1.04	2.18 _b	1.08	1.83 _c	0.96	1.71 _d	0.97	1.92 _e	0.97

Note. Means in the same row that do not share the same subscript as terrorism differ at $p < .05$.

Table 4

Spearman's Correlations of Perceived Threat, Perceived Uncertainty, Perceived Control, and Worry With Demographic Variables by Hazard

Variable	Age	Education	Gender	Income
Motor vehicles				
Perceived threat	-.10***	.04	.06*	.03
Perceived uncertainty	-.02	-.03	.06*	-.05
Perceived control	.02	.01	-.11***	.09**
Worry	-.12***	-.02	.10***	-.02
Climate change				
Perceived threat	.02	-.05*	.06*	-.08**
Perceived uncertainty	-.04	.09***	-.03	.02
Perceived control	-.04	.01	.04	.01
Worry	-.08**	.02	.03	-.04
Recreational physical activity				
Perceived threat	-.09***	-.01	-.09***	.05
Perceived uncertainty	<-.01	-.06*	-.03	-.05
Perceived control	-.04	.20***	-.06*	.21***
Worry	-.11***	-.02	.03	-.02
Cellular phones				
Perceived threat	-.11***	-.01	-.02	.03
Perceived uncertainty	-.01	.03	.02	-.05
Perceived control	-.04	.16***	<.01	.16***
Worry	-.01	-.02	.07*	-.10***
Terrorism				
Perceived threat	.02	-.10***	.09***	-.05
Perceived uncertainty	-.08**	.03	.02	.01
Perceived control	.01	-.03	-.06*	-.05
Worry	-.02	-.08**	.09***	-.06*

* $p < .05$. ** $p < .01$. *** $p < .001$.

$N = 1,404$; cellular phones, $N = 1,374$; and terrorism, $N = 1,420$. Using a Mahalanobis criterion of .001 ($\chi^2 = 20.52$ with 5 *df*), no multivariate outliers were identified for any of the analyses. Also, multicollinearity was not a problem for any of the analyses, as no condition index approached the

Table 5

Pearson's Correlations Between Perceived Threat, Perceived Uncertainty, Perceived Control, and Worry by Hazard

Variable	1	2	3
Motor vehicles			
1. Perceived threat	—		
2. Perceived uncertainty	.22***	—	
3. Perceived control	-.08**	<.01	—
4. Worry	.40***	.30***	<-.01
Climate change			
1. Perceived threat	—		
2. Perceived uncertainty	.23***	—	
3. Perceived control	.10***	.03	—
4. Worry	.50***	.27***	.13***
Recreational physical activity			
1. Perceived threat	—		
2. Perceived uncertainty	.20***	—	
3. Perceived control	.03	.00	—
4. Worry	.28***	.22***	-.02
Cellular phones			
1. Perceived threat	—		
2. Perceived uncertainty	.21***	—	
3. Perceived control	-.08***	.06*	—
4. Worry	.37***	.28***	-.09***
Terrorism			
1. Perceived threat	—		
2. Perceived uncertainty	.18***	—	
3. Perceived control	.09***	.01	—
4. Worry	.42***	.23***	.11***

* $p < .05$. ** $p < .01$. *** $p < .001$.

recommended cutoff value of 30 (condition index values ranged from 13.90 for the analysis predicting worry about cellular phones to 16.40 for the analysis predicting worry about motor vehicles; Tabachnick & Fidell, 2001).

The results of sequential linear regression analyses are presented in Table 6 after each step. In examining this table, it should be recalled that perceived threat, perceived uncertainty, perceived control, and worry were rated in relation to each hazard. With the exception of age and gender, the variables included in each analysis, therefore, are distinct. The final models accounted for between 10.6% (recreational physical activity) to 29.1% (climate change) of the variance in worry about the hazards. The inclusion of ratings of perceived threat, perceived uncertainty, and perceived control in Step 2 significantly improved the prediction of worry above and beyond age and gender for all of the hazards: motor vehicles, $\Delta R^2 = .19$, $F_{inc}(3, 1405) = 113.14$, $p < .001$; climate change, $\Delta R^2 = .29$, $F_{inc}(3, 1407) = 190.65$, $p < .001$; recreational physical activity, $\Delta R^2 = .10$, $F_{inc}(3, 1398) = 52.54$, $p < .001$; cellular phones, $\Delta R^2 = .19$, $F_{inc}(3, 1368) = 110.13$, $p < .001$; and terrorism, $\Delta R^2 = .20$, $F_{inc}(3, 1414) = 119.84$, $p < .001$.

Further examination of individual predictors reveals that older age was associated with significantly less worry about motor vehicles, climate change, and recreational physical activity; and significantly more worry about cellular phones. Female gender was associated with significantly greater worry about all hazards but climate change. Ratings of perceived threat and uncertainty were consistently and significantly positively associated with worry about all the hazards. However, relationships between ratings of perceived control and worry varied according the type of hazard: They negatively predicted worry about cellular phones, positively predicted worry about both climate change and terrorism, and failed to emerge as predictors of worry about motor vehicles or recreational physical activity.

Discussion

The primary aim of the present study was to shed light on the nature of Canadians' terrorism risk perceptions and worry. In addition, a multi-method, multi-hazard approach was used to identify unique characteristics of terrorism risk perceptions, and to determine how these might differ from perceptions of other hazards on various key cognitive dimensions. Terrorism risk perceptions were found to have a number of unique characteristics. Specifically, terrorism elicited a relatively much higher number of word associations reflecting sociopolitical themes and a relatively much lower number of word associations reflecting individual behavior. Also, a comparison of terrorism risk perceptions with those of other hazards on the key dimensions of threat, uncertainty, and control revealed that Canadians perceive terrorism as a relatively low, although highly uncertain and uncontrollable threat. Of greatest interest, however, was the unexpected positive relationship

Table 6
Summary of Sequential Regression Analyses With Perceived Threat, Uncertainty, and Control as Predictors of Worry by Hazard

Predictor	Motor vehicles			Climate change			Recreational physical activity			Cellular phones			Terrorism		
	β	t	R^2	β	t	R^2	β	t	R^2	β	t	R^2	β	t	R^2
Step 1			.02***			<.01			.01**			<.01			.01**
Age	-.12	-4.67***		-.07	-2.27**		-.09	-3.43**		.03	0.98		-.02	-0.68	
Gender	.11	3.98***		.03	1.07		.03	0.99		.06	2.06*		.08	3.09**	
Step 2			.21***			.29***			.11***			.19***			.21***
Age	-.08	-3.47***		-.08	-3.38***		-.08	-2.95**		.06	2.24*		-.02	-0.85	
Gender	.07	3.10***		<-.01	-0.06		.05	2.11*		.06	2.55*		.06	2.37*	
Perceived threat	.33	13.62***		.46	19.90***		.23	9.00***		.33	13.33***		.38	15.47***	
Perceived uncertainty	.22	9.14***		.17	7.22***		.17	6.74***		.22	8.66***		.16	6.63***	
Perceived control	.03	1.16		.08	3.34***		-.02	-0.88		-.07	-2.98**		.08	3.45***	

Note. Perceived threat, perceived uncertainty, perceived control, and worry are hazard-specific indices. Gender was coded such that the reference category was male. * $p < .05$. ** $p < .01$. *** $p < .001$.

between perceived control and worry, which emerged for both terrorism and climate change.

Findings of Content Analyses

Among the most striking differences revealed by content analyses of word associations was the fact that several more respondents mentioned individual behavior in response to lifestyle hazards than they did for environmental hazards. In fact, terrorism was the only hazard in relation to which more respondents mentioned management issues than individual behavior, suggesting that Canadians may primarily consider control over this hazard to be the responsibility of institutions. Also, uncertainty only emerged as a theme of word associations to climate change, cellular phones, and terrorism. With respect to cellular phones, this finding might be interpreted in light of the growing debate surrounding the health risks posed by radiofrequency fields associated with this new technology (Habash, Brodsky, Leiss, Krewski, & Repacholi, 2003; Hutter, Moshammer, Wallner, & Kundi, 2004; Kuster, Schuderer, Christ, Futter, & Ebert, 2004). Uncertainty about the health risks of climate change and terrorism may be related to stated difficulties in predicting the magnitude and nature of the consequences of these environmental hazards (Kunreuther, 2002; Lemyre et al., 2005).

The salience of sociopolitical factors in perceptions of terrorism, but not of lifestyle hazards, was also notable. This finding is consistent with those of previous studies by Gibson and her colleagues (Gibson et al., 2007; Lemyre, Clément, & Gibson, 2004), in which Canadians were found to frame their conceptualizations of terrorism within the nation's sociopolitical context. One criticism of the literature on health risk perception entails the fact that research rarely takes into account the larger social context in which these are embedded (Bruchon-Schweitzer, 2002; Tulloch & Lupton, 2003).

Given that sociopolitical themes also emerged in word associations provided for climate change, future research on perceptions of environmental hazards may put more emphasis on the identification and consideration of relevant social contextual factors. One potential factor that has received increasing attention in the literature on health risk perception is social trust. Indeed, Covello, Peters, Wojtecki, and Hyde (2001) included trust in institutions to the list of factors determining reactions to risk issues, emphasizing that these reactions may, in turn, shape behaviors. Hence, greater consideration of trust or related concepts as they relate to terrorism may prove to be a fruitful direction for research in this area (Rogers et al., 2007).

In spite of these important differences, content analyses of word associations also revealed some recurring themes. In particular, several themes

reflecting the concept of threat or relating to the control of health risks emerged. For instance, human health impact and level of perceived risk were identified as themes for all of the hazards. Also, themes surrounding individual behavior or management issues that may play a role in the control of health risks were quite prominent across hazards. These findings provide converging evidence of the longstanding importance of perceptions surrounding threat and control in models predicting health behavior, and further suggest that these should remain as core cognitive components (Rogers, 1975, 1983; Witte, 1998).

Findings of Quantitative Analyses

In a next step, terrorism risk perceptions were compared to those of other hazards on the key dimensions of threat, uncertainty, control, and worry. With the exception of cellular phones, terrorism was perceived as the least threatening hazard and as no more threatening than recreational physical activity (which elicited a high number of word associations referring to its benefits). Likewise, several participants of semi-structured interviews held with individuals across the country around the same time indicated that they did not feel that terrorism was likely to happen in Canada. Rationales ranged from the belief that Canada has a friendly, pacifist image in the world to the belief that nothing has ever happened in Canada (Lemyre et al., 2004).

Despite increased acknowledgment of terrorism as a global threat, it is recognized that the risks of an attack occurring are low, in actuality, when considered next to those associated with lifestyle (Leithner, 2003; Slovic, 2002a). What has pushed terrorism to the forefront of risk-management issues in recent years is recognition of the potential magnitude of its impacts, which are not necessarily dependent on individuals' direct experience with an attack (Hyams et al., 2002; Waeckerle et al., 2001). Indeed, the events of September 11, 2001, had notable indirect impacts on Canada, including devastating effects on the Canadian airline industry and Canada's involvement in the war on terror (Fiorino, 2001; Harumi & Lee, 2005).

The fact that terrorism yielded low ratings on the dimension of perceived threat may suggest that respondents primarily thought about the likelihood of occurrence of terrorism while making their judgments, as opposed to the seriousness of its consequences. Indeed, perceived threat was assessed using perceived risk to personal health as a proxy measure, since the notion of health risk is thought to encompass the likelihood of probabilistic events, as well as the seriousness of their consequences to health. Including separate measures of these aspects of health risk perception in future research could help determine whether the perceived seriousness of consequences of terrorism is also low.

Although respondents perceived terrorism as the most uncertain hazard, variation across hazards was less pronounced on this dimension. While this finding may genuinely reflect similarities in respondents' perceptions of the level of uncertainty surrounding these seemingly diverse hazards, the findings should be interpreted with caution. Specifically, the relatively higher proportions of respondents who answered items assessing perceived uncertainty with *don't know/no opinion* suggest that they may not have clearly understood this concept. In any case, the construct of perceived uncertainty would benefit from further conceptual clarification, as it appears to be an important dimension of perceptions for some types of hazards, particularly those of an environmental nature.

By contrast, ratings of perceived control varied greatly across hazards. Respondents clearly perceived themselves as having the least personal control over terrorism and climate change risks. This finding is consistent with the relative infrequency of themes reflecting individual behavior in word associations for these hazards, and likely reflects the fact that lifestyle hazards are relatively easier to control. For instance, people may choose alternate modes of transportation, opt out of participating in recreational physical activity, or refrain from using cellular phones. Climate change and terrorism, on the other hand, are harder to avoid.

As expected, regression analyses revealed that respondents invariably expressed greater worry about hazards when they felt more threatened by them and perceived them as more uncertain. However, associations involving perceptions of control were inconsistent. Specifically, respondents with greater perceived control over cellular phones were significantly less likely to be worried about their risks, while those with greater perceived control over motor vehicles and recreational physical activity were no more likely to be worried about the related risks. In direct contrast to the notion of perceived control as a protective factor, however, respondents with greater perceived control over climate change and terrorism were significantly more likely to be worried about these hazards (Frazier & Waid, 1999; Skinner, 1996).

Given the inherent difficulties of controlling terrorism and climate change, these findings raise the question of whether it is even advantageous for individuals to perceive themselves as having control over these environmental hazards (Walker, 2001). On the other hand, different forms or dimensions of perceived control may exist, some of which might afford benefits. For instance, scholars have distinguished primary from secondary control strategies (Rothbaum, Weisz, & Snyder, 1982); that is, strategies aimed at changing the situation versus those aimed at changing oneself. With respect to hazards, a distinction could be made between efforts aimed at managing the probability that a hazard will incur its consequences and those aimed at managing its consequences.

Referring to personal control over *risks from* motor vehicles, climate change, recreational physical activity, cellular phone, or terrorism, the items used to measure perceived control in the present study likely tapped into individuals' perceived ability to manage the probability that each hazard would incur its consequences, rather than their perceived ability to manage these consequences. Thus, the results suggest that perceiving oneself as having this form of control over environmental hazards (e.g., climate change, terrorism) is unfavorable. Accordingly, a survey conducted among a sample of Israeli citizens (Klar et al., 2002) revealed that worry about terrorism was higher among individuals who perceived themselves as having more control over their ability "to reduce their chances of victimization in terrorist attacks" (p. 207). These findings, however, do not necessarily rule out the possibility that individuals could benefit from perceiving themselves as able to manage the consequences of such hazards.

In another study, Benight et al. (2000) found that perceived coping efficacy (which might be considered a form of perceived control over the consequences of an event) was associated with lower trauma-related distress following the 1995 Oklahoma City bombing. Thus, improving individuals' perceived efficacy in coping with potential terrorist events might be helpful. One promising strategy, recently used in the U.K., is to provide information to the public about steps to take in the event of an emergency, such as a terrorist attack (HM Government, 2007). Despite being received with criticism as a result of public concern with raising fear, the results of one study suggest that the provision of this type of information may actually mitigate fear-related behavior following a terrorist attack (Rogers et al., 2007; Rubin et al., 2005).

Strengths and Limitations

An alternative explanation for inconsistencies in associations between perceived control and worry across hazards may relate to study limitations. First, this relationship may not have reached significance for motor vehicles and recreational physical activity because of limited clarity regarding the nature of these hazards. Indeed, word associations revealed that respondents had a wide range of issues in mind while thinking about risks from both of these hazards. While most respondents thought about accidents in relation to motor vehicles, a large proportion of them also thought about environmental pollutants. Respondents also thought about a wide range of activities as examples of recreational physical activity risks. However, post hoc analyses (not presented here) performed among a subset of respondents who provided similar word associations for motor vehicles did not yield significant results.

This approach does not necessarily address the lack of clarity, which may have attenuated relationships between perceived control and worry.

A second issue contributing to the modesty of observed relationships might have been that exposure to these hazards was not assessed. It was not possible, therefore, to screen out individuals who simply are not in contact with some of the hazards (e.g., individuals who do not use cellular phones or who do not travel by motor vehicle). In addition, stronger relationships may have been observed had perceived threat, uncertainty, control, and worry each been assessed using multiple items, rather than a single question. This is nonetheless common practice in research on health risk perception. Often, research in this area is aimed at shedding light on current issues, and the time frame in which research of this nature is conducted is not always conducive to the rigorous development of psychometric scales.

Finally, while the sampling strategy ensured that the study sample was representative of the overall Canadian population on some characteristics, the low response rate may have introduced some bias. Possibly related to this is the fact that respondents with a higher level of education and income were slightly overrepresented in the final sample. The inclusion of a wider range of age groups is still a tremendous improvement from studies of university students, which are common in psychological research. Rather than guiding policy, the findings may nevertheless serve as a strong launching point for additional research by emphasizing the need to clarify the nature of some cognitive dimensions of terrorism risk perceptions.

In sum, the current study reveals a number of interesting findings on the way individuals perceive terrorism in Canada. In relative terms, the respondents did not perceive terrorism as posing much of a threat, although they viewed it as particularly uncertain and as one over which they have little personal control. Also, support was found for the hypothesized relationships of perceived threat and uncertainty with worry about terrorism. However, higher perceived control over terrorism was unexpectedly associated with greater worry about terrorism, suggesting that it may be more appropriate to study other types of control perceptions within the context of this threat.

While a good start, the contribution of the present findings to the understanding of individual response to terrorism is limited in that only terrorism risk perceptions and worry were examined. Nevertheless, this represents a well needed contribution to the body of research on perceptions of terrorism as a health risk, which has primarily treated the issue reactively and examined but a narrow range of the multiple cognitive dimensions underlying terrorism risk perceptions. A multi-hazard approach certainly helped to gain a more solid understanding of the uniqueness of Canadians' terrorism risk perceptions and worry, and to identify areas in need of more focus.

Environmental in nature, terrorism is perceived not only in terms of its qualitative dimensions, but also as a function of the social and political processes that surround it. Future research is warranted to further explore the role of social contextual factors, as well as examine the relationships of terrorism risk perceptions and worry with various behavioral responses. Research of this type may not only provide risk managers with a means to predict psychological and behavioral consequences of terrorism; it is critical to the development of strategies aimed at fostering a better exchange of information on emotionally charged issues, such as terrorism. Clearly, such strategies are of chief importance to the successful resolution of any type of controversy surrounding health, safety, or environmental issues (Covello et al., 2001).

References

- Allen, M., Ambrose, D., Halpenny, G., & Simmie, T. (2003). *Telephone refusal rates still rising: Results of the 2002 Response Rate Survey*. Retrieved June 21, 2007, from www.mria-arim.ca/COMMITTEES/ResponseArticle01.asp
- Benight, C. C., Freyaldenhoven, R. W., Hughes, J., Ruiz, J. M., Zoschke, T. A., & Lovallo, W. R. (2000). Coping self-efficacy and psychological distress following the Oklahoma City bombing. *Journal of Applied Social Psychology, 30*, 1331–1344.
- Benthin, A., Slovic, P., Moran, P., Severson, H., Mertz, C. K., & Gerrard, M. (1995). Adolescent health-threatening and health-enhancing behaviors: A study of word association and imagery. *Journal of Adolescent Health, 17*, 143–152.
- Bergstrom, R. L., & McCaul, K. D. (2004). Perceived risk and worry: The effects of 9/11 on willingness to fly. *Journal of Applied Social Psychology, 34*, 1846–1856.
- Berry, D. C. (2004). *Risk, communication, and health psychology*. Maidenhead, UK: Open University Press.
- Bleich, A., Gelkopf, M., & Solomon, Z. (2003). Exposure to terrorism, stress-related mental health symptoms, and coping behaviors among a nationally representative sample in Israel. *Journal of the American Medical Association, 290*, 612–620.
- Bruchon-Schweitzer, M. (2002). *Psychologie de la santé: Modèles, concepts, et méthodes* [The psychology of health: Models, concepts, and methods]. Paris: Dunod.
- Covello, V. T., Peters, R. G., Wojtecki, J. G., & Hyde, R. C. (2001). Risk communication, the West Nile virus epidemic, and bioterrorism:

- Responding to the communication challenges posed by the intentional or unintentional release of a pathogen in an urban setting. *Journal of Urban Health*, 78, 382–391.
- Feigenson, N., Bailis, D., & Klein, W. (2004). Perceptions of terrorism and disease risks: A cross-national comparison. *Missouri Law Review*, 69, 991–1012.
- Fiorino, F. (2001). Canada and Japan seek to ease impact of terrorism. *Aviation Week and Space Technology*, 155, 30–31.
- Fischhoff, B., Bruine de Bruin, W., Perrin, W., & Downs, D. (2004). Travel risks in a time of terror: Judgments and choices. *Risk Analysis*, 24, 1301–1309.
- Fischhoff, B., Gonzalez, R. M., Small, D. A., & Lerner, J. S. (2003). Judged terror risk and proximity to the World Trade Center. *Journal of Risk and Uncertainty*, 26, 137–151.
- Fischhoff, B., Gonzalez, R. M., Small, D. A., & Lerner, J. S. (2005). Evolving judgments of terror risks: Foresight, hindsight, and emotion. *Journal of Experimental Psychology: Applied*, 11, 124–139.
- Fischhoff, B., Slovic, P., Lichtenstein, S., Read, S., & Combs, B. (1978). How safe is safe enough? A psychometric study of attitudes towards technological risks and benefits. *Policy Sciences*, 9, 127–152.
- Frazier, L. D., & Waid, L. D. (1999). Influences on anxiety in later life: The role of health status, health perceptions, and health locus of control. *Aging and Mental Health*, 3, 213–220.
- Gibson, S., Lemyre, L., Clément, M., Markon, M. P. L., & Lee, J. E. C. (2007). Terrorism threats and preparedness in Canada: The perspective of the Canadian public. *Biosecurity and Bioterrorism: Biodefense Strategy, Practice, and Science*, 5, 134–144.
- Glaser, B. & Strauss, A. (1967). *The discovery of grounded theory*. Chicago: Aldine.
- Goodwin, R., Wilson, M., & Gaines, S. (2005). Terror threat perception and its consequences in contemporary Britain. *British Journal of Psychology*, 96, 389–406.
- Habash, R. W. Y., Brodsky, L. M., Leiss, W., Krewski, D., & Repacholi, M. (2003). Health risks of electromagnetic fields. Part II: Evaluation and assessment of radio frequency radiation. *Critical Review of Biomedical Engineering*, 31, 141–195.
- Harumi, I., & Lee, D. (2005). Comparing the impact of the September 11th terrorist attacks on international airline demand. *International Journal of the Economics of Business*, 12, 225–249.
- HM Government. (2007). *Preparing for emergencies: What you need to know*. Retrieved June 21, 2007, from www.preparingforemergencies.gov.uk/you/booklet/pdfs/england2.pdf

- Houghton, J. R., Murray, E., & Ball, D. J. (1999). Risk ranking by the British public: A survey of worry about a broad spectrum of risk issues. *Human and Ecological Risk Assessment*, 5, 509–526.
- Hutter, H.-P., Moshhammer, H., Wallner, P., & Kundi, M. (2004). Public perception of risk concerning cell towers and mobile phones. *Social and Preventive Medicine*, 49, 62–66.
- Hyams, K. C., Murphy, F. M., & Wessely, S. (2002). Responding to chemical, biological, or nuclear terrorism: The indirect and long-term health effects may present the greatest challenge. *Journal of Health Politics, Policy, and Law*, 27, 273–291.
- Jenkin, C. M. (2006). Risk perception and terrorism: Applying the psychometric paradigm. *Homeland Security Affairs*, 2(2), Retrieved April 12, 2007, from www.hsaj.org/?fullarticle=2.2.6
- Joffe, H. (2002a). Representations of health risks: What social psychology can offer to health promotion? *Health Education Journal*, 61, 153–165.
- Joffe, H. (2002b). Social representations and health psychology. *Social Science Information*, 41, 559–580.
- Kasperson, R. E., Renn, O., Slovic, P., Brown, H. S., Emel, R., Goble, R.X., et al. (1988). The social amplification of risk: A conceptual framework. *Risk Analysis*, 8, 177–187.
- Klar, Y., Zakay, D., & Sharvit, K. (2002). “If I don’t get blown up . . .” Realism in the face of terrorism in an Israeli nationwide sample. *Risk Decision and Policy*, 7, 203–219.
- Krewski, D., Lemyre, L., Turner, M. C., Lee, J. E. C., Dallaire, C., Bouchard, L., et al. (2005). Project 2.1: National Survey of Health Risk Perception and Acceptability in Canadians. In D. Krewski, L. Lemyre, L. Bouchard, K. Brand, C. Dallaire, & P. Mercier (Eds.), *Public perception and acceptable levels of health risk among Canadians: A research report to Health Canada* (Project No. 6795-15-2002/4770021). Ottawa, Canada: Health Canada, Research Management and Dissemination Division.
- Krewski, D., Lemyre, L., Turner, M. C., Lee, J. E. C., Dallaire, C., Bouchard, L., et al. (2006). Public perception of population health risks in Canada: Health hazards and sources of information. *Human and Ecological Risk Assessment*, 12, 626–644.
- Krewski, D., Lemyre, L., Turner, M. C., Lee, J. E. C., Dallaire, C., Bouchard, L., et al. (2008). Public perception of population health risks in Canada: Risk perception beliefs. *Health, Risk, and Society*, 10, 167–179.
- Krewski, D., Lemyre, L., Turner, M. C., Lee, J. E. C., Dallaire, C., Bouchard, L., et al. (2009). Public perception of population health risks in Canada: Health hazards and health conditions. *International Journal of Risk Assessment and Management*, 11, 299–318.

- Kunreuther, H. (2002). Risk analysis and risk management in an uncertain world. *Risk Analysis*, 22, 655–664.
- Kuster, N., Schuderer, J., Christ, A., Futter, P., & Ebert, S. (2004). Guidance for exposure design of human studies addressing health risk evaluations of mobile phones. *Bioelectromagnetics*, 25, 524–529.
- Langford, I. H., Marris, C., McDonald, A., Goldstein, J. R., & O’Riordan, T. (1999). Simultaneous analysis of individual and aggregate responses in psychometric data using multilevel modeling. *Risk Analysis*, 19, 675–683.
- Leithner, C. (2003). The terror trap. *Policy*, 19, 34–36.
- Leman-Langlois, S., & Brodeur, J.-P. (2005). Terrorism old and new: Counterterrorism in Canada. *Police Practice and Research*, 6, 121–140.
- Lemyre, L., Clément, M., Corneil, W., Craig, L., Boutette, P., Tyshenko, M., et al. (2005). A psychosocial risk assessment and management framework to enhance response to CBRN terrorism threats and attacks. *Biosecurity and Bioterrorism: Biodefense Strategy, Practice, and Science*, 3, 316–330.
- Lemyre, L., Clément, M., Corneil, W., Lee, J. E. C., Gibson, S., Gaylord, G., et al. (2005, March). *Integrating psychosocial aspects into preparedness and response to terrorism*. Paper presented at the interdisciplinary conference “(In)Security,” conducted by the National Security Working Group, Ottawa, Ontario, Canada.
- Lemyre, L., Clément, M., & Gibson, S. (2004). *Summary report on the focus groups held with members of the public on the psychosocial aspects of CBRN terrorism*. Ottawa, Ontario, Canada: University of Ottawa, Institute of Population Health.
- Lemyre, L., Lee, J. E. C., Mercier, P., Bouchard, L., & Krewski, D. (2006). The structure of Canadians’ health risk perceptions: Environmental, therapeutic, and social health risks. *Health, Risk, and Society*, 8, 185–195.
- Lerner, J. S., Gonzalez, R. M., Small, D. A., & Fischhoff, B. (2003). Effects of fear and anger on perceived risks of terrorism: A national field experiment. *Psychological Science*, 14, 144–150.
- Leventhal, H. (1971). Fear appeals and persuasions: The differentiation of a motivational construct. *American Journal of Public Health*, 61, 1208–1224.
- Morgan, G., Fischhoff, B., Bostrom, A., & Atman, C. J. (2001). *Risk communication: A mental models approach*. Cambridge, UK: Cambridge University Press.
- Peters, E., & Slovic, P. (1996). The role of affect and worldviews as orienting dispositions in the perception and acceptance of nuclear power. *Journal of Applied Social Psychology*, 26, 1427–1453.
- Pope, C., Ziebland, S., & Mays, N. (2000). Analysing qualitative data. *British Medical Journal*, 320, 114–116.

- Rogers, M. B., Amlôt, R., Rubin, G. J., Wessely, S., & Krieger, K. (2007). Mediating the social and psychological impacts of terrorist attacks: The role of risk perception and risk communication. *International Review of Psychiatry, 19*, 279–288.
- Rogers, R. W. (1975). A protection motivation theory of fear appeals and attitude change. *The Journal of Psychology, 91*, 93–114.
- Rogers, R. W. (1983). Cognitive and physiological processes in fear appeals and attitude change: A revised theory of protection motivation. In J. R. Cacioppo & R. E. Petty (Eds.), *Social psychophysiology: A source book* (pp. 153–176). New York: Guilford.
- Rothbaum, F., Weisz, J. R., & Snyder, S. S. (1982). Changing the world and changing the self: A two-process model of perceived control. *Journal of Personality and Social Psychology, 42*, 5–37.
- Rubin, G. J., Brewin, C. R., Greenberg, N., Simpson, J., & Wessely, S. (2005). Psychological and behavioural reactions to the bombings on July 7, 2005: Cross-sectional survey of a representative sample of Londoners. *British Medical Journal, 331*, 606–611.
- Ruiter, R. A. C., Verplanken, B., Kok, G., & Verrij, M. Q. (2003). The role of coping appraisal in reactions to fear appeals: Do we need threat information? *Journal of Health Psychology, 8*, 465–474.
- Schütz, H., Wiedemann, P. M., & Gray, P. C. R. (2000). *Risk perception beyond the psychometric paradigm* (Rep. No. Heft 78). Jülich, Germany: German Research Centre Jülich, Programme Group Human Environment Technology (MUT).
- Siegrist, M., Keller, C., & Kiers, H. A. L. (2005). A new look at the psychometric paradigm of perception of hazards. *Risk Analysis, 25*, 211–222.
- Sjöberg, L. (1996). A discussion of the limitations of the psychometric and cultural theory approaches to risk perception. *Radiation Protection Dosimetry, 68*, 219–225.
- Sjöberg, L. (1998). Worry and risk perception. *Risk Analysis, 18*, 85–93.
- Sjöberg, L. (2000). Factors in risk perception. *Risk Analysis, 20*, 1–11.
- Sjöberg, L. (2002). "Then we take Berlin . . ." *The perceived risk of terrorism* (SSE/EFI Working Paper Series in Business Administration No. 2002: 11). Stockholm, Sweden: Stockholm School of Economics, Centre for Risk Research. Retrieved April 14, 2007, from <http://dana.ucc.nau.edu/~lmo5/econPDFs/terror/percievedRiskTerror.pdf>
- Skinner, E. A. (1996). A guide to constructs of control. *Journal of Personality and Social Psychology, 71*, 549–570.
- Slovic, P. (1987). Perception of risk. *Science, 236*, 280–285.
- Slovic, P. (2002a). *The perception of risk*. Sterling, VA: Earthscan.
- Slovic, P. (2002b). Terrorism as a hazard: A new species of trouble. *Risk Analysis, 22*, 425–426.

- Slovic, P., Finucane, M. L., Peters, E., & MacGregor, D. (2003, February). *Risk as analysis and risk as feelings: Some thoughts about affect, reason, risk, and rationality*. Paper presented at the National Cancer Institute workshop on Conceptualizing and Measuring Risk Perceptions, Washington, DC.
- Slovic, P., Fischhoff, B., Lichtenstein, S., & Roe, F. J. C. (1981). Perceived risk: Psychological factors and social implications (and discussion). *Proceedings of the Royal Society of London: Series A. Mathematical and Physical Sciences*, 376, 17–34.
- Slovic, P., Flynn, J., Mertz, C. K., & Mullican, L. (1993). *Health-risk perception in Canada* (Report No. 93-EHD-170). Ottawa, Ontario, Canada: Department of National Health and Welfare.
- Slovic, P., Kraus, N. N., Lappe, H., Letzel, H., & Malmfors, T. (1989). Risk perception of prescription drugs: Report from a survey in Sweden. *Pharmaceutical Medicine*, 4, 43–65.
- Steg, L., & Sievers, I. (2000). Cultural theory and individual perceptions of environmental risks. *Environment and Behavior*, 32, 250–269.
- Stein, B. D., Tanielian, T. L., Eisenman, D. P., Keyser, D. J., Burnam, M. A., & Pincus, H. A. (2004). Emotional and behavioral consequences of bioterrorism: Planning a public health response. *Milbank Quarterly*, 82, 413–455.
- Tabachnick, B. G., & Fidell, L. S. (2001). *Using multivariate statistics* (4th ed.). Needham Heights, MA: Allyn & Bacon.
- Takao, K., Motoyoshi, T., Sato, T., & Fukuzono, T. (2003, July). *Do perceived flood risk and fear of floods directly affect behavioral intentions of preparedness against floods? The case of the Tokai flood disaster in Japan*. Paper presented at the 3rd annual meeting of the Disaster Prevention Research Institute and the International Institute of Applied Systems Analysis, “Integrated Disaster Risk Management: Coping With Regional Vulnerability,” Kyoto, Japan.
- Tennfjord, O. S., & Rundmo, T. (2007). Risk perception and worry related to adolescents’ judgments of three types of risk. *Journal of Risk Research*, 10, 67–84.
- Tulloch, J., & Lupton, D. (2003). *Risk and everyday life*. Thousand Oaks, CA: Sage.
- Waeckerle, J. F., Seamans, S., Whiteside, M., Pons, P. T., White, S., Burstein, J. L., et al. (2001). Executive summary: Developing objectives, content, and competencies for the training of emergency medical technicians, emergency physicians, and emergency nurses to care for casualties resulting from nuclear, biological, or chemical (NBC) incidents. *Annals of Emergency Medicine*, 37, 587–601.
- Walker, J. (2001). *Control and the psychology of health*. Buckingham, UK: Open University Press.

- Witte, K. (1998). *Theory-based interventions and evaluations of outreach efforts* [Research review]. Seattle, WA: National Network of Libraries of Medicine Pacific Northwest Region, Outreach Evaluation Resource Centre. Retrieved March 9, 2007, from <http://nnlm.gov/evaluation/pub/witte/>
- Wray, R. J., Kreuter, M. W., Jacobsen, H., Clements, B., & Evans, R. G. (2004). Theoretical perspectives on public communication preparedness for terrorist attacks. *Family and Community Health, 27*, 232–241.