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RESEARCH ARTICLES

Beyond the Hazard: The Role of Beliefs in Health Risk Perception

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ABSTRACT

This article addresses how beliefs about health risks cluster and how these relate to perceptions of risk among Canadians. A principal components analysis conducted on items reflecting various beliefs from the Canadian National Health Risk Perception Survey extracted four underlying dimensions: Cancer Dread, Trust in Regulators, Environmental Concern, and Personal Agency. Factor scores were then used to investigate relationships between belief factors and the perceived health risk of various hazards with gender, education, income, and province of residence as covariates. Environmental and Therapeutic health risk perceptions were significantly higher in respondents with high Cancer Dread and high Environmental Concern, but lower in respondents with high Trust in Regulators. Environmental health risk perceptions were lower in respondents with high Personal Agency, whereas Social health risk perceptions were higher in respondents with high Cancer Dread and Personal Agency. Results suggest that information about health risk–related beliefs can be useful in improving our understanding of the public's perceived risk of health hazards.

Key Words: health beliefs, health risks, risk perception, Canada.

INTRODUCTION

There has been increasing interest in the factors that shape perceptions of risk. Investigations on the role of psychosocial factors have suggested that beliefs can be important predictors of risk perception by guiding perceivers' attention to various aspects of potential hazards (Dake 1991; Peters and Slovic 1996). Pursuant to this trend, the goals of the current study were to examine the way various health risk–related beliefs are grouped and to explore the way such groupings relate to perceptions of risk.

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In its early stages, research in the area of health risk assessment was primarily driven by a need for objective assessments of the probability and impact of specific adverse health outcomes (USNRC 1983). It has since become increasingly evident to researchers and policy-makers that the public's perception of risk does not coincide with scientific risk assessments (Slovic 1992; Slovic *et al.* 1995). Consequently, efforts have been put toward understanding the process by which members of the public arrive at assessments of risk. For instance, Leiss (1994) has suggested that three major attributes influence the extent to which a hazard is perceived as a risk in the eyes of the public: (1) the degree to which it is understood; (2) the degree to which it involves feelings of dread; and (3) the size and type of the population at risk. More recently, researchers have begun to identify person-specific characteristics that shape perceptions of risk (Marris *et al.* 1998). Among these characteristics have been attitudes.

Allport (1935) defined attitude as "a mental and neural state of readiness, organized through experience, exerting a directive or dynamic influence upon the individual's response to all objects and situations with which it is related" (as cited in Alcock *et al.* 2001, p 97). Accordingly, attitudes are conceptualized as consisting of three related but distinct components (Eagly and Chaiken 1993; Farley and Stasson 2003): the cognitive component, which refers to one's beliefs about the issue; the affective component, which refers to all emotions related to the issue (often referred to as opinions); and the behavioral component, which refers to the potential actions involved. Each component has been shown to play a unique role in determining the valence and strength of attitudes (Breckler 1984).

An important aspect of attitudes is that they serve a knowledge function. That is, attitudes assist people in making sense of their world through their influence on information processing and judgment (Fazio *et al.* 1992). Indeed, research has shown that one's pre-existing attitudes about a particular issue can influence what is recalled about a related situation (Eagly *et al.* 1999; Gushue and Carter 2000), as well as how related situations are evaluated (Kuiper and Dance 1994). Moreover, objects toward which people hold strong attitudes are more likely to attract attention when presented in a visual display (Roskos-Ewoldsen and Fazio 1992).

Among those who incorporated attitudes into research on risk perception was Dake (1991), who argued that attitudes guide people's responses in complex situations and can thereby influence their risk perceptions. Consistently, Peters and Slovic (1996) found that worldviews, defined as measures of a person's attitudes toward political, economic, and social relations, are important predictors of the perceived risk of nuclear power, presumably by guiding perceivers' attention to different aspects of the technology (*e.g.*, costs versus benefits). Similarly, environmental beliefs have been associated with the acceptance of various technologies that are potentially harmful to the environment (Siegrist 1998; Steg and Sievers 2000).

One particular attitude that has been studied is trust, which reflects the willingness to rely on those who have the responsibility for making decisions and taking actions related to the management of public health and safety (Cvetkovich *et al.* 2002; Maeda and Miyahara 2003; Poortinga and Pidgeon 2003; Siegrist and Cvetkovich 2000; Siegrist *et al.* 2000). Numerous cases have been documented in which public outrage about risk was attributable to distrust in industry and risk-management professionals (Leiss 1994; Slovic 1993; Slovic *et al.* 1991).

Although a number of studies have investigated the role of attitudes in perceptions of technological hazards, fewer have investigated their role in the perception of hazards that are more social in nature. In one case, Bouyer *et al.* (2001) examined the effects of person-specific factors such as worldviews and personality (*e.g.*, transitional anxiety states, enduring anxiety dispositions) on risk perceptions of various types of hazards in French men and women. They investigated a long list of hazards, including those from pollutants, public transportation and energy production, outdoor activities, urban violence, and psychotropic drugs and found that relationships between the person-specific factors and risk perceptions varied across different types of hazards. For instance, whereas transitional anxiety was related to higher risk perceptions of common individual hazards, pollutants, and outdoor activities, it was related to lower risk perceptions of public transportation and energy production. However, Bouyer *et al.* (2001) did not examine relationships between personality factors and worldviews, nor did they examine interaction effects involving these.

The Canadian National Health Risk Perception Survey was initially administered in 1992 with the aim of informing governmental policy-makers and agencies on issues relevant to risk management decisions. Although the survey instrument was not designed to be used as an attitude scale, it contained a series of items related to beliefs about health risks as part of the global recognition by researchers of the importance of sociopolitical attitudes as predictors of perceived risk. However, relationships between these items and health risk perceptions were only reported item-wise or on total scores for groups of items that clustered together from an expert point of view (Krewski *et al.* 1995a, b). A primary aim of the present study was therefore to explore the structure of the health risk–related beliefs surveyed in 1992. Given that only beliefs were surveyed at that time, exploration was limited to the cognitive component of attitudes. Still, the fact that this component involves elements of knowledge renders it a more amenable vehicle for public information survey and public policy. A secondary aim was to replicate Bouyer *et al.*'s (2001) work in their use of an elaborate list of hazards (some technological and some social) and to extend the results to Canada. In addition to organizing and simplifying the multivariate nature of both beliefs and hazards, relationships were examined between belief factors and health risk perceptions of three classes of hazards: Environmental, Therapeutic, and Social hazards (Lemyre *et al.* 2004).

METHODS

A detailed description of the questionnaire used in the 1992 Canadian National Health Risk Perception Survey as well as the survey procedure can be found in Slovic *et al.* (1993). This section contains only the methodological information essential to the current investigation.

Participants

A stratified random sample of 1,506 respondents was obtained that matched the 1992 Canadian adult population in terms of household size, community size, age, and gender. Participants were at least 18 years of age, with a modal age category of

30 to 44 years. Data from 501 men and 612 women were sufficiently complete to be used in the current analyses, representing 74.9% of the original sample.

Measures

Health risk ratings

Respondents rated the health risk to the Canadian public of 38 hazards on a 1 to 5 rating scale (1 = almost no health risk, 2 = slight health risk, 3 = moderate health risk, 4 = high health risk, or 5 = I don't know/no opinion). A wide range of hazards was covered in this section, including items related to technology, lifestyle, pollution, common substances, crime and violence, and medical devices.

Beliefs

A series of 38 statements reflecting various beliefs related to health risks were generated by a panel of researchers (see Table 1). These statements were designed to reflect (i) beliefs about local and global environmental health risks, (ii) beliefs about health risks from chemicals, (iii) beliefs about regulation, (iv) sensitivity to the relationship between amount of hazard exposure and degree of health risk, (v) degree of trust in animal studies to determine human health risk, (vi) beliefs about cancer, (vii) willingness to entertain risk/benefit tradeoffs, (viii) beliefs about health risks and energy policy, and (ix) Dake's (1991) proposed worldviews (*e.g.*, "I feel that I have very little control over risks to my health," "Decisions about health risks should be left to the experts"). An additional 6 statements reflected miscellaneous beliefs. Respondents rated the degree to which they agreed with each statement by selecting the appropriate rating category (1 = disagree strongly, 2 = disagree somewhat, 3 = agree somewhat, 4 = agree strongly, and 5 = I don't know/no opinion).

RESULTS

Missing values (with the exception of demographic information) were replaced with mean scores of the appropriate item. The proportion of missing values for each variable ranged from 0 to 12%.

Health Risk Perceptions

A previous principal components analysis performed on health risk ratings of the 38 hazards yielded 3 components: Environmental, Therapeutic, and Social health risk perceptions (Lemyre *et al.* 2004). Environmental health risk perceptions accounted for 14.3% of the total variance. This component included items relating to radiation, chemicals, or contaminants that are found within the global environment (*e.g.*, nuclear waste, nuclear power plants, PCPs or dioxin, chemical pollution in the environment, waste incinerators). Therapeutic health risk perceptions, on the other hand, accounted for 11.5% of the total variance, primarily due to items with medical or therapeutic qualities (*e.g.*, contraceptives, contact lenses, medical X-rays). Finally, Social health risk perceptions accounted for an additional 10.6% of the total variance and involved high loadings on items pertaining to lifestyle, as well

Table 1. Factor loadings of 38 belief statements rated by Canadians on degree of personal agreement.

Item	Mean (*SD*)	Belief factor			
		Cancer Dread	Trust in Regulators	Environmental Concern	Personal Agency
If a person is exposed to radiation, then that person will probably get cancer some day.	2.86 (.89)	**0.72**	−0.05	0.08	−0.01
Most chemicals cause cancer.	2.57 (.93)	**0.67**	0.04	0.01	−0.01
If a person is exposed to a chemical that can cause cancer then that person will probably get cancer some day.	2.79 (.85)	**0.66**	−0.04	0.02	0.09
Chemicals are either safe or dangerous. There is really no in between.	2.55 (1.08)	**0.52**	0.10	−0.01	0.12
No matter how low the level of radiation, it can still cause cancer.	2.82 (.85)	**0.52**	0.08	0.17	0.06
If a scientific study produces evidence that a chemical causes cancer in animals, then we can be reasonably sure that the chemical will cause cancer in humans.	3.16 (.77)	**0.48**	0.01	**0.36**	0.15
If even a tiny amount of a substance that can cause cancer were found in my tap water, I wouldn't drink it.	3.21 (.87)	**0.44**	−0.13	0.07	0.27
I feel I have very little control over risks to my health.	2.46 (1.02)	**0.43**	0.18	−0.06	−0.26
A cancer-causing substance turns normal cells into cancer cells through contact, much like the spread of a highly contagious disease.	2.43 (.92)	**0.39**	0.14	0.08	0.07
Canadians should be prepared to accept some risk to their health in order to strengthen the economy.	1.93 (1.00)	0.15	**0.58**	0.03	−0.03

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Table 1. Factor loadings of 38 belief statements rated by Canadians on degree of personal agreement. *(Continued)*

		Belief factor			
Item	Mean (*SD*)	Cancer Dread	Trust in Regulators	Environmental Concern	Personal Agency
I don't worry much about chemicals because there are just too many other things in my life that I have to deal with.	2.21 (1.00)	−0.11	**0.56**	−0.10	−0.18
Because chemicals provide many benefits to society, there should be less regulation than there currently is.	1.67 (.82)	0.08	**0.55**	−0.28	0.01
Canadian society is becoming too concerned with small risks.	2.31 (.96)	0.06	**0.52**	−0.10	−0.04
I am prepared to accept some risk in order to achieve the potential health benefit of drugs or medical devices.	2.44 (.93)	−0.08	**0.51**	0.30	0.05
When there is a really serious health problem, the government will regulate it. Until they alert me about a specific problem, I don't really have to worry.	1.78 (.86)	0.20	**0.51**	**−0.42**	−0.02
If something like a chemical is going to harm me it will, and there isn't much that I can do about it—what will be will be.	1.99 (1.01)	0.22	**0.49**	−0.24	−0.30
The body usually repairs the damage caused by exposure to radiation so that cancer does not occur.	2.14 (.86)	−0.18	**0.45**	0.03	0.08
Decisions about health risks should be left to the experts.	2.21 (1.01)	**0.32**	**0.42**	−0.16	0.05
I believe chemical risks are adequately regulated.	2.52 (.87)	0.04	**0.42**	-0.25	**0.37**
Use of chemicals has improved our health more than it has harmed it.	2.32 (.96)	**−0.36**	**0.41**	0.07	0.16

In light of health concerns about acid rain, damage to the ozone layer, and climate change associated with the burning of coal and oil, Canada should rely more heavily upon nuclear power to meet its future electricity needs.	2.39 (.96)	−0.12	**0.33**	−0.04	0.25
A high technology society is important for improving our health and social well-being.	2.96 (.83)	0.17	**0.33**	0.09	0.27
The greenhouse effect is a serious problem which could lead to harmful changes in the environment and in people's health.	3.39 (.74)	0.01	−0.06	**0.59**	0.13
The more often a person is exposed to a substance that can cause cancer the more likely he or she is to get cancer.	3.42 (.76)	0.25	−0.04	**0.53**	−0.01
The land, air, and water around us are, in general, more contaminated than ever before.	3.65 (.65)	0.16	−0.14	**0.52**	0.04
There are serious environmental health problems were I live.	2.44 (.94)	0.13	0.03	**0.49**	**−0.38**
In light of these same concerns, Canada should place greater emphasis on energy conservation.	3.61 (.58)	−0.03	−0.12	**0.39**	0.29
I pay close attention to warning labels on products that I use.	3.45 (.76)	0.07	−0.21	0.24	**0.46**
People can offset health risks from pollution by improving their individual lifestyle, such as exercising and eating properly.	3.48 (.77)	0.15	0.03	0.12	**0.43**

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Table 1. Factor loadings of 38 belief statements rated by Canadians on degree of personal agreement. *(Continued)*

Item	Mean (*SD*)	Belief factor			
		Cancer Dread	Trust in Regulators	Environmental Concern	Personal Agency
I believe my community is becoming a healthier place in which to live.	2.27 (.89)	−0.01	0.18	**−0.36**	**0.41**
Experts are able to make accurate estimates of the health risks from chemicals in the environment.	2.64 (.84)	0.19	0.24	0.03	**0.41**
I believe that a risk-free environment is an attainable goal in Canada.	2.75 (.97)	0.20	0.06	0.06	**0.40**
I try hard to avoid contact with chemicals and chemical products in my daily life.	3.08 (.86)	**0.35**	−0.17	0.08	**0.36**
The risk of getting cancer from lifestyle factors such as smoking and diet is much greater than the risk of cancer from chemicals in the environment.	2.70 (.94)	−0.16	0.30	0.01	0.24
The way an animal reacts to a chemical is a reliable predictor of how a human would react to it.	2.65 (.95)	0.14	0.22	0.25	0.12
Natural chemicals are not as harmful as man-made chemicals.	2.67 (.98)	0.15	0.13	0.23	0.11
A prescription drug that has not been formally tested, but has been used for 20 years, is safer than a new prescription drug	2.40 (.93)	0.11	0.31	0.09	−0.06
Fruits and vegetables contain natural substances that can cause cancer.	1.98 (.89)	0.17	0.21	0.14	−0.18

Note. Means represent mean ratings for each item. Factor loadings greater than .30 are in bold.

as items relating to societal problems (*e.g.*, motor vehicle accidents, drinking alcoholic beverages, crime and violence, cigarette smoking, street drugs).

Factor scores were computed for each of the components using the Anderson-Rubin approach, which has the benefit of producing scores that are uncorrelated with each other even for factors that are correlated (Tabachnick and Fidell 2001). Because the three factor scores would serve as dependent variables in a multivariate analysis of covariance (MANCOVA), this method was thought to be most appropriate as the assignment of variance becomes ambiguous while assessing the importance of dependent variables if these are correlated.

Beliefs

A principal components analysis was conducted on the 38 belief statements. A non-rotated initial solution produced 11 factors with eigenvalues greater than 1. A 4-factor solution was retained based on the Scree test and on the interpretability of these factors. Factor loadings for each of the 38 belief statements are displayed in Table 1. A quartimax rotation was performed in order to clarify some cross-loadings. The final solution accounted for 30.1% of the total variance.

The first factor, which accounted for 9.4% of the total variance, was labelled "Cancer Dread." It comprised numerous statements reflecting sensitivity to the relation between environmental contaminants and cancer. The second factor, called "Trust in Regulators," was characterized by statements reflecting fatalism, reliance on authority, low personal control, and a lack of worry over health risks. This factor explained 9.2% of the total variance. The third factor accounted for 6.2% of the total variance, and was called "Environmental Concern" due to high loadings of statements reflecting a high degree of concern over environmental issues. A high loading was also observed for one statement on exposure to contaminants and the development of cancer. The last factor was called "Personal Agency," and was characterized by high loadings on statements involving an active engagement in protective behaviors, as well as a general belief that health risks are controllable. It accounted for an additional 5.3% of the total variance.

Anderson-Rubin factor scores were computed for Cancer Dread, Trust in Regulators, Environmental Concern, and Personal Agency using the SPSS Save Factor Scores option. High and low groups were subsequently formed for each factor using means as a criterion for grouping. A breakdown of mean factor scores by gender, education, income, and province of residence is presented in Table 2.

Multivariate Analysis of Covariance

A 3×4 breakdown of mean Environmental, Therapeutic, and Social health risk perception scores by high and low Cancer Dread, Trust in Regulators, Environmental Concern, and Personal Agency groups is presented in Table 3. In order to investigate the relationship between health risk perceptions and beliefs, a MANCOVA was performed using the three health risk perception scores as dependent variables and a high versus low classification of Cancer Dread, Trust in Regulators, Environmental Concern, and Personal Agency as independent variables. A multivariate analysis was conducted to protect against inflated Type 1 error (Tabachnick and Fidell 2001). Five cases were deleted from the analysis because of missing information on level of

Table 2. Cancer dread, trust in regulators, environmental concern, and personal agency mean factor scores by demographic group.

	Belief factor			
Demographic group	Cancer Dread	Trust in Regulators	Environmental Concern	Personal Agency
Gender*				
Male	−.06	.14	<−.01	−.07
Female	.05	−.12	.01	.06
Education*				
Public school	.75	.50	−.31	.12
High school	.30	.07	−.13	.04
College/CEGEP	−.07	−.14	.02	<.01
University	−.48	−.07	.27	−.08
Graduate school	−.85	−.17	.24	−.14
Income*				
<$19,000	.38	.20	−.15	−.05
$20,000–24,999	.31	.12	−.12	.12
$25,000–29,999	.18	−.04	−.17	−.02
$30,000–34,999	.09	.10	−.11	.07
$35,000–39,999	−.10	−.15	−.02	.01
$40,000–49,999	−.15	−.20	.21	−.05
$50,000–59,999	−.11	−.21	.14	.02
$60,000–74,999	−.25	.05	.11	<.01
$75,000 and over	−.58	.06	.19	.04
Province of residence*				
Newfoundland	.32	.18	−.01	.21
Nova Scotia	−.05	−.13	.27	.06
P.E.I.	.15	−.48	.90	.64
New Brunswick	.39	.14	−.11	.18
Quebec	.26	.02	−.37	−.03
Ontario	−.13	.03	.15	−.02
Manitoba	−.18	−.01	.16	−.07
Saskatchewan	−.29	.23	−.03	.09
Alberta	−.12	.06	.22	−.04
British Columbia	−.14	−.28	.23	.04

Note. $^{*}p < .001$ in MANCOVA.

education and income, leaving a total of $n = 1{,}108$ cases for analysis. On the basis of findings in numerous studies (Slovic 1999; Finuncane *et al.* 2000; Palmer 2003; Lemyre *et al.* 2004), gender, level of education, and income were included as covariates in the analysis. Moreover, given that some of the health hazards assessed in the survey might be specific to certain local environments, province of residence was also included in the analysis as a covariate.

Health risk perceptions significantly differed according to the covariates of gender ($\Lambda = .93$, $F\ (3, 1086) = 28.05$, $p < .001$), education ($\Lambda = .98$, $F\ (3, 1086) = 6.67$, $p < .001$), income ($\Lambda = .97$, $F\ (3, 1086) = 10.41$, $p < .001$), and province of residence ($\Lambda = .98$, $F\ (3, 1086) = 6.31$, $p < .001$).

Table 3. Mean health risk perception factor scores by high and low cancer dread, trust in regulators, environmental concern, and personal agency groups.

	Health risk perceptions		
Grouping variable	Environmental	Therapeutic	Social
Cancer Dread*			
Low	−.26	−.21	−.14
High	.25	.20	.14
Trust in Regulators*			
Low	.17	.07	<−.01
High	−.18	−.07	.01
Environmental Concern*			
Low	−.09	−.06	<.01
High	.08	.05	.01
Personal Agency*			
Low	.05	.08	−.07
High	−.05	−.08	.08

*Note.** $p < .001$ in MANCOVA.

Health risk perceptions also differed by Cancer Dread ($\Lambda = .93$, F (3, 1086) = 29.38, $p < .001$), Trust in Regulators ($\Lambda = .96$, F (3, 1086) = 16.30, $p < .001$), Environmental Concern ($\Lambda = .98$, F (3, 1086) = 9.00, $p < .001$), and Personal Agency ($\Lambda = .98$, F (3, 1086) = 6.84, $p < .001$). None of the interactions reached statistical significance.

The role of beliefs in health risk perceptions after covariate adjustment was further investigated in univariate analyses. Environmental health risk perceptions were found to be significantly higher in respondents with high Cancer Dread, F (1, 1086) = 40.75, $p < .001$. Environmental health risk perceptions were perceived lower among respondents with high Trust in Regulators (F (1, 1086) = 37.99, $p < .001$). Lastly, Environmental health risk perceptions were higher in respondents with high Environmental Concern, F (1, 1086) = 14.71, $p < .001$. Although not statistically significant, respondents with high Personal Agency had marginally lower Environmental health risk perceptions than those with low Personal Agency, F (1, 1086) = 3.75, $p > .05$.

A similar pattern of results was observed for Therapeutic health risk perceptions. These were significantly higher in respondents with high Cancer Dread, F (1, 1086) = 25.69, $p < .001$ and significantly lower in respondents with high Trust in Regulators, F (1, 1086) = 5.97, $p < .05$. Moreover, Therapeutic health risk perceptions were higher in respondents with high Environmental Concern, F (1, 1086) = 6.93, $p < .01$. Lastly, respondents with high Personal Agency had lower Therapeutic health risk perceptions than those with low Personal Agency, F (1, 1086) = 10.88, $p < .001$.

Social health risk perceptions only significantly differed according to Cancer Dread, F (1, 1086) = 6.22, $p < .05$, and Personal Agency, F (1, 1086) = 5.65, $p < .05$. Much like Environmental and Therapeutic health risk perceptions, Social health risk perceptions were higher in respondents with high Cancer Dread compared to

those with low Cancer Dread. Interestingly, Social health risk perceptions did not vary according to Trust in Regulators, nor did they vary by Environmental Concern. However, they did differ according to Personal Agency in a reverse direction to that of Environmental and Therapeutic health risk perceptions.

Multiple Regression Analyses

In order to assess the unique contribution of each belief factor to the prediction of health risk perceptions, three multiple regressions were run with Cancer Dread, Trust in Regulators, Environmental Concern, and Personal Agency as predictors of (i) Environmental health risk perceptions, (ii) Therapeutic health risk perceptions, and, finally, (iii) Social health risk perceptions.

Environmental health risk perceptions

Belief factors were significant predictors of Environmental health risk perceptions, $R^2 = .14$; $F(4, 1108) = 45.61$, $p < .001$, accounting for 14% of the variance. All belief factors but Personal Agency uniquely significantly contributed to the regression. Cancer Dread was the strongest predictor with $\beta = .31$, $t(1, 1108) = 11.00$, $p < .001$, followed by Trust in Regulators with $\beta = -.18$, $t(1, 1108) = -6.58$, $p < .001$, and Environmental Concern with $\beta = .11$, $t(1, 1108) = 4.09$, $p < .001$.

Therapeutic health risk perceptions

Belief factors significantly predicted Therapeutic health risk perceptions, $R^2 = .08$; $F(4, 1108) = 25.51$, $p < .001$, accounting for 8% of the variance. Here, all belief factors but Environmental Concern uniquely significantly contributed to the regression. Again, Cancer Dread was the strongest predictor with $\beta = .25$, $t(1, 1108) = 8.62$, $p < .001$, followed by Trust in Regulators with $\beta = -.13$, $t(1, 1108) = -4.52$, $p < .001$, and Personal Agency with $\beta = -.06$, $t(1, 1108) = -2.02$, $p < .05$.

Social health risk perceptions

Belief factors were significant predictors of Social health risk perceptions, $R^2 = .03$; $F(4, 1108) = 8.87$, $p < .001$, accounting for 3% of the variance. Only Cancer Dread and Personal Agency uniquely contributed to the regression. Cancer Dread was the strongest predictor with $\beta = .15$, $t(1, 1108) = 5.18$, $p < .001$, followed by Personal Agency with $\beta = .08$, $t(1, 1108) = 2.75$, $p < .001$.

DISCUSSION

The aims of the present study were to assess whether an underlying structure is embedded within various beliefs about health risks, and to investigate the role of such beliefs in shaping perceptions of different types of health hazards. Four factors were found to reflect the perceptual organization of beliefs. Cancer Dread reflected sensitivity to the relation between exposure to chemicals or radiation and cancer outcomes. Subsequent analyses revealed that respondents who scored high on Cancer Dread had higher Environmental, Therapeutic, and Social health risk perceptions. The fact that this factor was by far the strongest predictor of all health

risk perceptions is consistent with the notion that the degree of risk perceived to be associated with a given hazard is largely a function how much the hazard is dreaded (Leiss 1994). Although dread in the current study was not measured in the context of specific hazards as it has been in past research, many of the hazards that comprised the Environmental and Therapeutic health risk perception factors do lead to cancer outcomes. A smaller number of such hazards were included in the Social health risk factor. Still, it should be noted that 30% of all human cancers are attributable to cigarette smoking alone (Tubiana 2000). Thus, Cancer Dread might have been associated with perceived risk because respondents dreaded cancer as an outcome of exposure to the hazards that made up the factors. Cancer is among the most widely heard of, feared, and uncertain possible health hazard outcomes. Cancer Dread might therefore have served as a type of risk sensitivity index by indicating respondents' perceptual tendencies toward risk.

The second factor, Trust in Regulators, was characterized by high trust in government regulation, high perceived benefits, low worry, and low personal control. In essence, this factor reflected both a fatalistic view of as well as a sense of support for authoritative control over health risks. This result is reminiscent of Peters and Slovic's (1996) observation that fatalism and hierarchy are strongly associated. Although the exact nature of this factor was difficult to interpret, it was relatively clear that the overall feeling it conveyed was one of acceptance in the regulation of health risks by experts. In subsequent analyses, it was revealed that respondents who scored high on this factor had lower Environmental and Therapeutic health risk perceptions than respondents who scored low. However, no such association was revealed for Social health risk perceptions. One explanation for this finding might be that exposure to hazards that are Social in nature is considered by the respondents to depend primarily on individual behavior. Although regulation is involved in the content of cigarettes and medicinal drugs, risk is seen as avoidable by not using these products. There may be a perception that less can be done by the individual to avoid environmental health risks, for which control heavily relies on regulation by authorities.

Respondents who displayed high Environmental Concern had higher Environmental and Therapeutic health risk perceptions, but not Social health risk perceptions, as compared to those who displayed less concern. This is consistent with numerous studies in which it has been shown that environmental beliefs influence the perceived risk and benefits of technologies (Gardner*et al.* 1982; Siegrist 1998; Sparks *et al.* 1995). A common explanation for this association is that environmental beliefs affect risk perceptions by focusing individuals on specific elements of a potential hazard (O'Connor *et al.* 1999). In the present study, respondents with high concern for the environment most likely displayed higher Environmental and Therapeutic health risk perceptions than respondents with low concern because the negative effects of the hazards comprising these factors on the environment was more salient to them. Conversely, the fact that no so such association was revealed for Social health risk perceptions may be attributable to the fact that the hazards comprising this factor generally do not have a direct impact on the environment.

The Personal Agency factor reflected protective behaviors as well as a general belief that health risks can be controlled or eliminated. Respondents who scored high on Personal Agency had lower Environmental and Therapeutic health risk

perceptions, although this factor only significantly uniquely contributed to the prediction of the latter. One reason for this finding might be that taking active control over hazards leads to greater feelings of self-efficacy in dealing with them. Along with the simple belief that hazards are controllable, it would seem reasonable that feelings of self-efficacy helped reduce the perceived risk of therapeutic hazards to health. Wiegman and Gutteling (1995) have often argued that heightened risk perceptions result from low feelings of self-efficacy in dealing with hazards among members of the public. However, this would not explain why Social health risk perceptions were higher in respondents with high Personal Agency. Logically, if even people who are generally willing to engage in protective behavior still feel that social hazards are high, then they may ascribe a special kind of uncontrollability to this type of risk. Alternatively, individuals who engage in protective behavior may do so because they exaggerate the importance of social hazards. This is an issue for further investigation.

Overall, results suggest that beliefs can be useful in the search for a better understanding of the public's perception of risk. Although the belief factors only accounted for a small proportion of the variance, knowledge of scores on these factors nevertheless significantly enabled the prediction of Environmental, Therapeutic, and Social health risk perceptions. The modest results presented here suggest the existence of other factors that play a role in health risk perceptions. Nevertheless, the exact nature and extent of the role played by beliefs should be investigated further given that the questionnaire used here was not a validated belief scale *per se*. In addition, the nature of some of the belief factors was not always exactly clear. For example, although it was obvious that Trust in Regulators reflected a sort of unquestioned diffusion of control to authorities, it was not entirely clear whether trust was placed in regulators as a result of a learned helplessness over health hazards or whether it simply resulted from high support for authority. In order to avoid this problem, future studies should make greater use of existing belief or attitude scales. With the exception of Dake's (1991) worldview scales, surprisingly few risk perception studies have used validated attitude scales.

To conclude, the present study demonstrates that beliefs can be useful in understanding risk perceptions for a wide range of hazards. The fact that the data originated from a national survey conducted in 1992 may limit its descriptive accuracy of today's perceptions. Nevertheless, the functional process that links beliefs and risk perceptions remains of major relevance and importance. The study of beliefs has the potential to be very informative to risk managers and policy-makers. For instance, a survey of public beliefs could help risk managers anticipate which population segment is likely to respond strongly to particular risk decisions. It might also help pinpoint whether the public is realistic in terms of its sense of mastery over hazards, as well as its demand for risk management. Researchers and risk managers alike would likely benefit from further investigation into the role of beliefs in risk perception, with emphasis on the inclusion of more systematic and better-validated scales.

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