

# What Risks Are People Concerned About?

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An unusual questionnaire was used to explore what risks concern laypeople. It asked respondents to list, in their own words, as many risks of personal concern as they could. They then selected the five risks of greatest concern and answered a set of specific questions about each. A coding scheme was developed for categorizing these responses and was shown to have good reliability. The questionnaire was administered to a heterogeneous convenience sample of subjects. They reported a very broad range of risks of concern, which differed in plausible ways as a function of their gender and age. Females and student-age subjects were generally more concerned about the environment, whereas males and older subjects were more likely to mention health and safety risks. Both the extent of the risk-reduction actions that they reported and their expressed willingness to pay for future risk reductions were greater for risk that presented a direct personal threat (e.g., health risks) than for risks that posed a diffuse threat to the environment or to people in general (e.g., pollution). Respondents perceived themselves as bearing primary responsibility for managing threats to their own health, but generally saw government as bearing a heavier responsibility for managing environmental risks (especially for pollutants) and war. The questionnaire instrument and coding structure developed for this work are well-suited to a variety of future research applications. They provide a way to identify the risks that concern lay groups, as well as to track the evolution of those concerns over time.

**KEY WORDS:** Risk perception; risk communication; worry; public opinion; agenda-setting.

## 1. INTRODUCTION

Risk professionals frequently complain that laypeople are preoccupied with minor risks, while ignoring other risks that pose significant threats to health and safety.<sup>(1-4)</sup> The implication is that public attention and public resources are being misdirected by these misplaced concerns. However, this is surprisingly little sys-

tematic empirical evidence to either substantiate or contradict these claims.

The research reported here develops a research method for eliciting and analyzing judgments of risk priority, as well as for probing the perceived properties of such risks. This method allows one to explore what brings particular risks to the center of people's attention. Are they concerned primarily with the magnitude of risks? If so, what is their subjective definition of "magnitude?" Do their choices reflect the opportunities for controlling risks? If so, do they focus on risks that can (or should) be controlled by government (or by industry, or by personal action)? How do the risks that concern people vary as a function of background factors, such as age and gender? Do people feel that they have enough information about the risks that concern them most? The

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usefulness of this method is explored in two studies with diverse samples of subjects. In one, the set of possible risks was left unspecified. In the second, subjects were directed to consider risks to health, safety, and environment.

Various polling organizations have asked respondents to identify the risks that concern them most, from among a fixed set of alternatives. For example, in 1980, Resources for the Future conducted a large national study of public opinion about environmental issues at the request of the Council on Environmental Quality (CEQ). The questionnaire was administered by the Roper Organization and Cantril Research. They elicited respondents' judgments about the risks on their list in several ways, including a request to indicate "how worried or concerned you are" about each item and a request to select items on which the federal government is "spending too little." CEQ published an extensive discussion of the results and of related research.<sup>(5)</sup> More recently, the Roper Organization conducted a national study for the Environmental Protection Agency (EPA) in which respondents judged the severity of a large number of environmental risks.<sup>(4,6,7)</sup> The investigators rank-ordered each risk in terms of the fraction of respondents who had rated it as "very serious." These public rankings were then compared with rankings that EPA had generated as part of strategic planning exercise called "Unfinished Business."<sup>(4,8,9)</sup> The *New York Times* summarized as follows: ". . . the American public and the Environmental Protection Agency rank environmental threats quite differently, with the public's fear focused most sharply on hazardous waste sites that the Government views much less seriously."<sup>(5)</sup> Frederick W. Allen of EPA argued that "the most obvious reason for the differences is that the general public simply does not have all the information that was available to [EPA's] task force of experts."<sup>(4)</sup>

Studies using such closed-ended questions necessarily restrict respondents' attention to particular formulations of a limited set of risks. In the case of the CEQ and EPA surveys, that set focused on officially nominated environmental issues. Thus, in the EPA/Roper study "active hazardous waste sites" (62%), "abandoned hazardous waste sites" (61%), and "workers exposed to toxic chemicals" (60%) were at the top of the list of public concerns. However, the study provides only indirect evidence that the American people actually devote a significant fraction of their risk-related attention to these hazards. Moreover, those items that are nominated are described in a way that makes sense to the agency commissioning the studies, which may not match the conceptualization of lay participants. Thus, an item

may be ranked highly because it is expressed in a way that makes it sound bad, even though it was not previously on respondents' agenda. Conversely, an intuitively important risk may be neglected because respondents do not recognize it in the agency's formulation. A final limitation to this approach is that it provides relatively little insight into the processes that determined the rankings. Readers of the results can, at best, guess at how the respondents perceived the various risks, a risky enterprise.<sup>(10-13)</sup>

## 2. MACGREGOR'S FINDINGS

A richer approach to the problem was adopted by MacGregor in 1980. Results from this work are reported in a paper in this issue of *Risk Analysis*.<sup>(14)</sup> MacGregor used several different listing and ranking procedures to ask college students about the issues that worry them.

MacGregor's two studies produced several noteworthy findings. First, when respondents listed "five worries in the past week," achievement concerns topped their list (providing 35.6% of nominations), followed by concerns about money (18.5%) and personal relationships (15.5%). Health (6.8%) and safety (2.7%) concerns lagged far behind in this student population. Results for a task that involved allocating 100 "worry points" across general risk categories showed the same pattern, although the variation in level of concern was less extreme.

In short, these students' worries were found to bear little relation to the matters that most concern risk analysts. To put matters in perspective, worry about "managing current money needs" received a mean rating of 12.8 (on the 0-20 worry scale), while worry about "getting things done" and "achieving highly valued goals" received mean ratings of 11.6 and 11.2, respectively. By contrast, concerns about "pollution" and "nuclear power" received mean ratings of 7.7 and 6.6, while concerns about the negative effects of "alcohol," "leisure drugs," and "smoking" received average ratings of only 4.7, 3.8, and 2.9.

MacGregor's intriguing results raise several questions. One is how people's focal concerns shift with their position in life. For example, do concerns about health and safety become more salient as one becomes older? A second question is what happens when respondents are directed more specifically to consider risks. The set of potential worries is much larger than the set of risks. People generally interpret the word risk as referring to a negative event that might occur, not as referring to a negative state of affairs that already exists, or that will

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occur with uncertainty.<sup>(15)</sup> Worry is not restricted to possible negative events alone, however. People often worry about negative states of affairs that already exist (e.g., the failure of a love affair, dissatisfaction with one's job). Furthermore, many people interpret the word risk as referring to potential threats whose likelihood depends on the decision-maker's own actions,<sup>(15)</sup> whereas people often worry about things that they cannot influence.

Our research, which was begun in ignorance of MacGregor's results, extends them in four respects. First, we recruited more diverse samples of subjects, ranging in age from high school students to their grandparents. Second, our surveys focused on concern about risks *per se*, not on worry in general. As we argued earlier, the phrase "risks of concern" seems more restricted in meaning than the word "worry." Third, we allowed respondents to describe risks in their own terms. Finally, we had respondents rate the risks that they had nominated in a variety of ways, in order to gain insight regarding people's perceptions of those risks. One of those additional response modes was a measure of willingness to pay in order to have a risk reduced.

### 3. EXPERIMENT 1

The basic goal of our first experiment was to test a simple, self-administered questionnaire that could be used with a broad sample of the public in order to elicit judgments regarding the risks that concern them. Although this experiment was originally intended only to serve as a pilot study, it produced several substantive findings.

#### 3.1. The Instrument

The questionnaire began by asking respondents to "make a list, in whatever order they come to mind, of the risks which most concern you now." Once they had completed this task, subjects selected the five risks of greatest concern and ordered them by decreasing degree of concern. A portion of the questionnaire then opened into a booklet that allowed respondents to answer a series of questions relating to these five risks. Figure 1 illustrates the design of this somewhat unusual instrument.

#### 3.2. Respondents

Subjects for this pilot study were recruited opportunistically by the project team. In doing so, we sought diversity in the age and educational levels of our re-

spondents. As the left column in Table I indicates, the sample studied was quite diverse.

### 3.2. Results and Discussion

The risks generated by subjects were coded into the 12 categories listed in Table II. The coding was performed by one of the experimenters.<sup>5</sup>

The set of concerns evoked by our questionnaire was considerably different from that evoked by MacGregor's (see Table II): *Accidents* clearly topped our subjects' list, accounting for 37.1% of the risks mentioned. *Motor vehicle accidents* alone accounted for 21.6%. Disease was the next most common category (10.8%). By contrast, MacGregor's subjects nominated health and safety risks much less frequently. On the other hand, *social issues* (crime, money, divorce) were mentioned quite often in our study, just as they had been in MacGregor's (although his subjects focused on the social issues of student life). *Environmental, natural, and technological risks* (other than accidents) were seldom nominated in either study.

In order to obtain an index of subjects' degree of concern about each type of risk, we asked the following willingness-to-pay (WTP) question.

If you could spend money today that would eliminate any risk that you personally have from this source of risk for the rest of your life, how much would you be prepared to invest? (Large amounts could be handled with payments over time like in a mortgage.)

The possible responses were: "not much," "an hour's pay," "a day's pay," "a month's pay," and "a great deal." These answers were given scores of 1 through 5, respectively, meaning that they were treated as being very roughly linear in order of magnitude.

Mean responses are displayed in Table II. Subjects attached the highest priority to addressing *personal problems* ( $M=4.9$ ), *disease* ( $M=4.6$ ), and *war* ( $M=4.5$ ), implying willingness to pay more than a month's wages to eliminate each of these risks. *Environmental risks* also received high WTP ratings ( $M=4.1$ ). Despite being mentioned most frequently, *transportation accidents*, were rated only in the midrange of the scale ( $M=3.5$ ), indicating willingness to pay between a day's pay and a month's pay. Subjects attached the lowest priority to the *natural hazards* ( $M=2.0$ ) and other *technological hazards* ( $M=3.0$ ) that they had nominated, implying a will-

<sup>5</sup> As explained below, we developed a more elaborate coding scheme for Experiment 2, and had several members of our research team independently code the risks elicited there.

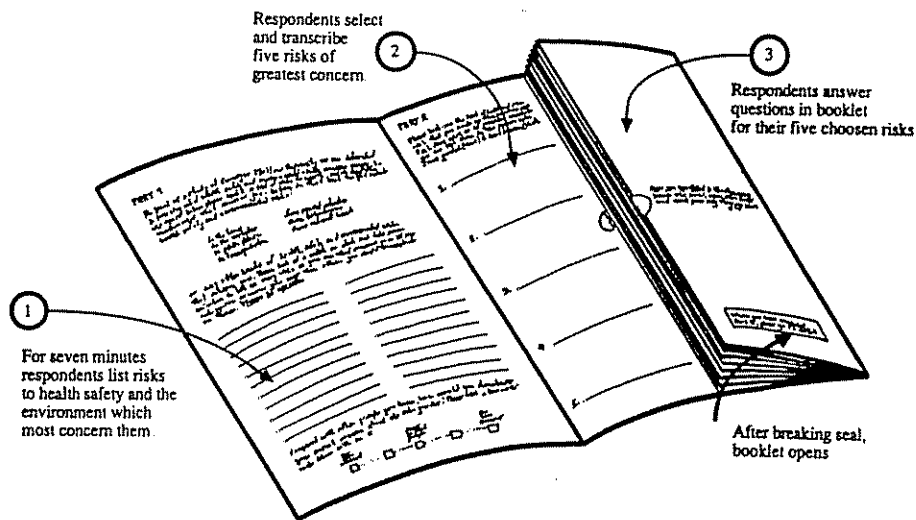


Fig. 1. Illustration of the questionnaire used in the studies. Respondents were asked to list risks that concerned them in the space on the left-hand page. Once they had completed this task, subjects were instructed to select the five risks of greatest concern, and write them into five spaces on the left side of the right-hand page, in order of decreasing concern. The questionnaire then unfolded so that they could answer a series of questions relating to these five risks of greatest concern.

ingness to pay on the order of an hour's pay to a day's pay.

In short, intensity of concern, as measured by willingness-to-pay, was distinct from frequency of mention. (Mean willingness-to-pay correlated only 0.065 with frequency of mention.) Personal problems, disease, and war ranked at the top of the willingness-to-pay list, even though accidents were mentioned far more frequently than other risks. The two lists agreed in one respect: natural hazards and technological hazards without environmental consequences fell at the bottom of both.

#### 4. EXPERIMENT 2

The results of both Experiment 1 and MacGregor's study indicate that if respondents nominate their own topics of concern, then they may not mention many risks to health, safety, and environment. Because those risks are the center of our research interest, the questionnaire of Experiment 2 was revised to ask subjects to ". . . please make a list, in whatever order they come to mind, of the health, safety, and environmental risks which most concern you now." In addition, we explicitly listed seven contexts in which such risks might arise: the home, the workplace, public places, transportation, special activities, technologies, and natural hazards. Subjects were asked to spend 7 min generating a list of such risks. Space was provided for 24 items. Next, subjects were

asked to select the 5 risks "of greatest concern to you," and to write these down on 5 lines in the booklet "ranging from greatest concern (item 1) to least concern (item 5)." The rest of the questionnaire unfolded as in Fig. 1, with the risk names always showing in the left margin. We will describe the additional questions when we discuss responses to them.

#### 4.1. Respondents

Student subjects for this experiment were recruited from high school classes in ecological science. These classes are part of the general science program, not the academic college preparatory program. Students who participated were offered extra course credit if they brought back three completed questionnaires: one that they (or someone of their generation) had filled out, one filled out by one of their parents (or someone from their parents' generation), and one filled out by one of their grandparents (or someone from their grandparents' generation). With this procedure, we obtained a diverse (although nonrandom) sample of respondents.

The right column in Table I describes these respondents. Each generation was well-represented, although a large majority of each was female. Roughly one third of the respondents had pursued educational training be-

Table I. Respondents' Characteristics

| Variable                  | % of respondents         |                          |
|---------------------------|--------------------------|--------------------------|
|                           | Experiment 1<br>(N = 30) | Experiment 2<br>(N = 87) |
| Gender                    |                          |                          |
| Female                    | 66.0                     | 79.3                     |
| Male                      | 34.0                     | 20.7                     |
| Education                 |                          |                          |
| Some HS                   | 3.3                      | 17.2                     |
| Completed HS              | 16.7                     | 48.3                     |
| Some college              | 30.0                     | 17.2                     |
| Completed college         | 20.0                     | 8.0                      |
| Graduate school           | 30.0                     | 9.2                      |
| Age                       |                          |                          |
| 0-20 years                | 3.3                      | 31.9                     |
| 21-40 years               | 66.7                     | 18.5                     |
| 41-60 years               | 26.7                     | 31.6                     |
| 61-80 years               | 3.3                      | 18.0                     |
| Generation                |                          |                          |
| Student                   | NA                       | 34.4                     |
| Parent                    | NA                       | 36.7                     |
| Grandparent               | NA                       | 28.9                     |
| Work status               |                          |                          |
| Employed                  | 76.7                     | 43.1                     |
| Student                   | 16.7                     | 16.4                     |
| Unemployed                | 3.3                      | 26.0                     |
| Retired                   | 3.3                      | 14.5                     |
| Type of work              |                          |                          |
| Homemaker                 | 3.6                      | 31.2                     |
| Secretarial/service/sales | 42.9                     | 11.7                     |
| Blue collar               | 10.7                     | 39.0                     |
| White collar              | 42.9                     | 18.2                     |

yond the high school level.<sup>6</sup> Most respondents were either employed or students, but a substantial percentage reported themselves to be retired or otherwise not working (mainly because they were homemakers).

#### 4.2. Coding Risks

The first step in analyzing our results was to develop a scheme for coding our subjects' risks. We began by developing a hierarchical set of risk categories that encompassed all the risks generated by our subjects. Table III presents this coding structure. The hierarchy has three levels. At the top level, risks were broadly grouped into the categories *health, safety, environment, society, and other*.<sup>7</sup> The second level broke these broad classes of risks down into much more specific risks. For example, the second level of *health* risks included *cancer and heart disease, sexually transmitted diseases, and substance abuse*. The third level in the hierarchy broke down categories that were very large or heterogeneous, or that involved risks of special interest. For example, *conventional pollution* was divided into *air pollution, water pollution, etc.*

The principal difficulty in applying this coding scheme is that some risks can be coded into multiple categories. For example, "driving accidents caused by drunk drivers" might be classified either as a *safety* risk under *motor vehicle accidents* (211) or as a *health* risk under *health impacts of substance abuse* (130). We developed the following procedure to address such ambiguities.

1. Use the most specific category available. Thus, "fire at work" should be categorized as *fire/explosion* (230) not *risks in the workplace* (250).
2. Never categorize a risk at a level under which there are specific sublevels. If an appropriate subcategory does not exist, use the subcategory "other." For example, use 350, not 300, for an environmental risk that does not fit under categories 310-340.
3. For risks involving multiple factors, choose the most direct cause of harm. Thus, choose 212, not 130, for "drunk airline pilots," because the accident is the immediate cause of harm, while substance abuse is only a predisposing cause. If

Table II. Frequencies with Which Risks Were Mentioned and Mean Willingness to Pay in Experiment 1

| Type of risk                  | No. | %    | Mean WTP <sup>a</sup> |
|-------------------------------|-----|------|-----------------------|
| Accident, car or plane        | 32  | 21.6 | 3.5                   |
| Accident, other               | 23  | 15.5 | 3.2                   |
| Disease                       | 16  | 10.8 | 4.6                   |
| Crime                         | 13  | 8.8  | 4.0                   |
| Economic/work                 | 13  | 8.8  | 4.1                   |
| Personal (divorce, . . .)     | 11  | 7.4  | 4.9                   |
| War                           | 10  | 6.8  | 4.5                   |
| Fire                          | 9   | 6.1  | 3.5                   |
| Environmental hazards         | 8   | 5.4  | 4.1                   |
| Natural hazard (flood, . . .) | 4   | 2.7  | 2.0                   |
| Technological hazards         | 4   | 2.7  | 3.0                   |
| Other                         | 5   | 3.4  | 4.4                   |

<sup>a</sup>On a scale where: 1 = not much; 2 = an hour's pay; 3 = a day's pay; 4 = a month's pay; 5 = a great deal.

<sup>6</sup> Of course, roughly one-third of the respondents were high school students who had not yet had the opportunity of attending college.

<sup>7</sup> The *other* category is for completeness only. All risks were eventually assigned to specific categories.

**Table III.** Risk Coding Categories and Relative Frequencies of Occurrence in Experiment 2\*

|  |
|--|
| <b>100 Health {22.8%}</b>  |
| 110 Cancer, heart disease (4.8%)   |
| 120 Sexually transmitted diseases (including AIDS, herpes) (5.9%)                              |
| 130 Health impacts of substance abuse (including drugs, alcohol, smoking) (7.4%)               |
| 140 Risks from medications and medical treatment (1.1%)  |
| 150 Safe/nutritious food (0.9%)  |
| 160 Other (2.8%)   |
| <b>200 Safety {22.4%}</b>  |
| 210 Transportation (9.6%)  |
| 211 Motor vehicles (including pedestrians) [6.7%]  |
| 212 Air [1.7%]   |
| 213 Other [1.1%]   |
| 220 Natural hazards (earthquake, flood, storm, etc.) (2.4%)                                    |
| 230 Fire/explosion (3.3%)  |
| 240 Risks in the home (excluding fire/explosion) (0.9%)  |
| 250 Risks in the workplace (excluding fire/explosion, noise, and all chronic exposures) (2.4%) |
| 260 Noise (1.3%)   |
| 270 Other (2.6%)   |
| <b>300 Environment {44.1%}</b>   |
| 310 Conventional pollution (21.1%)   |
| 311 Air [7.6%]   |
| 312 Water [7.0%]   |
| 313 Solid waste (including garbage, litter, trash, but not "toxic waste") [4.8%]               |
| 314 Other (including no medium and multiple media) [1.7%]                                      |
| 320 Exotic pollution (12.6%)   |
| 321 Toxic/hazardous chemicals [5.2%]   |
| 322 Pesticides, fertilizers [2.0%]   |
| 323 Ionizing radiation (excluding water) [4.8%]  |
| 324 Non-ionizing radiation, including electromagnetic fields [0.0%]                            |
| 325 Other [0.7%]   |
| 330 Ecological and large-scale environmental problems (8.0%)                                   |
| 331 Acid rain [1.7%]   |
| 332 Ocean impacts, including oil spills [0.9%]   |
| 333 Stratospheric ozone (including skin cancer from depletion) [2.6%]                          |
| 334 Species depletion and extinction [2.4%]  |
| 335 Other [0.4%]   |
| 340 Human ecology (2.0%)   |
| 341 Conservation of resources/depletion of nonrenewable resources [0.7%]                       |
| 342 Population/food/starvation [1.3%]  |
| 343 Other [0.0%]   |
| 350 Other (0.4%)   |
| <b>400 Society {10.7%}</b>   |
| 410 Financial risks and costs (1.3%)   |
| 420 Social/ethical/cultural risks to youth/children (1.5%)                                     |
| 430 Social/ethical/cultural risks to the elderly (1.3%)  |
| 440 Social/ethical/cultural impacts of technology (0.4%)                                       |
| 450 Violence (4.6%)  |
| 451 Crime [1.5%]   |
| 452 War/peace (including conventional and nuclear war) [3.0%]                                  |
| 453 Other [0.0%]   |
| 460 Other (1.5%)   |
| <b>500 Other {0.0%}</b>  |

\*Numbers in { }, ( ), and [ ] indicate category, subcategory, and sub-subcategory percentages, respectively.

in doubt, choose the factor that seems most salient to laypeople.

- If the route of harm is left implicit (e.g., "accumulation of unburned welding gas in closed spaces"), choose the most likely source of concern.
- When faced with ambiguity between safety and health, place risks involving sudden or immediate consequences under safety and risks involving chronic exposure or delayed consequences under health.

In all, these 92 subjects generated 460 risks. Many, however, were described identically. For example, 13 subjects used the single word "cancer" to describe one of their top five risks, while 25 subjects used the single word "AIDS." That left 229 unique risks (including singular and plural versions of a given risk). The first two authors independently classified these 299 risks, using the five principles outlined above. After comparing their classifications, they created a consensus code for each of the 299 risks. Finally, we calculated the percentage of occasions that each coder's independent classification had agreed with the consensus code, weighting each risk according to the number of times that it appeared in the full set. The two coders had weighted agreement scores of 93.3% and 96.5%.

Seven other members of our research team then coded the 299 unique risks.<sup>8</sup> Their weighted agreement scores (with our consensus code) ranged from 71.1–88.7%, with a median of 87.0% and a mean of 83.0%. Thus, our coding scheme provided a reliable basis for classifying the large and diverse set of risks generated by our subjects.

#### 4.3. Results and Discussion

Table III shows how frequently the different types of risks were mentioned. At level 1 of our hierarchy, environmental risks were mentioned most often (44.1%), followed by health risks (22.8%), safety risks (22.4%), and societal risks (10.7%). At the lower levels (2 or 3 of the hierarchy), the 10 most commonly mentioned risks were: air pollution (7.6%), substance abuse (7.4%), water pollution (7.0%), motor vehicle accidents (6.7%), sexually transmitted disease (5.9%),<sup>9</sup> toxic/hazardous chemicals (5.2%), cancer and heart disease (4.8%), solid

<sup>8</sup> Six of these coders were Ph.D. students or postdoctoral fellows in Engineering and Public Policy; the seventh was a graduate student in Public Health.

<sup>9</sup> AIDS accounted for 5.4% of all risks mentioned.

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waste (4.8%), ionizing radiation (4.8%), and fire/explosion (3.3%).

In order to make the comprehensive list of Table III more comprehensible, Table IV breaks it down at two levels of aggregation, as well as providing a breakdown by gender and generation. The top four lines present the four Level 1 categories. The rest of the table presents a selection of more detailed categories. These were chosen because they were mentioned frequently, because they had current public policy interest, or because they were very different from other category members (e.g., war among societal risks).

In both parts of the table, the concerns of the different population subgroups were generally quite similar. One modest gender difference was in the relative frequency of mentioning different top-level categories ( $\chi^2(3) = 8.4, p = 0.04$ ). Women mentioned environmental risks much more than men, whereas men were more likely to mention safety and health risks. There was no significant overall effect in the bottom part of the table ( $\chi^2(9) = 12.3, p = 0.20$ ). Women were, however, more likely to mention all three types of environmental risks, whereas men mentioned more risks falling

into the *safety-other* category, which included a variety of safety hazards arising in the home and workplace which men seem more likely to face.

There were also some weak generational differences. In the top part of the table, students mentioned environmental risks more often than did subjects in the parent and grandparent groups ( $\chi^2(6) = 12.3, p = 0.06$ ). In the lower half of the table, students mentioned all three types of environmental risks more frequently (although their parents were equally likely to mention *large-scale ecological risks*), whereas the older generations were more likely to mention *health-other*, *safety-other*, and *societal-other* risks ( $\chi^2(18) = 24.5, p = 0.14$ ). Parents and grandparents produced 80% of all mentions of cancer and heart diseases (category 110). Grandparents provided five of the six mentions categorized as social/ethical/cultural risks involving the elderly (430), while one parent mentioned the sixth (being a burden in old age).

In short, students were more concerned about long-term environmental risks, whereas older respondents were more likely to mention the more mundane risks to health, safety, and personal and societal well-being that become

Table IV. Types of Risks Mentioned by Gender and Generation in Experiment 2\*

| Type of risk                 | Gender |       | Generation |        |          | All subjects |
|------------------------------|--------|-------|------------|--------|----------|--------------|
|                              | Female | Male  | Student    | Parent | GrandPar |              |
| Health                       | 21.4%  | 25.6% | 18.1%      | 25.0%  | 26.8%    | 22.8%        |
| Safety                       | 21.1   | 31.1  | 18.8       | 25.0   | 26.0     | 22.4         |
| Environment                  | 47.5   | 31.1  | 54.4       | 38.4   | 35.4     | 44.1         |
| Society                      | 10.1   | 12.2  | 8.7        | 11.6   | 11.8     | 10.7         |
| Health                       |        |       |            |        |          |              |
| Substance abuse              | 6.8    | 8.9   | 6.0        | 7.9    | 8.7      | 7.4          |
| Sexual disease               | 5.3    | 5.6   | 4.7        | 6.7    | 5.5      | 5.9          |
| Other                        | 9.2    | 11.1  | 7.4        | 10.4   | 12.6     | 9.6          |
| Safety                       |        |       |            |        |          |              |
| Transportation               | 10.1   | 8.9   | 9.4        | 9.8    | 10.2     | 9.6          |
| Natural hazards              | 2.4    | 3.3   | 2.0        | 3.1    | 2.4      | 2.4          |
| Other                        | 8.6    | 18.9  | 7.4        | 12.2   | 13.4     | 10.4         |
| Environment                  |        |       |            |        |          |              |
| Conventional pollution       | 22.6   | 13.3  | 26.9       | 17.1   | 17.3     | 21.1         |
| Exotic pollution             | 13.4   | 10.0  | 16.1       | 9.8    | 13.4     | 12.6         |
| Large ecological and other - | 11.6   | 7.8   | 11.4       | 11.6   | 4.7      | 10.4         |
| Society                      |        |       |            |        |          |              |
| War                          | 3.0    | 3.3   | 4.7        | 1.8    | 2.4      | 3.0          |
| Other                        | 7.1    | 8.9   | 4.0        | 9.8    | 9.5      | 7.6          |
| Column N                     | 337    | 90    | 149        | 164    | 127      | 460          |

\*Table entries are column percentages. Column N refers to number of risks.

more evident as one experiences more of life. Although these are plausible intergenerational differences, they may be partially due to the students having been recruited from a high school ecology class, which emphasized environmental issues.

#### 4.3.1. Willingness to Pay

The rightmost column of Table V shows willingness-to-pay judgments elicited with the same procedure as in Experiment 1. At the highest level of aggregation, health risks evoked the largest judgments. The mean response of 3.68 indicates that subjects were willing to pay, on average, almost a month's salary to eliminate the health risks that they had mentioned. Societal safety risks evoked mean judgments slightly in excess of a day's pay. Despite being mentioned most often, environmental risks evoked the smallest average WTP judgment, slightly less than one day's pay. A one-way analysis of variance indicated that these differences in WTP across the four top-level risk types were statistically significant ( $F(3,415)$

$= 6.24, p < 0.001$ ).<sup>10</sup> One possible reason for the lower WTP judgments with environmental risks is that they often posed a diffuse threat to people in general, whereas the other risks generally posed more direct threats to the respondent.<sup>11</sup> One possible explanation of the lower mean WTP judgments for environmental risks in this study, compared with Experiment 1, is that the primary effect of forcing subjects to focus on those risks was to bring less important risks on to their agenda.

A similar picture emerges with the willingness-to-pay data for specific risk types (bottom on Table V). Interestingly, subjects were willing to pay less to avert the risk of war than to avert other social risks. Possibly, subjects viewed war as posing a diffuse risk to society in general, unlike the other social risks which tended to be more personal. Possibly, they had more trouble imagining an investment that would reduce the risks of war.

<sup>10</sup> Introducing Generation and Sex of subject as covariates increased the level of significance.

<sup>11</sup> In addition, some respondents may have been reluctant to pay to reduce environmental problems if those were perceived as having been caused by others who benefited from their creation.<sup>(16)</sup>

Table V. Perceived Efficacy and Willingness-to-Pay as a Function of Risk Type in Experiment 2

| Type of risk               | Efficacy <sup>a</sup> |               |             | Willing-to-pay <sup>b</sup> | N   |
|----------------------------|-----------------------|---------------|-------------|-----------------------------|-----|
|                            | I can do              | Anyone can do | I have done |                             |     |
| Health                     | 3.04                  | 4.01          | 3.38        | 3.68                        | 105 |
| Safety                     | 2.46                  | 3.77          | 2.73        | 3.19                        | 103 |
| Environment                | 2.46                  | 3.94          | 2.17        | 2.85                        | 203 |
| Society                    | 2.33                  | 3.42          | 2.84        | 3.37                        | 49  |
| Health                     |                       |               |             |                             |     |
| Substance abuse            | 3.68                  | 4.27          | 3.44        | 3.68                        | 34  |
| Sexual disease             | 2.59                  | 3.85          | 3.44        | 3.56                        | 27  |
| Other                      | 2.81                  | 3.91          | 3.28        | 3.76                        | 44  |
| Safety                     |                       |               |             |                             |     |
| Transportation             | 2.09                  | 3.84          | 2.80        | 3.42                        | 44  |
| Natural hazards            | 1.09                  | 2.55          | 2.09        | 2.91                        | 11  |
| Other                      | 3.13                  | 4.00          | 2.81        | 3.02                        | 48  |
| Environment                |                       |               |             |                             |     |
| Conventional pollution     | 2.78                  | 4.28          | 2.48        | 2.82                        | 97  |
| Exotic pollution           | 2.07                  | 3.57          | 1.77        | 2.82                        | 58  |
| Large ecological and other | 2.29                  | 3.73          | 2.00        | 2.96                        | 48  |
| Society                    |                       |               |             |                             |     |
| War                        | 1.64                  | 4.00          | 2.07        | 2.79                        | 14  |
| Other                      | 2.62                  | 3.18          | 3.14        | 3.60                        | 35  |

<sup>a</sup>1 = not much; 5 = a lot.

<sup>b</sup>1 = not much; 2 = an hour's pay; 3 = a day's pay; 4 = a month's pay; 5 = a great deal.

#### 4.3.2. Perceived Efficacy

We measured beliefs regarding the opportunities to control these risks by asking, "To what extent is this a risk that *you personally* can do something about, especially as the risk applies to you or your family." Subjects responded on a 5-point scale anchored at 1 = "I can't do much" and 5 = "I could do a lot." Similarly, we asked, "To what extent is this a risk that *anyone anywhere* can do something about?" Here the scale endpoints were 1 = "little can be done" and 5 = "a lot can be done."

Responses to the "anyone anywhere" question generally indicated a belief that much can be done to reduce most risks (top section; Table V), with the least optimism regarding societal risks. Comparing adjacent cells in the first two columns of Table V shows that subjects had less faith that they personally could reduce these risks. They saw themselves, like society, as having the greatest control over health risks and the least control over societal risks. Analysis of variance revealed a statistically significant Type-of-Risk effect for both "anyone anywhere can" ( $F(3,415) = 2.85, p = 0.04$ ) and "you can" ( $F(3,415) = 4.47, p = 0.004$ ).<sup>12</sup> The tendency to perceive less personal efficacy than societal efficacy (you can < anyone can) was also statistically significant ( $F(1,374) = 124, p = 0.001$ ).

One interesting result in the more detailed summaries is that natural hazards were judged least controllable for either individuals (you can) or society (anyone anywhere can). Second, subjects believed that both they and society could do the most to control substance abuse (alcohol, drugs, and tobacco), perhaps surprising given societal concern over these problems. On the other hand, subjects saw themselves as able to do little about pollution risks, but society was able to do much. The risks of war showed the same pattern in perceived controllability.

#### 4.3.4. Risk Management Actions Taken

Respondents were asked, "Within the limits of what you could personally do about this risk, how much have you already done?" The endpoints of this scale were 1 = "I have not done very much" and 5 = "I have done all I can do." This is a complex question because subjects are asked to gauge what they have done against what they could do. A high rating is possible even when

subjects have done very little, if that is all that they could do. For the health, safety, and societal risk categories (Table V), average "I have done" judgments were greater than average "I can do" responses, indicating that many subjects properly understood the conditional nature of the "have done" questions.

Subjects reported having done the most to exploit their opportunities to control health risks and the least regarding environmental risks. Across the four categories, the differences were statistically significant ( $F(3,415) = 14.0, p < 0.001$ ).<sup>13</sup> In the lower part of the table, the highest "have done" scores were for the three types of health risk. The lowest were for natural hazards, exotic pollution, large-scale environmental and ecological problems, and war. Thus, subjects saw themselves as having done the most of what they could regarding risks posing the most direct threat to their personal well-being and the least with respect to risks posing a diffuse threat to the environment or to people in general.

#### 4.3.5. Perceived Responsibility

We next asked subjects, "Whose responsibility should it be to control the risk that you (and your family) experience from this risk? Feel free to check more than one response." The possible answers were: my own, local or state government, federal government, industry, private individuals, or others.

Table VI displays responses to these questions. Subjects generally ascribed greater responsibility to themselves and to state/local and federal government than to industry or other private individuals—except for environmental risks, where government and industry bore primary responsibility. A multivariate test indicated that this Risk Category-by-Agent of Responsibility interaction was statistically significant ( $F(12,1198) = 13.0, p < 0.001$ ).

The lower part of the table reveals a complex pattern, with responsibility varying across risks, even within the same top-level risk category. For example, subjects saw themselves as primarily responsible for dealing with substance abuse and health/other risks, but held the federal government responsible for dealing with the risk of sexual disease. Most sexual disease references were to AIDS, where the federal government has played a leading role in both research and information dissemination. Subjects held state and local government responsible for

<sup>12</sup> Both effects remained statistically reliable when Generation and Sex of subject were introduced as covariates in the analysis.

<sup>13</sup> This Type-of-Risk effect remained statistically reliable when Generation and Sex of subject were introduced as covariates in the analysis.

Table VI. Perceived Responsibility as a Function of Type of Risk in Experiment 2\*

| Type of risk                  | Responsibility for controlling risk |                      |                  |          |                        | N   |
|-------------------------------|-------------------------------------|----------------------|------------------|----------|------------------------|-----|
|                               | My own                              | State/Local<br>govt. | Federal<br>govt. | Industry | Private<br>individuals |     |
| Health                        | .68                                 | .39                  | .39              | .15      | .40                    | 105 |
| Safety                        | .46                                 | .45                  | .27              | .26      | .32                    | 103 |
| Environment                   | .32                                 | .45                  | .56              | .52      | .19                    | 203 |
| Society                       | .53                                 | .50                  | .48              | .37      | .45                    | 49  |
| Health                        |                                     |                      |                  |          |                        |     |
| Substance<br>abuse            | .68                                 | .47                  | .32              | .12      | .32                    | 34  |
| Sexual disease                | .63                                 | .63                  | .70              | .22      | .52                    | 27  |
| Other                         | .71                                 | .18                  | .25              | .14      | .39                    | 44  |
| Safety                        |                                     |                      |                  |          |                        |     |
| Transportation                | .34                                 | .61                  | .34              | .23      | .34                    | 44  |
| Natural hazards               | .27                                 | .55                  | .46              | .18      | .46                    | 11  |
| Other                         | .60                                 | .27                  | .17              | .31      | .27                    | 48  |
| Environment                   |                                     |                      |                  |          |                        |     |
| Conventional<br>pollution     | .41                                 | .54                  | .49              | .52      | .21                    | 97  |
| Exotic pollution              | .16                                 | .41                  | .64              | .53      | .10                    | 58  |
| Large ecological<br>and other | .31                                 | .33                  | .60              | .50      | .25                    | 48  |
| Society                       |                                     |                      |                  |          |                        |     |
| War                           | .21                                 | .36                  | 1.00             | .14      | .21                    | 14  |
| Other                         | .66                                 | .60                  | .51              | .17      | .29                    | 35  |

\*Each table entry indicates the proportion of respondents who indicated that the actor in question bore a responsibility for controlling the type of risk in question. Subjects were instructed to assign responsibility to two or more actors in cases where that seemed appropriate to them. Thus, row proportions do not sum to 1.

transportation and natural hazard risks, but saw themselves as responsible for other safety risks (mainly accidents in the home or workplace). Finally, every subject who listed war as one of their top five risks of concern saw the federal government as bearing responsibility for controlling this risk, while only one in five reported bearing personal responsibility.

#### 4.3.6. Amount of Information

The final items in the survey read: (a) "The amount of information, both useful and not, that I have gotten on this risk is: little; some; lots." (b) "The information I have received on this risk has included: little of what I needed; some of what I needed; all that I needed."

As shown in Table VII, 69% of respondents reported having "lots" information about health risks, whereas none claimed to have "lots" of information about the risks of war (and 54% reported having only

"little"). That pattern was reversed for other societal risks and most health and safety risks (except for sexually transmitted diseases, which were in the middle). They reported having intermediate amounts of information about environmental risks. A log-linear analysis indicated that the association between amount of information and type of risk was statistically significant for both the top-level risk categories ( $\chi^2(6) = 20.4, p = 0.002$ ) and the more specific categories ( $\chi^2(20) = 56.4, p < 0.001$ ).

Judgments of the "information I have received [relative to what] I need" also varied considerably across risks. For all risk types, the most common response was "some of the information that I need." Subjects were most likely to report that they had all the information that was needed for substance abuse, safety risks, and societal risks (other than war). They were least likely to make this claim for war and environmental risks. A log-linear analysis indicated that the association between type of risk and responses to this question was statistically

Table VII. Amount of Information as a Function of Type of Risk in Experiment 2<sup>a</sup>

| Type of risk               | Amount of information available |      |      | Amount of information relative to need |      |     | Ns    |
|----------------------------|---------------------------------|------|------|--|------|-----|-------|
|                            | Little                          | Some | Lots | Little                                 | Some | All |       |
| <b>Health</b>              |                                 |      |      |  |      |     |       |
| Substance abuse            | 9                               | 22   | 69   | 0                                      | 65   | 35  | 32/31 |
| Sexual disease             | 8                               | 58   | 35   | 8                                      | 73   | 19  | 26/26 |
| Other                      | 14                              | 31   | 55   | 15                                     | 61   | 24  | 42/41 |
| <b>Safety</b>              |                                 |      |      |  |      |     |       |
| Transportation             | 25                              | 36   | 39   | 21                                     | 49   | 30  | 44/43 |
| Natural hazards            | 9                               | 45   | 45   | 9                                      | 55   | 36  | 11/11 |
| Other                      | 20                              | 38   | 42   | 16                                     | 43   | 41  | 45/44 |
| <b>Environment</b>         |                                 |      |      |  |      |     |       |
| Conventional pollution     | 17                              | 55   | 28   | 14                                     | 72   | 15  | 88/81 |
| Exotic pollution           | 26                              | 54   | 20   | 29                                     | 55   | 16  | 50/49 |
| Large ecological and other | 15                              | 46   | 39   | 21                                     | 64   | 15  | 41/39 |
| <b>Society</b>             |                                 |      |      |  |      |     |       |
| War                        | 54                              | 46   | 0    | 38                                     | 54   | 8   | 13/13 |
| Other                      | 6                               | 45   | 49   | 12                                     | 55   | 33  | 33/33 |

<sup>a</sup>Table entries are row percentages for the item in question. The row Ns gives the number of responses to the two questions, respectively.

significant for both the top-level ( $\chi^2(6) = 21.9, p < 0.001$ ) and mid-level categories ( $\chi^2(20) = 43.0, p < 0.002$ ).

#### 4.3.7. Relations Among Dependent Variables

Correlations among the 12 dependent measures were generally quite weak. With such a large sample, even rather small correlations can be significantly different from zero.<sup>14</sup> Restricting attention to correlations explaining 10% of variance yielded the following results:

- Subjects' reported risk-reduction efforts were correlated with their perceived ability to take effective action ( $r=0.38$ ) and their perceived responsibility to do so ( $r=0.42$ ). They were only modestly correlated with the perception of having enough information ( $r=0.23$ ).
- What subjects see themselves as able to do is also correlated with what they see anyone anywhere as

capable of doing ( $r=0.33$ ) and with what they find themselves responsible for ( $r=0.41$ ).

- The more information that subjects reported having, the more likely they were to report having enough information ( $r=0.56$ ).

## 5. CONCLUSION

Methodologically, these studies offer a measurement procedure and coding scheme that could be applied in a variety of circumstances for examining what risks concern people and what factors determine those concerns. Although our coding structure was based on the responses of our subjects, we took pains to make it generally applicable. Despite its complexity, our coding scheme can apparently be employed reliably.<sup>15</sup>

Substantively, the two experiments produced several interesting empirical results. First, subjects reported concern over a very broad range of risks. In Experiment

<sup>14</sup> In computing these correlations, we treated the ratings of each risk mentioned as a vector of data. Thus, each correlation is based on more than 400 observations.

<sup>15</sup> Although trained in a variety of disciplines, our coders were all members of a research group focused on risk management. With a less informed group, more training might be needed to achieve the reliability levels achieved here.

1, where their selections were unrestricted, risks to health, safety, and environment were mentioned infrequently. Specifying this domain in Experiment 2 still left a total of 299 different concerns. Among them, environmental risks were mentioned most often, followed by health and safety risks, with societal risks ranking last. The salience of environmental concerns may have been heightened for the student subjects here, who were recruited through a high school ecology class.

Second, risks of concern differed in plausible ways as a function of gender and generation. Females and student-age subjects were generally more concerned about the environment, whereas males and older subjects were more likely to mention health and safety risks.

Third, both willingness-to-pay and the extent of past risk-reduction actions ("have done") were greater for risks that present a direct personal threat (e.g., health risks) than for risks that pose a threat to the environment or to people in general (e.g., exotic pollution).

Fourth, people perceived themselves as bearing primary responsibility for managing threats to their health, but generally saw government as bearing a heavier responsibility for managing environmental risks and war.

Finally, people attach the greatest priority and are most likely to act on risks where they feel efficacious and responsible *and* have the information needed to take effective action.

Overall, we believe that we have developed a credible procedure for measuring the content and structure of people's concerns. With more systematic sampling, this procedure could be used to direct risk communications (by identifying the topics of greatest concern) or to evaluate risk communications (in terms of how they have affected priorities). With modest changes in the initial risk-nomination task, it could be used to study perceptions of risks that do not rank high among individual subjects' concerns, but which are important to other subjects or to risk experts. In time, one might be able to understand whether risks reach the list of concerns by virtue of being understood or not, of seeming controllable or not, and so on.

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