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Perceptions of Risk in the Management of Nuclear Wastes: Mapping Elite and Mass Beliefs and Attitudes

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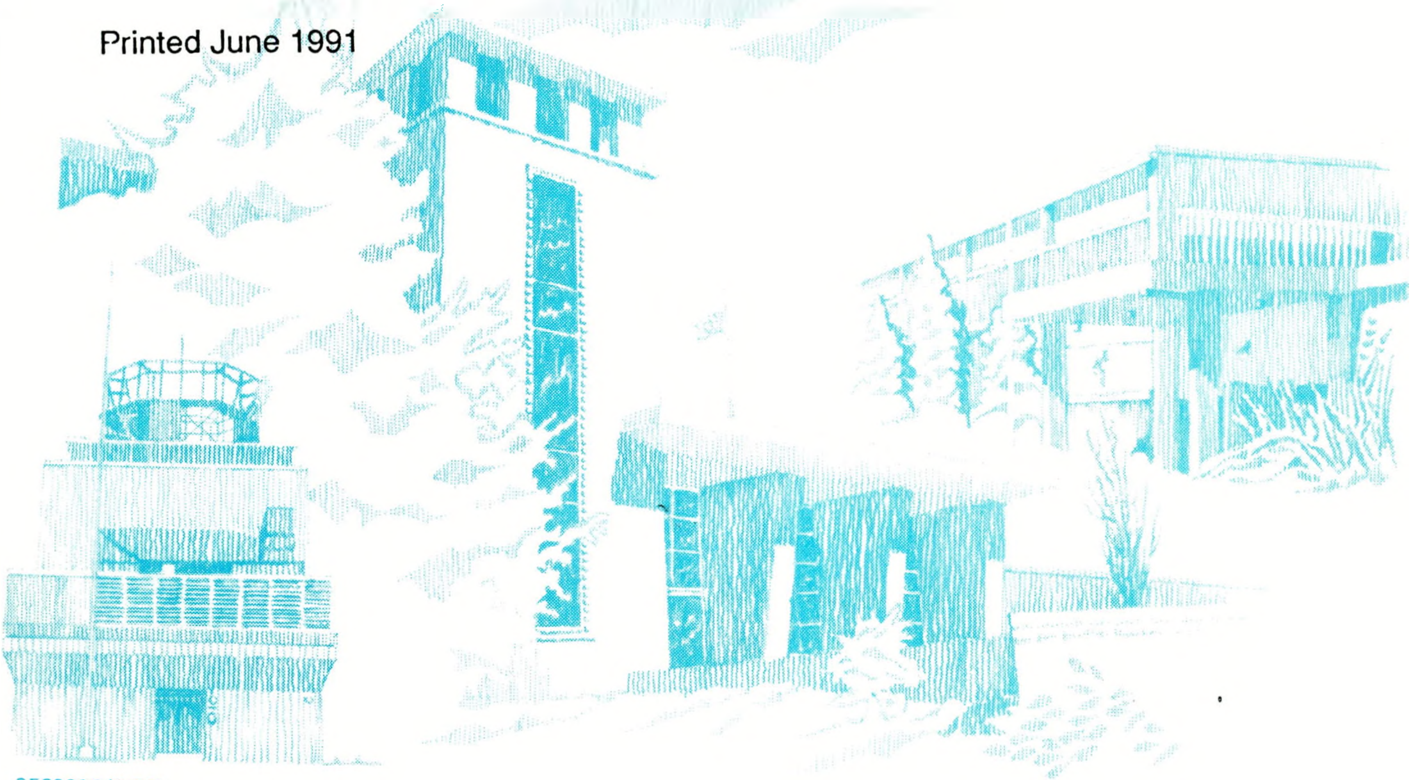
Prepared by Sandia National Laboratories Albuquerque, New Mexico 87185
and Livermore, California 94550 for the United States Department of Energy
under Contract DE-AC04-76DP00789

Printed June 1991



SF2900Q(8-81)

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SAND90-7002
Unlimited Release
Printed June 1991

SAND--90-7002

DE91 015370

PERCEPTIONS OF RISK IN THE MANAGEMENT OF NUCLEAR WASTES: MAPPING ELITE AND MASS BELIEFS AND ATTITUDES*

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ABSTRACT

This report describes the results of a set of five surveys designed to assess the perceived risks of nuclear waste management policy in Colorado and New Mexico. Within these states, mail surveys of randomly selected samples were taken of members of the American Association for the Advancement of Science, members of the Sierra Club, members of business associations, and state legislators. In addition, a telephone sample of randomly selected households was conducted in Colorado and New Mexico.

Using these data, the perceptions of the risk of nuclear waste management -- from production of nuclear energy through permanent storage of nuclear wastes -- are compared for each of the five samples. The degree of trust in, and the perceived political influence of, the more prominent policy actors are assessed (including the U.S. Department of Energy, the Environmental Protection Agency, national environmental groups, national laboratories, and others). Certain cognitive attributes, including degree of subjective certainty regarding beliefs about risks of nuclear wastes, and likelihood of altering perceived risks when confronted with new information, are compared across samples. In addition, the sample scores from rudimentary knowledge tests about the characteristics of radiation are compared. The relationships among the knowledge scores, cognitive attributes and risk perceptions are evaluated.

Perceptions of the balance of media coverage (including national and local television news and newspapers) are measured, as are the possible direct and indirect roles of media exposure in risk perception. Aggregate models, testing an array of hypotheses about the bases of nuclear waste risk perceptions, are conducted. These tests indicate that risk perceptions are related to a complex set of factors, and that these factors may differ significantly across the different subpopulations (e.g., political ideology is an important indicator of risk perception for legislators, but not for scientists). Finally, the relationships between risk perception and political participation -- including registering to vote, political party affiliation, and level of political activism -- are analyzed.

* The work described in this report was done for Sandia National Laboratories under Contract No. 69-1002.

ACKNOWLEDGEMENTS

This report is made possible through funding provided by Sandia National Laboratories. Its contents, including analyses and conclusions, are those of the authors, and do not represent the policies or positions of Sandia National Laboratory.

We received assistance from many people in the process of completing this project. First and foremost, we thank Tracy Adams, whose technical and coordinating skills kept the project on track. We received crucial help from Dr. Leo Gomez, Dr. Richard Lynch, Dr. A. William Snyder, and Dr. Regina Hunter of Sandia National Laboratories, and Dr. Richard Barke of the Georgia Institute of Technology. Allison Conway, Albert Jiron, Kenneth Miller, Stacie Robb, Walter Smith, and Gilbert St.Clair of the University of New Mexico's Institute for Public Policy also helped us greatly when we needed it most. Roger James and Carol Silva, both at the University of Rochester, helped with the early stages of the project.

The Sierra Club chapters in New Mexico and Colorado graciously assisted us by providing random samples of their membership lists, as did the American Association for the Advancement of Science, the Colorado Chamber of Commerce, and the New Mexico Association of Commerce and Industry. We are also deeply indebted to the thousands of individuals who took the time to respond to our surveys.

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CHAPTER 1

STUDY BACKGROUND AND PURPOSE

This project was undertaken in an effort to better understand the bases of citizen and elite perceptions of the risks associated with the management of nuclear wastes. Our concern is with *what* people believe about risks of nuclear waste management: How *risky* is it? Can such wastes be *safely* managed with existing technologies? How *trusted* are those charged with the management of federally-produced nuclear wastes?

The project was designed to assess differences in perceptions of risk among members of the general public and several "elite" groups that tend to be more extensively involved in setting nuclear waste policy including: the scientific community, members of environmental groups, members of business associations, and state legislators.[1] What are the differences and similarities among the scientific, environmental, business and legislative groups? Which holds beliefs and attitudes that are most similar to -- and most at variance with -- those held by the general public?

Of particular interest is the process by which individuals receive and assimilate information about nuclear waste issues. Do they perceive the information provided by the media -- print and broadcast -- as biased? Do they perceptually screen information to give particular messages greater weight in shaping opinions than others? How certain are they about the risks associated with nuclear wastes, and what kinds of opinions are held with greatest certainty?

In addition, the project was devised to provide insight into the processes by which people form their perceptions of the riskiness of nuclear waste management. To what degree is this perception the byproduct of deeply held ideological values? In what measure is it the result of a particular perception of the severity of environmental problems and our society's ability to deal with those problems? What is the effect of the individual's trust in various organizations that play leadership roles in the nuclear waste policy debate? Finally, how does the level of knowledge -- measured both as the general level of education and as knowledge of basic radiobiological processes -- relate to perceptions of the risks associated with nuclear waste management?

The foci of the project are the states of Colorado and New Mexico. These states were chosen for two reasons. They are both "nuclear states," in that both have significant industrial utilization of nuclear materials and both have extensive federal facilities that produce and/or utilize such materials. Both have been the focus of intense political conflict over the production, use and disposal of federal nuclear wastes. These characteristics assure that citizens of these states have had ample opportunity for exposure to extensive debate over the issues associated with nuclear wastes, as well as to the presentation of that debate by the media and the various political actors involved in the policy process.

Overall the project is intended to assess the "cognitive maps," or relationships among basic values, beliefs and causal perceptions, information processes and policy

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[1] For our purposes, an "elite" group is one whose members tend to be more extensively involved, better informed, and generally more influential in policy making than is true of the average citizen.

perceptions, for the nuclear waste issue among the general public, scientists, environmental group members, members of business associations, and state legislators. It is our hope that all participants in the debate will be able to make constructive use of these findings in attempts to formulate reasonable and effective policies for the management of nuclear wastes.

1.1 STUDY DESIGN

In order to tap the cognitive maps applicable to an issue as complex as that of nuclear waste management, it is first necessary to construct a reasonable representation of the primary categories generally used to grasp the issue and to delineate the dimensions of agreement and dispute that characterize debate over the issue.[2] The primary dimensions of belief and dispute within the nuclear waste policy subsystem were developed through the use of focus group sessions with members of two primary elite groups -- members of environmental groups and of industrial/business groups. Members of our research team used the results of the focus group sessions to develop questions that would tap the primary themes uncovered by the focus group analysis. The objective was development of a questionnaire that captures the crucial values (and value rankings), fundamental policy positions (e.g., appropriate divisions of power, distributions of wealth, etc.) and specific policy positions relevant to the nuclear waste issue. The basic questionnaire developed through this process is shown in Appendix A.[3]

Using the questionnaire developed from the focus groups, stratified mail surveys of the four elite groups were conducted, including (a) a representative sample of the members of the Colorado and New Mexico physics, biology, geology, chemistry, medicine, and engineering sections of the American Association for the Advancement of Science (hereafter referred to as "scientist sample" or "scientists"); (b) representative samples of the memberships of the Colorado and New Mexico chapters of the Sierra Club (hereafter referred to as "environmental group member sample" or "environmentalists"); (c) representative samples of the members of the Colorado Chamber of Commerce and the New Mexico Association of Commerce and Industry[4] (hereafter referred to as "business sample" or "business association members"); and (d) the entire bodies of the Colorado and New Mexico state legislatures (hereafter referred to as "legislator sample" or "legislators").

The mail surveys were conducted using the "Total Design Method," employing an advance notice letter, a survey with cover letter, a second wave of surveys for those not responding to the initial wave within three weeks, and a follow-up sum-

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2 Note that this assessment of categories and dimensions of dispute and agreement are *not* intended to be an "objective" representation of the characteristics of the issue. Rather they are to tap how people generally *perceive* the issue. For a discussion of the issues involved in understanding and measuring cognitive maps, see R. Axelrod, *Structure of Decision: The Cognitive Maps of Political Elites* (Princeton, NJ: Princeton University Press, 1976).

3 The demographic section of the questionnaire was varied for each of the different subgroups. In addition, the telephone sample of the general public included a question asking the respondent to identify "the most important problem" confronting their states at that time.

4 New Mexico has no state-wide Chamber of Commerce, so the Association of Commerce and Industry was selected as the business group most comparable to Colorado's Chamber of Commerce.

mary of the survey results for those respondents who requested it.[5] The initial sample sizes and the response rates for each of the mail surveys are shown in Table 1.1.

Table 1.1: Mail Sample Sizes and Response Rates

Population	Stratification	Sample Size	Response
Legislators	Colorado	100	43 (43%)
	New Mexico	113	55 (52%)
Scientists	Colorado	923	570 (67%)
	New Mexico	590	441 (75%)
Environmentalists	Colorado	757	461 (61%)
	New Mexico	749	486 (65%)
Business Association Members	Colorado	1310	615 (47%)
	New Mexico	377	206 (55%)

In addition to the mail surveys, the questionnaire was applied via telephone interviews to two randomly selected samples of households in Colorado and New Mexico in June, 1990 (hereafter referred to as "general public sample" or "general public"). Due to the limits on length of telephone surveys, some of the questions from the mail survey were omitted from the telephone questionnaire. The telephone survey was conducted by the UNM Institute for Public Policy's Survey Research Center (SRC), using the SRC's computer-assisted telephone interviewing system. The sampling frame for New Mexico was prepared by the SRC, and the Colorado sampling frame was obtained from Survey Sampling Inc. of Fairfield, Connecticut. The telephone survey consisted of 588 respondents from New Mexico, and 510 from Colorado.[6]

1.2 Study Methodology and Limitations

We have attempted to quantify public attitudes, beliefs, and policy preferences through standard use of focus group and survey analysis. As with any such project, the limitations of the analysis must be kept in mind when interpreting the results.

In part, the limitations from studies of this kind stem from the difficulties associated with *quantifying* attitudes, beliefs and perceptions. These phenomena tend to be more complex and varied than standard quantitative scales or categories are capable of measuring. This problem is compounded when the wide diversity of individuals sampled requires that the questions be posed to those who have an average background, education level, and interest in the area of concern. The result is that

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[5] For a discussion of mail survey methodology, see E. Babbie, *Survey Research Methods, 2nd Ed.* (Belmont, CA: Wadsworth Publishing Co., 1990): pp. 176-186.

[6] Note that the populations identified for this research are overlapping; businesspersons can be environmentalists and/or scientists, and *all* are part of the general public.

the survey response categories will be most confining to the most highly educated or thoughtful of the respondents.[7]

The result is that the responses to the questions are best interpreted as *proxy measures* for the beliefs, attitudes and policy positions that one seeks to measure. As such, our measures provide a reasonable basis for understanding the patterns of relationships among the variables measured and differences across samples, but *should not* be taken as equivalent to a referendum of the issue of nuclear waste.

In addition to the limits associated with the quantification of complex concepts and beliefs, bias in the sample responses may result from sampling error. In order to assure that the samples are as representative of their populations as possible, we have employed random selection procedures for all samples. Nevertheless, the sample estimates may depart from the true population parameters due to simple random error. In samples of the size we have employed, the sampling error is in the range of three to four percentage points at the 95% level of confidence. This means that, should samples of the size used here be taken repeatedly, sample estimates would fall within three to four percentage points of the true population parameters 95% of the time.

Because the mail surveys taken of the elite samples were self-administered, they may also be subject to bias due to systematic differences between those who do and do not respond. This posed a significant problem for this research because two of our samples in particular -- the business and legislator samples -- are notoriously difficult to reach through mail surveys. To minimize this problem, we opted for the Total Design Method, as described above, in order to obtain the highest possible response rates. Response rates above 60% are considered quite good; those in the 50% plus range are considered acceptable. Since we had several samples in the 40% to 50% range (see Table 1.1, above), we also employed a tracking technique that compared the responses to the survey questions with the length of time it took to receive the response. The logic is that those who are slowest to respond will be most like those who do not respond at all. Therefore, in samples with lower response rates, we looked for statistically significant relationships between the response lag (number of days between original mailing and receipt of response) and the measured perceptions of risk.[8] In order to be conservative, we checked all samples with response rates of less than 60%. In none of these samples was there a relationship between the response lag and the measurement of perceived risk. Thus we can be reasonably sure that our mail samples are not subject to significant response bias.

Throughout the project, the UNM Institute for Public Policy has maintained the highest standards for survey interviewer training, survey administration, coding and analysis. While these efforts provide no guarantee that our results are error-free, we believe we have kept such errors to a minimum.

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[7] True to these expectations, the highest rate of "talk-back" criticizing the limitations of the questions and response categories came from the most highly educated of our samples -- the scientist sample.

[8] For a discussion of this type of test, see E. Babbie, *op. cit.*, pp. 179-180.

CHAPTER 2

PERCEIVED RISKS OF NUCLEAR WASTE MANAGEMENT

The focus of the project is to discern the perceptions of risk associated with the management of nuclear waste held by an array of distinct populations. As is usually called for in the measurement of variables that can only be perceived indirectly, we have employed multiple indicators of risk perception. Our objective in this chapter is to assess the perceived *level* of the risk, and the perceived *urgency* of ameliorating that risk, for each of five distinct populations. This chapter describes how we measure risk perceptions and provides the distributions of risk perceptions for each population on each measure.

2.1 INDICATORS OF NUCLEAR WASTE RISK PERCEPTIONS

Measurement of the perception of risk associated with an activity is not always a straightforward process. In part the response to "how risky" an event or activity is believed to be may derive from an individual's predisposition toward risk acceptance or risk aversion.[1] A highly "risk averse" individual may perceive great risk in many activities, whereas a "risk seeking" individual may perceive more moderate risks. In addition, when assessing risk from a complex process like nuclear waste management, individuals may perceive quite different levels of risk across the distinct stages of the process.

With these considerations in mind, we have collected multiple indicators of the perceived risk of nuclear waste management. First, we disaggregated the nuclear waste cycle into four stages: (1) the production of nuclear energy, (2) the temporary on-site storage of nuclear wastes, (3) the transportation of nuclear wastes, and (4) the permanent storage of nuclear wastes. The measure was designed to capture the risk associated with each phase of the management of nuclear waste from its production in the creation of nuclear energy to its permanent storage. For each stage, respondents were asked to indicate their perception of the level of risk on the following scale:

1❑ extreme risk 2❑ a lot of risk 3❑ some risk 4❑ slight risk 5❑ no risk

Thus, for each stage, each respondent provided their perception of the level of risk on a numeric, five-point scale.

In addition, in order to control for more general predisposition toward risk, we created a "standardized" measure that is designed to adjust for the level of perceived urgency of reducing risk over an array of potential hazards. For some respondents, *all* potential risks may be perceived as serious threats warranting public action. For others, few if any hazards may call for public action. The logic is that general predispositions toward risk may only be evident over an array of distinct potential hazards. Our array includes six potential hazards, including consumption of saccha-

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[1] For some of the classic literature on this topic, see D. Bernoullie, "Exposition of a New Theory on the Measurement of Risk," *Econometrics*, v. 22 (1954), pp. 23-36; P. Slovic, B. Fischhoff, and S. Lichtenstien, "Response Mode, Framing, and Information-Processing Effects in Risk Assessment," in R. Hogerth (ed.) *New Directions for Methodology of Social and Behavioral Science* (San Francisco: Jossey-Bass, 1982); and A. Tversky and D. Kahneman, "Choices, Values and Frames" *American Psychologist* v. 39 (April, 1984), pp. 341-350.

rin, nuclear energy generation, downhill skiing, genetic engineering, handguns, and coal energy generation.[2] Note that this array includes hazards that may stem from sports accidents, crime, consumption of chemicals, pollution resulting from traditional (coal) energy production, and high-tech biological and radiation sources. The question was introduced as follows:

> Government policies may be designed to reduce many different sorts of risk. For each of the following potential hazards, please indicate how critical it is that government action be taken to reduce that kind of risk, with one being not at all critical and ten being extremely critical.

For each of the identified hazards, and for radioactive waste, the respondent was given a ten-point scale on which to identify the degree of risk represented by the hazard:

Not Critical									Very Critical
1❑	2❑	3❑	4❑	5❑	6❑	7❑	8❑	9❑	10❑

Construction of the standardized risk was accomplished by calculating each respondent's mean response value for the array of six hazards, which was then subtracted from the perceived urgency of reducing the risk of radioactive wastes. A score less than zero would thus represent a position that it is less urgent for government to reduce risks from radioactive waste than from other hazards; a positive value indicates that amelioration of risks of radioactive wastes have a higher priority than do other hazards.

Each of these indicators were calculated and analyzed for each of the five samples. The results are presented in the following sections.

2.1.1 General Public Sample

Responses of the general public to the questions concerning perceived risks associated with the stages of the nuclear waste process are provided in Table 2.1. As is evident from the patterns of responses, the respondents to the general public sample are most concerned about the risks of the transportation of nuclear wastes; fully 65.4% of the respondents perceive transportation of nuclear wastes to pose "extreme" or "a lot" of risk. Second greatest concern was evident about temporary storage, with 58.7% perceiving extreme or "lots" of risk. Comparisons of average scores for all of the hazards, for each sample, are shown in Appendix B.

Table 2.1: Perceptions of Risk in the Stages of the Nuclear Waste Process by General Public
(n=1098)

	1 Extreme Risk	2 A Lot of Risk	3 Some Risk	4 Slight Risk	5 No Risk	Avg Score
Production	29.5%	22.4%	36.5%	8.9%	1.8%	2.31
Temporary Storage	33.4	25.3	29.0	7.8	2.1	2.18
Transportation	39.3	26.1	23.6	8.4	1.6	2.06
Permanent Storage	32.9	23.1	27.5	10.8	3.2	2.26

[2] These types of hazards were selected to span the domains of (a) degree of "dread risk" and (b) degree of "unknown risk" as identified by P. Slovic, "Perception of Risk," *Science*, v. 236 (April, 1987), pp. 280-285.

The general public sample responses to the question concerning the urgency of ameliorating the risks of nuclear wastes are shown in Table 2.2 and Figure 2.1. Generally, as shown on the "standardized urgency of risk" score in Table 2.2, the general public perceives these risks to be in substantially greater need of amelioration than other sorts of risks.

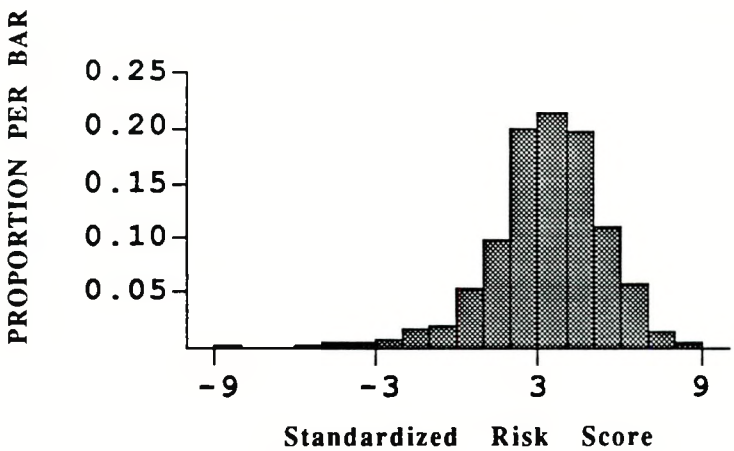
Table 2.2: Perceptions of the Urgency of Government Action to Reduce Risks of Radioactive Wastes by General Public
(n=1098)

	Mean	Range	Std Deviation
Raw Urgency of Risk Score:	8.45	1 - 10*	2.14
Standardized Urgency of Risk Score:	3.25	-9 - +9**	2.02

* A score of 1="not critical"; a score of 10="very critical".

** A score of -9 indicates that government action to reduce risks of radioactive waste is *much less critical* than for other hazards; +9 indicates that actions to reduce risks of radioactive wastes are *much more* critical.

Figure 2.1: Standardized Urgency of Risk Scores, General Public Sample



2.1.2 SCIENTIST SAMPLE

Respondents in the scientist sample perceive less risk in each of the four stages of the nuclear waste management process than does the general public. In fact, the temporary storage of nuclear waste, which scientists perceive to pose the **greatest** risk overall (mean value 2.91) receives a **lower** score than does the **least** risky stage (production of nuclear energy, mean value 2.31) of the general public sample. For this sample, 31.1% of the respondents perceive temporary storage to pose "extreme" or "a lot" of risk. Respondents in the scientist sample evaluate the permanent storage of nuclear waste to be the least risky of any stage, and fully 43.4% perceive it to pose only a "slight risk" or "no risk" at all.

Table 2.3: Perceptions of Risk in the Stages of the Nuclear Waste Process by Scientist Sample
(n=1011)

	1 Extreme Risk	2 A Lot of Risk	3 Some Risk	4 Slight Risk	5 No Risk	Avg Score
Production	7.1%	19.1%	41.2%	32.0%	0.5%	3.00
Temporary Storage	5.4	25.7	43.2	24.3	1.3	2.91
Transportation	7.2	20.9	38.4	31.7	1.7	3.00
Permanent Storage	7.2	18.0	31.4	38.3	5.1	3.16

Scientists also perceive the amelioration of nuclear waste risks as relatively less urgent than does the general public. As shown in Table 2.4, scientists give a standardized risk urgency score of 2.55 to nuclear wastes, compared to 3.25 for the general public sample.

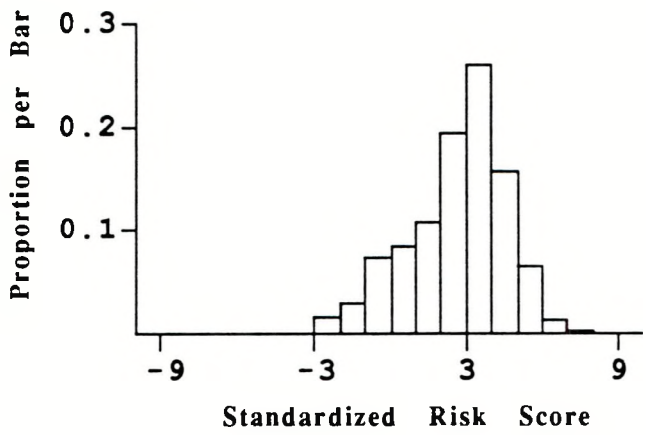
Table 2.4: Perceptions of the Urgency of Government Action to Reduce Risks of Radioactive Wastes by Scientist Sample
(n=1011)

	Mean	Range	Std Deviation
Raw Urgency of Risk Score:	7.66	1 - 10*	2.62
Standardized Urgency of Risk Score:	2.55	-9 - +9**	1.95

* A score of 1="not critical"; a score of 10="very critical".

** A score of -9 indicates that government action to reduce risks of radioactive waste is *much less critical* than for other hazards; +9 indicates that actions to reduce risks of radioactive wastes are *much more* critical.

Figure 2.2: Standardized Risk Urgency Scores, Scientist Sample



2.1.3 ENVIRONMENTAL GROUP MEMBER SAMPLE

More than 67.4% of the respondents in the environmental group member sample perceive **all four stages** of the waste management process to pose "extreme" or "a lot of risk." The transportation of nuclear waste is perceived to be the most risky (mean value 2.00); 71.1% of environmental group member respondents perceive it to pose "extreme" or "a lot of risk." Interestingly, temporary storage is perceived to pose the least risk of the four stages, although more than 67% of respondents perceive it to pose "extreme" or "a lot of risk." In all stages of the waste cycle, the *mean* level of risk is so close that differences are statistically insignificant.

Table 2.5: Perceptions of Risk in the Stages of the Nuclear Waste Process by Environmental Group Member Sample
(n=947)

	1 Extreme Risk	2 A Lot of Risk	3 Some Risk	4 Slight Risk	5 No Risk	Avg Score
Production	35.3%	33.6%	25.6%	6.5%	0.1%	2.05
Temporary Storage	30.9	36.5	28.4	4.1	0.0	2.06
Transportation	37.6	33.5	22.8	5.2	0.0	2.00
Permanent Storage	36.4	33.0	21.7	7.9	0.3	2.02

Turning to Table 2.6, note that the environmental group member sample gives *very* high absolute values to the urgency of action to reduce nuclear waste risks. Yet, when standardized by comparison with other hazards, the urgency falls quite close to that given by the general public sample (Table 2.2). Also note, as shown in Figure 2.3, that there is relatively little variation in the standardized risk urgency scores for environmentalists. Thus, numbers of this group tend to agree on the extremity of the risk.

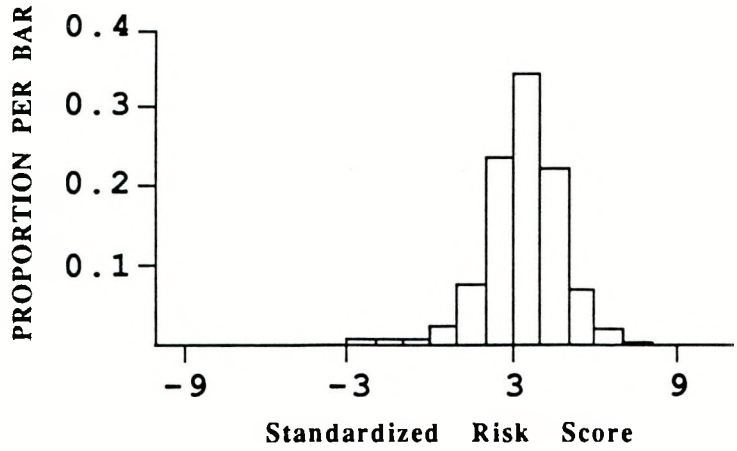
Table 2.6: Perceptions of the Urgency of Government Action to Reduce Risks of Radioactive Wastes by Environmental Group Member Sample
(n=947)

	Mean	Range	Std Deviation
Raw Urgency of Risk Score:	9.23	1 - 10*	1.50
Standardized Urgency of Risk Score:	3.28	-9 - +9**	1.37

* A score of 1="not critical"; a score of 10="very critical".

** A score of -9 indicates that government action to reduce risks of radioactive waste is *much less critical* than for other hazards; +9 indicates that actions to reduce risks of radioactive wastes are *much more* critical.

Figure 2.3: Standardized Risk Urgency Score, Environmental Group Member Sample



2.1.4 BUSINESS SAMPLE

Respondents in the business sample perceive the transportation and temporary storage of nuclear waste to pose the greatest risk (mean value 2.73), where 37.0% evaluate transportation to pose "extreme" or "a lot of risk," and 36.2% of respondents judge the temporary storage of nuclear waste to pose "extreme" or "a lot of risk." The permanent storage of nuclear waste and the production of nuclear energy attained similar mean scores and are perceived to be statistically significantly less risky than the transportation or temporary storage of nuclear waste.

Table 2.7: Perceptions of Risk in the Stages of the Nuclear Waste Process by Business Sample
(n=821)

	1 Extreme Risk	2 A Lot of Risk	3 Some Risk	4 Slight Risk	5 No Risk	Avg Score
Production	9.4%	19.9%	46.7%	22.6%	0.5%	2.85
Temporary Storage	11.6	24.6	42.8	19.1	0.7	2.73
Transportation	13.0	24.0	40.4	20.1	1.7	2.73
Permanent Storage	12.3	22.7	33.7	26.7	3.7	2.87

For the business sample, the absolute value of the urgency of government action to reduce risks of nuclear waste was relatively low -- a score of 7.73. Yet, when standardized, it was relatively close to that of the general public and environmental group member samples. These values are shown in Table 2.8 and Figure 2.4.

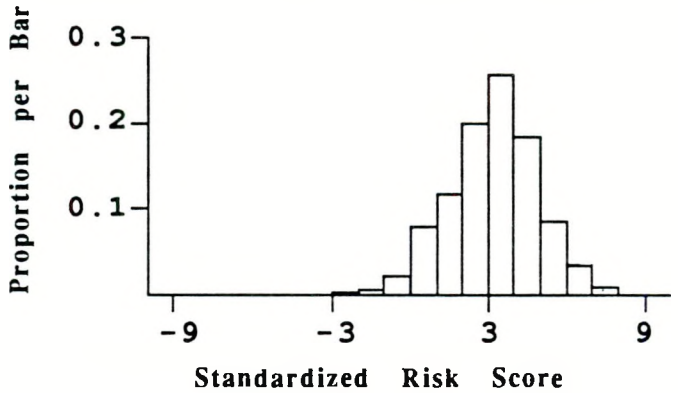
Table 2.8: Perceptions of the Urgency of Government Action to Reduce Risks of Radioactive Wastes by Business Sample
(n=821)

	Mean	Range	Std Deviation
Raw Urgency of Risk Score:	7.73	1 - 10*	2.41
Standardized Urgency of Risk Score:	3.11	-9 - +9**	1.71

* A score of 1="not critical"; a score of 10="very critical".

** A score of -9 indicates that government action to reduce risks of radioactive waste is *much less critical* than for other hazards; +9 indicates that actions to reduce risks of radioactive wastes are *much more* critical.

Figure 2.4: Standardized Risk Urgency Score, Business Sample



2.1.5 LEGISLATOR SAMPLE

For the Colorado and New Mexico legislators, the assessment of the risk posed by the four waste management stages is relatively moderate. The temporary storage of nuclear waste is perceived to pose the greater risk of the four stages; 36.2% of the legislators evaluate it as posing "extreme risk" or "a lot of risk." An interesting result from the legislator sample is the relatively high percentage of respondents who perceive "slight risk" or "no risk" in the nuclear waste process; 35.8% perceive the permanent storage of nuclear waste to pose only "slight risk" or "no risk"; and the most risky, temporary storage of nuclear waste, is still perceived to pose only "slight risk" or "no risk" by 17.1% of the legislator sample.

Table 2.9: Perceptions of Risk in the Stages of the Nuclear Waste Process by Legislator Sample
(n=98)

	1 Extreme Risk	2 A Lot of Risk	3 Some Risk	4 Slight Risk	5 No Risk	Avg Score
Production	9.4 %	18.8%	43.8%	27.1%	1.1%	2.92
Temporary Storage	12.8	23.4	46.8	16.0	1.1	2.70
Transportation	11.7	14.9	39.4	33.0	1.1	3.00
Permanent Storage	12.6	14.7	36.8	31.6	4.2	3.00

Regarding the urgency of government action to ameliorate the risk of nuclear waste, the legislators look remarkably like the scientists. The absolute score is a relatively low 7.3, and the standardized score is also a relatively low 2.73. These results are shown in Table 2.10 and Figure 2.5.

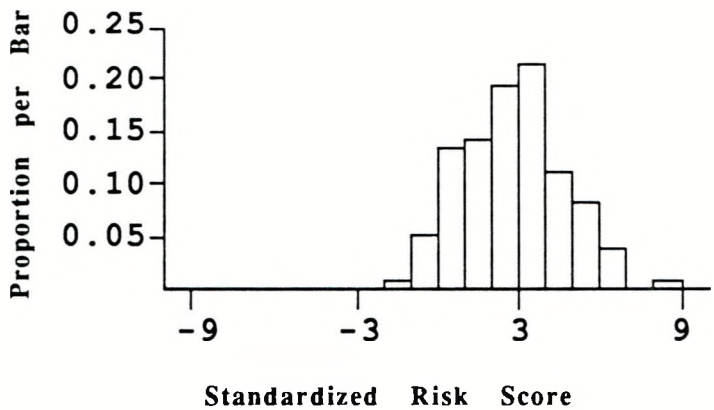
Table 2.10: Perceptions of the Urgency of Government Action to Reduce Risks of Radioactive Wastes by Legislator Sample
(n=98)

	Mean	Range	Std Deviation
Raw Urgency of Risk Score:	7.3	1 - 10*	2.68
Standardized Urgency of Risk Score:	2.73	-9 - +9**	1.83

* A score of 1="not critical"; a score of 10="very critical".

** A score of -9 indicates that government action to reduce risks of radioactive waste is *much less critical* than for other hazards; +9 indicates that actions to reduce risks of radioactive wastes are *much more* critical.

Figure 2.5: Standardized Risk Urgency Score, Legislator Sample



2.2 SUMMARY

There are distinct variations across samples in the perception of the level of risk associated with the various stages of the nuclear waste cycle. The scientists, legislators and business respondents rank **temporary storage** as posing the **greatest** risk, and the general public ranks it second behind transportation. The environmental group members, on the other hand, perceive temporary storage to pose the **least** risk of the four stages.

Looking at perceptions of *overall* level of risk, the environmental group member sample perceives the greatest degree of risk in the nuclear waste process followed closely by the general public sample. However, the stage evaluated by environmental group members as posing the **least** risk (temporary storage; mean value 2.06), is equal to the **greatest** perceived risk of the general public (transportation; mean value 2.06). Of the five samples surveyed, scientists perceive the least overall risk, followed very closely by legislator and business samples. All

three of these samples perceive the permanent storage of nuclear waste to pose the least risk.

The pattern of results from the analysis of the perceived urgency for government action to reduce the risk of nuclear wastes is similar to that of the evaluations of the stages of the waste management process. The environmental group member sample perceives the greatest urgency for government action to reduce the risk of nuclear wastes (mean value of 9.23; on a scale where ten represents most urgent). The general population perceives similar levels of urgency (mean value 8.45). Once again, respondents in the legislator, business and scientist samples perceive substantially less urgency for government action with mean values falling between 7.3 for the legislators to 7.73 for the business sample.

All five samples perceive a greater urgency for government action to reduce the risk of nuclear wastes than for other types of hazards, as indicated by the standardized risk urgency scores. The environmental group members perceive the greatest urgency for the reduction of nuclear waste risk *vis-a-vis* other risks (standardized risk score 3.28) followed closely by the general public (SR score 3.25). The scientists express the *least* difference in relative urgency (SR score 2.55), followed by the legislator sample (SR score 2.73). Respondents of the business sample fall in the mid-range with a SR score of 3.11.

In all measures of the perceived risk of nuclear waste management, and the evaluation of the risk of nuclear waste as compared to other risks, the pattern remains constant. The environmental group members perceive the greatest risk, and are closely mirrored by the perception of risks by the general public. Legislators, scientists and business association members tend toward perception of *less* risk.

CHAPTER 3

PERCEPTIONS OF POLITICAL TRUST AND INFLUENCE IN NUCLEAR WASTE POLITICS

Part of our interest is in the degree of trust that individuals from the various populations hold for the actors regularly involved in the nuclear waste management policy making process. Also of concern is the degree to which the levels of trust for the various interest groups and governmental agencies are related to the perceived risks of nuclear waste management.

In this chapter we analyze the levels of trust held by the general public for seven different kinds of policy actors. We also examine the degree to which these actors are "linked" in the public perception -- that is, which actors tend to be lumped together in public perceptions of trust? Next, we examine the relationships between the general public's trust for the various actors and the perceived risks of nuclear waste management. Finally, we provide the measures of trust for the political actors held by each of the elite sample subgroups.

3.1 IDENTIFYING POLITICAL ACTORS AND MEASURING TRUST

In order to identify which actors were most directly and prominently active in the nuclear waste policy making process, an extensive review was conducted of the hearings before Congress over the past five years on nuclear and chemical waste issues.[1] The most prominent participants were, in order of frequency of provision of testimony, representatives of **federal agencies** (the U.S. Environmental Protection Agency and the U.S. Department of Energy), **environmental interest groups** (including the Sierra Club, the Natural Resources Defense Council, the National Wildlife Federation and others), major **business and industrial associations** (such as the Chemical Manufacturers Association and the American Petroleum Institute), and a host of **individual scientists** affiliated with the national laboratories, universities and other organizations.

Based on our review of the Congressional testimony about nuclear wastes, we included measures of trust for the following kinds of political actors: scientists at U.S. National Laboratories, spokespersons for chemical companies, spokespersons for national environmental groups, spokespersons for the U.S. Department of Energy, spokespersons for nuclear power plants, university research scientists, and spokespersons for the U.S. Environmental Protection Agency.

The degree of trust placed in the various actors was assessed by asking survey respondents the following question:

> Suppose that a controversial decision had just been reached about how the nation should manage chemical and nuclear wastes. We would like to know how much trust you would place in statements made by the following officials, where one is not at all trustworthy and ten is completely trustworthy.

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[1] The documentation provided by the *Congressional Information Service* was used to identify each hearing held on nuclear waste issues. The affiliation(s) of each participant in each of the hearings was recorded and used as the basis for identifying the regular subsystem actors.

For all seven of the listed policy actors, respondents were asked to indicate their level of trust on the following scale:

Not at All Trustworthy									Completely Trustworthy
1☐	2☐	3☐	4☐	5☐	6☐	7☐	8☐	9☐	10☐

3.2 GENERAL PUBLIC'S TRUST IN POLICY ACTORS

As shown in Table 3.1, average levels of trust from the general public sample range from a high of 6.7 for university research scientists to a low of 3.2 for chemical company spokespersons. Between extremes are the generally more trusted spokespersons for national environmental groups (6.0), scientists at U.S. National Laboratories (5.8), and spokespersons for the U.S. Environmental Protection Agency ("EPA") (5.8), followed by the somewhat less-trusted spokespersons for U.S. Department of Energy ("DOE") (4.9) and spokespersons for nuclear power plants (3.9).

Table 3.1: General Public's Levels of Trust in Nuclear and Chemical Waste Policy Making

Actor	Average Trust Score	Std Dev.
University research scientists	6.7†	2.3
Spokespersons for national environmental groups	6.0*	2.6
Scientists at U.S. National Laboratories	5.8†	2.6
Spokespersons for the U.S. Environmental Protection Agency	5.8†	2.6
Spokespersons for the U.S. Department of Energy	4.9*†	2.6
Spokespersons for nuclear power plants	3.9*†	2.6
Spokespersons for chemical companies	3.2*	2.4

* Indicates mean value is statistically significantly below mean of next higher ranked actor.
† Indicates that mean is significantly above mean of next lower ranked actor.

Due to variation in the sample responses, care must be taken in inferring from the ranking of sample trust scores to the perceived levels of trust by the general public. As indicated in Table 3.1, the level of trust in university research scientists outstrips that of any other group. However, the next set of actors -- including spokespersons for national environmental groups, the EPA, and U.S. National Laboratory scientists -- are statistically indistinguishable, meaning that one cannot tell from the sample whether the general public places greater or lesser levels of trust among these groups. Spokespersons for these groups ***do*** have levels of trust that are significantly higher than spokespersons for the DOE, nuclear power plants, or chemical companies. DOE, in turn, has trust levels significantly above nuclear power plants and chemical companies. Finally, spokespersons for nuclear power plants are given greater trust than are those of chemical companies.

Overall, these results confirm that the members of the general public hold differing levels of trust for the various actors involved in shaping nuclear waste management policy. We tested five distinct explanations to explore these variations in trust.

First, trust may be related to the basic **demographic attributes** of the respondent, including age, income, and education level. Political awareness and predispositions may result from the years in which the respondent came to political awareness. Younger respondents, for example, may be more favorably predisposed to environmental groups, and less to nuclear power plants (due to the prominence of such highly publicized events as "Earth Day" or the accident at Three Mile Island early in their political experience). Older respondents may be less influenced by such events. Education and income may also be important, affecting the general level of understanding of current events, as well as the perception of the stakes involved in the policy dispute.

Second, **political ideology** may affect levels of trust. In the current ideological cosmos of the United States, individuals who describe their political perspective as "left" or "liberal" tend to distrust nuclear power and those who promote it, while those who opt for "right" or "conservative" designations tend to be less distrustful.[2] In addition, positions taken by the respondents on the more specific issue of environmental regulatory restrictions -- do we have too many or too few -- may underlie positions of trust in the nuclear waste policy debate.

Third, the overall **perception of environmental risk** may affect levels of trust. Individuals who perceive the environment to be under severe stress due to man-made pollutants, such that significant social and economic changes are required in order to avoid environmental catastrophe, may place less trust in those believed to be insufficiently active in promoting those changes. Those perceiving less environmental danger, and less need for drastic change, may put less trust in those calling for extensive change for environmental reasons.

Fourth, a sense of political helplessness, or **political inefficacy**, may affect levels of trust. Individuals who believe that they are able to affect the policies made by public agencies may accord those agencies more trust. Those who feel inefficacious, on the other hand, may be less trusting.

Finally, **exposure to the media** -- both newspapers and television news -- may affect levels of trust. If the media puts out a consistent message -- e.g., that certain organizations are untrustworthy -- then we would expect those most heavily exposed to the media to have less trust in those organizations. Thus, if the media carries a consistent message, it may be transmitted to those who receive the heaviest "dose" of media exposure.

Each of these hypotheses were tested for the general public, using multivariate regression analysis. The results of the hypothesis tests are shown in Table 3.2. Variables for each of the hypothesized explanations for variations in trust were regressed onto the trust scores for each of the policy actors. While the explanatory power of the tests is not large,[3] the test results are interesting. First, the extent of **media exposure** has *no effect* on any of the trust scores. Thus if media has an

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[2] See S. Del Sesto, "Conflicting Ideologies of Nuclear Reactor Safety," *Public Policy*, 28 (Winter 1980): pp 39-70. For a comparative overview of the interaction between ideology and nuclear power politics in different countries, see J. Jasper, *Nuclear Politics: Energy and the State in the United States, Sweden, and France* (Princeton, NJ: Princeton University Press, 1990), pp. 21-38.

[3] The R^2's for the trust models ranged from 0.03 to 0.13, indicating that the independent variables explained from three to thirteen percent of the variance in the measures of trust.

effect, it is more subtle than a direct effect on trust. This is an issue to which we will return in Chapter 5.

Table 3.2: Trust in Political Actors - General Public Sample

	U.S. Nat'l Lab Sci	Chem Co.	Env Gps	DOE	Nuc Plant	Univ Sci	EPA
(R^2)	(0.035)	(0.058)	(0.121)	(0.042)	(0.070)	(0.011)	(0.045)
(N)	(975)	(985)	(990)	(984)	(990)	(986)	(982)
Explanatory Variables							
Ideology & Political Efficacy							
Env. Reg (Q52)	•	•	-.126***	•	•	•	•
Pol Eff (Q51)	•	•	.077**	•	•	•.067*	
Ideology lib/con (Q73)	•	•	•	•	.095**	•	•
Perceptions of Problem Severity & Solutions							
Disaster (Q6)	0.172***	.128***	-.216***	.121***	.132***	•	•
Drastic Change (Q7)	•	-.143***	•	-.077*	-.162***	.078*	•
Demographic Attributes							
Age	•	•	-.065*	•	•	•	-.093**
Income	•	•	•	-.069*	-.069*	•	•
Education	•	•	-.076**	-.100**	•	•	-.111***

* **Indicates statistically significant at 0.05 level.**
** **Indicates statistically significant at 0.01 level.**
*** **Indicates statistically significant at 0.001 level.**

On the other hand, the correlation between ideology and perceived threat to the environment is substantial. For every actor except university scientists and the EPA, the **perception of environmental disaster** (Question 6) is strongly tied to levels of trust. The greater the perception of disaster, the *lower* the trust in DOE, U.S. National Laboratory scientists, nuclear power plant and chemical company spokespersons, and the *higher* the trust in environmental groups. In addition, those who believe we must make "drastic changes in our lifestyle" to keep the environment clean and safe (Question 7) have *less* trust for chemical company, nuclear power plant and DOE spokespersons, and have more trust for university research scientists. **Ideology** as measured by "liberal" to "conservative" self-description (Question 73) affects the level of trust only for chemical company spokespersons; the more "conservative" the respondent, the higher the level of trust. Those who perceive the need for more extensive environmental regulations (Question 52), on the other hand, hold greater trust for environmental groups. Neither the perception of pending environmental disaster nor ideology is associated with the respondents' trust ratings of EPA nor the university research scientists.

As expected, the respondents' **demographic** attributes are correlated with trust levels. *Younger* respondents give more trust to the EPA than do older respondents. The higher the **income** of the respondent, the less trust given to DOE and nuclear power plant spokespersons. The relationships between **education** and

trust are mixed: the higher the education level, the lower the level of trust in DOE, EPA, and environmental groups, and the higher the level of trust in U.S. National Laboratory scientists.

Finally, **political efficacy** is only modestly correlated with trust. The higher the respondent's perceived level of influence over environmental policy, the higher the trust ratings for the EPA and the environmental groups. Those who perceive themselves as less influential had lower trust ratings for these actors.

These results provide some insight into how the general public views the political arena in which nuclear and chemical waste policy are developed. First, note that perceptions of DOE appear to be more *politicized* than those of EPA. One's sense of environmental crisis and belief that we must change our lifestyle to protect the environment are strongly associated with trust in DOE, but not in EPA. This suggests that DOE is generally perceived to have taken an advocacy position in the debate, while EPA is perceived as playing a somewhat more "neutral" role. Second, as expected, demographic attributes are correlated with trust, but in complex ways. The pattern of trust across the age of respondents fits the expectation that younger respondents tend to be more inclined to support the "environmental movement," as indicated by their higher trust in environmental groups and the EPA. The relationships between income and trust seem to support the contention that, as wealth rises, individuals will focus more on "post-material" concerns, such as the environment:[4] as wealth rises, distrust in nuclear power plant spokespersons also rises. Higher education is generally associated with lower levels of trust. Finally, media exposure has no discernible direct relationship with trust levels.

3.3 General Public's Perceptions of Policy Alignments

Levels of trust also can provide insight into who, among the major policy actors affecting nuclear waste policy, tend to be seen as aligned with, or opposed to, one another by the general public. If actors are seen as aligned, then the level of trust given the aligned actors will *tend* to be similar for a given respondent. For groups that are seen as opposed, the level of trust will *tend* to move in opposite directions (higher for one, lower for the other). This pattern of correlations in trust ratings should hold regardless of whether the aligned or opposed groups are seen as trustworthy or untrustworthy.

Tests for alignments can be conducted using cluster analysis, employing correlations of the trust scores for each of the policy actors.[5] For this study, the proximity of groups refers to how highly correlated the trust scores are for any pair of actors. The cluster procedure calculates the most closely aligned pairs of actors, then "agglomerates" by finding the next closest actor, and successively adding more distantly correlated actors. At each addition, the procedure calculates the average euclidean distance between the new actor and the existing "cluster" of actors. The pairing and euclidean distances between points is presented in an intuitively useful manner in a dendrogram (Figure 3.1) that represents the proximities of the actors via the horizontal distance from the vertical axis. The further from the left axis that

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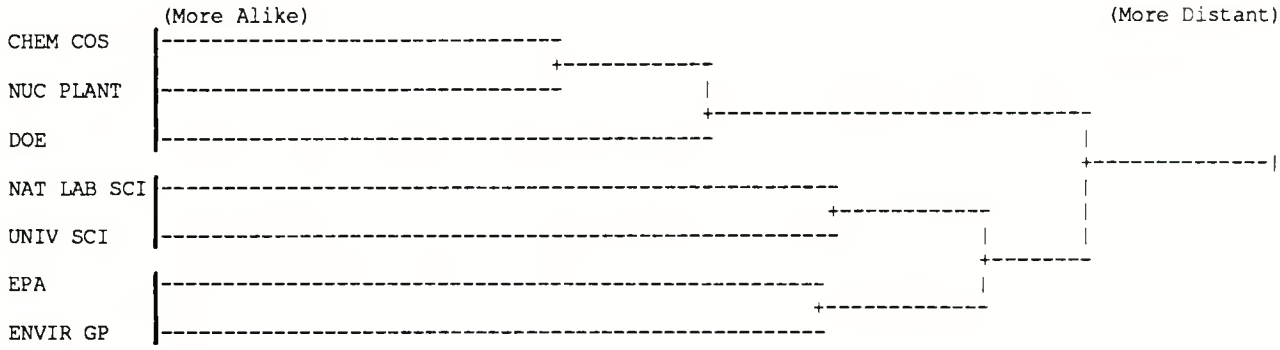
[4] See R. Inglehart, *Culture Shift in Advanced Industrial Society* (Princeton, NJ: Princeton University Press, 1990), where Inglehart argues that the rise of "post-materialist" politics is well underway in the U.S. and in Europe.

[5] For discussion of the use of cluster analysis, see H. Romesburg, *Cluster Analysis for Researchers*. (Belmont, CA: Lifetime Learning Publications, 1984).

two groups are joined (as represented by the "+" symbol), the more dissimilar they are perceived to be. Clusters -- or coalitions -- are evident when there is proximity within subsets of the actors, while the subsets themselves are spaced at considerable distance.

Figure 3.1: Trust Proximities for Policy Activists by General Public



As shown in Figure 3.1, subsets of the policy actors tend to be aligned in the perceptions of the general public. As indicated by levels of trust in their spokespersons, chemical companies and nuclear power plants are seen to be quite similar by the sample respondents. Next in rank of similarity is DOE, which is grouped with the nuclear power plants and chemical companies. A second apparent cluster, more loosely joined than the first, includes the EPA and environmental groups. Finally, a third cluster is suggested, pairing the university and U.S. National Laboratory scientists.

These results support the earlier discussion suggesting that DOE has become more "politicized," in the minds of the general public, than has EPA. Using trust correlations, DOE is linked more closely to the chemical companies and nuclear power plants. Thus, the general public may see DOE as part of a coalition, including nuclear power and chemical concerns, regarding the formulation of nuclear and chemical waste policy. The EPA, while linked to the environmental groups, is *less tightly* linked, as indicated by the horizontal distance on the dendrogram. Finally, the university and U.S. National Laboratory scientists are distinct from *both* groups, indicating that -- at least at the present time -- both sorts of scientists are seen as largely "non-partisan" in the nuclear waste policy debate.

3.4 TRUST AND PERCEIVED RISK

What difference does trust make? Does the level of trust given the various actors in the nuclear waste policy process make a difference in how the general public perceives the risks of nuclear waste management? It does not seem unreasonable to assume that, the greater the trust given those who produce the waste (as is true of nuclear power plants) or who are charged with development and execution of aspects of nuclear waste policy (as is true of both EPA and DOE), the less the perceived risk of the various stages of nuclear waste management. In addition, respondents may look to particularly trusted actors as "cue" or reference groups from whom they take their perceptions of the level of risk associated with the management of nuclear wastes.[6] If so, we would expect to find statistically discernible relationships between levels of trust and perceptions of nuclear waste management risk.

To test for relationships between trust and perceptions of risk in nuclear waste management we employed linear regression models, regressing the trust scores onto the perceived level of risk associated with each of the stages on nuclear waste management. The results are shown in Table 3.3.

Table 3.3: Modeling Relationships Among Trust and Perceived Risks for General Public

		Trust for:					
	R^2	Lab Sci	Env Gp.	DOE	Nuc Plant	Univ Sci	EPA
Production	0.11	0.04**	-0.08**	NA	0.09**	NA	NA
Temporary Storage	0.06	0.04**	-0.08**	NA	0.05**	NA	NA
Transportation	0.10	0.06**	-0.08**	NA	0.07**	NA	-0.04*
Permanent Storage	0.10	0.04**	-0.08**	NA	0.09**	NA	NA

* Denotes statistical significance at < .05 level.
** Denotes <.01 level.
NA indicates no statistically significant relationship.

First, recall that for our measures of perceived risk, extreme risk was scaled as "1," while no risk was scaled as "5." A negative relationship, as indicated by a negative value in Table 3.3, would indicate that increased trust for the actor is associated with increased perceptions of risk. A positive relationship indicates that increased trust is associated with decreased perceptions of risk. Second, the level of trust held for some actors has *no* relationship to perceived risks by the general public. Trust for university research scientists, who receive the highest average trust score, has no statistically discernible association with perceived risk. Surprisingly, the level of trust for DOE also has no discernible relationship with perceived risk for the general public.

Trust for U.S. National Laboratory scientists, on the other hand, *is* associated with public perceptions of the risks of nuclear waste management. For each stage of the nuclear waste management process, the greater the trust in these scientists, the

6 For a discussion of the importance of cue groups in affecting attitudes about nuclear energy, see J. Kuklinski, D. Metlay, and W.D. Kay, "Citizen Knowledge and Choices on the Complex Issue of Nuclear Energy," *American Journal of Political Science*, 26 (November 1982): pp. 615-642.

less the perceived risk. This pattern also holds for nuclear power plants; the greater the level of trust for nuclear power plant spokespersons, the less the perceived risk of nuclear waste management. But the relationship is reversed for national environmental organizations. For these groups, increased trust is associated with an increased perception of risk. Finally, trust of the EPA is statistically related only to perceived risk of the transportation of nuclear wastes, and this relationship is relatively weak. Nevertheless, increased trust of EPA is related to increased perception of nuclear waste management risk.

These results indicate that, for some actors, trust is systematically associated with perceived risks. That is not to say that the level of trust for these actors *causes* the perception of risk; indeed, as we will show in Chapter 6, trust and perceived risk might *both* stem from some other underlying factors (such as ideology). Nevertheless, the pattern of risk perception and trust holds some important implications for the process of developing nuclear waste management policy. Put simply, political conflict over policy positions is very likely to be compounded by the pattern of trust and distrust. This pattern is most apparent with respect to trust in nuclear power plants and the environmental groups; those who disagree with the policy positions taken by these groups *also tend to distrust them.* This means that policy positions taken by these actors are likely to be selectively filtered by the general public, essentially discounting the policy statements made by those who hold divergent views. The misfortune is that the policy debate and public perception are likely to become increasingly polarized as distrust reinforces preconceived policy positions.

An added implication is that U.S. National Laboratory scientists appear to be in danger of being drawn into a partisan debate that might diminish the level of trust accorded them by the general public. While these scientists are currently given fairly high levels of trust (see Table 3.1) and are perceived to be nonpartisan (Figure 3.1), the already evident association of trust for these scientists with perceived levels of risk might eventually lead to a general view that the U.S. National Laboratory scientists *are* partisans. Unlike traditional interest groups, scientists tend to be evaluated on the basis of how "objective" they are perceived to be. Should the U.S. National Laboratory scientists become identified in the public mind as partisans in the nuclear waste debate, the trust accorded them by the public -- and particularly trust with respect to nuclear waste management -- is likely to diminish. This speculation cannot be tested with the data analyzed in this project, but can be analyzed by tracking change in levels of trust over time.

3.5 LEVELS OF ELITE TRUST IN POLICY ACTORS

Respondents to each of our elite samples were also asked to indicate their levels of trust for the primary actors in the nuclear waste policy subsystem. The results are shown in Tables 3.4 through 3.7.

Table 3.4: Levels of Trust in Nuclear and Chemical Waste Policy Making -- Scientist Sample

Actor	Average Trust Score	Std Dev.
University research scientists	7.5	1.8
Scientists at U.S. National Laboratories	7.3	1.9
Spokespersons for the U.S. Environmental Protection Agency	5.5	2.1
Spokespersons for national environmental groups	5.1	2.2
Spokespersons for the U.S. Department of Energy	4.4	2.1
Spokespersons for nuclear power plants	3.8	2.1
Spokespersons for chemical companies	3.6	2.0

The scientist sample gives highest trust scores to the U.S. National Laboratory and university research scientists. Next in rank of trust are spokespersons for the EPA and environmental groups, followed at some distance by spokespersons for DOE. Finally, as with the general public, spokespersons for nuclear power plants and chemical companies receive the lowest trust scores from the scientist sample.

Table 3.5: Levels of Trust in Nuclear and Chemical Waste Policy Making -- Environmental Group Member Sample

Actor	Average Trust Score	Std Dev.
Spokespersons for national environmental groups	7.3	1.9
University research scientists	7.1	1.9
Scientists at U.S. National Laboratories	5.8	2.3
Spokespersons for the U.S. Environmental Protection Agency	5.1	2.3
Spokespersons for the U.S. Department of Energy	3.5	2.1
Spokespersons for nuclear power plants	2.4	1.8
Spokespersons for chemical companies	2.2	1.5

Respondents to the environmental group member sample, not surprisingly, give greatest trust to spokespersons for national environmental groups, followed closely by university research scientists. U.S. National Laboratory scientists score next highest, followed by EPA. Next in level of trust, DOE scores a full 1.5 points lower than EPA (on the 10-point trust scale). Lowest in the environmental group members' trust ranking are the nuclear power plant and chemical company spokespersons, at 2.4 and 2.2 points, respectively.

Table 3.6: Levels of Trust in Nuclear and Chemical Waste Policy Making -- Business Sample

Actor	Average Trust Score	Std Dev.
Scientists at U.S. National Laboratories	6.5	1.9
University research scientists	6.5	1.9
Spokespersons for the U.S. Environmental Protection Agency	5.0	2.0
Spokespersons for the U.S. Department of Energy	4.7	1.9
Spokespersons for nuclear power plants	4.1	1.9
Spokespersons for national environmental groups	4.1	2.1
Spokespersons for chemical companies	3.9	2.0

For the business sample, U.S. National Laboratory and university research scientists receive the highest trust scores. Following considerably behind (a gap of 1.5 points) is EPA, and (slightly further behind) DOE. Next, spokespersons for nuclear power plants and national environmental groups are given nearly identical trust scores of 4.1. Finally, spokespersons for chemical companies are given the lowest trust scores, at 3.9. Note that, even though in last place in the business association members' trust rankings, chemical company spokespersons are accorded far more trust by the business sample than they are by the environmental group member sample.

Table 3.7: Levels of Trust in Nuclear and Chemical Waste Policy Making -- Legislator Sample

Actor	Average Trust Score	Std Dev.
Scientists at U.S. National Laboratories	6.7	2.0
University research scientists	6.6	2.0
Spokespersons for the U.S. Environmental Protection Agency	4.9	2.2
Spokespersons for national environmental groups	4.5	2.3
Spokespersons for the U.S. Department of Energy	4.3	2.0
Spokespersons for chemical companies	3.9	1.8
Spokespersons for nuclear power plants	3.8	1.9

Finally, the legislator sample gives greatest trust to U.S. National Laboratory and university research scientists. Spokespersons for EPA, national environmental groups, and DOE follow with relatively close scores. Spokespersons for chemical companies and nuclear power plants are given scores slightly lower than those for DOE.

3.6 Perceptions of Influence in Hazardous Waste Policy

Part of what characterizes how citizens perceive politics concerns *who has power*. Who, in the eye of the observer, has greatest influence over the course of policy making? Of equal importance; are some actors seen to have disproportionate power, or are others believed to be "locked out" of the policy-making process by

virtue of *lack* of influence? The issue here is largely procedural; is the political process "fair" in that all actors with a stake in the issue are believed to have a share in shaping public policy? Or is the policy-making process perceived to be dominated by only a few "special interests"?

In order to assess these questions, we asked respondents to each of our samples to indicate how influential they perceived the various actors in the nuclear waste policy system to be. The question was worded as follows:[7]

> We'd like to get your impressions of how politically influential various actors are in determining policy on nuclear and chemical waste. On a scale of one to ten with one the least influential and ten the most influential, how would you rate the influence of the following actors?
>
> Least Influential — Most Influential
> 1❑ 2❑ 3❑ 4❑ 5❑ 6❑ 7❑ 8❑ 9❑ 10❑

Perceived political influence scores were calculated for each of five kinds of potential political actors: citizens, environmental groups, business and industry groups, government officials, and the media. The results for each sample are shown in Tables 3.8 through 3.12.

Table 3.8: Perceptions of Political Influence in Nuclear and Chemical Waste Policy by General Public

	Avg. Influence Rating	Std. Dev.
Media	6.52†	2.53
Environmental groups	6.27*	2.26
Government officials	6.24	2.64
Business/industry groups	6.10†	2.59
Citizens	5.25*	2.63

* Indicates mean value is statistically significantly below mean of next higher ranked actor.
† Indicates that mean is significantly above mean of next lower ranked actor.

As shown in Table 3.8, the general public perceives *all five* of the listed actors to be at least somewhat influential in shaping nuclear waste management policy. Citizens are seen as least influential, with an average influence score of 5.25 (near the scale mid-point). The perception of citizen influence is statistically significantly lower than that of any other group. On the other extreme, the media is perceived to be more influential than any other actor, with a score of 6.52. Between extremes, environmental groups and government officials are seen as about equally influential, and both are seen as slightly *more* influential than business/industrial groups.

[7] Question wording was shortened slightly for the telephone survey.

Table 3.9: Perceptions of Political Influence in Nuclear and Chemical Waste Policy by Scientist Sample

	Avg Influence Rating	Std. Dev.
Media	7.30	2.00
Business/industry groups	7.15	1.98
Government officials	7.11†	1.99
Environmental groups	6.68*†	1.83
Citizens	4.62*	2.31

* Indicates mean value is statistically significantly below mean of next higher ranked actor.
† Indicates that mean is significantly above mean of next lower ranked actor.

Among the respondents to the scientist sample, the extremes of perceived political influence are the same as for the general public: Media is seen as most influential (at 7.3), though its score is not statistically significantly higher than that of the business/industry groups (7.15). At the bottom, with a low score of 4.62, is citizen influence. The business/industry group influence score is very close to that of government officials, but is significantly greater than that of the environmental groups (6.68). In the view of the scientists, then, citizens play only a marginal role in nuclear waste policy making, while dominant influence is shared among the media, business/industry groups, and government officials.

Table 3.10: Perceptions of Political Influence in Nuclear and Chemical Waste Policy by Environmental Group Member Sample

	Avg Influence Rating	Std. Dev.
Business/industry groups	7.90†	2.12
Government officials	7.52*†	2.09
Media	7.03*†	2.01
Environmental groups	6.45†*	1.99
Citizens	4.61*	2.42

* Indicates mean value is statistically significantly below mean of next higher ranked actor.
† Indicates that mean is significantly above mean of next lower ranked actor.

For the environmental group member sample, citizens again rank at the bottom of the perceived influence ladder, but the top spot is occupied by the business/industry groups. Government officials rank a close second, followed by the media, while environmental groups place fourth -- over 1.3 points behind the business/industrial groups. For this group, then, influence over nuclear waste policy is perceived as concentrated in the hands of the business elite, while environmental groups and (especially) the general pubic are perceived to hold far less power.

Table 3.11: Perceptions of Political Influence in Nuclear and Chemical Waste Policy by Business Sample

	Avg Influence Rating	Std. Dev.
Media	7.46†	2.12
Environmental groups	6.77*	2.00
Government officials	6.64†	2.09
Business/industry groups	6.41†*	2.04
Citizens	5.10*	2.42

* Indicates mean value is statistically significantly below mean of next higher ranked actor.
† Indicates that mean is significantly above mean of next lower ranked actor.

The perception of political influence by respondents to the business sample provides an interesting contrast to that of the environmental group member sample. As with the other samples, citizens are seen to have least influence over nuclear waste policy -- though they are not perceived to be quite so far behind. Media is well out front, with an influence score of 7.46. Second in perceived influence are the environmental groups, who are very closely followed by government officials. Fourth in ranking of influence -- statistically significantly behind environmental groups and government officials -- are the business/industrial groups. Thus, from the business perspective, nuclear waste policy making is dominated by media, environmental groups and government officials -- quite a different view from that of the environmentalists.

Table 3.12: Perceptions of Political Influence in Nuclear and Chemical Waste Policy by Legislator Sample

	Avg Influence Rating	Std. Dev.
Media	6.70	2.55
Business/industry groups	6.50	2.14
Government officials	6.38	2.12
Citizens	6.32	2.59
Environmental groups	6.05	2.03

* Indicates mean value is statistically significantly below mean of next higher ranked actor.
† Indicates that mean is significantly above mean of next lower ranked actor.

Our final sample, Colorado and New Mexico legislators, is particularly interesting because the legislators -- more than any other group -- can be expected to observe first-hand the interplay of influence in the setting of nuclear waste policy. For that reason, the legislators' perspective on who has influence should be particularly revealing. Results for the influence questions from this sample are shown in Table 3.12.

First, note that the rankings provided by the legislators are all quite close -- the range is from a low of 6.05 to a high of 6.70. Legislators also evidence greater variation within their estimates of perceived influence, as indicated by the relatively large standard deviations. Nevertheless, the rank ordering of the influence ratings is interesting: Media is perceived to be most influential, followed closely by business/industry groups and government officials. Unlike all other samples, legislators place citizens fourth, instead of last. Least influential, in the view of the legislators, are the environmental groups. Also somewhat surprising, in light of this low ranking, is the fact that legislators evidence less variance in their assessments of the (low) influence of the environmental groups than they do for any other group on the list. In other words, legislators tend to agree among themselves about that low ranking.

Overall, in assessing perceptions of influence in nuclear waste policy making, we find some areas of broad agreement and some surprising disagreement. In all but the environmental group member sample, the **media is perceived to be most influential**. In all but the legislator sample, **citizens are perceived as having the least influence**. Business and industrial groups are believed to have the *most* influence by environmentalists, holding influence *second* only to the media by the scientists and legislators, and they rank *fourth* -- only ahead of citizens -- by the business and general public samples. Government officials are seen as moderately influential by all groups; they rank in the median -- third out of the five types of actors -- for all samples but the environmental group members, who put government officials second behind business/industrial groups. Environmental groups are seen as highly influential -- second only to media -- by the business and general public samples, but are given low influence ratings (last or second to last) by all other groups.

What are the implications? First, those actors most commonly identified as "interest" or "public interest" groups -- business/industrial groups and environmental groups -- are not widely perceived to hold greatest power in setting nuclear waste management policy. Indeed, these groups tend to perceive each other as more powerful, and themselves as less powerful, than do other groups. Thus the perception of a single powerful interest, able to dominate nuclear waste policy making, seems not to be widespread. The perception of fragmented power, here as elsewhere in American politics, seems to be the rule. Second, the media is widely believed to be the most influential actor in the nuclear waste policy arena. Thus, if the media is perceived to be systematically "biased" on nuclear waste issues -- a matter to which we will turn in Chapter 5 -- then there is a basis for a widespread perception that the media plays an improper role in nuclear waste policy making. Third, in all but the legislator sample, citizens were perceived to play the *least* influential role. Interestingly, the general public gives citizens a higher influence rating (5.25 on a ten-point scale) than do any other except the legislator sample (which gives citizens a score of 6.32). Thus, while seeing themselves as less influential than the regular policy actors, the general public still perceives itself as having at least *some* influence.

3.7 SUMMARY

This chapter has analyzed the ways in which our sample respondents perceive policy makers and the policy-making process for nuclear waste management. Looking at levels of public trust for the primary actors in the nuclear waste policy process, we identified variations both in the general public's trust and in the kinds

of alignments that the general public perceives in the policy-making process. In general, scientists are given greatest trust, while spokespersons for the EPA, environmental groups and DOE hold moderate trust, and nuclear power plant and chemical company spokespersons hold least trust. Analyzing the correlates of trust, the general public's trust for DOE appears to be more politicized than that for EPA, and DOE tends to be perceived as aligned with nuclear power plants and chemical companies.

Among the elite samples, greatest trust generally is given to U.S. National Laboratory and university research scientists, and least trust to spokespersons for nuclear power plants and chemical companies, but there are interesting variations across the samples. Environmental group members give greatest trust to national environmental groups, while business association members give such groups a relatively low trust rating. Business association members rank spokespersons for nuclear power plants and national environmental groups as essentially equally trustworthy. Virtually all groups give EPA higher trust ratings than they do DOE.

Regarding perceptions of political influence in nuclear waste management policy, most of our samples perceive the media to be most influential and citizens to be least influential. Business association members tend to see environmental groups as relatively more influential, and environmental group members tend to see business/industrial groups as relatively more influential, than do other groups. Legislators, on average, give their lowest influence rating to the national environmental groups. Overall, there does not appear to be a pattern of perception that any particular group, including citizens, is being "locked out" of the nuclear waste policy-making process.

CHAPTER 4

INFORMATION AND KNOWLEDGE IN NUCLEAR WASTE POLICY

As compared with most policy concerns, the issues involved in nuclear waste management are fraught with technical complexity and uncertainty. When citizens or policy makers seek to form opinions and policy preferences, they are confronted by a welter of conflicting claims, competing experts, and intensely held (and vocalized) beliefs by opposing political coalitions. In such a context, *how skeptical* are the general public and the various elite populations of the information they receive about the risks of nuclear wastes? How *certain* are they about their own perceptions of the risks of nuclear waste management? How willing are they to *change* what they believe about the risks of nuclear wastes in light of new information -- and in what directions? And what are their perceptions of the nature and effects of radiation?

In part we are interested in whether individuals tend to process or filter information in ways that affect what they believe. Is one's level of certainty related to how risky one believes nuclear wastes to be? Is one's propensity to question new information associated with what one believes about risks of radiation? Do individuals tend to pay more attention and give greater credence to information that is correlated with *increased* or *decreased* levels of risk? If so, is this filtering of information associated with how severe the risks of radiation are perceived to be? And finally, how is one's understanding of the nature and effects of radiation related to perceptions of the risks of nuclear waste management?

4.1 PATTERNS OF INFORMATION PROCESSING

Our surveys included a set of questions that were designed to tap how people receive and process information about nuclear waste. First, we included a question that attempted to measure the *level of subjective certainty* with which the respondents' beliefs are held. Our interest was in how strongly the respondents hold their beliefs about nuclear waste risk. The question was worded as follows:

> Some people have strong convictions about the risks from nuclear and chemical waste, while other people are less certain about their beliefs. Where would you place yourself? Are you:
>
> 1❑ very certain 2❑ somewhat certain 3❑ somewhat uncertain 4❑ very uncertain

The distributions of responses to this question, for all five of the samples, are shown in Table 4.1.

Table 4.1: Subjective Certainty About Risks of Chemical and Nuclear Wastes by Sample

	1 Very Certain	2 Somewhat Certain	3 Somewhat Uncertain	4 Very Uncertain	Mean	Std Dev
General public	32.6%	40.1%	21.3%	5.9%	2.01	0.88
Scientists	34.1	51.9	11.0	3.0	1.83	0.74
Environmentalists	47.7	41.2	9.6	1.5	1.65	0.71
Business	19.2	55.9	23.5	1.5	2.07	0.69
Legislators	27.1	60.4	11.5	1.0	1.86	0.64

As indicated by the mean scores in Table 4.1, the sample with the greatest certainty (somewhere between "somewhat" and "very certain") is that of the environmental group members. The scientist sample, nearly tied with the legislator sample, has the next highest mean score (very close to "somewhat certain"). The general public and business samples are the least certain, with mean scores indicating that they are slightly less than "somewhat certain."

Of particular interest are the percentages of each sample that are "very certain" of their beliefs. This percentage can be taken to indicate the portion of the population that has, essentially, made up their minds on the issue. Note that, in the environmental group member sample, almost 48% (nearly half) of the respondents are very certain of their beliefs. That exceeds the scientist sample by almost 14 percentage points. Business association members, on the other hand, are "very certain" of their beliefs only 19.2% of the time. These values suggest that a large fraction of the environmental group member sample is already quite convinced about the level of risk associated with nuclear wastes; the business sample, on the other hand, is far less certain.

A related issue is the degree to which the members of the various samples *question the accuracy* of the information that they receive about the risks of nuclear wastes. Sample respondents were asked the following question:

> People get information about the risks of nuclear and chemical wastes from a variety of sources. How often would you say that you find yourself questioning the accuracy of the information you receive on these issues?
>
> 1❑ always 2❑ often 3❑ some of the time 4❑ rarely 5❑ never

The resulting distribution of responses to this question, for each of our five samples, is shown in Table 4.2.

Table 4.2: Questioning Information About Risks of Nuclear and Chemical Wastes by Sample

	1 Always	2 Often	3 Sometimes	4 Rarely	5 Never	Mean	Std Dev
General public	14.3%	39.9%	38.0%	5.8%	1.1%	2.39	0.84
Scientists	25.7	54.2	18.7	1.2	0.0	1.95	0.70
Environmentalists	20.4	54.0	23.3	2.1	0.1	2.07	0.73
Business	22.4	54.0	21.6	2.0	0.0	2.03	0.72
Legislators	13.5	55.2	29.2	2.1	0.0	2.20	0.69

In essence, this question taps the degree of skepticism that individuals hold about information provided about risks of nuclear and chemical wastes. Scientists, for whom skepticism is a professional virtue, are the most likely to question the accuracy of information about these risks. Next are business association members -- who are, apparently, both relatively uncertain (Table 4.1) *and* skeptical of information about risks. Environmentalists are only slightly less skeptical than business association members, followed by legislators and the general public. Note that for all samples *well over half* of our respondents said that they always or often question the accuracy of the information they receive on the risks of nuclear and chemical wastes. This indicates that there is a widespread perception -- particularly in the elite samples -- that care must be taken in evaluating information on this issue.

4.2 Patterns of Information Filtering and Risk Perception

Beyond certainty and skepticism, we are interested in how new information might be filtered in the process of making and adjusting perceptions of the risks associated with nuclear waste management issues. By filtering, we mean a process by which some kinds of information are discounted while others kinds are given greater weight. Specifically, is there a propensity among the samples to treat information that *escalates* perception of nuclear waste risks differently than information that *diminishes* the perceived risks? If so, perceptual filtering serves to "bias" the relationship between new information about nuclear waste risks and risk perception in one direction or the other.[1]

We tested for the presence of perceptual filters by measuring the likelihood that the respondent would adjust beliefs in light of new information, from identical sources, indicating that current risk perceptions are (a) too high or (b) too low. The questions were worded was as follows:

> Suppose a source you consider to be neutral provided new information about the risks of nuclear waste that indicated that these risks were *greater* than you had previously believed. How likely would you be to change your point of view?
>
> Now, suppose that the same neutral source provided information that indicated that the risks of nuclear waste were *less* than you had previously believed. How likely would you be to change your point of view?

[1] Another way to think of an information filter would be to imagine an individual confronted with a random distribution of information about the risks of nuclear wastes -- spanning the range from information indicating that there are *no significant risks* to information suggesting that these risks are *enormously greater* than had previously been believed. The filter represents any systematic bias in the manner in which the individual accepts and rejects information from across that distribution.

For both questions, we employed the following response scale:

1❑ very unlikely 2❑ somewhat unlikely 3❑ somewhat likely 4❑ very likely

The patterns of responses for each of these questions, for all five samples, are shown in Tables 4.3 and 4.4.

Table 4.3: Willingness to Increase Perceived Risk on the Basis of New Information by Sample

	1 Very Unlikely	2 Somewhat Unlikely	3 Somewhat Likely	4 Very Likely	Mean	Std.Dev
General public	11.2%	18.4%	44.9%	25.5%	2.85	0.93
Scientists	6.1	13.4	57.2	23.3	2.98	0.78
Environmentalists	12.3	8.1	45.9	33.8	3.01	0.96
Business	5.7	12.9	61.9	19.5	2.95	0.74
Legislators	9.1	14.5	69.1	7.3	2.74	0.73

As indicated by the mean values for each sample shown in Table 4.3, the environmental group member sample has the greatest propensity to adjust beliefs in light of new information suggesting that risks are greater than had previously been believed. Least likely to change beliefs are legislators -- though they, too, are far closer to "somewhat likely" than "somewhat unlikely" to increase their perceptions of risk.

Table 4.4: Willingness to Decrease Perceived Risk on the Basis of New Information by Sample

	1 Very Unlikely	2 Somewhat Unlikely	3 Somewhat Likely	4 Very Likely	Mean	Std.Dev
General public	17.5%	30.0%	43.1%	9.4%	2.44	0.89
Scientists	6.5	19.9	58.6	15.0	2.82	0.76
Environmentalists	14.2	32.8	45.2	7.8	2.47	0.83
Business	7.9	19.5	60.0	12.6	2.77	0.76
Legislators	10.9	14.5	70.9	3.6	2.67	0.72

Turning to Table 4.4, the scientist sample shows the greatest propensity to adjust beliefs in light of new information suggesting that risks are *less* than had previously been believed. Nevertheless, comparing Tables 4.3 and 4.4, scientists still appear to be less likely to diminish perceived risk than to escalate it. This difference is particularly apparent for the environmental group member sample.

In order to facilitate comparisons of likelihood of belief change, and test for the existence of perceptual filtering, we calculated the difference between the respondents' likelihood to increase and decrease perceptions of risk for each sample. For these values, a positive number represents a greater willingness to increase perceived risk in light of new information, and a negative number indicates a greater willingness to decrease perceived risk in light of new information. A zero value indicates an equal likelihood of changing beliefs in either direction. These calculations, for each sample, are shown in Figure 4.5.

Table 4.5: The "Risk Ratchet" by Sample

	Mean	Std. Dev.	*t*-stat	P-value
General public	0.41	1.04	12.81	0.000
Scientists	0.16	0.74	6.61	0.000
Environmentalists	0.54	1.00	16.29	0.000
Business	0.18	0.66	7.67	0.000
Legislators	0.18	0.71	2.44	0.016

As shown in Table 4.5, on average, respondents to all samples show a greater willingness to increase perceived risks than to decrease them on the basis of new information, even if the information comes from the same source. For each sample, we also tested to see if this difference is statistically significant. The "P-value" column shows the probability that, given the sample standard error, the difference is actually zero (if the difference is zero, then change in risk perception in either direction is equally likely). In all cases, the P-value is very small, indicating that the positive bias is not an artifact of sampling variation.

Due to its prevalence and strong statistical significance, we have dubbed this phenomenon the "risk ratchet." The perceptual filtering evident in the risk ratchet acts to *filter in* information that increases perceived risk, and to *filter out* information that decreases perceived risk. Thus, given exposure to a wide array of information making claims about the risks associated with nuclear wastes, from sources believed to be equally objective, individuals have a propensity to accept those claims that heighten perceived risk and reject those that diminish perceived risk.

Looking at the specific values of the risk ratchet, it is on average largest for the respondents to the environmental group member sample (0.54). The general public also has a substantial positive risk ratchet (0.41). Scientists, business association members and legislators all have significantly smaller (though still positive), and remarkably similar, ratchet scores.

Why would all of our samples have positive average ratchet scores? One clue was provided in survey instrument "talk-back," in which survey respondents elaborated on their responses through notes in the margins of the survey. One such note, from the scientist sample, indicated that the respondent self-consciously chose a positive risk ratchet because in his view the costs of overestimating risk were less than the costs of underestimating them. Thus our respondents *may* have been opting to give greater credence to information that heightened perceived risk because they believe that **risk avoidance**, even if the probability of the occurrence is very small, is less costly than acceptance of the consequences of the risk.

While speculative, this line of reasoning suggests that as a society we would do well to examine the costs of risk mitigation, as well as the expected costs of the risks themselves. Recent scholarship suggests that these costs can be large, and may even produce illusory gains in safety.[2] Nevertheless, these results provide strong evidence

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[2] See, e.g., M. Douglas and A. Wildavsky, *Risk and Safety* (Berkeley, CA: University of California Press, 1982); Y. Aharoni, *The No-Risk Society* (Chatham NJ: Chatham House, 1981); A. Wildavsky, *Searching for Safety* (New Brunswick: Transaction Publishers, 1988); and R. Zeckhauser and W. Kip Viscusi, "Risk Within Reason," *Science*, v. 248 (May 4, 1990), pp. 559-564.

that both the general public *and* the various elite groups have a significant tendency to filter information in a way that heightens perceived risks of nuclear wastes.

4.3 KNOWLEDGE OF RADIATION BIOLOGY AND RISK PERCEPTIONS

One of our interests concerns what people believe about the effects of radiation: Are these beliefs in line with current theory and evidence about radiation? How do the different populations -- the general public, scientists, environmental group members, business people, and legislators -- perceive these effects? And finally, how are these beliefs correlated with one's perceptions of the risk of nuclear waste management?

A number of studies have attempted to look at the relationships between "knowledge" and attitudes toward the related issue of nuclear power. In most cases, the domain of knowledge measured has concerned such matters as the number of working power plants in a state or the regulatory structure under which they operate,[3] or comparisons of the respondent's and expert morbidity/mortality assessments for certain kinds of hazards.[4] In virtually all cases, knowledge as measured has no discernible correlation with risk perception once other factors, such as ideology or "world view" were taken into account. But what of more specific kinds of knowledge -- such as knowledge about the effects of radiation on human tissue, or the differences between natural and man-made radiation? Would these make a difference in risk perception?

With the assistance of Dr. Leo Gomez of Sandia National Laboratories, we developed a set of questions designed to assess perceptions of the nature and effects of radiation. The question introduction and content used for this analysis are as follows:

> People have different opinions about the effects of radiation on people and the environment. We are interested in your views. Please indicate whether you agree or disagree with the following statements:
>
> > Since the detonation of the first atomic bomb, man-made radiation has resulted in new species of plants and animals.
> >
> > There's no difference in the effects of exposure to radiation that comes from man-made and naturally-occurring sources.
> >
> > The human body can repair tissue damage caused by exposure to radiation.

For each question, the response categories were "agree" and "disagree." In each case, the object was to provide a question that, taken generally, had an answer that best fit current theory and evidence. Thus, regarding the first question, there is no evidence that new species of plants and animals have resulted from man-made radiation. For the second question, radiation has the same kinds of physiological effects, regardless of whether its source is man-made or naturally occurring. And, regarding the third question, the human body most certainly can repair tissue damage caused by exposure to radiation, as evidenced by anyone who has recovered from a sunburn.

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[3] J. Kuklinski, D. Metlay, and W.D. Kay, "Citizen Knowledge and Choices in the Complex Issue of Nuclear Energy," *American Journal of Political Science*, v. 26 (November 1982), pp. 615-642.

[4] K. Dake and A. Wildavsky, "Rival Theories of Risk Perception: Who Fears What and Why?" *Daedalus* (1990), forthcoming.

Responses to these questions are best interpreted as proxy variables for the respondents' knowledge of radiation and its effects. But they must be interpreted with caution; the scope of the knowledge questions was limited (due to an already lengthy survey questionnaire), and some knowledgeable respondents may have responded to considerations not included in the questions.[5] For these reasons, we take the results of the analysis of the radiation knowledge questions as suggestive, rather than conclusive, of the relationship between knowledge of radiation and perceptions of risk.

The responses to the radiation knowledge questions are shown in Table 4.6. For each question, the values show the percentage of respondents, for each sample, who gave the response that best fits current theory and evidence. The average score ranges from zero to three, with zero indicating that (on average) the sample respondents answered *none* of the questions correctly, while three would indicate that (on average) the sample respondents answered all three questions correctly.

Table 4.6: Responses to Radiation Knowledge Questions

	New Species	Man-Made/Natural	Tissue Repair	Average Score
General public	48.8%	18.4%	20.1%	0.87
Scientists	91.5	77.2	57.9	2.27
Environmentalists	74.0	39.9	20.6	1.35
Business	81.5	38.6	25.9	1.46
Legislators	80.6	35.7	24.5	1.41

First, note that the respondents to the scientist sample obtained the highest scores on all questions. This is to be expected, and provides some assurance that the questions tap the sort of knowledge of radiation that we sought to measure. The general public scored lowest, for which the average respondent could answer less than one question correctly. The general public respondents were particularly prone to believe that the effects of exposure to man-made and natural radiation are different. Furthermore, only half of the respondents to the general public sample could correctly state that new species of plants and animals *have not* resulted from man-made radiation. Environmental group members scored a little higher, and business association members and legislators only slightly higher still.

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[5] Some respondents (almost exclusively in the scientist sample) read more into our questions than we had intended. The most frequent problem occurred with the third knowledge question (concerning the ability of the human body to repair tissue damaged by radiation), for which several respondents observed that the extent of tissue damage is dependent on the dose, and that at some dosage levels tissue can no longer be repaired. Thus some respondents may have known that human tissue can repair itself from radiation damage, but responded to the question on the basis of dosage considerations. Our approach was to record both the actual response (agree or disagree) and a "corrected" response that took into account the added considerations mentioned by the respondent. The only sample where a difference resulted was the scientist sample, where on the human tissue repair question 6.4% of the respondents stated that the human body *could not* repair tissue damage caused by radiation, then elaborated that such repair would be impossible under high dosages. When we tested for the effects of both the actual and "corrected" responses on perceived risk, there were no differences in coefficient size or statistical significance. Thus, for the analysis presented here, we use only the actual responses for all samples.

4.4 COGNITIVE ATTRIBUTES, KNOWLEDGE AND RISK PERCEPTION

What are the relationships between perceptions of the risks of nuclear wastes and one's level of subjective certainty, screening of information, and knowledge of radiation? We analyzed these relationships by modeling the associations of each respondent's scores for subjective certainty (Table 4.1), questioning information accuracy (Table 4.2), the risk ratchet (Table 4.5), and radiation knowledge (Table 4.6) with the perception of the risks of nuclear waste. In this case, to simplify the analysis, the perceived risk is represented by the average of the risk perceived due to the temporary storage, transportation and permanent storage of radioactive wastes. The model results, indicating the relationships between each of the cognitive attributes and the radiation knowledge scores on perceived risk, are shown in Table 4.7.

Table 4.7: Cognitive Attributes and Average Nuclear Waste† Risk Perception by Sample

	Independent Variables				
	Risk Ratchet	Subj. Certainty	Info Accuracy	Knowledge Score	R^2
General public	-0.124***	0.107***	0.093**	0.223***	0.075
Scientists	-0.166***	-0.011	-0.008	0.301***	0.118
Environmentalists	-0.145***	0.394***	0.134***	0.215***	0.284
Business	-0.367***	0.074	0.018	0.340***	0.194
Legislators	-0.281**	-0.031	0.058	0.354***	0.185

† **Dependent Variable:** Average Score for Perceived Risk of (1) Temporary Storage, (2) Transportation, and (3) Permanent Storage of Nuclear Wastes.
* **Statistically significant** at the 0.05 level.
** **Statistically significant** at the 0.01 level.
*** **Statistically significant** at the 0.001 level.

Note that the risk ratchet is significantly correlated with the level of perceived risk in all samples. As indicated by the negative coefficients, the larger the risk ratchet (i.e., the greater the propensity to filter out information diminishing perceived risks) the higher the perceived risk. The knowledge scores also have statistically significant correlations in all samples. In this case, the higher the radiation knowledge score, the lower the perceived risk of nuclear wastes. These factors -- filtering information and radiation knowledge -- seem to be strongly associated with risk perceptions.

Levels of both subjective certainty and skepticism regarding the accuracy of information about nuclear wastes are statistically significant for the general public and environmental group samples only. In both cases, the greater the level of certainty about one's beliefs regarding nuclear wastes, the greater the perceived risks of nuclear wastes. In addition, for both samples, the more frequently the respondent questions the accuracy of information about risks of nuclear wastes, the greater their perception of those risks. Thus, for the general public and members of environmental groups, greater certainty and greater skepticism about information both appear to lead to a greater perception of riskiness of nuclear wastes.

For this analysis, we are looking only at overall relationships between the knowledge/cognitive variables and risk perception, and we have not controlled for the contributions of other factors. These other factors -- such as perception of prob-

lem severity, ideology, or demographics -- may well explain portions of the variation in *both* risk perceptions and the cognitive/knowledge variables. If so, controls will reduce the association of these variables with risk perception. We turn to that issue in Chapter 6.

4.5 SUMMARY

The analyses presented in this chapter have focused on the link between perceptions of nuclear waste and both knowledge of the subject and cognitive attributes. Two of the measures examined in this chapter have statistically significant relationships with the degree of perceived nuclear waste risk for all of the sample populations: our radiation knowledge score and the risk ratchet. These measures have the same relationship in all of the samples. An increase in the knowledge score is related to a decreased risk perception, and a greater propensity to adjust one's belief in light of information suggesting greater rather than lesser risk of nuclear waste (a positive risk ratchet) is associated with an increased assessment of the overall risk posed by the nuclear waste management process.

The general public scores substantially lower on the knowledge scale than any other sample, and has the second highest positive risk ratchet. Additionally, these two measures have a strong positive relationship with perceived risk for the general public. Two other measures also have statistically discernable relationships with the general public's perceptions of nuclear waste risk. The certainty with which a member of this sample holds his or her beliefs regarding the risks of nuclear waste has a relatively strong association, where higher levels of certainty are correlated with greater perceived risk. However, of all the samples, the general public is the second most uncertain about their beliefs with the mean value falling near the "somewhat certain" response category. The other measure that helps to explain variance in the general public's assessed risk of nuclear waste is the extent to which they question the validity of information they receive about these risks. Of all the samples surveyed, the general public is the most trusting of information, and the more trusting an individual respondent, the less risk nuclear waste is perceived to pose.

Only the knowledge measure and the risk ratchet have a statistically discernable relationship with the degree of perceived risk for respondents to the scientist sample. As expected, the scientists scored highest on the knowledge scale and as knowledge increased, the perceived risks associated with nuclear waste decreased. In addition, the scientists have the smallest risk ratchet -- though it is still positive. Scientists are also the most skeptical of the information they receive about the risks of nuclear waste and the second most certain of their beliefs; however, these measures do not appear to be associated with their overall evaluation of nuclear waste risk.

The perception of the risk of nuclear waste by the respondents to the environmental group member sample is related to the same indicators as respondents to the general public sample. However, the distribution of the environmental group member sample across these measures differs significantly. The environmental group members tend to be most certain about the risks of nuclear waste, and are relatively skeptical of the information they receive about risk associated with nuclear waste. Environmental group members are the most likely to increase rather than decrease their perceived risk of nuclear waste based on new information, and they have the largest risk ratchet among the samples. All of these tendencies are

related to an increase in the perceived risk associated with nuclear waste management. The environmental group member sample had the second lowest knowledge score, though differences with the business and legislator samples are slight. As with our other samples, the higher the respondent's knowledge score, the lower the perceived risk of nuclear waste.

The members of the business association and legislator samples responded similarly across these measures. Respondents to both samples are relatively certain of their beliefs regarding the risks of nuclear waste and tend to question the accuracy of the information about these risks "often." However, neither of these cognitive attribute measures is significantly related to their perceived risks of the nuclear waste management process. The risk ratchet, identical for the two groups, is substantially lower than both the general public and the environmental group member samples. The respondents to these two samples have a modest risk ratchet, indicating a slight (though statistically significant) tendency to weight information that heightens perceived risk more heavily than information that diminishes perceived risk. The radiation knowledge scores for these two samples are very similar, substantially lower than the scientists but greater than the environmentalist and the general public sample scores. Knowledge of the processes of radiation has the same relationship with the perceived risk of this sample as it has for all other groups, where an increase in knowledge is associated with a perception of smaller risks involved in the nuclear waste management process.

CHAPTER 5

MEDIA AND RISK PERCEPTION

In dealing with issues as complex as nuclear waste management, all citizens rely on public information about the hazards and benefits of the various options considered in the policy process. As the primary purveyors of such information for most citizens, the news media play a pivotal role in informing us about nuclear waste management issues.

We are interested in how well, or how poorly, the media are seen by our sample respondents to perform this critical task. Are the media seen as "biased" in their coverage of environmental issues? How influential are the news media perceived to be regarding nuclear waste issues? If they are perceived to be influential, does media exposure have any discernible relationship to fears of nuclear waste management?

5.1 PERCEPTIONS OF MEDIA BIAS

In order to tap both the general pattern of a group's perception of media bias and the differences in the perceived bias of various news mediums, respondents were asked the following question:

> On a scale of one to five, where one indicates that the news media always overstate the risks to the environment, and five indicates that the news media always understate the risks, how would you rate the following news media's coverage?

Respondents were asked to rate newspapers, national television news, and local television news on the following scale:

Overstates Understates
1❑ 2❑ 3❑ 4❑ 5❑

Table 5.1 presents the results regarding perceived bias in newspaper coverage of environmental hazards for all samples. These results indicate a fairly widespread perception that newspapers *overstate* the risks to the environment. Respondents in the business sample are most likely to perceive a bias toward overstatement of such hazards in newspaper reporting, although the scientist, legislator and general public samples all perceive some overstatement of risk to the environment. The only sample to perceive a bias toward *understatement* of the risks to the environment in newspaper reporting is that of the the environmental group members. The environmental group member sample and the business sample differ most in their perceptions of media bias, where only 17.5% of environmentalists perceive the newspaper to overstate hazards to the environment compared to 68.9% of the business association members.

Table 5.1: Perceptions of Newspaper Media Bias by Sample

	1 Overstates	2	3	4	5 Understates	Mean
General public	17.0%	21.8%	38.5%	12.6%	10.1%	2.77
Scientists	15.5	36.7	37.2	9.1	1.4	2.44
Environmentalists	3.4	14.1	46.9	27.2	8.3	3.23
Business	28.9	40.0	25.8	3.8	1.5	2.09
Legislators	18.7	39.6	25.0	11.5	5.2	2.45

Perceptions of bias in environmental reporting by local television news are shown in Table 5.2. Patterns evident in Table 5.2 suggest that, as with newspapers, there is a general perception of overstatement of risks to the environment in the local television media. Once again, the environmental group member sample is the only one to perceive a systematic understatement of risks to the environment (with a mean of 3.25).

Table 5.2: Perceptions of Local Television Media Bias by Sample

	1 Overstates	2	3	4	5 Understates	Mean
General public	15.8%	22.5%	35.4%	14.2%	12.8%	2.87
Scientists	23.2	37.1	26.9	9.7	3.2	2.32
Environmentalists	5.5	17.1	37.7	26.5	13.2	3.25
Business	31.6	37.6	23.5	5.1	2.2	2.09
Legislators	20.8	36.5	26.0	12.5	4.2	2.43

Finally, the results of perceived bias in national television news for all samples are shown in Table 5.3. The business sample mean for the bias of national television media is 1.97, revealing the greatest perception of the overstatement bias of the media on this issue. Scientists and legislators also perceive significant bias toward overstatement of environmental hazards, while the general public sample shows less -- but still significant -- perception of such a bias. The environmental group member sample, on the other hand, perceives a bias toward understatement of environmental hazards on national television news (with an average score of 3.17).

Table 5.3: Perceptions of National Television Media Bias by Sample

	1 Overstates	2	3	4	5 Understates	Mean
General public	18.2%	21.1%	34.1%	15.3%	11.3%	2.80
Scientists	24.8	36.2	28.3	8.3	2.3	2.27
Environmentalists	4.9	18.3	41.9	24.9	9.9	3.17
Business	37.0	36.4	20.7	3.8	2.0	1.97
Legislators	25.3	38.9	23.2	7.4	5.3	2.28

In summary, there is a consistent pattern across types of news media among our samples. For all types of news media, the business sample perceives substantial bias toward overstatement of environmental risks, as do the scientist and legislator samples. For the general public, perceived bias is also in the direction of overstatement, though the perception is far less pronounced. The only exception is the environmentalists, who see all types of news media as *understating* these risks.

All of our samples, then, perceive significant bias in environmental reporting across all types of news media. The following sections analyze the relationship between this perceived bias and perceptions of the risks of nuclear waste management.

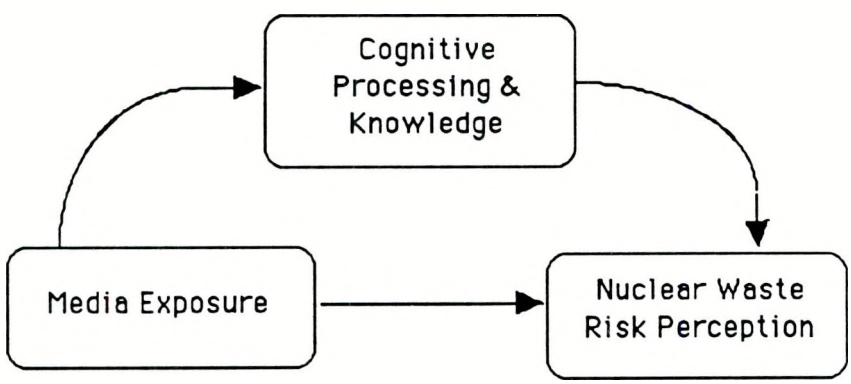
5.2 MODELING MEDIA EXPOSURE AND INFLUENCE

As demonstrated in Chapter 3, all but the environmental group member sample perceive the media to be the most influential actor in the nuclear waste policy making process (see Tables 3.7 through 3.11). The environmental group member sample ranks media third in influence behind business/industry groups and government officials, and greater in influence than environmental groups or citizens. In addition, as shown above, *all* of our samples perceive significant bias in the content of news media reporting on environmental hazards.

One plausible hypothesis that can be drawn from these findings is that media reporting may result in a systematic bias in perceptions of environmental risk. In particular, those with the greatest frequency of media exposure, across all types of media, may have a greater fear of the risks involved with nuclear waste management. Testing this hypothesis, we look at the relationship between frequency of exposure (number of days per week) to television network news and newspapers, and perceptions of nuclear waste risk for all samples.

Interestingly, frequency of media exposure has no statistically discernable association with risk perception in *any* of our samples. Thus, apparently there is little **direct effect** of media on risk perception, despite the widespread belief that the media is a highly influential player in nuclear waste politics. However, it may be that the effects of media are more subtle; perhaps media exposure affects *other* attributes that in turn affect risk perception. In particular, it is possible that media exposure is related to the cognitive processing and knowledge scores discussed in Chapter 4. If such a relationship exists, it may have a structure something like that illustrated in Figure 5.1.

Figure 5.1: Possible Effects of Media Exposure on Perceptions of the Risks of Nuclear Wastes



We hypothesized that frequency of exposure to various media may have an influence on the risk ratchet and knowledge variables, as discussed in Chapter 4. To measure media exposure, we asked, "How often do you watch evening network news?", and "How often do you read a newspaper?" Response choices included: every day, three or four days per week, one or two days per week, and less than once per week. The results of ordinary least squares regressions for the five samples in each of these areas are summarized in Tables 5.4 and 5.5. For each of these tests, we controlled for the contributions of age, income, and education.

Table 5.4: Modeling the Relationships Between Network Television News and Newspapers and Knowledge Scores by Sample

	Exposure to Network TV News Coefficient	Exposure to Newspapers Coefficient
General public	0.081**	-0.084***
Scientists	0.046	-0.016
Environmentalists	0.040	-0.041
Business	0.073**	-0.025
Legislators	0.146	-0.027

* Indicates significance at the 0.10 level.
** Indicates significance at the 0.05 level.
*** Indicates significance at the 0.01 level.
**** Indicates significance at the 0.001 level.

As indicated in Table 5.4, in only a few cases is the relationship between media exposure and the knowledge score statistically significant. In the general public sample, the *less* frequently the respondent watches television network news, the *higher* the knowledge score. On the other hand, the less frequently the respondent reads a newspaper, the *lower* the knowledge score. For the business sample, only television news has a statistically discernible relationship; as with the general public sample, the less frequently television news is watched, the higher the knowledge score. While no other relationships between media and the knowledge score are statistically significant, note that the signs of the estimated coefficients for all samples for television news are positive (more TV, less knowledge), while the signs for the estimated coefficients for newspapers are all negative (more newspapers, more knowledge).

Table 5.5: Modeling the Relationships Between Network Television News and Newspapers on the Risk Ratchet by Sample

	Exposure to Network TV News Coefficient	Exposure to Newspapers Coefficient
General public	0.056*	-0.020
Scientists	0.038	-0.043
Environmentalists	0.019	-0.011
Business groups	-0.001	0.112***
Legislators	-0.014	0.198*

* Indicates significance at the 0.10 level.
** Indicates significance at the 0.05 level.
*** Indicates significance at the 0.01 level.
**** Indicates significance at the 0.001 level.

Turning now to the relationship between media exposure and the risk ratchet, again there are only a few statistically significant relationships. For the general public sample, there appears to be a *very weak* link between the risk ratchet and the frequency of watching television news; the more frequently one watches, the smaller the risk ratchet. For the business association member sample, frequency of

exposure to newspapers has a substantial effect; as frequency rises, the size of the risk ratchet decreases. This relationship also seems to hold for the legislator sample, though statistical significance of the estimate is weak.

What can we conclude about the indirect contributions of media to risk perceptions? First, we have evidence that, at least for the general public and business samples, media exposure does systematically affect knowledge scores; exposure to television news -- which is perceived as inclined to greatly overstate environmental problems by both samples -- is linked to *decreased knowledge scores*, which in turn is related to greater perceived risks of nuclear wastes. While not statistically significant for all samples, the *overall pattern* of estimated coefficients for the relationship between media exposure and knowledge suggests that this relationship might be pervasive across the various populations. The relationship between the media and the risk ratchet is more mixed; for the general public sample, it appears that more television news is associated with a smaller risk ratchet. For the business and legislator samples, more frequent newspaper exposure seems also to be associated with reduced risk ratchet. Thus, while mixed, the most systematic contributions of media seem to be in the area of knowledge, which in turn is associated with risk perceptions. In addition, different kinds of media have different relationships, with television news linked to less knowledge, and newspaper linked to more.

5.3 SUMMARY

Media bias in television news and newspapers is perceived to be in the form of overstatement of risk by all but the environmental group members, who claim the media understate risks to the environment. Business association members tend to see the media as most biased toward overstatement, especially national television. In addition, the media are also seen as the most influential actors in the nuclear waste management policy area by all but the environmentalists (who rank them third in influence behind businesses and government officials).

Media exposure, overall, does not have a direct relationship with perceptions of risks of nuclear waste. However, it is linked with the knowledge questions and (to a lesser extent) with the risk ratchet. The more frequent the exposure to television news, the *lower* the respondent's knowledge score; the more frequently the respondent reads a newspaper, the *higher* the knowledge score. The relationship of media to the ratchet is mixed; television seems to have a weak association with the general public sample, reducing the size of the risk ratchet. Newspapers seem to affect the business and legislator samples, with greater frequency leading to smaller ratchets. Knowledge and the ratchet, in turn, both affect perceived risk as shown in Chapter 4.

Thus the effect of media is more complex that we had initially hypothesized. First, it is not homogeneous in its effect: television news and newspapers appear to have opposite relationships with respect to our knowledge scores. In addition, media exposure does not affect all samples in the same way. Note that media exposure has *no* statistically discernable association with either the environmental group member or scientist samples. Levels of knowledge and risk ratchets for these groups, apparently, are derived from means other than the media. The general public and business sample responses -- particularly regarding knowledge -- appear to be significantly related to media exposure.

CHAPTER 6

MODELING NUCLEAR WASTE RISK PERCEPTIONS

Where do perceptions of the risks associated with nuclear wastes come from? Through the preceding chapters, we have addressed this question from a number of vantage points, assessing the relationships among trust in political actors, patterns of cognitive processing, knowledge of radiation, and media influence. In each of these discussions, we have attempted to make sense of the relationships between perceived risk and a specific subgroup of attributes, beliefs or other factors that we suspect may influence the perception of the riskiness of nuclear wastes. In this chapter we will combine these subsets in an attempt to discern the cognitive structure that underlies nuclear waste risk perception.

In part, the importance of analyzing an aggregate model stems from the fact that an association between risk and any single factor (such as trust) may prove to be spurious if both trust and risk perception are really responding to some other variable (e.g., ideology). If so, analysis of the combined model will permit us to ascertain which factors affect risk perceptions, and which are spurious or intervening variables. That, and the inclusion of a more extensive set of explanatory variables, is the intent of this chapter.

6.1 MAPPING VALUES, BELIEFS AND RISK PERCEPTIONS

A number of alternative hypotheses have been advanced in the literature to explain risk perception. Each points to a different factor (or combination of factors) to explain why risk perception varies from one person or group to another. Recent empirical analysis has tested a number of such explanations of risk perception, including the arguments that risk perception stems primarily from (a) one's knowledge of the hazard, (b) personality attributes, (c) socio-economic attributes such as wealth and education, and (d) culture or "world view."[1] While we do not intend to summarize that literature here, it is useful to break out some of the sets of factors that may be important contributors to nuclear waste risk perception. In the following paragraphs we sketch an array of possible explanations for variation in risk perception, and identify the variables from our study that can be employed to test the explanations.

Fundamental Norms and Priorities. According to a relatively recent line of scholarship, individuals might assess risks in terms of fundamental values and priorities. As theorized by Paul Sabatier, individuals may have a structure of beliefs based on a "deep core" of fundamental norms and axioms that act to constrain their more specific beliefs.[2] Deep core beliefs pertain to fundamental values and ontological truths about nature. Included would be beliefs about the fundamental character-

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[1] See R. Dake and A. Wildavsky, "Rival Theories of Risk Perception: Who Fears What and Why?" *Deadalus*, v. 119 (Fall 1990). Also see M. Douglas and A. Wildavsky, *Risk and Safety* (Berkeley, CA: University of California Press, 1982); Y. Aharoni, *The No-Risk Society* (Chatham NJ: Chatham House, 1981); and A. Wildavsky, *Searching for Safety* (New Brunswick: Transaction Publishers, 1988).

[2] P. Sabatier, "An Advocacy Coalition Framework of Policy Change and the Role of Policy-Oriented Learning Therein," *Policy Sciences*, v. 21 (1988), pp. 129-168.

istics of human nature (are we basically self-interested or altruistic?), the role of mankind in nature (does mankind hold dominion over nature, or are we merely another part of it?), and even about the possibility of obtaining genuine knowledge of nature through science. According to Sabatier, such deep core elements are very resistant to change. Thus, if perceptions of risk stem primarily from deep core values, one would expect that risk perceptions themselves would be likely to change little, if at all.

We have included a number of variables that test for the possibility that fundamental beliefs and values drive risk perceptions. Included are the responses to the following questions about mankind and our relationship to nature:

> People hold a variety of opinions about human nature. Some people believe that a *concern for others and for nature* is natural to people, while others argue that people are *completely selfish*. On a scale of one to five, where one is that people are completely selfish, and five is that people are naturally concerned for others and the environment, where would you place human nature?
>
> | Completely Selfish | | | | Concerned for Others/Env. |
> |---|---|---|---|---|
> | 1❑ | 2❑ | 3❑ | 4❑ | 5❑ |
>
> Some people believe that mankind has dominion over nature, and should use it as a resource to serve human ends; others argue that humans are merely a small part of nature, and should severely limit human actions to those that do absolutely no harm to the environment or other creatures. On a five-point scale, where one indicates that humans should do absolutely no harm to the environment, and five indicates that humans should have dominion over nature, what is your opinion?
>
Absolutely No Harm				Dominion
1❑	2❑	3❑	4❑	5❑

Also included was a set of questions about the fundamental nature of science and technology, each of which was scaled on a five-point "strongly agree" to "strongly disagree" response scale:

> Science tells us the truth about the world.
>
> Scientific evidence can be interpreted to fit any point of view.
>
> Technology can solve society's problems.
>
> Technology has become dangerous and unmanageable.

With these questions, we attempt to assess whether an individual's fundamental beliefs tend to be the primary factors underlying perceptions of risk.

Attitudes About Social and Individual Risks. An alternative explanation is that risk perceptions in specific contexts (like nuclear waste management) are derived from more generalized predispositions toward "risk acceptance" or "risk aversion." In addition, specific risk perceptions may be based on concerns about the *allocation* of risk -- one's willingness to accept risk that is imposed by others, or to impose risks on others without their consent. To tap these issues, we will employ the responses to the following questions, each of which were scaled on a five-point response scales, ranging from "strongly agree" to "strongly disagree."

When the risk is very small, it is okay for society to impose that risk on individuals without their consent.

Even if the potential benefits to society are very large, it is wrong to impose risk on individuals without their consent.

It is okay for society to impose risk without consent if the individuals harmed by the policy are compensated for their loss.

Risk can be eliminated in modern societies.

For society as a whole to survive and prosper, it is necessary that some risks and sacrifices be accepted.

Ideology and Political Efficacy. One of the most widely employed explanations for risk perception in nuclear energy issues is that such perceptions are driven by ideology.[3] We would add to this explanation the possibility that one's sense of political efficacy -- or feeling that one can influence public policy -- may affect perceived risk. Those who believe that they are unable to influence nuclear waste policy may well perceive the resultant risks to be greater than those who believe that they can.

To tap the possible relationship between perceived risk of nuclear waste and ideology, we used the following question:

> On a seven-point scale of political ideology, individuals can be arranged from point one -- extremely liberal, to point seven -- extremely conservative. In terms of your own political ideology, where do you place yourself on this scale?

Extremely Liberal						Extremely Conservative
1❑	2❑	3❑	4❑	5❑	6❑	7❑

For the possible link between political efficacy and risk perception, we used the following set of questions, each of which was scaled on a five-point "strongly agree" to "strongly disagree" scale:

Everyone has a moral obligation to participate for the sake of the community.

No one is obligated to participate, but participation may be necessary to get what you want.

Participation is best left to those who are the most qualified.

People like me don't have any say about what government does in environmental policy.

Perceptions of Problem Severity and Solutions. Another reasonable explanation for variations in risk perception is that different people perceive environmental problems, in aggregate, to have quite different levels of severity. For some, environmental problems may appear to be overwhelming, while others may view them as relatively minor. Some may believe that drastic social and economic

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[3] See, e.g., J. Kuklinski, D. Metlay, and W.D. Kay, "Citizen Knowledge and Choices on the Complex Issue of Nuclear Energy," *American Journal of Political Science*, 26 (November 1982), pp. 615-642.

change will be necessary to avoid environmental disaster, while others see little, if any change as necessary. Thus, it may be that the sense of the overall severity of the environmental problem drives perceptions of more specific risks. To assess this possibility, we included a set of questions including the following:

> Some people believe that pollution, global warming, ozone depletion and other man-made problems have put us on the *brink of environmental crisis* in which it will be impossible for humans to survive as we have in the past. Others believe that these fears are overstated, and that we are *not in serious environmental danger*. What is your opinion? On a five-point scale, where one means we are on the brink of a serious environmental disaster, and five means that environmental danger is slight, what do you think?
>
> Disaster 1❑ 2❑ 3❑ 4❑ Slight Danger 5❑
>
> Please indicate whether you agree strongly, agree, disagree, or disagree strongly with the following statement: The environment can be kept clean and safe without making drastic changes in our lifestyle.
>
> The only solution to the radioactive waste problem is to shut down all production of new waste.
>
> The application of *already existing technologies* can reduce the risks of nuclear waste to acceptable levels.
>
> Some people believe that government already imposes too many environmental restrictions on what individuals and businesses can do. Others believe that more environmental restrictions are necessary. What is your opinion? If one is we need a lot more restrictions, and five is we need a lot less restrictions, where would you place yourself on this scale?
>
> A Lot More 1❑ 2❑ 3❑ 4❑ A Lot Less 5❑

Trust in Political Actors. As discussed in Chapter 3, individuals may perceive different levels of risk due to their trust (or lack thereof) in the various actors involved in the policy process. Trust of those charged with development and implementation of policies could affect one's sense of the safety of the nuclear waste management process. In addition, individuals may look to reference groups to find cues regarding how to perceive risks. These possibilities will be tested using the variables measuring trust in U.S. National Laboratory scientists, university research scientists, spokespersons for the EPA, DOE, national environmental groups, and nuclear power plants, as described in Chapter 3.

Knowledge, Conviction, and the Risk Ratchet. As discussed in Chapter 4, we have tentatively shown that patterns of cognitive processing -- including skepticism regarding information on risks, the conviction with which beliefs are held, and information filtering -- are related to perceived risks. In addition, knowledge of radiation, as tapped by our proxy knowledge variable, was shown to have some relationships. But do these effects hold when included in a more complete model of the bases of risk perception? We will test for that possibility by including the variables for belief certainty, skepticism of new information on nuclear waste risks, the "risk ratchet," and the proxy for knowledge. For more extensive descriptions of these variables, see Chapter 4.

Media Influence. In Chapter 5, we sought to assess the correlations of frequency of media exposure and risk perceptions. As noted in a sample model of media influence, we found no direct relationships. But it may be that, in a more comprehensive model, the effects of the frequency of media exposure will be more apparent. For this reason, we include the frequency of media exposure as an explanatory variable.

Demographic Attributes. Finally, we include the standard demographics variables -- income, age, and education -- both to assess their relationship to perceived risk and to act as controls to assure that the effect of these demographics is held constant in measuring the effects of each of the other explanatory variables in assessing nuclear waste risk perception.

6.2 AN AGGREGATE MODEL OF RISK PERCEPTIONS

Using ordinary least squares regression analysis, the explanatory variables described above were included in an aggregate model of risk perception. Note that the inclusion of each of the sets of explanatory hypotheses assures that, simultaneously, each hypothesis is tested *holding all other variables constant.* Thus, each relationship is tested independently, excluding spurious and indirect relationships.

The model is specified to explain variation in the *average* perception of risk for the three nuclear waste process stages:[4] temporary storage, transportation, and permanent storage. This is done to simplify the analysis and discussion of results, since analysis of each stage separately would prove unwieldy.

The results of the aggregate model analysis, for each of the five samples, are shown in Table 6.1. To facilitate discussion, the question numbers corresponding to those in Appendix A, as well as short descriptive tags, are used to designate each explanatory variable. The explanatory variables themselves are grouped into the sets described in the preceding sections of this chapter. The entries in Table 6.1 represent the relationships between each of the explanatory variables and the average perception of nuclear wastes, holding the effects of all other explanatory variables constant. Thus all relationships are cleaned of the possible mediating effects of the other explanatory variables. This is particularly important when there is reason to believe that some of the explanatory variables are related to each other, as is the case with ideology and perceived need for drastic social and economic change to protect the environment.[5] In addition, the values shown are the *standardized coefficients* for the estimated relationship between the explanatory variable and the respondent's perceived risk of nuclear waste. Use of the standardized coefficient permits us to compare the relative contributions of the explanatory variables to the perception of risk. Where there is no statistically discernible relationship (at the 0.05 level or greater), the lack of influence is indicated by a • symbol. When an explanatory variable has no relationship to risk perception *in any sample* it has been omitted from Table 6.1 altogether.

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4 For these analyses, we look only at perceptions of risk associated with nuclear waste. Thus we exclude the measure of risk of nuclear energy generation discussed in Chapter 2.

5 In the popular sample, for example, ideology and the perceived need for drastic change are modestly positively correlated (Pearson's r = 0.09). If both variables are related to perceived risk, estimates of the associations between either variable and perceived risk would be overestimated without controls.

Table 6.1: Aggregate Models of the Variables Involved in Perceived Risks of Nuclear Waste

SAMPLE:		GEN'L PUBLIC	SCIENTISTS	ENVIRON.	BUSINESS	LEGISLATORS
(AR^2)[6]		(0.306)	(0.543)	(0.577)	(0.562)	(0.641)
(N)		(871)	(907)	(742)	(712)	(86)
EXPLANATORY VARIABLES						
Fundamental Norms & Priorities						
Selfish	(Q1)	•	•	-0.068**	•	•
Interpretation	(Q15)	•	0.059**	0.090**	•	•
Unmanageable	(Q17)	•	•	•	0.077**	•
Attitudes About Social &Individual Risks						
Small Ind. risk	(Q8)	•	•	-0.107***	•	•
Lg. Soc. Benefits	(Q9)	0.107***	•	•	0.094***	•
Elimination	(Q11)	0.090**	0.092***	•	•	•
Ideology & Political Efficacy						
Moral Obligation	(Q48)	•	0.060**	•	0.114***	•
Ideology lib/con	(Q73)	•	•	•	•	0.324***
Perceptions of Problem Severity & Solutions						
Disaster	(Q6)	0.174***	0.116***	0.125***	•	•
Drastic Change	(Q7)	-0.112***	-0.048*	•	•	•
Shut down prod.	(Q45)	0.276***	0.292***	0.294***	0.284***	0.461***
Existing Tech	(Q46)	-0.112***	-0.232***	-0.108***	-0.167***	-0.185**
Trust in Political Actors						
U.S. Nat'l Lab	(Q29)	•	•	0.076**	•	•
Environ. Groups	(Q31)	•	•	-0.083**	-0.074**	•
Nuclear Power	(Q33)	•	0.153***	0.089***	0.157***	•
Knowledge, Conviction, & the Risk Ratchet						
Risk Ratchet		-0.070*	•	-0.089***	-0.084**	•
Knowledge Score		0.096***	0.085***	0.107***	0.101***	•
Skepticism	(Q41)	0.074**	•	•	•	•
Certainty	(Q42)	0.059*	•	0.106***	•	•
Media Influence						
Freq. Newspprs	(Q61)	•	•	-0.066**	•	•
Demographic Attributes						
Age		0.094***	0.141***	•	0.127***	•
Income		•	•	0.079**	•	•

*** Indicates statistically significant at 0.05 level.**
**** Indicates statistically significant at 0.01 level.**
***** Indicates statistically significant at 0.001 level.**

[6] The adjusted R^2 (or AR^2) indicates the proportion of variance in the dependent variable explained by the modeled independent variables, adjusted for the number of independent variables used.

As shown by the adjusted R^2's for each model, the explanatory variables in combination are able to explain substantial proportions of the variance in the perceived risk of nuclear waste. Since the adjusted R^2 can be taken to represent the proportion of the variance in perceived risk accounted for by the combination of explanatory variables, the model explains about 30% of the variation in perceived risk among respondents to the general public sample, about 55% of the variation for the scientist, environmental group member, and business association member respondents, and 64% for the legislator respondents. By the usual standards of social science, using individual level data, all of the models have fairly substantial explanatory capacity.

Turning to the specific sets of explanatory variables, it appears that an individual's **fundamental norms and priorities** have only modest correlations with perceptions of risk, and these effects were limited to the scientist, environmental group member, and business association member samples. For the scientist and environmental group member samples, agreement with the statement that "scientific evidence can be interpreted to fit any point of view" is correlated with a greater level of perceived risk of nuclear waste. Thus a belief that scientific data can be abused -- basically used as ammunition in political debate -- is correlated with a greater concerns about the risks of nuclear wastes. In addition, for the environmental group members, basic assumptions about mankind prove to be significant (though the magnitude of the relationship is small). Somewhat surprisingly, those environmental group member respondents who believe human nature to be more concerned about others and the environment (as opposed to completely selfish) are *more* fearful of nuclear wastes. For the business association member sample, the only fundamental belief associated with perceived risks concern technology; those more inclined to perceive technology as "dangerous and unmanageable" are more fearful of nuclear wastes.

Regarding the explanation that risk perception is a function of **general attitudes about societal and individual risk**, again the analysis shows interesting (though modest) relationships. For the general public, environmental group member, and business association member samples, concern about imposition of risk on others is significantly related to the perceived risks of nuclear wastes. Those who believe it is wrong to impose risks onto others without consent -- regardless of whether the risk is small or the benefits to society are large -- perceive greater risks in nuclear wastes. Thus it appears that, in part, concern about the risk of nuclear wastes has to do with the perception that it is a risk imposed on an unconsenting population. This indicates that a theme underlying disputes over nuclear wastes has to do with *who imposes risk on whom*, quite independently of assessments of the probability of an accident or the magnitude of its effect on the population.

For the scientist and general public samples, the analysis indicates that perceived risks are correlated with one's most general understanding of risk -- is it possible to eliminate risk in modern society? Those among the scientist and general public samples who tend to agree that risks can be eliminated in modern society tend also to be the most fearful of nuclear wastes. Conversely, those who disagree -- who are most inclined to see risk as an inherent part of modern society -- are least fearful of nuclear wastes. These results indicate that fears of nuclear waste emanate in part from perceptions of the capacity of society to eliminate or minimize risks more generally.

We hypothesized that **ideology and attitudes concerning political efficacy** would affect perceptions of the risks of nuclear waste. The results of the analysis, particularly in light of earlier research,[7] are surprising. First, political efficacy has no discernible relationship in any of the samples. In addition, traditional left/right ideology, controlling for other explanatory variables, has no discernible relationship to risk perception *except* within the legislator sample. For the legislators, the more "conservative" one is, the lower the perceived risks of nuclear wastes. The fact that ideology does not matter for risk perception in the other samples indicates that, at least in part, nuclear waste issues (and perhaps nuclear issues in general) *cut across* traditional ideological lines.[8] Only among legislators, who must work within the more traditional ideological divisions that so thoroughly characterize inter-party conflict and legislative tactics, does traditional ideology retain a clear and substantial relationship.

Tapping another dimension of ideology, the belief that "everyone has a moral obligation to participate for the sake of the community" proves to be significant for both the scientist and business samples. Those who tend to believe that everyone is morally obligated to participate for the good of the community tend to perceive greater risks. Those who disagree, seeing participation as an option rather than a moral obligation, tend to see lesser risks.

Beliefs about the **severity of environmental problems and potential solutions** to nuclear waste problems prove to be significant and powerful predictors of perceived risks of nuclear wastes in all samples. Within the general public, scientist and environmental group member samples, those who believe that man-made problems have put us on the "brink of environmental disaster" perceive far greater risks from nuclear wastes than do those who see environmental problems as "slight." And, within the general public and scientist samples, belief that the environment can be kept "clean and safe without making drastic changes in our lifestyle" is linked to a far *lesser* fear of nuclear wastes. In general, it appears that perceptions of the risks of nuclear wastes are tied to more general beliefs about the seriousness of threats to the environment; as these fears grow, so does fear of nuclear wastes.

Not surprisingly, those who believe the management of nuclear waste to be beyond our current technological and/or political capacities tend to perceive far greater risks. What is surprising is the *strength* of the correlation of this belief; for all samples, the influence of these explanatory variables far outstrips that of any other. Those who disagree that "application of already existing technologies can reduce the risks of nuclear wastes to acceptable levels" perceive far greater risks *in all samples*. In addition, those who believe the problems of nuclear waste management to be so intractable that "the only solution to the radioactive waste problem is to shut down all production of new waste" are *substantially* more fearful of nuclear wastes, again in all samples. Thus, a great deal of the fearfulness of nuclear waste appears to stem from pragmatic considerations: is our society capable of managing those wastes? Those who are not so convinced believe nuclear wastes to be a great risk to us all.

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[7] For example, J. Kukinski et al., *op. cit.*

[8] For some recent work on ideology and elite attitudes toward nuclear power, see S. Rothman and S. R. Lichter, "Elite Ideology and Risk Perception in Nuclear Energy Policy," *American Political Science Review*, v. 81 (June, 1987): pp. 388-404.

As discussed in Chapter 3, **trust for the primary actors in the nuclear waste policy process** appears to substantially correlated with risk perceptions. Interestingly, the relationship between trust and perceived risk for respondents to the general public sample (as discussed in Chapter 3) is completely "washed out" when we control for other explanatory variables. This indicates that the general public's trust is related to other explanatory variables -- such as perceptions of problem severity -- that *also* explain perceived risk. Hence, when both variables are included in the model, the contribution of trust drops out.

But trust does appear to be related to perceived risk by respondents to the environmental group member sample, the business sample, and (to a lesser degree) the scientist sample. For environmental group members, increased trust in U.S. National Laboratory scientists and spokespersons for nuclear power plants is related to *reduced* risk perception of nuclear wastes. On the other hand, greater trust in spokespersons for national environmental groups is linked to *greater* perceived risk of nuclear wastes. The business sample indicates the same relationships, except that there is no discernible relationship between risk perception and trust for U.S. National Laboratory scientists. Finally, for the scientist sample, the only trust variable that proves significant is for nuclear power plant spokespersons; the greater the trust for this actor, the less the perceived risk of nuclear waste. Also of interest is the fact that trust for DOE, EPA and university research scientists seems *not* to be correlated with perceived risks for any of our samples.

As discussed in Chapter 4, the cognitive process and knowledge variables have significant relationships with perceived risks of nuclear waste. As indicated in Table 6.1, these relationships tend to hold even when we control for the contributions of the other explanatory variables. For the general public, environmental group member and business samples, a greater propensity to accept information about greater risks than reduced risks (i.e., a positive *risk ratchet*) is correlated with greater perceived risk of nuclear waste. For all samples *but* the legislators, higher knowledge scores are linked to *reduced* risk perception of nuclear wastes. For the general public sample only, a greater skepticism about information regarding nuclear wastes corresponds to a greater perception of risk. Finally, for both the general public and environmental group member samples, those with the *greatest certainty* about their beliefs regarding nuclear wastes tend also to be the most fearful of nuclear wastes. Note that, when compared to the other samples, risk perceptions of the scientists and legislators are modestly correlated with these knowledge and cognitive processing variables, while strong correlations exist in the general public sample. For scientists, this probably results from the fact that respondents tend generally to be quite knowledgeable about radiation (see Chapter 4), and hence variation in their perception of the risks of nuclear wastes might stem from other factors. For legislators, the lack of relationship between these variables and perceived risk appears to be, quite simply, because legislators respond overwhelmingly to other factors -- notably, to ideology and perceptions of our ability to manage nuclear wastes.

As discussed in Chapter 5, the media have little direct correspondence with perceptions of nuclear waste risk. Controlling for other variables, only environmentalists show a statistically discernible relationship between media exposure and perceived risk. In that case, more frequent exposure to newspapers correlates with less fear of nuclear wastes. But remember that much of the effect of media might be indirect, as shown in Chapter 4. Thus, the results shown in Table 6.1 serve to confirm that -- even controlling for the contributions of the other explanatory variables -- the primary import of media for risk perception is probably indirect, via its relation-

ship to such variables as knowledge and the risk ratchet. These variables, in turn, have a significant correlation with risk perception.

Finally, several demographic attributes are associated with risk perceptions. Age is significant for the general public, scientist, and business samples. In all cases, as age increases perceived risks of nuclear waste decline. Income, controlling for other explanatory variables, is significant only for the environmental group member sample; as income rises, perception of the risk nuclear waste declines. Education proves not to have a statistically discernible contribution in any sample.

6.3 SUMMARY AND CONCLUSIONS

Overall, beliefs about the severity of environmental problems and about society's ability (technical and otherwise) to adequately manage nuclear wastes prove to be the strongest predictors of the perceived risks of nuclear wastes in *all* of our samples. Otherwise, quite distinct patterns of relationships among the explanatory variables and fear of nuclear wastes are evident across our samples.

For the general public, knowledge and cognitive processing prove to be strong predictors of the perceived risks of nuclear wastes. The better the knowledge score the less the risk perception, and the smaller the risk ratchet, the less the risk perception. Increased certainty about one's beliefs, and increased skepticism of new information, are both linked to greater perceived risks of nuclear wastes. Very general views of risk -- whether risk can be eliminated in modern societies, and whether it is acceptable for society to impose risks on individuals without their consent -- play a modest role in shaping perceptions of risk. And finally, age -- the only demographic variable with impact -- acts to diminish fears of nuclear wastes.

For the scientist sample, increased trust in spokespersons for nuclear power plants is associated with decreased risk perception of nuclear wastes, as is a higher knowledge score. Those scientists who tend to believe risk can be eliminated in modern society perceive greater risk. In addition, those who are more skeptical about the application of scientific evidence perceive greater risks.

Among the environmental group members, trust in various political actors and the knowledge/cognitive processing variables tend to be quite important. Trust of national environmental groups is associated with increased risk perception, while trust of U.S. National Laboratory scientists and producers of nuclear power is correlated with decreased risk perception. As is true of the other samples, a higher knowledge score and a lower risk ratchet are linked to decreased perceived risks. Finally, the belief that it is wrong to impose risk on those who do not consent to it is associated with perceived risk.

For the business sample, trust is again significant: greater trust for national environmental groups, and lower trust for nuclear power plant spokespersons, are related to increased fears of nuclear wastes. Once again, a higher knowledge score, and a smaller risk ratchet, are associated with diminished perceived risk. Risk perception by the business sample respondents is also linked to a belief that one is morally obligated to participate for the good of society. Those who accept this position also perceive more risk from nuclear wastes.

Finally, the legislators respond almost exclusively to perceptions of society's capacity to manage nuclear wastes and to political ideology. As with all our samples, those who do not believe we currently have the technology to reduce risks of nuclear wastes to acceptable levels, and who believe that the only solution to the problem of

nuclear wastes is to cease producing them, perceive the greatest risks. In addition, those legislators who describe themselves as more "liberal" tend to perceive greater risks than do those who describe themselves as more conservative.

CHAPTER 7

POLITICAL PARTICIPATION AND RISK PERCEPTION

While understanding the variables associated with the perceived risks of nuclear waste helps to explain patterns of risk acceptance across populations, it does not indicate how, or if, these perceptions are translated into expressions of public preference. If risk perception is related to patterns of political participation, translation of risk perceptions into policy is likely to be skewed in favor of those who participate most heavily. The most common means of participation in our process is voting. Hence, we will examine whether voters hold different views of the risk of nuclear waste than non-voters. In addition, political parties are important channels through which public policy preferences are expressed. Therefore, we will compare the perceptions of risks across political parties. Finally, we will analyze the the relationship between nuclear waste risk perceptions and "political activism," meaning the frequency with which the individual engages in activities intended to influence environmental policy.

Using our general public sample, we can look at differences in the risk perceptions of those who are, and are not, registered to vote. Likewise, we can detect systematic differences in perceptions of risk of those who are affiliated with different political parties. In addition, using responses to a question about the frequency with which the respondent engages in activities designed to influence environmental policy ("activism"), we will analyze the link between activism and perceptions of risk. In each case, we will be able to gauge *which* beliefs regarding the risks of nuclear waste are most likely to be articulated in the political process, and by which political parties.

Note that the analyses performed here are considerably less complex than has been true of those presented in the preceding chapters. In each case, we are looking at a relationship between only two variables -- perceived risk and a measure of political behavior. For that reason, this section is comparatively brief.

7.1 PARTY IDENTIFICATION AND RISK PERCEPTION

One of the most common forms of political expression is voting. The question we raise here is whether there are differences in risk perceptions between those who are registered to vote and those who are not. While we cannot assume everyone who is registered will vote, or that nuclear risk will be the dominant consideration when they cast their votes, we can analyze the degree to which voters and non-voters differ in perceived risks. These differences are reported in Table 7.1.

Table 7.1: Voter Registration and Risk Perceptions of Nuclear Waste Management Stages

Registered	Production	Temporary Storage	Transportation	Permanent Storage
Yes	2.35*	2.20	2.09*	2.30*
No	2.09	2.04	1.88	2.05

* Indicates a statistically significant difference between groups at 95% confidence level.

In the general public sample, people who are registered to vote have a statistically significantly *lower* perception of risk than those who are not registered to vote. Temporary storage is the only category where there is no statistically discernable difference between the two. For both registered voters and those not registered, the greatest risk is perceived to be related to the transport of nuclear waste. People who are not registered to vote, however, see this activity as *very* risky; the non-registered mean of 1.88 suggests perception of "a lot of risk," tending slightly to "extreme risk." For those who are registered to vote, the mean value of 2.09 represents a position slightly *below* "a lot of risk." Overall then, voters have less fear of nuclear wastes -- in nearly all stages of the waste process -- than is true of the non-registered population.

7.2 POLITICAL PARTIES AND RISK PERCEPTION

In order to explore the relationship between party identification and risk perceptions, respondents were asked "With which political party do you identify?" An analysis of variance shows the differences among self-identified Democrats, Independents and Republicans regarding the degree of risk perceived in all four stages of the nuclear waste management process. Table 7.2 presents a summary of the mean values for each group based on a five-point scale where one is "extreme risk," two is "a lot of risk," three is "some risk," four is "slight risk," and five is "no risk."

Table 7.2: Party Identification and Risk Perceptions of Nuclear Waste Management Stages

	Production	Temporary Storage	Transportation	Permanent Storage
Democrat	2.18	2.06	2.00	2.22
Independent	2.30	2.13	2.00	2.13
Republican	2.51*	2.39*	2.21*	2.48*

* Indicates Republicans are statistically significantly different from both Democrats and Independents at the 95% level. The differences between Democrats and Independents are not statistically discernable.

As indicated in Table 7.2, Republicans perceive significantly less risk than do Democrats and Independents in all stages of the nuclear waste management process. The differences in means between the Democrats and Independents are not statistically discernable, meaning that, in all cases, Independents hold positions more like Democrats than Republicans on these issues. The largest difference in perceived risk appears to be regarding the production and temporary storage of nuclear wastes.

It is interesting to note that the ranking of risks varies for each of the groups. While all parties perceive transportation to be the most risky, Republicans and Independents believe production to have the least risk and Democrats see permanent storage as the least risky.

7.3 ACTIVISM AND RISK PERCEPTION

Individuals can attempt to affect nuclear waste policy through a variety of means such as contacting officials, participating in demonstrations, etc. Those who are more active may have different levels of risk perception than those who are less active. In order to determine an individual's level of activism, respondents were

asked, "In an average month, about how many times do you participate in an activity that is intended to influence environmental policy?"

Somewhat surprisingly, levels of activism have *no relationship* to the perceptions of nuclear waste management risk. Our analysis indicates that those who never, or rarely, seek to influence environmental policy have perceptions of the risk involved in nuclear waste management that are very similar to those who actively seek to influence environmental policy. Thus, within the general public, "activists" tend to span the full range of views regarding the risks of nuclear wastes.

7.4 SUMMARY

Understanding the origins of risk perception is only the beginning of understanding the complex nature of nuclear waste management as a political issue. How, and if, these perceptions are translated into policy through the political system is very important. We have sought to show how the political process may act to filter public perceptions regarding the risks of the nuclear waste process. First, registered voters tend to perceive less risk in all stages of the nuclear waste process than those who are not registered. Second, perceptions of risks among Republicans appear to be lower than is true for Democrats or Independents. Finally, there tends to be no systematic relationship between the frequency of political involvement and risk perceptions.

CHAPTER 8

SUMMARY AND CONCLUSIONS

This report contains the results of our analysis of responses to five surveys designed to measure the perceptions of the risks associated with nuclear waste management in Colorado and New Mexico. Samples were taken of the New Mexico and Colorado general public, members of environmental groups, scientists, members of business associations, and New Mexico and Colorado state legislators. Our objective was to gain insights into perceptions of the risks associated with nuclear wastes to facilitate development of reasonable nuclear waste management policies. In each of the foregoing chapters, we have analyzed specific aspects of these risk perceptions -- ranging from the distributions of risk perceptions (who fears what and how much?), through some of the means by which risk perceptions arise, to how these perceptions may be disproportionately expressed in the political process. In this chapter, we provide a concluding summary of our most important results.

Our measures of risk across distinct populations show substantial differences in the perceived risk of nuclear wastes. On average, the legislator sample perceives the lowest level of risks across all stages of the nuclear waste process, followed by the scientist and business samples. The greatest risk is perceived by the environmental group member sample. The general public sample perceives slightly less risk, on average, than the environmental group member sample. Thus, in terms of *levels* of perceived risk, the general public is most similar to the environmental group members.

Looking across the stages of the nuclear waste process, all groups but the scientists rank transportation of nuclear wastes as being the most (or tied for the most) risky. Scientists perceive temporary storage to be the most risky. The scientists, legislators and business association members rank permanent storage as the least risky stage of the process. Among environmentalists, *all* stages are perceived as highly risky, and are so closely tied as to be statistically indistinguishable.

Trust for the primary actors involved in the nuclear waste policy process varies considerably. Within the general public sample, greatest trust goes to university research scientists. Scientists from U.S. National Laboratories, national environmental groups and the EPA are the next most trusted groups, all given quite similar trust scores. DOE is given somewhat lower trust, followed at the bottom of the trust scale by spokespersons for nuclear power plants and chemical companies.

Using the correlations among trust scores, we used cluster analysis to see if the general public perceives the primary actors in the nuclear waste policy process to be aligned in coalitions. The results as shown in Figure 3.1, suggest that DOE is seen as a part of a coalition with nuclear power plants and chemical companies, while EPA is aligned with (much more loosely) the national environmental groups. University and U.S. National Laboratory scientists are spaced between these other clusters, indicating that they are seen as relatively neutral.

These results suggest that within the nuclear waste policy area DOE is perceived as playing a somewhat partisan role, aligned with nuclear power producers and chemical companies, against the environmental groups and EPA. In addition, political conflict over policy positions is very likely to be compounded by the overall

pattern of trust and distrust. This pattern is most apparent with respect to trust in spokespersons for nuclear power plants and environmental groups; those who disagree with the policy positions taken by these groups *also tend to distrust them.* This means that policy positions taken by these actors are likely to be selectively filtered by the general public, essentially discounting the policy statements made by those who hold divergent views. The misfortune is that the policy debate is likely to become increasingly polarized as partisans cease to listen to opponents and "talk past each other." If this propensity for distrust to reinforce preconceived policy positions becomes generalized to the nuclear waste policy process, prospects for reasoned policy development will be significantly undermined.

We also analyzed perceptions of political influence in nuclear waste policy, and discovered that those actors most commonly identified as "interest" or "public interest" groups -- business/industrial groups and environmental groups -- are not widely perceived to hold greatest power in setting nuclear waste management policy. Indeed, these groups tend to perceive *each other* as more powerful, and *themselves* as less powerful, than do other groups. Thus the perception of a single powerful interest, able to dominate nuclear waste policy making, seems not to be widespread.

Our analysis of views of political influence further suggests that most respondents perceive power in the nuclear waste process to be quite *fragmented,* and distributed over a number of different actors. The media is widely believed to be the most influential actor in the nuclear waste policy arena. In all but the legislator sample, citizens are perceived to play the *least* influential role. Interestingly, the general public sample gives citizens a higher influence rating (5.25 on a ten-point scale) than does any other except the legislator sample (which gives citizens a score of 6.32). Thus, while seeing themselves as less influential than the regular policy actors, the general public still perceives itself as having at least *some* influence.

Turning to how people screen and process information about nuclear wastes, we observed that the level of knowledge about radiation (as measured by our proxy knowledge score) and one's propensity to filter information about risk are important factors in risk perception. Our knowledge score, based on answers to a set of questions about the characteristics and effects of radiation, relates significantly to risk perception. The better one's knowledge score, the *less* the perceived risk of nuclear waste. Regarding the filtering of information about risk, we discovered that, *in all samples*, individuals tend systematically to **filter in** information that increases perceived risk, and **filter out** information that diminishes perceived risk. Information that makes people more fearful tends to stick, while information that dampens fears tends to bounce off. We dubbed this phenomena the "risk ratchet," because its effect will be to "ratchet up" perceptions of risk.

Other cognitive factors also were related to risk. Within the general public and environmental group member samples, the greater the level of *subjective certainty* about one's beliefs regarding nuclear wastes, the greater the perceived risks of nuclear wastes. In addition, the more skeptical the respondent is about the accuracy of information about risks of nuclear wastes, the more fearful the respondent is of nuclear wastes. Thus, for the general public and members of environmental groups, both greater certainty and greater skepticism about information appear to be related to a greater perception of riskiness of nuclear wastes.

Analyzing perceptions of the role of the media in nuclear waste policy making, we found that virtually all samples perceived the media to be biased. Respondents to the environmental group member sample indicate that, on average,

the media *understates* environmental risks. All other groups, especially the business and scientist samples, perceive the media to *overstate* environmental risks.

Given that the media are seen as biased in their reporting on environmental issues *and* as highly influential (by all samples but the environmental group members), we tested to see if exposure to the media is related to risk perceptions. While no *direct* relationship between media exposure and risk perception is evident, the level of exposure does appear to be correlated with knowledge and the risk ratchet. Particularly for the general public sample, the more frequently one watches television news, the *lower* one's radiation knowledge score. The lower the knowledge score, the greater the perceived risk of nuclear wastes. The more frequently one reads the newspaper, on the other hand, the higher the knowledge score. In general, the relationship between media and risk perceptions appears to be indirect, and more complex than would be presumed given the widespread perception of both significant influence *and* bias in reporting.

Our aggregate models of risk perception, including an array of explanatory variables, indicates that the most important contributors to fear of nuclear waste are general perceptions of the seriousness of current environmental problems and beliefs about our technological capacity to adequately manage nuclear wastes. Those who believe current technology to be inadequate to reduce risks of nuclear wastes -- and who argue that stopping production is the *only* way to deal with nuclear wastes -- perceive the most risk. In addition, those most inclined to believe the environment to be in severe jeopardy are far more fearful of nuclear wastes. One implication is that a heightened fear of environmental problems generally -- including global warming, acid rain, and other issues largely unrelated to nuclear wastes -- will be linked with increased fears of nuclear wastes.

The aggregated model also indicates that trust of various political actors is an important contributor to risk perceptions, but primarily for the environmental and business samples. Within these samples, greater trust for national environmental groups is associated with greater fear of nuclear waste. Trust of nuclear power plant spokespersons and U.S. National Laboratory scientists, on the other hand, is linked to less fear of nuclear wastes. The aggregate model also confirms that, even controlling for a wide array of other factors, the knowledge scores and the risk ratchet are important predictors of risk perception for most samples.

Somewhat surprisingly, once we control for other possible influences, political ideology has no relationship to risk perceptions *except for the legislator sample*. In that sample, ideology contributes substantially, with liberals tending to perceive greater risk from nuclear wastes, and conservatives perceiving less risk.

Finally, we examined patterns of political participation to see if those who regularly or frequently participate in politics hold risk perceptions at variance with the general public. Our analysis indicates that registered voters perceive nuclear wastes to be significantly *less* risky than those who are not registered to vote. Across political parties, Democrats and Independents tend to perceive nuclear waste management to pose greater risks than do Republicans. And finally, within the general public sample, those who participate more frequently (i.e., "activists") do not, on average, have risk perceptions at variance with the general public. These results indicate that, at least in the Colorado/New Mexico region, broad patterns of participation in electoral politics tilt the playing field slightly in favor of those who perceive nuclear waste management to be *less* risky.

APPENDIX A: SURVEY QUESTIONNAIRE

PLEASE INDICATE YOUR ANSWER BY PLACING A "✔" IN THE BOX NEXT TO YOUR RESPONSE.

1. People hold a variety of opinions about human nature. Some people believe that a *concern for others and for nature* is natural to people, while others argue that people are *completely selfish*. On a scale of one to five, where one is that people are completely selfish, and five is that people are naturally concerned for others and the environment, where would you place human nature?

Completely Selfish			Concerned for Others/Env.	
1❑	2❑	3❑	4❑	5❑

2. Some people believe that mankind has dominion over nature, and should use it as a resource to serve human ends; others argue that humans are merely a small part of nature, and should severely limit human actions to those that do absolutely no harm to the environment or other creatures. On a five-point scale, where one indicates that humans should do absolutely no harm to the environment, and five indicates that humans should have dominion over nature, what is your opinion?

Absolutely No Harm				Dominion
1❑	2❑	3❑	4❑	5❑

People place different emphases on the problems facing society. We're interested in how you compare the urgency of some of these problems. Specifically we'd like to know how you compare the urgency of dealing with issues of *economic competitiveness* between the U.S. and other countries like Japan and West Germany, the *environmental problems* like global warming and ozone depletion, *national defense problems*, and *public health problems* like control and prevention of cancer and infant mortality.

3. If you compare *economic competitiveness* with *environmental problems*, would you say that the problem of **economic competitiveness** is a lot more serious, somewhat more serious, about the same, somewhat less serious, or a lot less serious than **environmental problems?**

   1❑ a lot more serious
   2❑ somewhat more serious
   3❑ about the same
   4❑ somewhat less serious
   5❑ a lot less serious

4. How would you compare *public health problems* with *environmental problems*? Would you say that **public health problems** are a lot more serious, somewhat more serious, about the same, somewhat less serious, or a lot less serious than **environmental problems?**

   1❑ a lot more serious
   2❑ somewhat more serious
   3❑ about the same
   4❑ somewhat less serious
   5❑ a lot less serious

5. And how would you compare *national defense* and *environmental problems*? Do you think that **national defense problems** are a lot more serious, somewhat more serious, about the same, somewhat less serious, or a lot less serious than **environmental problems?**

   1❑ a lot more serious
   2❑ somewhat more serious
   3❑ about the same
   4❑ somewhat less serious
   5❑ a lot less serious

6. Some people believe that pollution, global warming, ozone depletion and other man-made problems have put us on the *brink of environmental crisis* in which it will be impossible for humans to survive as we have in the past. Others believe that these fears are overstated, and that we are *not in serious environmental danger*. What is your opinion? On a five-point scale, where one means we are on the brink of a serious environmental disaster, and five means that environmental danger is slight, what do you think?

Disaster				Slight Danger
1❑	2❑	3❑	4❑	5❑

Please indicate whether you agree strongly, agree, disagree, or disagree strongly with the following statement.

7. The environment can be kept clean and safe without making drastic changes in our lifestyle.

1❑ agree strongly 2❑ agree 3❑ disagree 4❑ disagree strongly

Now let's focus on the risks we face living in modern society. There is substantial disagreement over whether it is acceptable for society to impose risks on individuals without their consent. We are interested in your views on this subject. Please indicate whether you agree strongly, agree, disagree or disagree strongly with the following statements.

8. When the risk is very small, it is okay for society to impose that risk on individuals without their consent.

1❑ agree strongly 2❑ agree 3❑ disagree 4❑ disagree strongly

9. Even if the potential benefits to society are very large, it is wrong to impose risk on individuals without their consent.

1❑ agree strongly 2❑ agree 3❑ disagree 4❑ disagree strongly

10. It is okay for society to impose risk without consent if the individuals harmed by the policy are compensated for their loss.

1❑ agree strongly 2❑ agree 3❑ disagree 4❑ disagree strongly

11. Risk can be eliminated in modern societies.

1❑ agree strongly 2❑ agree 3❑ disagree 4❑ disagree strongly

12. For society as a whole to survive and prosper, it is necessary that some risks and sacrifices be accepted?

1❑ agree strongly 2❑ agree 3❑ disagree 4❑ disagree strongly

13. Some people think that decisions about the *applications of advanced technologies*, such as genetic engineering and nuclear energy should be made by experts, other people think that these decisions should be handled primarily by citizens or their representatives. On a scale of one to seven, with one indicating that decisions about the applications of advanced technologies should be made by experts, and seven indicating that these decisions should be made primarily by citizens or their representatives, where would you place yourself on this scale?

Experts						Citizens/Representatives
1❑	2❑	3❑	4❑	5❑	6❑	7❑

We are interested in your attitudes about the role of science and technology in society. Please indicate whether you agree strongly, agree, disagree or disagree strongly with the following statements.

14. Science tells us the truth about the world.

1❑ agree strongly 2❑ agree 3❑ disagree 4❑ disagree strongly

15. Scientific evidence can be interpreted to fit any point of view.

1❑ agree strongly 2❑ agree 3❑ disagree 4❑ disagree strongly

16. Technology can solve society's problems.

1❑ agree strongly 2❑ agree 3❑ disagree 4❑ disagree strongly

17. Technology has become dangerous and unmanageable.

1❑ agree strongly 2❑ agree 3❑ disagree 4❑ disagree strongly

Next we would like you to evaluate the risk involved in the following situations.

18. The production of nuclear energy poses:

1❑ extreme risk 2❑ a lot of risk 3❑ some risk 4❑ slight risk 5❑ no risk

19. Temporary storage of nuclear waste in the facilities where it was produced poses:

1❑ extreme risk 2❑ a lot of risk 3❑ some risk 4❑ slight risk 5❑ no risk

20. The transportation of nuclear waste poses:

1❑ extreme risk 2❑ a lot of risk 3❑ some risk 4❑ slight risk 5❑ no risk

21. The permanent storage of nuclear waste poses:

1❑ extreme risk 2❑ a lot of risk 3❑ some risk 4❑ slight risk 5❑ no risk

Government policies may be designed to reduce many different sorts of risk. For each of the following potential hazards, please indicate how critical it is that government action be taken to reduce that kind of risk, with one being not at all critical and ten being extremely critical.

	Not Critical									Very Critical
22. Consumption of saccharin	1❑	2❑	3❑	4❑	5❑	6❑	7❑	8❑	9❑	10❑
23. Nuclear energy generation	1❑	2❑	3❑	4❑	5❑	6❑	7❑	8❑	9❑	10❑
24. Downhill skiing	1❑	2❑	3❑	4❑	5❑	6❑	7❑	8❑	9❑	10❑
25. Genetic engineering	1❑	2❑	3❑	4❑	5❑	6❑	7❑	8❑	9❑	10❑
26. Radioactive waste	1❑	2❑	3❑	4❑	5❑	6❑	7❑	8❑	9❑	10❑
27. Handguns	1❑	2❑	3❑	4❑	5❑	6❑	7❑	8❑	9❑	10❑
28. Coal energy generation	1❑	2❑	3❑	4❑	5❑	6❑	7❑	8❑	9❑	10❑

Suppose that a controversial decision had just been reached about how the nation should manage chemical and nuclear wastes. We would like to know how much trust you would place in statements made by the following officials, where one is not at all trustworthy and ten is completely trustworthy.

		Not at all trustworthy									Completely trustworthy
29.	Scientists at U.S. National Laboratories	1❑	2❑	3❑	4❑	5❑	6❑	7❑	8❑	9❑	10❑
30.	Spokespersons for chemical companies	1❑	2❑	3❑	4❑	5❑	6❑	7❑	8❑	9❑	10❑
31.	Spokespersons for national environmental groups	1❑	2❑	3❑	4❑	5❑	6❑	7❑	8❑	9❑	10❑
32.	Spokespersons for the U.S. Department of Energy	1❑	2❑	3❑	4❑	5❑	6❑	7❑	8❑	9❑	10❑
33.	Spokespersons for nuclear power plants	1❑	2❑	3❑	4❑	5❑	6❑	7❑	8❑	9❑	10❑
34.	University research scientists	1❑	2❑	3❑	4❑	5❑	6❑	7❑	8❑	9❑	10❑
35.	Spokespersons for the U.S. Environmental Protection Agency	1❑	2❑	3❑	4❑	5❑	6❑	7❑	8❑	9❑	10❑

Next we'd like to get your impressions of how politically influential various actors are in determining policy on nuclear and chemical waste. On a scale of 1 to 10 with 1 the least influential and 10 the most influential, how would you rate the influence of the following actors.

		Least influential									Most influential
36.	Citizens	1❑	2❑	3❑	4❑	5❑	6❑	7❑	8❑	9❑	10❑
37.	Environmental groups	1❑	2❑	3❑	4❑	5❑	6❑	7❑	8❑	9❑	10❑
38.	Business/industry groups	1❑	2❑	3❑	4❑	5❑	6❑	7❑	8❑	9❑	10❑
39.	Government officials	1❑	2❑	3❑	4❑	5❑	6❑	7❑	8❑	9❑	10❑
40.	Media	1❑	2❑	3❑	4❑	5❑	6❑	7❑	8❑	9❑	10❑

41. People get information about the risks of nuclear and chemical wastes from a variety of sources. How often would you say that you find yourself questioning the accuracy of the information you receive on these issues?

1❑ always 2❑ often 3❑ some of the time 4❑ rarely 5❑ never

42. Some people have strong convictions about the risks from nuclear and chemical waste, while other people are less certain about their beliefs. Where would you place yourself? Are you:

1❑ very certain
2❑ somewhat certain
3❑ somewhat uncertain
4❑ very uncertain

43. Suppose a source you consider to be neutral provided new information about the risks of nuclear waste that indicated that these risks were greater than you had previously believed. How likely would you be to change your point of view?

1❑ very unlikely
2❑ somewhat unlikely
3❑ somewhat likely
4❑ very likely

44. Now, suppose that the same neutral source provided information that indicated that the risks of nuclear waste were less than you had previously believed. How likely would you be to change your point of view?

1❑ very unlikely
2❑ somewhat unlikely
3❑ somewhat likely
4❑ very likely

Please indicate whether you agree strongly, agree, disagree or disagree strongly with the following statements:

45. The only solution to the radioactive waste problem is to shut down all production of new waste.

1❑ agree strongly 2❑ agree 3❑ disagree 4❑ disagree strongly

46. The application of *already existing technologies* can reduce the risks of nuclear waste to acceptable levels.

1❑ agree strongly 2❑ agree 3❑ disagree 4❑ disagree strongly

47. Some people believe that if you *educate people they'll choose to behave responsibly* toward others and toward the environment; others argue that the only way to get people to act responsibly is to rely on *rules and regulation that restrict what people are allowed to do.* On a scale of one to five, where one indicates that rules and regulations are necessary for responsible behavior and five indicates that education will result in responsible choices, what do you think?

Restrictions				Education
1❑	2❑	3❑	4❑	5❑

Political participation includes activities like voting, contacting a congressperson, joining interest groups and running for office. Please indicate whether you agree strongly, agree, disagree or disagree strongly with the following statements.

48. Everyone has a moral obligation to participate for the sake of the community.

1❑ agree strongly 2❑ agree 3❑ disagree 4❑ disagree strongly

49. No one is obligated to participate, but participation may be necessary to get what you want.

1❑ agree strongly 2❑ agree 3❑ disagree 4❑ disagree strongly

50. Participation is best left to those who are the most qualified.

1❑ agree strongly 2❑ agree 3❑ disagree 4❑ disagree strongly

51. People like me don't have any say about what government does in environmental policy.

1❑ agree strongly 2❑ agree 3❑ disagree 4❑ disagree strongly

52. Some people believe that government already imposes too many environmental restrictions on what individuals and businesses can do. Others believe that more environmental restrictions are necessary. What is your opinion? If one is we need a lot more restrictions, and five is we need a lot less restrictions, where would you place yourself on this scale?

A lot more				A lot less
1❑	2❑	3❑	4❑	5❑

People have different opinions about the effects of radiation on people and the environment. We are interested in your views. Please indicate whether you agree or disagree with the following statements.

53. One of the chief problems with the storage of radioactive waste is that it continues to be radioactive for many times the average human life span.

1❑ agree 2❑ disagree

54. Since the detonation of the first atomic bomb, man-made radiation has resulted in new species of plants and animals.

1❑ agree 2❑ disagree

55. There's no difference in the effects of exposure to radiation that comes from man-made and naturally-occurring sources.

1❑ agree 2❑ disagree

56. The human body can repair tissue damage caused by exposure to radiation.

1❑ agree 2❑ disagree

We are interested in your perceptions of the fairness and accuracy of the environmental information presented in the news media. On a scale of one to five, where one indicates that the news media always overstate the risks to the environment, and five indicates that the news media always understate the risks, how would you rate the news media's coverage?

	Overstate				Understate
57. The newspapers?	1❑	2❑	3❑	4❑	5❑
58. The national TV news?	1❑	2❑	3❑	4❑	5❑
59. The local TV news?	1❑	2❑	3❑	4❑	5❑

60. How often do you watch evening network news?

1❑ everyday
2❑ 3 or 4 days per week
3❑ 1 or 2 days per week
4❑ less than once per week

61. How often do you read a newspaper?

1❑ everyday
2❑ 3 or 4 days per week
3❑ 1 or 2 days per week
4❑ less than once per week

62. Please indicate the highest educational degree that you hold:

1❑ B.S. 4❑ M.A.
2❑ B.A. 5❑ Ph.D.
3❑ M.S.

63. What is your field of research? _____

64. What is the type of institution for which you work?

1❑ private research 5❑ county/city agency
2❑ private/non-profit 6❑ business/consultant
3❑ federal agency 7❑ university
4❑ state agency 8❑ other (please specify)_____

65. Are you a member of an environmental group?

1❑ yes 2❑ no

If yes, please indicate which group(s):

1❑ Sierra Club 6❑ Nature Conservancy
2❑ Environmental Defense Fund 7❑ Audubon Society
3❑ Natural Resources Defense Council 8❑ Greenpeace
4❑ Friends of the Earth 9❑ Environmental Policy Institute
5❑ Wilderness Society 10❑ Other _____

66. Thinking generally, how politically active do you consider yourself to be in environmental issues?

Not Active Very Active
1❑ 2❑ 3❑ 4❑ 5❑ 6❑ 7❑ 8❑ 9❑ 10❑

67. In an average month, about how many times do you participate in an activity that is intended to influence environmental policy?

_____

Finally, we need some background information about you.

68. How much education have you had?

1❑ K thru 8th grade 5❑ Some college
2❑ Some high school 6❑ College graduate
3❑ High school graduate 7❑ Graduate work
4❑ Post high school trade school

69. How old were you on your last birthday?

_____

70. What is your race or ethnic background?

1❑ White 5❑ Asian
2❑ African-American 6❑ American Indian
3❑ Spanish-American 7❑ Other _____
4❑ Mexican-American

71. Are you registered to vote?

1❑ Yes 2❑ No

72. With which political party do you identify?

1❑ Democrat 3❑ Republican
2❑ Independent 4❑ Other _____

73. On a seven-point scale of political ideology, individuals can be arranged from point one -- extremely liberal, to point seven -- extremely conservative. In terms of your own political ideology, where do you place yourself on this scale?

1❑ extremely liberal
2❑ liberal
3❑ slightly liberal
4❑ moderate
5❑ slightly conservative
6❑ conservative
7❑ extremely conservative

74. Is your total family income for the past year less than $10,000, $10,000 to $20,000, $20,000 to $30,000, $30,000 to $40,000, $40,000 to $50,000, or more than $50,000?

1❑ Less than $10,000
2❑ $10,000 to $20,000
3❑ $20,000 to $30,000
4❑ $30,000 to $40,000
5❑ $40,000 to $50,000
6❑ Over $50,000

75. Are you: 1❑ Female 2❑ Male

Thank you for completing this survey. The ID number stamped on this page is for our tracking purposes only: your responses are completely confidential, and only aggregated results will be reported.

Should you desire a summary of the results of this survey, please provide a mailing address on a separate sheet of paper. Results will be ready for mailing by mid-September. Once again, thank you for your participation in this survey.

APPENDIX B: RISK URGENCY

The question read as follows:

Government policies may be designed to reduce many different sorts of risk. For each of the following potential hazards, please indicate how critical it is that government action be taken to reduce that kind of risk, with one being not at all critical and ten being extremely critical.

	Not Critical									Very Critical
22. Consumption of saccharin	1❑	2❑	3❑	4❑	5❑	6❑	7❑	8❑	9❑	10❑
23. Nuclear energy generation	1❑	2❑	3❑	4❑	5❑	6❑	7❑	8❑	9❑	10❑
24. Downhill skiing	1❑	2❑	3❑	4❑	5❑	6❑	7❑	8❑	9❑	10❑
25. Genetic engineering	1❑	2❑	3❑	4❑	5❑	6❑	7❑	8❑	9❑	10❑
26. Radioactive waste	1❑	2❑	3❑	4❑	5❑	6❑	7❑	8❑	9❑	10❑
27. Handguns	1❑	2❑	3❑	4❑	5❑	6❑	7❑	8❑	9❑	10❑
28. Coal energy generation	1❑	2❑	3❑	4❑	5❑	6❑	7❑	8❑	9❑	10❑

Table B.1: Average Risk Urgency Scores, by Hazard

	Gen'l Public	Scientist	Environmentalist	Business	Legislators
Consumption of saccharin	4.25	2.53	3.22	2.65	3.05
Nuclear energy generation	7.10	7.02	8.62	6.80	6.26
Downhill skiing	2.32	1.62	1.70	1.55	2.04
Genetic engineering	5.86	5.27	6.75	5.83	5.69
Radioactive waste	8.45	7.66	9.23	7.73	7.25
Handguns	6.15	7.28	7.45	5.69	4.75
Coal energy generation	5.42	5.91	7.48	5.19	7.89