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MODELING THE EFFECTS OF UNCERTAINTY ON FEAR OF NUCLEAR WASTE: DIFFERENCES AMONG SCIENCE, BUSINESS AND ENVIRONMENTAL GROUP MEMBERS

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ABSTRACT

This paper analyzes the relationships between the subjective assessment of riskiness of managing nuclear waste and the level of certainty regarding the assessment. Uncertainty can be operationalized in two ways. The direct approach asks a person to assess their own subjective beliefs about a potential hazard. The indirect approach assesses how readily an individual will change his or her beliefs when confronted with new information that conflicts with prior beliefs. This paper tests for the relationships between these two distinct operationalizations of uncertainty and overall assessments of the risks posed by radioactive wastes.

First we analyze the relationships between stated levels of uncertainty about the effects of radiation on the level of perceived risks from radioactive wastes. Second, we assess the linkage between willingness to alter prior beliefs about the risks of radioactive wastes in response to new information provided by "a neutral source" (or responsiveness of beliefs) and uncertainty. Using data taken from random mail surveys of members of scientific, business, and environmental groups in Colorado and New Mexico in the summer of 1990, we test hypotheses that (a) greater uncertainty is associated with greater perceived risks, and (b) greater responsiveness of beliefs to new information is associated with greater uncertainty. The import of these hypotheses concerns the dynamics of uncertainty in controversial technical policy issues, wherein perceived risks are a primary ingredient in policy positions taken by participants in policy disputes.

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Modeling the Effects of Uncertainty on Fear of Nuclear Waste

1. Introduction

Public policies increasingly involve issues that are characterized by scientific complexity and uncertainty. Particularly for environmental concerns such as acid rain, ozone depletion, global warming, and radioactive waste policies, scientific uncertainties have become central issues in extended political controversies over how policies should be formulated. Differences among the claims of technical experts feed still greater uncertainties in mass publics, fueling the political controversy. But how does uncertainty *per se* affect the structure and dynamics of beliefs about environmental hazards? Does uncertainty systematically increase the perception of hazard and risk? How does uncertainty affect willingness to *change* perceptions of risk and hazard? Furthermore, does uncertainty lead to uniformly greater willingness to revise prior beliefs in light of new information, or is willingness systematically skewed in particular directions? In other words, what are the systematic processes by which we can expect uncertainty to affect the course of environmental controversies?

Part of our interest concerns differences in the ways that uncertainty might affect the policy-relevant beliefs of scientific and technical (S&T) experts as compared with other, less technically literate, participants in environmental policy debates. Does uncertainty operate differently for individuals who are more likely to be formally trained in probabilistic modeling and theories (i.e., most scientists and engineers) than it does for those who understand uncertainty in a more intuitive, less formal, fashion? If so, what characterizes that difference?

By attempting to answer these questions, we seek to provoke thought about how uncertainty affects the dynamics of environmental policy controversies. We focus on a particular environmental controversy -- the management of radioactive wastes -- that exemplifies the coupling of uncertainty with controversy.[1] Using data from a battery of surveys about nuclear (and other) issues collected in the summer of 1990 from random samples of the memberships of scientific, business and environmental groups, we examine how the respondents' subjective uncertainty is related to perceived risks, and to willingness to alter beliefs in light of new information. In the next section of this paper we describe the data employed for this analysis. Section Three describes our specific hypotheses, followed (in Section Four) by the analysis of the data. In Section Five we discuss our findings, drawing implications for the dynamics of policy controversies.

2. Data

The data used for this analysis are taken from a set of mail surveys implemented in July, 1990.[2] The survey instrument was designed to provide data on an array of attitudes, beliefs and policy positions concerning nuclear and chemical waste policies.[3] Of importance for this study were questions on *perceptions of the risks* posed by a series of stages of the nuclear waste management process including (a) production of nuclear energy, (b) temporary storage of nuclear wastes at the facilities where they are generated, (c) transportation of nuclear wastes, and (d) the permanent storage (or disposal) of nuclear wastes. Respondents were asked to respond to each of these questions on a five-point Likert-type scale ranging from "extremely risky" to "not at all risky". For this analysis, we used an average score across all

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1 See, for example, Paul Slovic, Mark Layman and James Flynn, "Lessons from Yucca Mountain," *Environment*. v. 33 n. 3 (April) 1991: pp. 7-30.

2 The surveys were implemented by the University of New Mexico's Institute for Public Policy with funding provided by Sandia National Laboratories, under Contract No. 69-1002. The analysis and conclusions presented in this paper are those of the authors, and are not intended to represent the positions of Sandia National Laboratories.

3 With the exception of slight variation in the demographic sections of the survey instruments, identical questions were asked, in the same order, of each of the samples.

four stages, hereinafter referred to as NWRISK. On this 5-point scale, a *lower* score indicates *greater* perceived risk.

In addition, respondents were asked to indicate how certain they were of their beliefs concerning the risks of nuclear (and chemical) wastes. Again using a Likert-type scale, the response categories ranged from "very certain" to "very uncertain." We will refer to this variable as CERTAIN. On this four-point scale, the lower the score, the *greater* the certainty. We then asked each respondent to indicate how likely they would be to *change* their beliefs about the risks of nuclear waste in response to new information provided by a source considered to be neutral. Included were two questions, the first of which asked for the likelihood of change when the new information indicated that nuclear risks were *greater* than the respondent had previously believed, and the second asked for the likelihood of change if the new information indicated that nuclear risks were *less* than previously believed.[4] The response categories consisted of a four-point scale ranging from "very likely" to "not at all likely". We refer to these variables as UPRISK and DOWNRISK, respectively. The exact wording and scales for each of the questions is provided in Appendix A. Summary statistics for each of the variables used are shown in Appendix B.

The surveys were applied to five samples, three of which are examined here.[5] Each of the samples were collected in the states of Colorado and New Mexico, which were chosen due to the extended controversy in these states over radioactive wastes from Rocky Flats, New Mexico's two national laboratories, and the Waste Isolation Pilot Plant radioactive waste storage facility in south-eastern New Mexico. The first sample was a selected randomly from a subset of the membership of the American Association for the Advancement of Science (AAAS).[6] The second was a random selection from the membership list of the Association of Commerce and Industry (ACI), a group primarily consisting of industrial and commercial business people. The third sample was taken from the Colorado and New Mexico chapters of the Sierra Club.[7]

Our sampling approach was a modification of the Total Design Method specified by Dillman,[8] including a first mailing to all included individuals informing them of the survey, its purpose, and identifying ourselves. This was followed up by three waves of survey mailings, with each respondent receiving the additional surveys if the prior survey had not been returned within a specified time. Finally, those respondents who requested the information were provided with an overview of the survey results. The process resulted in the response rates shown in Table 1.

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[4] These questions were intentionally asked sequentially in the survey to encourage the respondent to assess their answers to the two questions jointly. Thus, we would expect that if there is a bias in the responses, it will be in favor of consistency in responses to the two questions. In other words, differences in willingness to change perceived risks in response to new information with different valence are designed to have been the result of a conscious choice made by the respondent. "Talk-back" from the respondents in the form of margin comments on the surveys and attached notes and letters confirmed that, at least in many cases, the two questions were considered jointly.

[5] The two surveys not included here were of (a) a random household telephone survey of Colorado and New Mexico and (b) a sample of the state legislators from both states.

[6] We thank the AAAS for its cooperation in providing the membership list for Colorado and New Mexico.

[7] We greatly appreciate the cooperation and assistance of the Executive Committees of these two Sierra Club Chapters in the conduct of the survey.

[8] Don Dillman, *Mail and Telephone Surveys: The Total Design Method.* New York, NY: John Wiley and Sons, 1978.

TABLE 1: SURVEY POPULATIONS, SAMPLE SIZES, AND RESPONSE RATES

Population	Stratification	Sample Size	Response
Scientist group (AAAS)	Colorado	923	570 (67%)
	New Mexico	590	441 (75%)
Business group (ACI)	Colorado	1310	615 (47%)
	New Mexico	377	206 (55%)
Environmental group (Sierra)	Colorado	757	461 (61%)
	New Mexico	749	486 (65%)

3. Concepts and Hypotheses

Our initial approach to the question of how uncertainty plays a role in shaping or constraining beliefs environmental policy disputes is consistent with the general approach of Bayesian analysis. First, we conceive of the beliefs of an individual about nuclear risks as being characterized by a probability distribution. The location (mean or median) of the distribution is a point estimate of an individuals' feeling about the risk; it is here measured by the NWRISK score. The dispersion of the distribution measures how certain the individual is in their assessment of the risk and is here measured by the CERTAIN variable.

Bayesian theory posits no necessary connection between the location and dispersion of one's beliefs. For example, *any* degree of certainty can be associated with an assessment that nuclear waste is very risky. In our own problem this means there could be any relationship between how certain an individual is and their perceived risk location. This leads us to consider the following hypothesis which examines whether there is any relationship between these measures:

H_1: There is no relationship between CERTAIN and NWRISK.

Furthermore, implied in this hypothesis is the contention that there will be no differences across the three groups of respondents.

Next, we hypothesize that the greater the subjective uncertainty associated with an individual's beliefs about the risks of nuclear wastes, the greater the propensity to modify those beliefs in light of new information provided by a neutral source. We separately consider the propensity to shift to greater and lesser perceived risks. Thus:

H_2: The higher the score (and the less certain) on CERTAIN, the greater the willingness to modify the prior location on nuclear risks (UPRISK) in the direction of greater perceived risk, and

H_3: The higher the score on CERTAIN, the greater the willingness to modify the prior location on nuclear risks (DOWNRISK) in the direction of lower perceived risk.

Finally, we hypothesize that this relationship will hold irrespective of the direction of change implied by the new information; the propensity to change beliefs in light of new information should be symmetric:

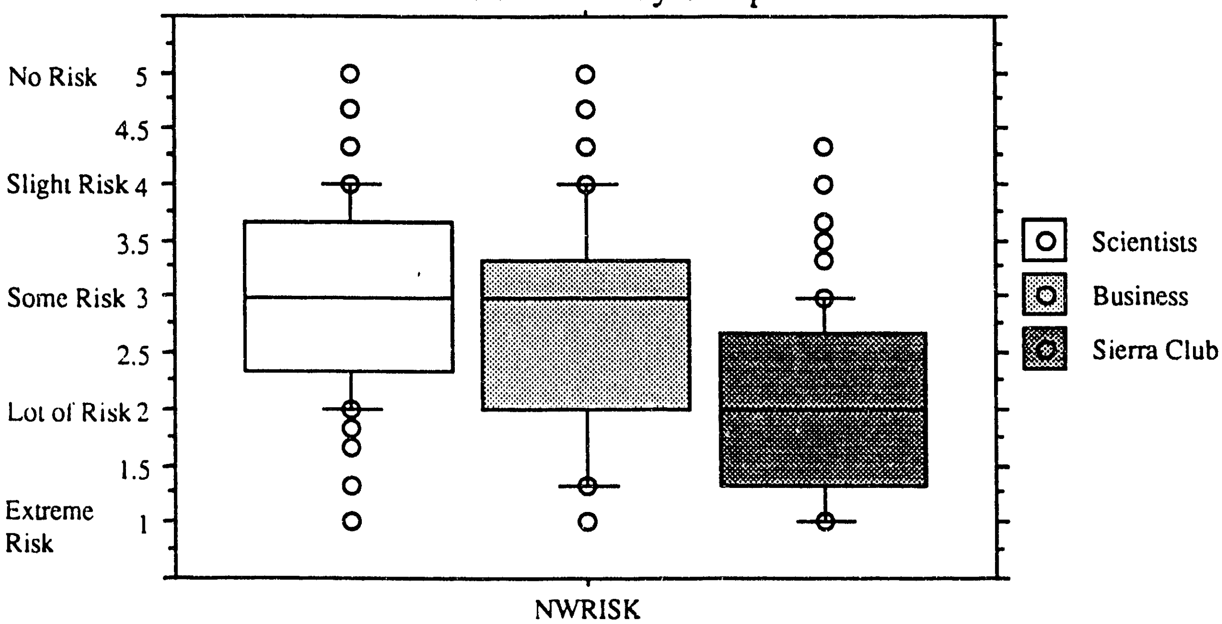
H_4: The effects of CERTAIN on the *difference* between willingness to modify prior location on the basis of new information suggesting that risks are higher (UPRISK) or lower (DOWNRISK) than previously believed will be zero.

4. Analysis

Our first hypothesis concerns the possible relationship between uncertainty and prior position regarding nuclear risk. Before assessing this relationship, it is interesting to note the different mean locations and distributions across the three samples. The mean scores are 3.01 for the scientists, 2.78 for the business group, and 2.01 for the environmental group. This relationship is illustrated, using box-plots, in Figure 1. Thus, on average, the environmental group members perceive substantially more risk than the business group members (with mean difference of 0.76, and a difference of means p-value of <0.0001) who, in turn, see significantly greater risk than the scientists (with a mean difference of 0.25, p-value of <0.0001).

There are also interesting differences in the average scores for subjective certainty (CERTAIN) across the three samples. Environmental group members are the most certain of their beliefs (with an average score of 1.65), followed by the scientists (average score of 1.83) and the business group members (2.07). The differences between each of these sample means is highly statistically significant (p-value <0.0001). Thus, the samples represent quite distinct populations *both* with respect to location and dispersion of perceived nuclear risks.

Figure 1: Box Plot of Average Scores on Perceived Risks of Nuclear Waste by Sample



Is uncertainty related to perceived levels of risk within the three samples? To examine this relationship, we used OLS to regress NWRISK onto CERTAIN for each of the three samples. The results are shown in Table 2.

TABLE 2: SUBJECTIVE UNCERTAINTY AND PERCEIVED NUCLEAR RISK
(REGRESSING NWRISK ONTO CERTAIN)

Sample	N-size	Intercept	Beta	t-Stat	P-Value	R^2
Scientist	988	3.01	0.04	0.13	0.90	0.00
Business	809	2.61	0.08	1.80	0.07	0.01
Environmental	925	1.26	0.46	13.26	<0.00	0.16

For the scientists, there is no statistically discernible relationship between uncertainty and the positions taken on nuclear risks. For each of the other groups, however, there is a discernible association between greater uncertainty and *less* perceived risk. For the business group, this relationship is weak, just failing to reach statistical significance in a two-tailed test. But this relationship is pronounced for the environmental group members, for whom uncertainty alone accounts for 16% of the variation in perceived nuclear risks.

Recall that Bayesian theory offers no clear direction about the relationship one should expect between uncertainty and perceived risks. Our results indicate that this relationship differs greatly from one kind of population to another, and that -- for some groups at least -- uncertainty is strongly linked to the point estimates that individuals make of nuclear risks. Interestingly, the scientist group -- made up of those most likely to be trained in probability theory and statistical modeling -- is the only one for which there is no statistically discernible relationship. For this group, uncertainty is neutral with respect to taking positions on risk. These results provide strong evidence that uncertainty plays a different role in shaping risk perceptions in different populations.

Bayesian theory contends that, as uncertainty rises, willingness to update positions in light of new information should also increase. In essence, individuals are presumed to have prior positions that are constantly subject to new information, by which prior positions may be mapped into posterior beliefs. The greater the uncertainty with which the prior positions are held, the greater the effect the new information will have in revising that position. We test this for this relationship in Hypotheses 3 and 4, the results of which are shown in Tables 3 and 4.

TABLE 3: SUBJECTIVE UNCERTAINTY AND WILLINGNESS TO INCREASE PRIOR RISK PERCEPTION IN RESPONSE TO NEW INFORMATION
(REGRESSING UPRISK ONTO CERTAIN)

Sample	N-size	Intercept	Beta	t-Stat	P-Value*	R^2
Scientist	984	2.86	0.06	1.81	0.04	0.00
Business	810	2.62	0.16	4.27	<0.00	0.02
Environmental	916	2.65	0.22	4.95	<0.00	0.03

*Note: P-Value is for a one-tailed test.

As shown in Tables 3 and 4, our data are consistent with Bayesian theory in that the more uncertain our respondents were, the the greater the propensity to modify beliefs in light of new information. There are, however, marked differences across the samples.[9] For both UPRISK and DOWNRISK, the scientist group had the largest intercept term (indicating greater willingness to change beliefs). At the same time, the scientist group had the smallest CERTAIN slope coefficient, indicating a weaker relationship between uncertainty and willingness to change prior beliefs about nuclear risks. In both cases, the environmental group members had the lowest intercept term (indicating less willingness to change prior beliefs), but the largest slope CERTAIN coefficient (indicating a greater relationship between uncertainty and willingness to change prior beliefs). Overall, these results indicate that scientists are generally more prone to update beliefs in light of new information than members of business or environmental groups, but this willingness among scientists is less driven by uncertainty than it is for the other groups.

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[9] In order to compare the effects of uncertainty across the samples, a model employing all samples with an intercept dummy and a CERTAIN slope dummy for the environmental and business groups was run. This allowed us to estimate the magnitude, and test for the statistical significance, of the differences in the effects of CERTAIN on willingness to change prior beliefs across the samples. For both UPRISK and DOWNRISK, the slope and intercept differences between the scientists and the other two groups were statistically significant. The direction of the differences are described in the text.

TABLE 4: SUBJECTIVE UNCERTAINTY AND WILLINGNESS TO DECREASE PRIOR RISK PERCEPTION IN RESPONSE TO NEW INFORMATION
(REGRESSING DOWNRISK ONTO CERTAIN)

Sample	N-size	Intercept	Beta	t-Stat	P-Value	R^2
Scientist	985	2.60	0.12	3.65	0.00	0.01
Business	810	2.25	0.25	6.63	<0.00	0.05
Environmental	919	1.80	0.41	11.19	<0.00	0.12

Our final hypothesis concerns the symmetry of response to new information suggesting that risks are greater, or less, than previously believed. Bayesian theory posits that, *ceteris paribus*, new information indicating that risks are greater than previously believed should have the same magnitude of effect on posterior beliefs as information suggesting that risk are less than previously believed. Thus we hypothesized no difference between the effects of CERTAIN on UPRISK and DOWNRISK. To operationalize the test, we subtracted DOWNRISK from UPRISK, creating a new variable, CHNGRISK. If there is no difference between willingness to modify perceived risks up or down, we should expect CHNGRISK to have a mean of zero. And, if uncertainty operates symmetrically on willingness to change beliefs, there should be no relationship between CERTAIN and CHNGRISK.

Our hypothesis was disconfirmed by our data, as shown in Table 6. First, note that the intercept terms for each sample are positive (and all are statistically significant beyond the 0.01 level test), indicating that those who are highly certain are more likely to update beliefs to reflect new data showing that risks are greater than one's prior position than they are to update beliefs in light of data showing that risks are lower than their prior position. A simple *t*-test on the mean values of CHNGRISK for each sample confirmed that, for each group, CHNGRISK is positive and statistically different from zero. Thus it appears that there is a systematic tendency for individuals to more readily respond to information that increases perceived risk than to information that would dampen perceived risks. Of course, this difference is not necessarily inconsistent with Bayesian theory. The respondents may have been taking into account perceived consequences of an asymmetric loss function, wherein the costs of underestimating risks are higher than the costs of overestimating them. We have dubbed this tendency a "risk ratchet," reflecting the bias it reflects toward ratcheting perceived risks upward.[10] Note, however, that the size of this ratchet is greatest for the environmental group sample, and smallest for the business group.

TABLE 6: RELATIONSHIP BETWEEN CERTAINTY AND DIRECTIONAL ASYMMETRY IN UPDATING PERCEPTIONS
(REGRESSING CHNGRISK ONTO CERTAIN)

Sample	N-size	Intercept	Beta	t-Stat	P-Value*	R^2
Scientist	982	0.26	-0.06	-1.82	0.07	0.00
Business	808	0.36	-0.09	-2.69	<0.01	0.01
Environmental	913	0.84	-0.18	-3.91	<0.00	0.02

*Note: P-Value is for a two-tailed test.

What is the relationship between uncertainty and the asymmetry in updating risk perceptions? As shown in Table 6, the beta coefficients for CERTAIN are negative in each case, and statistically significant for the business and environmental groups (the scientists just miss the 0.05 level cut-off). This suggests that, the more uncertain the individual, the less the

[10] This relationship was described earlier in Hank Jenkins-Smith, Jennifer Espey, Amelia Rouse and Douglas Molund, *Perceptions of Risk in the Management of Nuclear Waste: Mapping Elite and Mass Beliefs and Attitudes*. Albuquerque, New Mexico: Sandia National Laboratory, Report No. SAND90-7002, 1991: Chapter 4.

propensity to give systematically greater weight to information that would increase perceived risk. In fact, the sign and size of the beta coefficients indicate that CHNGRISK approaches zero as CERTAIN approaches the top (least certain) end of its range. Thus, the asymmetry in updating perceived risk appears to grow as the individual becomes more certain.

As we have shown above (in Table 2), certainty and prior position are related for both the environmental and business groups; the greater the certainty, the greater the perceived risk. Thus, it may be that the effects of uncertainty varies across groups, depending in part on the kinds of positions taken by the members of that group, and in the relationship between uncertainty and the positions taken. Groups that take more extreme positions, for example, may be relatively impervious to the effects of uncertainty on willingness to update beliefs in particular directions. To test for this possibility, we again modeled the effects of uncertainty on the asymmetry of willingness to adjust beliefs, this time with the prior position (NWRISK) included as a control variable. The results are shown in Table 7.

TABLE 7: SUBJECTIVE UNCERTAINTY, PRIOR POSITION, AND WILLINGNESS TO REVISE PRIOR BELIEFS
(REGRESSING CHNGRISK ONTO CERTAIN & NWRISK)

Sample	N-size	Intercept	CERTAIN Beta	NWRISK Beta	R^2
Scientist	977	0.73	-0.06*	-0.16****	0.03
Business	803	0.91	-0.07**	-0.21****	0.09
Environmental	909	1.21	-0.03	-0.31****	0.07

Note: *=P-value <0.1; **<0.05; ***<0.01; ****<0.000

The results demonstrate that, when controlling for prior position, uncertainty ceases to be a significant factor in shaping willingness to update beliefs for some groups. For the environmental group members, who were on average the most certain and who perceived the greatest nuclear risk, inclusion of the prior position virtually eliminates the effects of uncertainty on the asymmetry in willingness to change beliefs. The estimated beta term for CERTAIN drops from -0.18 (in Table 6) to -0.03 (in Table 7) when prior position is controlled for, becoming statistically insignificant. Instead, it is the prior position (NWRISK) that appears to drive the asymmetry: the less nuclear risk that is perceived (or the higher the NWRISK score), the smaller the asymmetry (CHNGRISK). Thus, those who perceive extreme risks will be the least likely to diminish their perceived risks in light of new information, *regardless* of how uncertain they are of their beliefs. For these types of groups, it appears that the only kind of information that will lead to adjustment of prior positions will be that which ratchets risks still higher.

Note that prior position is a reasonably strong predictor of the asymmetry in willingness to update beliefs for all three of our samples, though it did not substantially diminish the estimated effects of uncertainty for the scientist or business samples. Thus, the bias in favor of "factoring in" information that is consistent with the prior beliefs appears to be universal, not excluding members of the scientific community. Nevertheless, for scientists and business groups uncertainty seems to provide a modest counterweight to prior beliefs, such that greater uncertainty (a higher CERTAIN score) can partially offset the effects of a prior position that nuclear risks are extreme (a low NWRISK score) on the asymmetry in responsiveness to new information. This offsetting effect is not evident for the environmental group members.

5. Discussion

Our intent has been to analyze the relationships between uncertainty and nuclear risk perceptions, taking a Bayesian approach to the relationship between uncertainty and modification of prior positions as a point of departure. Our results are reasonably consistent with Bayesian theory in that greater uncertainty is associated with greater willingness to modify beliefs in light of new information from a neutral source. However, we also found that (a) uncertainty tends to be significantly associated with the prior position of the individual (greater certainty is associated with greater perceived nuclear risk), (b) willingness to update beliefs is asymmetric (individuals more readily update perceived nuclear risks upward than downward in response to new information), and (c) that uncertainty tends to reduce the asymmetry in responsiveness to new information. Most important, we found that these patterns vary across groups, with members of scientific groups showing (a) a comparatively slight relationship between uncertainty and willingness to change beliefs and (b) less asymmetry in responsiveness to new information. Environmental groups, on the other hand, were (a) more certain and perceived more risk, (b) tended to have the strongest link between uncertainty and prior beliefs, and (c) had the greatest asymmetry in responsiveness to new information.

For those of us concerned about the role of uncertainty in risk perception processes, the most important implications are three-fold. First, uncertainty is interactive with other attributes of the individual's decision situation, such as the prior perception of risk. Second, the degree of certainty is associated with significant asymmetries in the ways that individuals update prior risk positions. For our problem, the greater the certainty, the larger the asymmetry in how individuals update perceptions in light of new information. Third, there appear to be substantial differences in how different groups link uncertainty and risk perception. These results lead us to believe that the study of the relationships between uncertainty and risk will be enriched by inclusion of both psychological concepts (such as that of cognitive dissonance) and specific characteristics of the individuals (or groups) under study.

The implications for policy debates involving potential environmental (and other) risks are also important. In policy disputes where the issue involves deeply held beliefs about highly technical issues, attempts to increase (or decrease) the level of certainty that individuals have about the issue through dissemination of information is likely to have quite different effects on different kinds of individuals. By way of illustration, imagine a policy debate in which a uniform distribution of information, ranging from plausible arguments that risks are non-existent to plausible arguments that risks are potentially catastrophic, is presented to an audience of affected individuals. In addition, assume that the individuals in the audience begin with a random distribution of prior positions and levels of certainty about the risk. If, as we have found here, asymmetries in the responsiveness to information in updating perceived risks tilt significantly in favor of increasing perceived risks, the progress of the policy debate should be characterized by a gradual ratcheting-up of the perceived risk. However, we would expect the rate of that ratcheting to differ across groups of individuals, according to other properties of that group. Those who initially perceived greatest risk and who were most certain would be likely to ratchet up their perceived risks fastest, while those who initially see least risk and/or are least certain would increase perceived risk slowest (or not at all). Thus the range of perceived risks might be expected to grow over time. In sum, the diffusion of information in this kind of context -- even if the information provided reasonably reflects the range of prior perceptions -- would be expected to refract differentially through prior position, uncertainty, and asymmetries in the ways that individuals update prior positions.

Appendix A: Survey Question Wording

Next we would like you to evaluate the risk involved in each of the following situations:

The production of nuclear energy poses:

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

Temporary storage of nuclear waste in the facilities where is was produced poses:

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

The transportation of nuclear waste poses:

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

The permanent storage of nuclear waste poses:

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

*Note: for this analysis, the prior four questions were averaged for each respondent to obtain the "**NWRISK**" variable described in the text.*

CERTAIN 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

UPRISK Suppose a source you consider to be neutral provided new information about the risks of nuclear waste that indicated that these risks were <u>greater</u> 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

DOWNRISK Now suppose that the same neutral source provided information that indicated that the risks of nuclear waste were <u>less</u> 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

Appendix B: Summary Statistics

TABLE B-1: UNIVARIATE STATISTICS FOR NWRISK BY SAMPLE

Sample	Mean	Std. Dev.	Std. Error	Count	Minimum	Maximum	# Missing
NW Risk, Total	2.60	.95	.02	2755	1.00	5.00	23
NW Risk, Scientists	3.02	.82	.03	999	1.00	5.00	11
NW Risk, Business	2.78	.90	.03	815	1.00	5.00	6
NW Risk, Sierra Club	2.01	.82	.03	941	1.00	4.33	6

Table B-2: Univariate Statistics for CERTAIN, UPRISK, and DOWNRISK

	Mean	Std. Dev.	Count
CERTAIN, Scientists	1.83	.74	997
CERTAIN, Business	2.07	.69	814
CERTAIN, Sierra Club	1.65	.71	929
UPRisk, Scientists	2.98	.78	988
UPRisk, Business	2.95	.74	811
UPRisk, Sierra Club	3.01	.95	918
DOWNRISK, Scientists	2.82	.76	987
DOWNRISK, Business	2.77	.77	811
DOWNRISK, Sierra Club	2.47	.83	921

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