

Environmental Assessment and Risk Analysis Element



Research Project Summary



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Public Response to Uncertainty in Environmental Risk Estimates

Branden B. Johnson¹ and Paul Slovic²

Abstract

The public seems wary of uncertainty in the form of a range of risk estimates. Citizens tend to believe that a government or industry that produces such a range is incompetent or dishonest or both. People also believe that neither institution discusses risk unless it is high, so that the true risk is more likely to be at or above the high end of the range than to be lower. Many would prefer to hear that a situation is either safe or unsafe rather than get numeric risk estimates, and suspect that expert disputes over risk magnitudes are due to ideology or employer bias rather than to technical uncertainties.

Introduction

Scientists and officials often wish to publicize their estimates of environmental health risk, which always have some uncertainty. Risk communicators have urged uncertainty be part of the message. The research reported here is among the first to test public reactions to such messages. The few other studies done suggested public reactions could vary from greater risk aversion to no effect to greater acceptance of risks. The research summarized here explored reactions to numeric estimates of uncertainty, particularly in ranges of risk estimates. It included federally-funded research for which Johnson and Slovic collected data mostly in Oregon, and research by Johnson with New Jersey data; results were similar and involved the same lead author, so both are reported here for a fuller explanation of public response to environmental risk uncertainties.

Methods

Two methods were used. Qualitative research included for the Johnson and Slovic studies (1995, 1998) 13 interviews with New Jersey and Pennsylvania residents; group interviews with 21 Oregonians; and open-ended questionnaires from 18 New Jerseyans. The Johnson study (2003) had eight interviews with people living a half-mile from industry, five other interviews, and a group interview with six volunteer firefighters. Quantitative research involved large-group surveys: 949 volunteers recruited through an advertisement in the Eugene, Oregon newspaper answered one of four surveys from 1993-5, and 213 responded (46% response rate) to a survey mailed in 2000 to a random sample of people living within a mile of one or more factories in central New Jersey.

The focus was on ranges of risk estimates, only one way to express uncertainty. For example, a scenario might announce "an added risk of getting cancer of one in a million (1 in 1,000,000) for local residents. However, the industry experts estimate that the true risk added could be as low as one in ten million (1 in 10,000,000) or as high as one in a hundred thousand (1 in 100,000)." The range thus runs from one in ten million to one in a hundred thousand. The "no uncertainty" version was one number (e.g., "1 in a million" extra cancer risk over a lifetime of exposure). The degree of uncertainty was varied across Oregon experiments: (1) "the true risk could be as low as" zero or a percentage (10% or 0.1%) of the risk estimate; (2) "as low as zero, or as high as ten times" the risk estimate; (3) adding to #2 the extra cases of cancer in a city the size of Eugene these numbers would entail; and (4) different explanations of identical ranges (extrapolation from animal studies to human risks, vs. extrapolation from high-dose to low-dose human exposures). The focal risk estimate varied from "one in a million" to "one in a thousand," to examine the effect of risk magnitude on reactions. Other aspects varied in some experiments were hazard source (natural or man-made) or kind (drinking water contamination vs. hazardous waste site), and presence or absence of a graphic of the risk estimate/ranges. The Johnson study used one scenario, with industry rather than government as the source of risk estimates.

Demographic data on survey participants are reported in detail in Johnson and Slovic (1995, 1998) and Johnson (2003). The Oregon sample was young (median age 20) and with above-average educations (e.g., 90% with at least some college—Johnson and Slovic, 1998); the New Jersey respondents were older (median age 49) and less-educated

(58% some college or better).

Results

Detailed results for particular experiments and measures can be found in Johnson and Slovic (1995, 1998) and Johnson (2003). Overall results are summarized here:

- Most individual and group interviewees were unaware that risk estimates were uncertain. But Oregon survey respondents tended to expect this, perhaps due to better education on average.
- Most people recognized uncertainty in risk estimates as shown in a hypothetical news story.
- In one Oregon experiment uncertainty evoked more concern than did the absence of uncertainty information, but in two other experiments there was no difference in concern.
- Depending upon the study, the number of people who thought the use of ranges of risk estimates made a government agency or industry seem competent or "more honest" was anywhere from equal to twice the number who thought otherwise. The largest group in all studies viewed ranges of risk estimates in an entirely positive light (honest and competent), but overall this was a minority view and smallest in the New Jersey study. The New Jersey group were much less likely to express a definitive opinion about the risk estimator's honesty or competence; nearly half (46%) said "don't know" in response to one or both questions. Whether these relative reactions to this kind of uncertainty information reflected lower educational levels, greater direct experience with industrial or other risks, the stimulus of "industry" rather than "government" as producer of the risk estimates, or a trend is unclear.
- A simple graphic depiction of the risk numbers (including uncertainty, where applicable) helped make the range of numbers more obvious to Oregon readers of hypothetical stories.
- Many risk professionals have presumed that the public prefers categorical safe/unsafe judgments to more nuanced risk distinctions. This was confirmed in one earlier empirical study with New Jersey residents (Weinstein, 1987), and for a majority of the New Jersey respondents in the current research (Johnson, 2003). For the highly educated survey respondents in the Oregon experiments, only 35% could be rated as having a "desire for certainty." The rest preferred getting numerical risk estimates, if not ranges of risk estimates.
- There is an overall bias toward focusing on the upper bound of a range of risk estimates. About half in the Oregon study said they would believe the highest number "is the correct one," and 14% asked to estimate the community's risk from a hazard scenario judged it to be at or above the upper bound of the hypothetical government risk estimates. The New Jersey respondents' estimates of community risks also were skewed toward the high end of the industry-offered range of risk estimates, although there was a much higher "don't know" response in this sample, perhaps reflecting the industry neighbors' lower education.
- Lower risk levels (one in a million) were deemed by Oregon respondents as more "preliminary" information

and sometimes less honest; higher risk levels (one in a thousand) were rated as more complete and honest information. Use of zero as a lower bound elicited doubt (e.g., "it's probably not zero"). Half agreed that "Government only makes an announcement about an environmental issue when there is a high risk involved"; even more in the New Jersey sample felt that industry only discusses high-risk environmental issues.

- Lower risk estimates over time (from one in a million to one in a billion, due to government trying "to obtain a more accurate number") left half of Oregonians unsure whether the second estimate was more competent. A third did not feel safer despite the lower risk, but most agreed the two studies together better described the risk than either alone.
- Despite the highest industry risk estimate still being low by professional standards, 87% of the New Jersey sample would be "very concerned" about living near this plant. Most preferred hearing such risk estimates from government rather than industry.
- If told for a hypothetical hazard that most scientists think the risk is low, but a few think it is higher (but still low in absolute terms), most of the Oregon sample assumed the worst, and doubted that the majority of scientists is correct. They felt that chemicals' risks should have already been definitely identified, and experts needed to seek consensus or "compromise." New Jersey respondents agreed, and felt scientists based risk estimates more on ideology or saving their jobs than purely scientific judgment; only a few technically trained people noted conflicting "models," professional "judgments," and other scientific grounds for dispute.
- New Jersey respondents were asked why industry experts had given a range of risk estimates. Answers were ignorance on the risk level (44%); deception by industry, usually to make the risk seem lower (32%); data or analysis problems, such as statistics, too many variables, or varied exposure (15%), and to protect themselves from being held accountable (9%).
- The New Jersey survey said, "Often experts disagree over the size of an industrial health or safety risk," and offered reasons for this disagreement. Only 3% chose "incompetence of the experts," 18% chose "the organizations for which the experts work," and 14% said it was "limited scientific knowledge about how risks might occur." About half (55%) hedged their bets by saying that incompetence, self-interest, and limited scientific knowledge together explained expert disagreement. Another 4% volunteered the combination of organizational interests and limited scientific knowledge; 5% said they did not know.

Conclusion and Recommendations

Some citizens recognize and appreciate acknowledgment of uncertainty in risk estimates. However, many seem to want safe/unsafe judgments rather than risk numbers, and rate sources of risk estimates as dishonest and/or incompetent if they provide ranges rather than point estimates. Suspicion that official risk estimates are biased low adds to the challenge of discussing uncertainties in risk estimates. These reactions seem very similar across locations (Oregon and New Jersey) and levels of education. If citizens believe

the topic of uncertainty is being raised in what they see as legitimate ways (for example, when it affects choices of action between cleanup options), then discussion of uncertainty might be productive. If, however, citizens suspect that uncertainty is being used to justify inaction on an issue about which they care, then this discussion could undermine the credibility and effectiveness of government and industry.

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Researched By

¹ Branden Johnson, New Jersey Department of Environmental Protection, Division of Science, Research and Technology

² Paul Slovic, University of Oregon and Decision Research, Inc.

Prepared By

¹ Branden Johnson, New Jersey Department of Environmental Protection, Division of Science, Research and Technology

STATE OF NEW JERSEY

James E. McGreevey, Governor

Department of Environmental Protection

Bradley M. Campbell, Commissioner

Division of Science, Research & Technology

Martin Rosen, Director

Environmental Assessment & Risk Analysis Element

Dr. Eileen Murphy, Assistant Director

Please send comments or requests to:

Division of Science, Research and Technology

P.O.Box 409, Trenton, NJ 08625

Phone: 609 984-6070

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