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# RISK ANALYSIS:

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# A NEED TO

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# COMMUNICATE

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**R**isk analysis has become an important scientific tool in assessing the magnitude and probability of a technology's potential adverse impacts. Although risk analysts and some decisionmakers are familiar with probability, most citizens only vaguely understand the concept.

Indeed, public perceptions of risk are often shaped by deterministic thinking: a technology is safe or unsafe, a medical treatment effective or useless, a pollutant perilous or innocuous.<sup>1</sup> Therefore, a primary goal of risk communication is to convey to a lay audience the basic concept and rationale of risk assessment.

Helping the public understand risk analysis is a first step toward policy consensus.<sup>2</sup> It is a prerequisite for building effective programs to deal with questions of public health, the management of potentially dangerous technologies, and the need to establish emergency plans for potentially dangerous situations (for example, the threat of hurricanes, forest fires, or nuclear accidents).

Moreover, risk communication could teach experts as much as it does the public. Public participation could broaden the issues addressed by risk analysts to include questions of equity and responsibility. It also could add a critical, common-sense perspective to evaluating the circumstances of risk and the ability of institutions to respond.<sup>3</sup>

But how can we facilitate communication between experts and citizens? What kinds of tools and strategies will appeal to citizens and, at the same time, effectively convey the basic concepts of risk analysis?

What follows is an analysis of risk communication based on a West German communications project conducted in the early 1980s. The project's purpose was to convey scientific information to non-expert citizens and have them use this information in selecting various energy options—nuclear, fossil, renewable, and conservation.

## EVALUATING THE RISK COMMUNICATION PROGRAM

Approximately 500 German citizens were divided into 24 small groups, called "planning cells." Project procedures have been described elsewhere.<sup>4</sup> Here, I will concentrate on the impact of the communications program on the respondents' attitudes toward energy systems and options.

How did respondents perceive the information on the risks and benefits of different energy systems? Did the project successfully convey the basic rationale of risk assessment? Was risk analysis used by respondents in their overall evaluations?

Unfortunately, there is insufficient evidence to respond fully to these questions. The project's objective was to elicit personal preferences and assessments of energy systems. Therefore, respondents were not asked to voice their opinions on the information-gathering procedures. For such insights, we relied on indirect data.

(1) We asked each respondent to make trade-offs between different risks. Risk-related data were given to perform this task because, without an understanding and appreciation of risk assessment, an intelligent response would be impossible.

(2) Each respondent was asked to make risk-related evaluations for health, safety, and the environment.

(3) Content analysis was used to investigate how each respondent justified his or her decision on the preferred energy option.

## PERCEPTION OF RISK-RELATED INFORMATION

Overall, respondents accepted risk assessment as a viable decision-making tool. They recognized the need for trade-offs to reconcile conflicting values. They also expressed a willingness to consider differences in probability to evaluate the potential adverse consequences of a given technology.

This finding contradicts previous research that often concluded that people would not accept trade-offs between environmental quality and other concerns.<sup>5</sup>

Moreover, the respondents—despite their divergent viewpoints—accepted the legitimacy of each other's values and conceded that decisions should not be made exclusively on the basis of what they deemed important.

One reason respondents accepted the need for difficult trade-offs was their familiarity with budget constraints in their everyday lives. For example, buying a car equipped with effective but expensive safety features versus purchasing an inexpensive but less safe vehicle was a dilemma that many respondents had faced.

Thus, the idea of relative safety was conveyed by drawing on the respondents' own experiences. Given this finding, the notion that most people are unwilling or unable to accept trade-offs should be reconsidered.<sup>6</sup>

Probability was more difficult to communicate. Most respondents had an abstract idea of probability, but its concrete meaning was difficult to convey. Average deaths per year (as expressed in most risk assessments) were acknowledged but were not regarded as decisive for judging the seriousness of a risk.

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Rather, the catastrophic potential of a risk dominated the respondents' overall estimation of riskiness.

For example, nuclear energy received a negative evaluation for potential overall health impacts but scored positively in almost all health risk subcategories (e.g., occupational health hazards, morbidity, and nonfatal health effects). Negative assessments were only assigned to its catastrophic potential. The positive scores found in most subcategories, however, could not overcome the respondents' overwhelmingly negative perceptions of nuclear power's catastrophic potential.

This finding is not unusual. Recent studies have confirmed the importance of catastrophic potential in determining an individual's perception of riskiness.<sup>7</sup>

Such public perceptions have been attributed to concern for society's inability to control potentially dangerous technologies and to cope with large accidents. Analysis also has indicated that the expected or perceived number of victims in a single accident is only slightly correlated with public perceptions of the riskiness of such an event.<sup>8</sup> The results of this German survey underscore this hypothesis. Respondents perceived average losses over time as much less important than the potential effect of a single catastrophe.

Furthermore, technologies with high catastrophic potential were viewed as more inequitable than technologies with more frequent, but less dramatic, effects. Although experts have demonstrated that low-probability, high-consequence risks usually are more equitable than high-frequency, low-consequence risks, most participants believed the opposite.<sup>9</sup> They were convinced that a rare event would more likely affect "innocent" bystanders and that those responsible for the event would likely escape responsibility.

Respondents, at times, equated probability with the behavior of reckless entrepreneurs who pursued high-risk economic ventures. These entrepreneurs may benefit personally in the short run, the respondents reasoned, but they risked the fate of the entire company in the long run. Moreover, the respondents believed that the longer a potentially hazardous outcome was held at bay, the more likely it would occur in the near future—that is, people were convinced that the probability of a catastrophe would increase every year the catastrophe did not occur. Under this premise, people assumed future generations would be more at risk than present generations.

We also attempted to make probability more comprehensible through the use of risk comparisons. The objective was to compare familiar risks to new and controversial risks.

Such comparisons were perceived with ambivalence. When we suggested that the probability of contracting lung cancer was much higher for smokers than for those living near coal-fired power plants, respondents reacted with disbelief or even anger. They accepted comparisons among similar sources, such as coal-fired or nuclear generating facilities, but not between dissimilar sources.

In essence, the communications strategy succeeded in conveying the logic of risk analysis and in explaining the meaning of probability. The participants also gained an understanding of the problems faced by policymakers, particularly in seeking a balance between protecting public health and fostering economic growth. Nevertheless, scientific probability estimates exerted only a minimal

impact on the rating of a given technology's potential health and environmental effects. Although the average expected fatality rate was accepted as a valuable tool for classifying risk, catastrophic potential was the prime contributor to an individual's perception.

## CHANGING ATTITUDES

We also were interested in attitude formation and change. How did respondents reach their decisions on the preferred energy options? Did risk-related information influence them?

Almost all participants gave much weight to health, safety, and the environment. Energy systems perceived as detrimental to these factors received negative or ambivalent evaluations, even if their economic benefits earned high marks.

The importance of health, safety, and the environment became even more prominent when respondents were divided into three subgroups: materialists (those who assigned the highest values to economic development and prosperity), environmentalists (those who assigned the highest value to environmental quality), and fence sitters (those who were unwilling to rate one goal higher than the other).<sup>10</sup>

Materialists ranked environmental quality almost as high as economic performance. Thus, they faced a true value conflict. In contrast, environmentalists assigned extremely high values to environmental quality and only marginal value to economic performance (except for employment).

Both groups were willing to make trade-offs, but materialists were more inclined to compromise than environmentalists. Furthermore, most environmentalists were convinced that environmentally benign energy systems would eventually prove cost-effective. The fence sitters assigned higher values to environmental than to economic concerns but perceived environmentally benign energy systems as less economical than environmentally harmful systems.

Because economic variables were less valued than health, safety, and the environment, we expected respondents to reject nuclear energy as an option. Surprisingly, however, almost 40 percent voiced support for nuclear energy. Yet, few who favored nuclear power attributed their opinion to the low probability of a severe nuclear accident. Rather, they conveyed more complex reasoning. While expressing support for nuclear energy, many also expressed support for social and "altruistic" goals such as environmental quality. But beyond the desire to pursue highly esteemed values, such as environmental quality, they acknowledged the need to base vital societal decisions on practical and economically sound goals. Thus, the respondents' assessments of energy options ultimately were governed by concerns for technical, economic, and political feasibility. This tendency to distinguish between abstract, heart-felt beliefs and practical, hard-headed concerns was reinforced by the respondents' inclination to defer to scientific and political experts.

Opponents of nuclear energy—which totaled about 50 percent of the sample—failed to experience similar conflicts. They believed that nuclear energy was uneconomical. Because, in their opinion, nuclear power afforded no economic benefits, assessing the trade-off between benefits and risks was super-

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fluous. Undecided respondents regarded nuclear power's benefits to be as high as its risks and had difficulty in reaching a decision. They favored a policy in which nuclear power would become the energy source of last resort—turned to after all other options had been exploited.

Scientific experts—whether they support or oppose nuclear power—agree on two important factors: (1) that radiation escaping from a nuclear power plant during normal operations does not harm the environment and (2) that renewable energies are labor-intensive and, therefore, boost employment.

Despite this agreement among experts, most respondents rejected such findings because they contradicted core elements of their attitudes. Research on attitude change has found that even overwhelming expert evidence is insufficient to change salient components of a person's central beliefs.<sup>11</sup> Thus, nuclear energy proponents refused to believe that renewable energy would increase employment, while opponents remained steadfast in their beliefs that nuclear power plants would devastate the environment.

This response illustrates a behavioral principal that social psychologists have called "avoidance of cognitive dissonance."<sup>12</sup> If a central element of an important attitude is challenged by new information, people will likely reject the information or regard it as biased. This allows one to avoid the painful process of redirecting his or her beliefs.

Despite this example, it would be wrong to imply that changes in attitudes or beliefs failed to occur. Most respondents indicated that they corrected many false assumptions about energy systems. Such changes, however, were confined largely to energy issues that had not yet triggered an emotional commitment to a specific position. In addition, beliefs were corrected even if a firm position had been formed before the exchange of information. These changes did not, however, reverse the position. Convincing respondents that a nuclear power plant was safer than they thought was one thing. Convincing them that nuclear energy in its totality was safer than other energy options was quite another. Highly politicized options triggered a commitment almost impossible to overcome or change.

## IMPLICATIONS

What are the implications of these results for risk communication and policymaking?

(1) It seems fair to conclude that most people do not share the scientific and technical basis of risk analysis (*i.e.*, multiply the probability by the magnitude of the event). The public does not give equal weight to magnitude and probability, preferring instead to view low-probability, high-consequence events with more fear and trepidation than high-probability, low-consequence events.<sup>13</sup>

(2) The divergence between risk experts and citizens is not caused by public ignorance or misunderstanding but rather is rooted in different value judgments. Experts rate the seriousness of risk as a function of the number of victims per time unit; people focus on the worst conceivable incident.

Most studies confirm that it is almost impossible to change fundamental values through communication.<sup>14</sup> Therefore, this conflict between experts and

citizens may not be easily reconciled. People may be persuaded to consider annual risk figures more carefully only if experts and politicians express equal readiness to include qualitative characteristics in their risk analyses or policies.

(3) Impartial and multiparty communication could enhance mutual understanding and facilitate compromises in risk-related conflicts. Each side must recognize and tolerate different perspectives of risk and must view risk communication as a learning process among experts, policymakers, and citizens.

(4) For risk information to be conveyed effectively, early communication is essential. If people are committed to a position, new information is not likely to change attitudes. Rather, it will be used to rationalize and bolster one's existing opinions. Contradictory evidence, moreover, will be rejected. Personal experience or changes in peer group judgments are prerequisites for reversing strongly held views. Both are usually beyond the means of risk communication programs.

## CONCLUSION

The West German project demonstrates the possibility of conveying risk concepts and analytical techniques to ordinary citizens.<sup>15</sup> Nearly all respondents became familiar with the concepts of probability and trade-offs, even for such sensitive comparisons as health and costs. The process achieved a basic understanding of the problems associated with regulating risk and laid the foundation for building trust and credibility.

Risk communication is not easy, but this project illustrates that strategies and concepts can be conveyed. Effective communication does not mean luring people into accepting risks that they fear or hope to avoid. It means, however, giving people the tools to understand and participate in debates about risk and risk sources. The major goal of risk communication is to enhance understanding, to develop mutual respect, and to acknowledge conflicting values in the decision-making process. Ultimately, risk communication should provide a platform for rational conflict resolution and effective, democratic policymaking.



## NOTES

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