

SUBJECT

# RISK ANALYSIS

**SESSION 8 Risk Perception**

## Session 8

### Risk Perception

#### Case study

In the 1960s, a rapid rise in nuclear technologies aroused unexpected panic in the public. Despite repeated affirmations from the scientific community that these technologies were indeed safe, the public feared both long-term dangers to the environment as well as immediate radioactive disasters. The disjunction between the scientific evidence about and public perception of these risks prompted scientists and social scientists to begin research on a crucial question: how do people formulate and respond to notions of risk?

Early research on risk perception assumed that people assess risk in a rational manner, weighing information before making a decision. This approach assumes that providing people with more information will alter their perceptions of risk. Subsequent research has demonstrated that providing more information alone will not assuage people's irrational fears and sometimes outlandish ideas about what is truly risky. The psychological approach to risk perception theory, championed by psychologist Paul Slovic, examines the particular heuristics and biases people invent to interpret the amount of risk in their environment.

In a classic review article published in *Science* in 1987, Slovic summarized various social and cultural factors that lead to inconsistent evaluations of risk in the general public. Slovic emphasizes the essential way in which experts' and laypeople's views of risk differ. Experts judge risk in terms of quantitative assessments of morbidity and mortality. Yet most people's perception of risk is far more complex, involving numerous psychological and cognitive processes. Slovic's review demonstrates the complexity of the general public's assessment of risk through its cogent appraisal of decades of research on risk perception theory.

Slovic's article focuses its attention on one particular type of risk perception research, the "psychometric paradigm." This paradigm, formulated largely in response to the early work of Chauncey Starr, attempts to quantify perceived risk using psychophysical scaling and multivariate analysis. The psychometric approach thus creates a kind of taxonomy of hazards that can be used to predict people's responses to new risks.

Perhaps more important than quantifying people's responses to various risks is to identify the qualitative characteristics that lead to specific valuations of risk. Slovic masterfully summarizes the key qualitative characteristics that result in judgments that a certain activity is risky or not. People tend to be intolerant of risks that they perceive as being uncontrollable, having catastrophic potential, having fatal consequences, or bearing an inequitable distribution of risks and benefits. Slovic notes that nuclear weapons and nuclear power score high on all of these characteristics. Also unbearable in the public view are risks that are unknown, new, and delayed in their manifestation of harm. These factors tend to be characteristic of chemical technologies in public opinion. The higher a hazard scores on these factors, the higher its perceived risk and the more people want to see the risk reduced, leading to calls for stricter regulation. Slovic ends his review with a nod toward sociological and anthropological studies of risk, noting that anxiety about risk may in some cases be a proxy for other social concerns. Many perceptions of risk are, of course, also socially and culturally informed.

Slovic's analysis goes a long way in explaining why people persist in extreme fears of nuclear energy while being relatively unafraid of driving automobiles, even though the latter has caused many more deaths than the former. The fact that there are so many automobile accidents enables the public to feel that it is capable of assessing the risk. In other words, the risk seems familiar and knowable. There is also a low level of media coverage of automobile accidents, and this coverage never depicts future or unknown events resulting from an accident. On the other hand, nuclear energy represents an unknown risk, one that cannot be readily analyzed by the public due to a relative lack of information. Nuclear accidents evoke widespread media coverage and warnings about possible future catastrophes. In this case, a lower risk phenomenon (nuclear energy) actually induces much more fear than a higher risk activity (driving an automobile).

Importantly, Slovic correctly predicted 25 years ago that DNA experiments would someday become controversial and frighten the public. Although the effects of genetically modified crops on ecosystems may be a cause for concern, fears of the supposed ill effects of these crops on human health are scientifically baseless. Today, although biologists insist that genetically modified crops pose no risk to human health, many members of the public fear that genetically modified crops will cause cancer and birth defects. Such crops grow under adverse circumstances and resist infection and destruction by insects in

areas of the world tormented by hunger, and therefore have the potential to dramatically improve nutritional status in countries plagued by starvation and malnutrition. Yet the unfamiliarity of the phenomenon and its delayed benefits make it a good candidate for inducing public fear and skepticism.

There is a subtle yet passionate plea beneath the surface of Slovic's review. The article calls for assessments of risk to be more accepting of the role of emotions and cognition in public conceptions of danger. Rather than simply disseminating more and more information about, for example, the safety of nuclear power, experts should be attentive to and sensitive about the public's broad conception of risk. The goal of this research is a vital one: to aid policy-makers by improving interaction with the public, by better directing educational efforts, and by predicting public responses to new technologies. In the end, Slovic argues that risk management is a two-way street: just as the public should take experts' assessments of risk into account, so should experts respect the various factors, from cultural to emotional, that result in the public's perception of risk.

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## **Risk Perception**

People respond to a risk or hazard in ways consistent to their perception of that risk. It is their perception that influences behavior or action (Mileti 1993). Understanding public perception of natural hazards is necessary in order to impact hazard preparedness, and can be a problem because residents of at-risk areas often have inaccurate beliefs about the hazard agent and its impacts, are unaware of available adjustments, and may have erroneous beliefs about the effectiveness of the adjustments of which they are aware (Lindell and Perry 1993). Research shows that adaptive actions are motivated by awareness of the hazard, knowledge of how it can affect the community, and feelings of personal vulnerability to the potential consequences (Janis and Mann 1977).

Frequent exposure to hazard relevant information does not automatically elicit attention and comprehension, let alone the acceptance, personalization, and retention required to initiate hazard adjustments (Mileti and Sorensen 1987).

Lindell and Perry argue that people do not actually need to understand the hazard in order to be motivated enough to prepare, but they need to believe that the hazard really exists and that protection is needed (1993).

Often, the problem for people to take action regarding a hazard is that they do not believe it really exists. One reason to explain this is that people rely on past experience. In 1992, Hurricane Andrew destroyed 80,000 homes and put 12 insurance companies out of business with its unprecedented force. Even though evacuation was mandatory in southern Florida, many people refused as never before in their memory had a hurricane traveled as far inland as Andrew. The people who were reluctant to evacuate were simply making rational decisions based on past experience (Tobin and Montz 1997).

**Risk perception** is the subjective judgment that people make about the characteristics and severity of a risk. The phrase is most commonly used in reference to natural hazards and threats to the environment or health, such as nuclear power. Several theories have been proposed to explain why different people make different estimates of the dangerousness of risks. Three major families of theory have been developed: psychology approaches (heuristics and cognitive), anthropology/sociology approaches (cultural theory) and interdisciplinary approaches (social amplification of risk framework).

### Early theories

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The study of risk perception arose out of the observation that experts and lay people often disagreed about how risky various technologies and natural hazards were.

The mid 1960s saw the rapid rise of nuclear technologies and the promise for clean and safe energy. However, public perception shifted against this new technology. Fears of both longitudinal dangers to the environment as well as immediate disasters creating radioactive wastelands turned the public against this new technology. The scientific and governmental communities asked why public perception was against the use of nuclear energy when all of the scientific experts were declaring how safe it really was. The problem, from the perspectives of the experts, was a difference between scientific facts and an exaggerated public perception of the dangers.

A key early paper was written in 1969 by Chauncey Starr.<sup>[2]</sup> Starr used a revealed preference approach to find out what risks are considered acceptable by society. He assumed that society had reached equilibrium in its judgment of risks, so whatever risk levels actually existed in society were acceptable. His

major finding was that people will accept risks 1,000 greater if they are voluntary (e.g. driving a car) than if they are involuntary (e.g. a nuclear disaster).

This early approach assumed that individuals behave in a rational manner, weighing information before making a decision. Individuals have exaggerated fears due to inadequate or incorrect information. Implied in this assumption is that additional information can help people understand true risk and hence lessen their opinion of danger.<sup>[11]</sup> While researchers in the engineering school did pioneer research in risk perception, by adapting theories from economics, it has little use in a practical setting. Numerous studies have rejected the belief that additional information, alone, will shift perceptions.<sup>[13]</sup>

### Psychology approach

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The psychology approach began with research in trying to understand how people process information. These early works maintain that people use cognitive heuristics in sorting and simplifying information which lead to biases in comprehension. Later work built on this foundation and became the *psychometric paradigm*. This approach identifies numerous factors responsible for influencing individual perceptions of risk, including dread, newness, stigma, and other factors.

Research also shows that risk perceptions are influenced by the emotional state of the perceiver.<sup>[15]</sup> The valence theory of risk perception only differentiates between positive emotions, such as happiness and optimism, and negative ones, such as fear and anger. According to valence theory, positive emotions lead to optimistic risk perceptions whereas negative emotions influence a more pessimistic view of risk.<sup>[16]</sup>

Research also has found that, whereas risk and benefit tend to be positively correlated across hazardous activities in the world, they are negatively correlated in people's minds and judgments.

### **Heuristics and biases**

The earliest psychometric research was done by psychologists Daniel Kahneman and Amos Tversky, who performed a series of gambling experiments to see how people evaluated probabilities. Their major finding was that people use a number of heuristics to evaluate information. These heuristics are usually useful shortcuts for thinking, but they may lead to inaccurate judgments in some situations – in which case they become cognitive biases.

- Representativeness: is usually employed when people are asked to judge the probability that an object or event belongs to a class / processes by its similarity:
  - insensitivity to prior probability
  - insensitivity to sample size
  - misconception of chance
  - insensitivity to predictability
  - illusion of validity
  - misconception of regression
- Availability heuristic: events that can be more easily brought to mind or imagined are judged to be more likely than events that could not easily be imagined:
  - biases due to retrievability of instances
  - biases due to the effectiveness of research set
  - biases of imaginability
  - illusory correlation
- Anchoring and Adjustment heuristic: people will often start with one piece of known information and then adjust it to create an estimate of an unknown risk – but the adjustment will usually not be big enough:
  - insufficient adjustment
  - biases in the evaluation of conjunctive and disjunctive event (conjunction fallacy)
  - anchoring in the assessment of subjective probability distributions
- Asymmetry between gains and losses: People are risk averse with respect to gains, preferring a sure thing over a gamble with a higher expected utility but which presents the possibility of getting nothing. On the other hand, people will be risk-seeking about losses, preferring to hope for the chance of losing nothing rather than taking a sure, but smaller, loss (e.g. insurance).
- Threshold effects: People prefer to move from uncertainty to certainty over making a similar gain in certainty that does not lead to full certainty. For example, most people would choose a vaccine that reduces the incidence of disease A from 10% to 0% over one that reduces the incidence of disease B from 20% to 10%.

Another key finding was that the experts are not necessarily any better at estimating probabilities than lay people. Experts were often overconfident in the exactness of their estimates, and put too much stock in small samples of data.<sup>[8]</sup>

## **Cognitive Psychology**

The majority of people in the general public express a greater concern for problems which appear to possess an immediate effect on everyday life such as hazardous waste or pesticide-use than for long-term problems that may affect future generations such as climate change or population growth.<sup>[9]</sup> People greatly rely on the scientific community to assess the threat of environmental problems because they usually do not directly experience the effects of phenomena such as climate change. The exposure most people have to climate change has been impersonal; most people only have virtual experience through documentaries and news media in what may seem like a “remote” area of the world.<sup>[10]</sup> However, coupled with the population’s wait-and-see attitude, people do not understand the importance of changing environmentally destructive behaviors even when experts provide detailed and clear risks caused by climate change.

### **Psychometric paradigm**

Research within the psychometric paradigm turned to focus on the roles of affect, emotion, and stigma in influencing risk perception. Melissa Finucane and Paul Slovic have been among the key researchers here. These researchers first challenged Starr's article by examining expressed preference – how much risk people say they are willing to accept. They found that, contrary to Starr's basic assumption, people generally saw most risks in society as being unacceptably high. They also found that the gap between voluntary and involuntary risks was not nearly as great as Starr claimed.

Slovic and team found that perceived risk is quantifiable and predictable. People tend to view current risk levels as unacceptably high for most activities.<sup>[12]</sup> All things being equal, the greater people perceived a benefit, the greater the tolerance for a risk.<sup>[8]</sup> If a person derived pleasure from using a product, people tended to judge its benefits as high and its risks as low. If the activity was disliked, the judgments were opposite.<sup>[13]</sup> Research in psychometrics has proven that risk perception is highly dependent on intuition, experiential thinking, and emotions.

Psychometric research identified a broad domain of characteristics that may be condensed into three high order factors: 1) the degree to which a risk is understood, 2) the degree to which it evokes a feeling of dread, and 3) the number of people exposed to the risk. A dread risk elicits visceral feelings of terror, uncontrollable, catastrophe, inequality, and uncontrolled. An unknown risk is new and unknown to science. The more a person dreads an activity, the higher its perceived risk and the more that person wants the risk reduced.<sup>[8]</sup>



## **Environmental Psychology**

In order to better address and understand the risk of complex environmental problems such as climate change, new interdisciplinary models of risk perception have been developed in recent years. For example, Helgeson, van der Linden and Chabay (2012) present a five factor model, where public risk perceptions of climate change are considered to be multidimensional, resulting from a combination of (1) cognitive, (2) emotional, (3) subconscious, (4) socio-cultural and (5) individual factors.<sup>[14]</sup> The model integrates insights from behavioral economics, cognitive psychology, cultural anthropology, the psychometric paradigm as well as the heuristics and biases approach.

### Anthropology/sociology approach

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The anthropology/sociology approach posits risk perceptions as produced by and supporting social institutions.<sup>[15]</sup> In this view, perceptions are socially constructed by institutions, cultural values, and ways of life.

### **Cultural theory**

One line of the Cultural Theory of risk is based on the work of anthropologist Mary Douglas and political scientist Aaron Wildavsky first published in 1982.<sup>[16]</sup> In cultural theory, Douglas and Wildavsky outline four “ways of life” in a grid/group arrangement. Each way of life corresponds to a specific social structure and a particular outlook on risk. Grid categorizes the degree to which people are constrained and circumscribed in their social role. The tighter binding of social constraints limits individual negotiation. Group refers to the extent to which individuals are bounded by feelings of belonging or solidarity. The greater the bonds, the less individual choice are subject to personal control.<sup>[17]</sup> Four ways of life include: Hierarchical, Individualist, Egalitarian, and Fatalist.

Risk perception researchers have not widely accepted this version of cultural theory. Even Douglas says that the theory is controversial; it poses a danger of moving out of the favored paradigm of individual rational choice of which many researchers are comfortable.<sup>[18]</sup>

On the other hand, writers who drawn upon a broader cultural theory perspective have argued that risk-perception analysis helps understand the public response to terrorism in a way that goes far beyond 'rational choice'. As John Handmer and Paul James write:

“ In the area of embodied risk, people are not as fearful of themselves as perhaps they should be on the issues of illicit drug use, unsafe sex and so on. Yet with the compounding of both more abstract and more embodied risk this package appears to have met its goal to generate support for government policy. Fear of 'outsiders' and of a non-specific, invisible and uncontrollable threat was a powerful motivator in shaping perception.<sup>[19]</sup> ”

### **National Culture and Risk Survey**

The First National Culture and Risk Survey of cultural cognition found that a person's worldview on the two social and cultural dimensions of "hierarchy-egalitarianism," and "individualism-solidarism" was predictive of their response to risk.<sup>[20]</sup>

#### Interdisciplinary approach

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### **Social amplification of risk framework**

The Social Amplification of Risk Framework (SARF), combines research in psychology, sociology, anthropology, and communications theory. SARF outlines how communications of risk events pass from the sender through intermediate stations to a receiver and in the process serve to amplify or attenuate perceptions of risk. All links in the communication chain, individuals, groups, media, etc., contain filters through which information is sorted and understood.

The framework attempts to explain the process by which risks are amplified, receiving public attention, or attenuated, receiving less public attention. The framework may be used to compare responses from different groups in a single event, or analyze the same risk issue in multiple events. In a single risk event, some groups may amplify their perception of risks while other groups may attenuate, or decrease, their perceptions of risk.

The main thesis of SARF states that risk events interact with individual psychological, social and other cultural factors in ways that either increase or decrease public perceptions of risk. Behaviors of individuals and groups then generate secondary social or economic impacts while also increasing or decreasing the physical risk itself.<sup>[21]</sup>

These **ripple effects** caused by the amplification of risk include enduring mental perceptions, impacts on business sales, and change in residential property values, changes in training and education, or social disorder. These secondary changes are perceived and reacted to by individuals and groups resulting in

third-order impacts. As each higher-order impacts are reacted to, they may ripple to other parties and locations. Traditional risk analyses neglect these ripple effect impacts and thus greatly underestimate the adverse effects from certain risk events. Public distortion of risk signals provides a corrective mechanism by which society assesses a fuller determination of the risk and its impacts to such things not traditionally factored into a risk analysis.