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RISKY ASSUMPTIONS

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Why do some communities vigorously oppose the siting of a nuclear reactor or liquified natural gas terminal in their vicinity despite expert assurances that these technologies are safe? Why, on the other hand, do expert warnings about earthquake faults or the dangers of large dams go unheeded? Making sense of such reactions falls to the psychological study of perceived risk. Some of the findings are ripe for application by policymakers and utilities officials, and also by individuals trying to deal with their personal fears.

We have recently completed a number of studies that asked people to judge the frequency and risk of death from a large number of hazardous activities, substances, and technologies, ranging from nuclear power to power lawnmowers. We found that people greatly overestimated the frequency of deaths from such dramatic, sensational causes as accidents, homicides, cancer, botulism, and tornadoes—and underestimated the frequency of death from unspectacular causes that claim one victim at a time and are common in nonfatal form—diabetes, stroke, tuberculosis, asthma, and emphysema. Accidents were judged to cause as many deaths as diseases; diseases actually take about 15 times as many lives. Homicides were judged to be about five times as frequent as suicides; suicides are actually 30 percent more frequent. Death from asthma was judged to occur only slightly more often than death from botulism; asthma is actually responsible for more than 900 times as many deaths.

Participants in our studies were college students and members of the League of Women Voters in Eugene, Oregon. In one experiment, we told them the annual death toll for motor vehicle accidents in the United States (50,000) and asked them to estimate the frequency of 40 other causes of death. In another, we gave participants pairs of causes of death and asked them to choose which cause in each pair was more frequent.

The errors of estimation we found seemed to reflect the working of a mental shortcut or "heuristic" that people commonly use when they judge the likelihood of risky events. The psychologists Daniel Kahneman and Amos Tversky have identified one heuristic of special importance, "availability," whereby people judge an event as likely or frequent if instances of it are easy to imagine or recall. Since frequent events are generally easier to imagine and recall than rare ones, availability is often an appropriate cue. However, availability is also affected by numerous factors unrelated to the real frequency of occurrence, such as how dramatic or sensational an event is. A recent disaster or a vivid film, such as *Jaws* or *The China Syndrome*, could inflate judgments of the likelihood of similar events.

In another study, we asked partici-

Illustration by Carlos L. Aguirre

Asked to rate the risk of death from 30 possible causes, people tend to inflate some fears and deflate others. Often, experts are no more accurate. Psychological studies help explain how perceptions come to be so distorted.

pants to rank the overall *risk* of dying from 30 activities or technologies on a list including, this time, nuclear power. We also obtained estimates from 15 experts across the country who are professionally involved in assessing risks, including a geographer, an environmental policy analyst, an economist, a lawyer, a biologist, a biochemist, and a government regulator of hazardous materials. Forty participating members of the League of Women Voters agreed closely with the experts in ranking some hazards, like power lawnmowers, as low in risk, and others, like handguns and motor vehicles, as high. But they ranked nuclear power as much more dangerous than the experts did [again, a dramatic issue], and thought x-rays, contraceptives, and non-nuclear electric power safer. [See chart, page 47.] In fact, the lethal potential of technologies such as nuclear power plants is in dispute even among experts, with technical estimates based on uncertain inferences about processes that are not always well understood.

The tendency of people to overestimate the frequency of dramatic or sensational events is compounded by similar biases in the news media. In collaboration with our colleague Barbara Combs, we examined reports of causes of death for six months of 1975 in two small newspapers on opposite coasts of the United States: the Eugene, Oregon *Register Guard* and the New Bedford, Massachusetts *Standard Times*. Reports of deaths involving diseases were relatively infrequent and received less space than reports of deaths from violent, often catastrophic, and more newsworthy events such as tornadoes, fires, drownings, homicides, and accidents, which were reported disproportionately often. For instance, even though diseases take about 100 times as many lives as homicides do, the papers carried about three times as many articles about homicides as they did about deaths involving diseases.

One pernicious aspect of heuristics is that people are often very confident about the judgments they base on them. In a follow-up to our study on causes of death, we asked participants for the odds that they were incorrect in choosing the more frequently lethal event in several pairs. For example, if they thought botulism killed more frequently than asthma, we asked them to estimate the odds on their being wrong. The participants frequently—25 percent of the time—said the odds against their judgment being wrong were 100 to 1 or greater. If they had given correct odds, such people in fact would have been wrong once in 100 times or less; instead, they were wrong about 1 out of every 8 times; thus they should have given themselves odds of 7 to 1. About 30 percent gave odds greater than 50 to 1 to the incorrect assertion

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that homicides outnumber suicides.

The psychological basis for this overconfidence seems to be people's insensitivity to the tenuousness of the assumptions on which they base their judgments. In this case, they may have assumed that frequent media reports of homicide and suicide accurately reflected the actual rates. Such overconfidence, of course, can keep us from realizing how little we know and how much additional information we need about the risks we face.

Another important and potentially tragic form of overconfidence is people's tendency to consider themselves personally immune to many hazards whose risks to others they would acknowledge readily. In a report titled "Are We All Among the Better Drivers?" Ola Svenson, a Swedish psychologist, showed that most people tend to rate themselves as among the most skillful and the safest drivers in the population. This effect does not seem to be limited just to driving. A recent study by Arno Rethans, a professor of marketing at Penn State, found that people rated their own risks from each of 29 hazardous consumer products like knives and hammers as lower than risks those products posed to others. Ninety-seven percent of Rethans's respondents thought they would be either average or above average in their ability to avoid bicycle and power lawnmower accidents—which is highly improbable. A study by Neil Weinstein, a psychologist at Rutgers University, found people to be unrealistically optimistic in evaluating the chances that good and bad life events would happen to them, such as living past 80 or having a heart attack.

We believe that several factors contribute to determining when such optimism comes into play. First, people tend to underestimate personal risks if they think hazards are under their control. Second, the hazards they underrate tend to be familiar ones in which risks are so low that personal experience of them is overwhelmingly benign. Automobile driving is a prime example. Although poor drivers may drive too fast or tailgate, they make trip after trip without mishap, "proving" to themselves their exceptional skill and caution. Moreover, indirect experience, via the media, shows them that when accidents do happen, they happen to others. Misleading experiences encourage erroneous conclusions; they can help rationalize a refusal to take protective action, such as wearing seat belts.

A corollary of being influenced by the information that is available is that one ignores the information that is unavailable: out of sight is out of mind. For this reason, experts also seem subject to overconfidence, particularly when they try to assess the risks of potentially catastrophic hazards that are rare or for which direct experience is lacking, such as nuclear-reactor accidents. If they cannot imagine important causes of possible problems, such causes will be omitted from their analysis—with no cue that the basis of their estimate is faulty until an actual problem occurs. (See "Post-Freudian Slips," *PT*, April 1980.)

In another of our experiments, we showed 15 professional automobile mechanics a diagram outlining various types of mechanical failures that could keep a car from starting. When we deliberately left many important problems, most of the experts failed to notice their absence. Other sources of bias in expert judgment are:

☐ Overconfidence in current scientific knowledge. For example, experts failed to recognize the harmful effects of x-rays until their use had become widespread and largely uncontrolled.

☐ Insensitivity to how technological systems function as a whole. The DC-10 crashed in two early flights because its designers had not realized that accidental decompression of the cargo compartment would destroy vital parts of the plane's control system.

☐ Failure to anticipate human responses to safety measures. The partial flood protection afforded by dams and levees gives people a false sense of security and promotes development on flood plains. When a rare flood exceeds the capacity of the dam, however, damage can be considerably greater than it might have been had the flood plain not been "protected."

☐ Human errors. Due to inadequate training, operating procedures, and control room design, operators at Three Mile Island misdiagnosed the

RANKING RISKS: VOTERS & EXPERTS

Asked to rank the risk of dying in the U.S. from 30 activities and technologies, League of Women Voters members agreed with experts on items like power mowers and handguns, but disagreed about radiation technologies like nuclear power and x-rays, and about contraceptives and non-nuclear electric power. League members, one of several groups the authors studied, represented the opinions of educated, informed citizens. The ranking 1 represents a judgment of the most risk; 30, of the least.

VOTERS		EXPERTS
1	Nuclear power	20
2	Motor vehicles	1
3	Handguns	4
4	Smoking	2
5	Motorcycles	6
6	Alcoholic beverages	3
7	General (private) aviation	12
8	Police work	17
9	Pesticides	8
10	Surgery	5
11	Fire fighting	18
12	Large construction	13
13	Hunting	23
14	Spray cans	28
15	Mountain climbing	29
16	Bicycles	15
17	Commercial aviation	16
18	Electric power (non-nuclear)	9
19	Swimming	10
20	Contraceptives	11
21	Skiing	30
22	X-rays	7
23	High school and college football	27
24	Railroads	19
25	Food preservatives	14
26	Food coloring	21
27	Power mowers	26
28	Prescription antibiotics	24
29	Home appliances	22
30	Vaccinations	25

problems of the reactor and took inappropriate corrective actions. A minor incident thus became a major accident.

Nowhere are the issues of perceived risk more salient or the stakes higher than in the controversy over nuclear power. Though a number of commentators have speculated that people's strong fears of nuclear power stem from a belief that death from radiation is somehow more horrible than death from other causes, our studies of members of the League of Women Voters indicate that instead, their fears appear to derive from concern over how many deaths are likely. Their mental images of a nuclear accident include the specter of hundreds of thousands, even millions, of immediate deaths, accompanied by incalculable and irreversible damage to the environment. These images bear little resemblance to the views of industry officials (and most technical experts), who expect redundant safety and containment systems to prevent almost all reactor accidents and limit the damage of those that do occur.

Industry proponents attribute this perception gap to public irrationality—"emotionalism that threatens technological progress." Increasingly, they call for programs to "educate" us about "real" nuclear power risks.

We question this attribution of irrationality, and we doubt that its proposed remedy, education, will easily succeed. For although people's fears may be exaggerated, they are not divorced from reality. People are aware of experts' serious mistakes in the past and of the experts' own disagreements about the risks of nuclear power. Hence, to be believed, any balanced presentation of information has to convey the uncertainty and disagreement that characterizes expert opinion. The immediate impact of such education is illustrated by the Swedish government's massive campaign in 1974 to inform people about nuclear power and other energy sources. More than 80,000 people listened to at least 10 hours of instruction sponsored by the Ministries of Education and Industry. Yet according to Dorothy Nelkin, a sociologist at Cornell, the most significant effect of this was to increase public confusion and uncertainty: people could not resolve conflicting technical views.

Then, too, education can also encourage people to imagine risks they might never have thought about otherwise. An engineer might argue for the safety of disposing of nuclear wastes in a salt bed, for example, by pointing out the improbability of each of the several ways radioactivity could accidentally be released. Rather than reassure the audience, the presentation might lead them to think, "I didn't realize there were that many things that could go wrong."

Another barrier to educational attempts is that people's beliefs change slowly and are extraordinarily resistant to new information. Research in social psychology has often demonstrated that once formed, people's initial impressions tend to structure the way they interpret subsequent information. They give full weight to evidence that is consistent with their initial beliefs while dismissing contrary evidence as unreliable, erroneous, or unrepresentative. Whereas opponents of nuclear power believe the accident at Three Mile Island "proved" how dangerous reactors are, proponents felt that it confirmed their faith in the effectiveness of the multiple safety and containment systems.

Since even well-informed citizens have difficulty in judging risk accurately, and the cognitive functioning of experts appears to be basically like that of everyone else, it seems clear that no one person or profession knows how to get the right answers. The best we can hope to do is to keep the particular kinds of mistakes to which each of us is prone to a minimum by being more aware of our tendency to make mistakes.

For nonexperts, the challenge is to be sensitive to the circumstances that might seriously distort judgments of risk and to be open to new evidence that may alter our current views. Experts need to recognize their own cognitive limitations, to sympathize with the concerns of the public, and to understand how people come to those concerns. As both groups get better at perceiving risks, society may be able to move on to the harder task of deciding which risks are worth running. Ω

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