Communicating About the Risks of Terrorism (or Anything Else)

Baruch Fischhoff
Carnegie Mellon University

Communication is essential to preventing terrorists from achieving their objectives. Effective communication can reduce terrorists' chances of mounting successful operations, creating threats that disrupt everyday life, and undermining the legitimacy of the societies that they attack. Psychological research has essential roles to play in that communication, identifying the public's information needs, designing responsive communications, and evaluating their success. Fulfilling those roles requires policies that treat two-way communication with the public as central to ensuring that a society is strengthened, rather than weakened, by its struggle with terror. There are scientific, organizational, and political barriers to achieving those goals. Psychological research can help to overcome them—and advance its science in the process.

Keywords: terror, risk, nuclear weapons, decision making, communication

Terrorists cannot threaten a modern state unless they neutralize its instruments of power, creating a vacuum that they can occupy. Doing so requires terror on the scale of civil war. Even sustained terror campaigns like those experienced by England, Northern Ireland, Russia, and Israel have not posed such threats. As was seen in the failure of strategic bombing during World War II and other conflicts, civilian populations can absorb great suffering before surrendering.

What terrorists can do is make life truly miserable. They can inflict direct damage to the people they injure, to the economies they disrupt, and to the leaders they discredit. They can inflict indirect damage by instilling fear over who will be next, by undermining investors' confidence in future economic activity, and by eroding faith in governments that cannot protect their people.

The direct effects of terrorism depend primarily on operational factors. How good are terrorists at recruitment, training, organization, execution, and fund-raising? How good are governments at deterring, disrupting, and punishing them? The indirect effects depend primarily on how effectively the parties communicate. How good are terrorists at spreading fear, anxiety, distrust, uncertainty, sadness, and recrimination? How good are governments at conveying assurance, confidence, and authority, despite any losses?

Communicating About the Risks of Terrorism

The political stakes riding on these communications are readily visible. After a halting initial response to the 9/11 attacks, the G. W. Bush administration tapped public fear and anger in ways that created strong general approval and enough support for specific policies to launch the Iraq War and pass the USA Patriot Act (see Huddy & Feldman, 2011, this issue). In contrast, a clumsy response to the Madrid bombings undermined the Aznar government's chances in the ensuing national elections in Spain. The sustained courage communicated by Northern Ireland's peace parties eventually provided an outlet for the weary public there. The violence of the second Intifada dealt a severe blow to Israel's peace movement and Palestinian civil society.

Thus, strengthening or weakening public morale is a principal means to political ends. Terrorists hope to demonstrate a government's inability to defend its citizens and to provoke disproportionate responses that suggest a lack of competence and composure. If successful, terrorists can claim the moral superiority of their cause and weaken resistance to it (as happens when countries change their foreign policies, hoping to avoid becoming targets).

Public morale is, of course, an end in itself. In that light, terrorism is just another threat to a society's overall well-being, along with natural hazards, economic declines, and domestic strife. That broad perspective encouraged creation of the U.S. Department of Homeland Security (DHS), with an all-hazards portfolio—even if DHS gave short shrift to everything but terrorism before Hurricane Katrina. The following statement by General Larry Welch, Chair of the Department of Homeland Security's Science

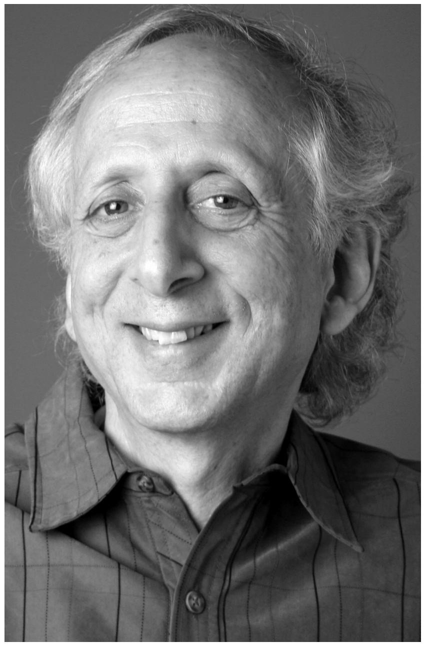
This article was published Online First August 8, 2011.

Baruch Fischhoff was a founding member of the Department of Homeland Security Science and Technology Advisory Committee and founding chair of the Environmental Protection Agency Homeland Security Advisory Committee. He chaired the National Research Council Committee on Social and Behavioral Science Contributions to Intelligence Analysis for National Security (sponsored by the Office of the Director of National Intelligence).

Preparation of this manuscript was partially supported by Army Research Office Multidisciplinary University Research Initiative Grant W911NF-08-1-0301.

Correspondence concerning this article should be addressed to Baruch Fischhoff, Department of Social and Decision Sciences and Department of Engineering and Public Policy, BP219E, Carnegie Mellon University, Pittsburgh, PA 15213-3890. E-mail: baruch@cmu.edu

 0003-066X/11/$12.00
Vol. 66, No. 6, 520–531 DOI: 10.1037/a0024570



Baruch Fischhoff

and Technology Advisory Committee, shows the importance attributed to public resilience:

> Turning to public interface and public resilience, we think it is enormously important because it is naive to think that you will prevent all damage or you will prevent all of the incidents that one seeks to prevent. While we would certainly give prevention a very high priority, the fact is that if the overall strategic objective is to preserve the American way of life (that is, to ensure that no set of threats can fundamentally change the U.S. as we know it), then you need a very resilient public. We need a public that can react to a wide range of things that can happen, much of which we will never predict in advance, and to sustain that which we all believe in.
>
> We give a very high importance to preparedness, realistic expectations and public understanding that lead to confidence. We will have some things to say about the responsibility to ensure that expectations are realistic. We will recommend that there be a major thrust to make DHS the "trusted source" for information in emergencies. That does not mean that all the expertise will come from DHS, but the public needs to know in an emergency that there's one communication channel that they can use to get the information and help they require. It needs to be a consistent source; it needs to be trustworthy. (U.S. Department of Homeland Security, Science and Technology Advisory Committee, 2005, p. 2).

Welch went on to say, "In order to provide that [trusted information], S&T has a role to play in providing both physical and social science expertise because it is both a physical science and a social science issue" (U.S. Department of Homeland Security, Science and Technology Advisory Committee, 2005, p. 3).

To these ends, communication is central to all phases of any national strategy, from left of the "boom" to its right—in the language sometimes used to describe the time course of attempted attacks. Before an attack, sound communications can help officials to understand their publics' needs, can help those publics to prepare (as far as they can and wish to do so), and can help all parties to establish the social ties needed to weather a storm. During an attack, sound communications can help people to make the best out of a bad situation, minimizing not only their immediate losses but also anger over being denied vital information. After an attack, sound communications can help to restore lost trust, letting people recover as fast as the damage allows.

Such vital responses to threats and losses represent the kind of resilience sought by General Welch. Knowing that, terrorists have communication strategies with the opposite intent. Before an attack, they try to sow fear; during it, they hope to create confusion; afterward, they seek to spur dissension. If successful, they can advance their cause even when their operations fail (as with the finger-pointing after the Christmas Day bombing attempt on Northwest Flight 253). Conversely, sound communications can strengthen a society by helping it to unite in the face of these challenges. As a result, governments worthy of trust must make communication central to their national strategy for dealing with terror. Of course, even the best words, delivered in the most effective ways, are no substitute for having the competencies addressed by other articles in this issue and for doing everything possible to reduce those risks.

The Sciences of Terrorist Risk Communication

As distinctive as terrorism may be, people face many other risks. Meeting their information needs has prompted extensive research into basic processes of risk perception and communication, with applications as diverse as nuclear power, pharmaceuticals, HIV/AIDS, natural disasters, breast cancer, breast implants, genetic testing, genetically modified crops, food contamination, and more (Breakwell, 2007; Casman & Fischhoff, 2008; Fischhoff, 2009; Löfstedt & Boholm, 2008; Morgan, Fischhoff, Bostrom, & Atman, 2002; Renn, 2008; Slovic, 2001, 2010).

Because there are many risks, many experts, and many publics, there can be no single answer to the questions of how well experts communicate terror risks and how well the public understands them. The following sections illustrate how psychological science can be applied to describing, evaluating, and improving terror risk communications. Table 1 summarizes the unique demands and collaborations of risk communications aimed at helping people to master the facts needed to make effective decisions. The following sections illustrate them with examples involving two related classes of terrorist risks: nuclear explosions and radioactive dispersion devices (atom bombs and dirty bombs, respectively). Creating communications for other risks faces analogous challenges.

Analyzing Information Needs

Communications have no value unless they contain useful information. They have limited value if they have needed information but bury it in irrelevancies (like the consumer medication information sheets accompanying prescription

Table 1
Creating Communications About Risks of Terror (or Anything Else)

Steps	Staff
Analysis: Identify the information most relevant to helping audience members make decisions that achieve their goals.	Subject matter experts, who can ensure fidelity to the best available technical knowledge
Design: Draft communications providing needed information in concise, comprehensible form.	Risk and decision analysts, who can identify the facts most relevant to the decisions facing audience members
Evaluation: Subject drafts to empirical evaluation, assessing whether people can extract enough information to make sound choices.	Communication specialists, who can maintain respectful two-way communication channels
Iteration: Repeat as needed, looking for weaknesses in the analysis, design, or evaluation.	Leaders, who can coordinate their staffs and ensure a coherent communication strategy

drugs). Communications may even have negative value if their contents are so poorly selected and presented that recipients resent being denied better information or do not realize how much they are missing. Thus, the first step in communication is identifying the core set of critical facts, from the often-vast universe of potentially relevant facts, that matter most to recipients.

Florig and Fischhoff (2007) demonstrated such analyses, identifying the information most relevant to communications before, during, and after a 10-kiloton terrorist nuclear explosion—one within the feasible range for a "homemade" device (i.e., not taken from a nuclear arsenal). Such a bomb would cause massive proximal damage, along with widespread contamination, whose radioactivity would diminish over time. As a result, prompt, effective sheltering (in a place that keeps radioactive particles from getting on the skin or in the lungs) can greatly reduce health effects should such an attack occur (Bouri, Norwood, & Sell, 2010). Understanding these risks is essential to placing them in perspective among all the world's conceivable worries (Fischhoff & Morgan, 2009).

Before. The DHS Emergency Supply List (U.S. Department of Homeland Security, n.d.) recommends permanently storing about two dozen items, including water, food, clothing, utensils, medicines, first aid supplies, personal sanitation supplies, a radio, flashlights, dust masks, and duct tape. An analysis based on 2006 retail prices estimated the cost of initially stocking these items at $465 and the annual restocking cost at $250, making for a 10-year cost of about $2,400 (assuming a 4% discount rate). From this perspective, the list might be useful to people who can afford its contents and who have secure storage areas. For others, it is irrelevant, perhaps even insulting, if interpreted as "You're on your own for self-protection. We're sorry, if you can't afford it."

Whether people who have the wherewithal would want to stock up should depend on the expected benefit of having those items on hand at home. That depends on the probability of being close enough to a nuclear explosion to be threatened by fallout and close enough to the shelter to be saved by it. A simple calculation (see Table 2 in Florig & Fischhoff, 2007) put that probability at roughly 1.6×10^{-5} over 10 years (equal to the product of the probabilities of a nuclear attack occurring anywhere during the period, of that attack being near the shelter, of wind blowing fallout toward the shelter, of a timely alert being sounded, of that alert being heard, of an individual being close enough to the shelter to use it, of the individual deciding to use it, and of it proving adequate). For a four-person household, the calculation makes the cost per expected life saved, by having a shelter, about $15 million (calculated by dividing the cost by the probability of saving a life). This value is about three times higher than the norm for U.S. government investments in life-saving measures (Robinson, 2007). Thus, if its only goal were protecting against a nuclear explosion, the list would be an ill-advised communication, because following its advice would deflect resources from more cost-effective ways to reduce risks. That conclusion might change if the analysis were broadened to consider other goals (e.g., protection from tornadoes or civil unrest) or if it used other estimates of costs and risks for the nuclear case. Without explicit analyses, though, there is no assurance that such advice is worth following. Widely accepted "best practices" can still be terrible if they've been unthinkingly copied from one source to the next.

During. Elaborate computer models have been created to predict the "fate and transport" of the radioactive materials that a nuclear explosion would disperse. A fully equipped emergency command center might have its choice among such models, updated with automatic feeds of meteorological data, and be just waiting to receive the "source term" giving the size, composition, and location of the radioactive material's release. These models' predictions might be helpful in plotting evacuation routes, after the fallout settles (see below). However, it would take an exceptional emergency system to absorb, analyze, and disseminate such information in the minutes following an attack.

Table 2 shows results from an analysis identifying information that could be disseminated before an attack preparing people for its immediate aftermath. Recognizing that people cannot be expected to remember very much

Table 2
Travel Recommendations After a 10-Kiloton Fission Bomb

Fallout arrival	Distance from blast	Risk from unsheltered exposure during first hour of fallout	Risk from 90% effective shelter during first hour of fallout	Recommendation
<15 min.	<4 km	Acutely fatal for all	Acutely fatal for most	Shelter in deepest space reachable within minutes.
15–60 min.	4–10 km	Acutely fatal for most; quadruple cancer risk for the few survivors	Acutely fatal for some; doubling of cancer risk for survivors	Travel only if certain that better shelter can be reached before fallout arrives. Use extra time to fortify shelter space.
30–90 min.	10–20 km	Acutely fatal for some; doubling of cancer risk for survivors	20% additional cancer risk	Travel if risk of exposure to fallout seems worth the benefit. Use extra time to fortify shelter space.
1–3 hours	20–50 km	20% additional cancer risk	2% additional cancer risk	Travel if risk of exposure to fallout seems worth the benefit. Failure to reach shelter before fallout arrives has health consequences that are significant, but not acutely fatal.
>2 hrs	50–100 km	5% additional cancer risk	<1% additional cancer risk	Sufficient time exists for travel to get home, collect family members, and/or flee.

Note. Cancer risks are based on dose estimates from Hotspot 2.05 (Homann, 2003) and are expressed as the increase in lifetime cancer risk over that from nonradiation causes. Reprinted from "Individuals' Decisions Affecting Radiation Exposure After a Nuclear Event" by H. K. Florig and B. Fischhoff, 2007, *Health Physics, 92,* p. 479. Copyright 2007 by the Health Physics Society.

from warnings about so unlikely an event as a nuclear attack, the analysis offers simple advice keyed to a single parameter that people might reasonably estimate during an attack: their approximate distance from the explosion (column 2). The analysis makes a conservative assumption about wind speed (10 mph [16 kph]) in order to produce a rough estimate of the time until fallout arrives (column 1). Comparing radiation risks with and without shelter (columns 3 and 4) leads to recommendations (column 5).

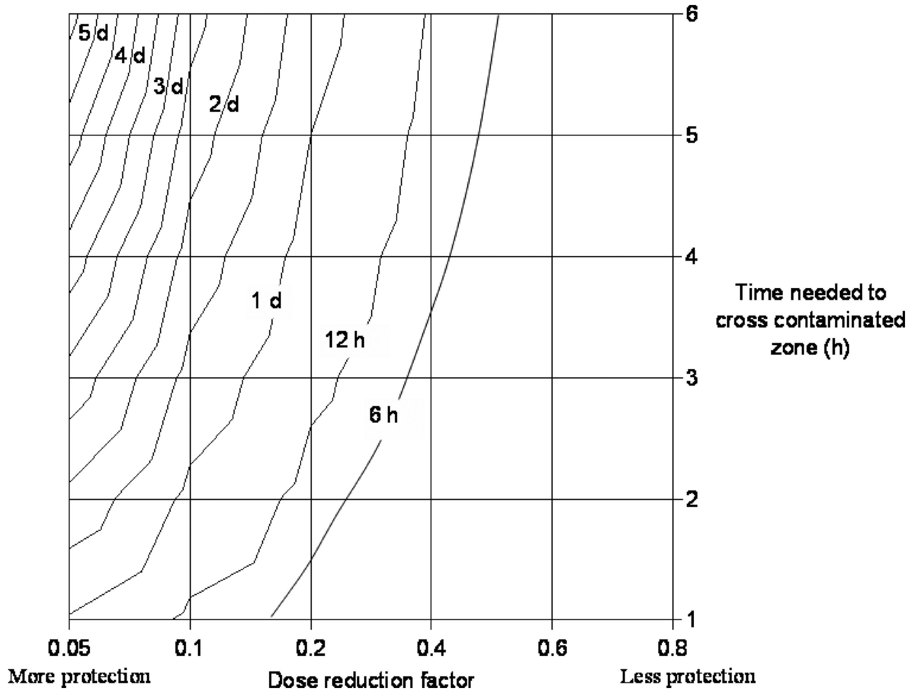
As simple as these distinctions are, they may be enough to inform critical decisions such as whether there is time to collect a child from school or a vital prescription from a pharmacy. Tailored to local conditions, they suggest such simple summaries as, "A nuclear explosion in Pittsburgh is likely to be downtown. If you're in the city [roughly 10 miles across], seek shelter immediately. If you're in the county [roughly 50 miles across], you have up to an hour." Balancing analytical precision and cognitive capacity, that may be as good as advice can get.

After. People in shelters will want to know when they can leave. So will those waiting for them outside the intense contamination zone. Figure 1 shows an analytical answer to this question, based on a single consideration: whether people would absorb more radiation by staying or leaving. That depends on how well the shelter protects (its "dose reduction factor") and how long it would take a person to cross the contamination zone. As shown by the equal-radiation curves, the optimal sheltering time could be as short as 6 hours (if the shelter is poor and the person can get out of the zone quickly) or as long as 5 days (with a good shelter and long transit time).

In this analysis, the answer is the same whatever the radiation dose (with the simplifying assumption of equal radiation throughout the zone). As a result, there is no need to collect or communicate information about the degree of contamination. What residents do need is information about the transit time to safety and the protection that their shelters provide. For the former, they need estimates from officials who know how bad it is outside. For the latter, they need to know how to evaluate their shelter (e.g., what they can infer from its building materials, wall thickness, and ventilation). Of course, these decisions are not about radiation protection alone. People may want to evacuate sooner (or later) depending on how uncomfortable, lonely, or fearful they are. However, officials have an obligation to conduct and communicate the analyses that people need.

Disciplined by analysis. Each of these analyses takes an "inside view," in the sense of formally analyzing the decisions that individuals face (Kahneman & Lovallo, 1993) in order to determine what to tell them. Without that discipline, communications reflect no more than guesses about what people need to know. These three analyses were fairly simple. The first added costs and multiplied probabilities; the second divided distance by wind speed to get time; the third compared exposures inside and outside a shelter (each estimated by a more

Figure 1
Equal-Radiation Curves Showing the Conditions Under Which People in Shelters Would Absorb the Same Radiation by Staying and Leaving



Note. Exposure to radiation is shown as a function of the shelter's dose-reduction factor (*x*-axis) and the time (in hours, or h) needed to traverse the fallout-contaminated zone during evacuation (*y*-axis). For example, after 6 hours, people would face the same radiation risk from staying as from leaving if their shelter has a dose-protection factor of 0.4 and they can cross the contaminated zone in 3.5 hours. Other things being equal, most would leave then. They should wait another 6 hours (12 hours overall) if it would take them 6 hours to cross the zone. With very protective shelters and long transit times, it might take several days (d) until there is less risk from going than from staying. Reprinted from "Individuals' Decisions Affecting Radiation Exposure After a Nuclear Event" by H. K. Florig and B. Fischhoff, 2007, *Health Physics, 92,* p. 481. Copyright 2007 by the Health Physics Society.

complex process). In these cases, expertise was needed primarily to identify the appropriate simple model and the best inputs for it. Fortunately (in this respect), the Cold War produced many studies of how radioactive materials disperse in the air, penetrate buildings and bodies, and wreak damage. These studies informed the simple calculations underlying Figure 1.

Some decisions require more complex analyses. For example, Dombroski, Fischhoff, and Fischbeck (2006) integrated models of particle dispersion, injury and radiation health effects, population location, and traffic patterns in order to predict the effects of a dirty bomb. Their casualty estimates were sensitive to some factors (e.g., the source term, detonation altitude) and insensitive to others. In particular, it did not matter that much what percentage of individuals near the explosion evacuated or sheltered in place as long as enough of them stayed off the road to allow emergency vehicles to rescue blast victims. Using a similar analytic approach, Casman, Fischhoff, Palmgren, Small, and Wu (2000) found that many systems for warning people about water contamination were useless without more rapid detection capabilities than they had for some contaminants (e.g., cryptosporidium). As a result, their warnings could contain no useful information. Useless communication systems not only waste the resources invested in them but leave the problem unaddressed.

Making Needed Information Useful

Once the critical information has been identified, it must be conveyed. Good practice here, too, begins with an inside view and involves asking what people currently believe so as to identify knowledge gaps that need closing and misconceptions that need fixing. It is easy enough to speculate about what needs to be said in the following three examples, before, during, and after a nuclear attack.

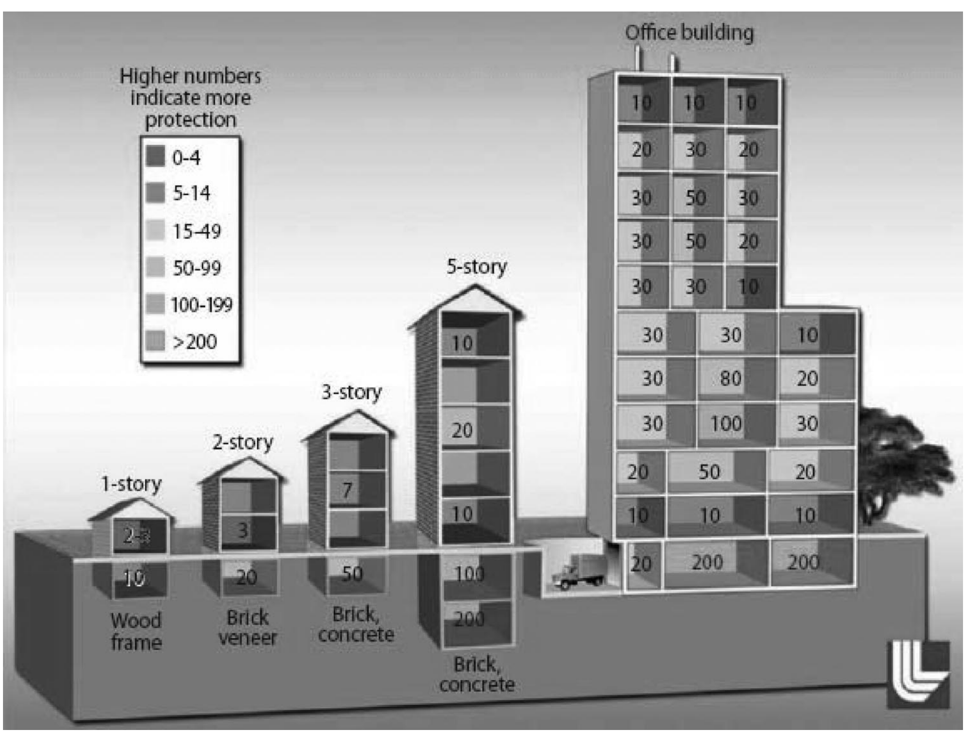
Before. DHS's Emergency Supply List contains everyday items needed to keep people going while they wait for things to improve. It should be immediately clear why most items are recommended. As with other checklists (Gawande, 2007), people might be grateful to be reminded of things that had slipped their minds (e.g., pet food, cash, a whistle, prescriptions). The recommended amount of water (one gallon per person per day) might come as a surprise, influencing their behavior if it made sense, being brushed off if not. Other items might irritate or even anger those who find them impossible (e.g., "I don't have a spare $500, even if I know that ATMs might be down after a nuclear attack." "Mice would get to the pet food in my shelter; thieves would get to the hidden cash; my meds need refrigeration.") Readers' intuitive probability of ever using a shelter and its contents might be higher or lower than DHS's implicit probability, depending on their imagination, powers of denial, and trust in government, among other things.

During. Some parts of the rationale for Table 2's recommendations about what to do after a nuclear explosion should be easy to explain: "Winds carry dangerous radioactive fallout. The further you are from the blast, the more time you have to improve your position (find shelter, collect loved ones, gather supplies, flee the area)." Other parts, though, might be less intuitive, such as what factors determine risk levels. Here, some elementary health physics might fill the gaps ("Radioactive particles are most dangerous when they get on your body or in your lungs.") in ways that allow people to make their own inferences ("I had better get inside, close the windows, and wash off"). Pursuing this strategy, with some of the same facts, clarified the value of radon testing ("If your house has a radon problem, it can be fixed by stopping gas intrusions from the subsoil under it. Radon's byproducts decay quickly. As a result, once the intrusions stop, so does the problem, leaving no lasting contamination.") (Bostrom, Fischhoff, & Morgan, 1992; Environmental Protection Agency, 1986).

After. The same physical principles explain the recommendations following from Figure 1, "A shelter can keep some, but not all, radioactive particles from getting on your skin and into your lungs. At some point, the radiation outside will settle and decay enough for the short, intense exposure during evacuation to be less risky than staying where you are. We'll tell you when that time comes, based on what we know about where the radiation went." Officials could add, "We're starting the evacuations with the least protective homes, based on real estate records." People without working radios or phones would have to guess when to leave their shelter. The information in Figure 2 might help them to assess and even improve their situation ("Only basements and internal rooms provide any real protection. Concrete is good.")

Kinds of communication. Atlhough focused on a nuclear attack, these three examples show the kinds of information typical to risk communications. There are *quantitative estimates*, showing the sizes of risks and the effectiveness of solutions (how much damage radiation can do, how much protection shelters provide). There are *scientific principles*, partly explaining the estimates (how radioactive particles travel, how they cause damage, how buildings protect). There are *epistemological concerns*, determining the strength of the analyses (how well a source term is known, how predictable evacuations are). There are

Figure 2
Protection Provided by Shelters, as a Function of Structure, Materials, and Location



Note. Reprinted from *Key Response Planning Factors for the Aftermath of Nuclear Terrorism* (p. 9) by B. R. Buddemeier and M. B. Dillon, 2009, Livermore, CA: Lawrence Livermore National Laboratory. Copyright 2009 by Lawrence Livermore National Laboratory.

also *neglected factors* (e.g., nonradiation reasons for leaving a shelter), *indirect effects* ("Evacuating people with the least protective housing first also means giving highest priority to the poorest people in our community."), and *background information* ("We have specially trained emergency teams in all nursing homes, so your loved ones will get good care, even if you can't reach them.") Which kinds of information need to be communicated depends on what people know already, an empirical question whose answer requires studying the target audience.

Whatever their content, communications must adopt a rhetorical stance that is either *persuasive*, trying to induce some behavior (e.g., stock up, take shelter), or *nonpersuasive*, trying to facilitate informed decision making (e.g., about how best to use the time until fallout arrives). Persuasion is appropriate when people want clear instructions, so that they need not master the facts (e.g., when time is short). Nonpersuasive communication is appropriate when people want knowledge, autonomy, and feelings of self-efficacy. People may naturally suspect the content of persuasive communications, wondering which facts have been spun, or may object to the idea of someone manipulating them "for their own good" (Fischhoff, 2007; Thaler & Sunstein, 2009). They may, conversely, resent nonpersuasive communications that leave them responsible for choices that they do not fully understand or don't want to think about. Here, too, getting the communications right requires studying recipients' desires and needs.

Testing for Success

Because they reflect basic psychological research and some dedicated studies (e.g., Bostrom et al., 1992), these speculations about the three nuclear explosion communications might be better than ones made without that knowledge. However, they are still speculations. Other speculations led the National Academies (2004) to feature basic information on physical processes when communicating on these topics. Its messages assumed that people will understand specific facts better if they first learn general ones, such as "When radioactive elements decay, they produce energetic emissions (alpha particles, beta particles or gamma rays) that can cause chemical changes in tissues. The average person in the United States receives a 'background' dose of about one-third of a rem." (A footnote gives the equivalence 1 Sievert = 100 rem.) Such physics facts might lead people to complete widely useful mental models or discourage them from reading further. How well any communication succeeds is an empirical question to be answered by evaluation studies.

Although empirical evaluation is straightforward (Fischhoff, 2009), there is surprisingly little research on the success of terror risk communications in conveying information essential to specific decisions (as opposed to conveying general information that it might be nice to know). Remarkably, the United States has no national tracking survey following the public's beliefs about the nature of terror risks, the effectiveness of response measures, the perceived degree of social support, the trustworthiness of various officials, and so on. In effect, the country has chosen to fly blind on these vital issues. Three examples from isolated studies may suggest what systematic research would reveal.

Table 3 shows responses of a representative sample of Americans surveyed late in 2002, a year after the 9/11 and anthrax attacks, amidst the smallpox vaccination campaign, the run-up to the Iraq War, and the outbreak of West Nile virus. Despite saturation media coverage and intense government efforts, several easily understood, essential facts had not been conveyed. Respondents had not learned that anthrax is not contagious, that West Nile is rarely fatal to people, that smallpox vaccine can be given after exposure, or that sheltering in place can be the best response to a dirty bomb. Respondents believed people will panic in such an attack, despite also believing that "ordinary citizens [had] behaved responsibly during the 2001 attacks." The unfounded expectation of panic is common among officials as well (Glass & Schoch-Spana, 2002; Tierney, 2003; Wessely, 2005).

Figure 3 shows judgments of another widely publicized risk (albeit one unlikely to be used by terrorists): the probability of the avian flu virus (H5N1) becoming transmissible among humans in the three years following the survey (conducted in October 2005). The experts were leading public health figures; the "experts" were leaders in other fields, mostly communication technologies that might help keep society running during a pandemic. The medical experts were divided. Most saw a low probability (around 10%), whereas a minority saw a high one (around 70%). The nonmedical "experts" mostly saw high probabilities, based on the torrent of media coverage at the time, which included lots of information but no numeric probabilities. Over the ensuing three years, the virus neither went away nor progressed far toward pandemic status. As a result, the medical experts' generally low probabilities seem fairly reasonable. However, the much higher probabilities that the nonmedical "experts" perceived make it seem as though the medical community had been alarmist. Thus, the public was told a lot, but not what it needed to know: the probability of a pandemic.

With unique threats, such as an avian flu pandemic or weapons of mass destruction, risks must be estimated analytically. Unless experts share their estimates, nonexperts must infer them from whatever the experts do reveal (Brandon, 2011, this issue; Kaptan & Fischhoff, 2010; Tetlock & Mellers, 2011, this issue). With repeated events, individuals can produce their own estimates, based on the frequency of observed events (Hasher & Zacks, 1984; Tversky & Kahneman, 1973). In some periods, terrorist attacks are frequent enough to allow such judgments. Figure 4 shows judgments made at the website of a major travel magazine for "the probability of being injured in a terrorist attack" during visits to three destinations (of eight in the study). At the time (late 2002), the Bali bombings had just occurred and the second Intifada was at what proved to be its peak. For Israel, the median estimate was roughly 10 times the rate for the preceding two years but still within the range of defensible values. For the other destinations, respondents' probability judgments also had plausible values, in addition to being sensibly correlated with other

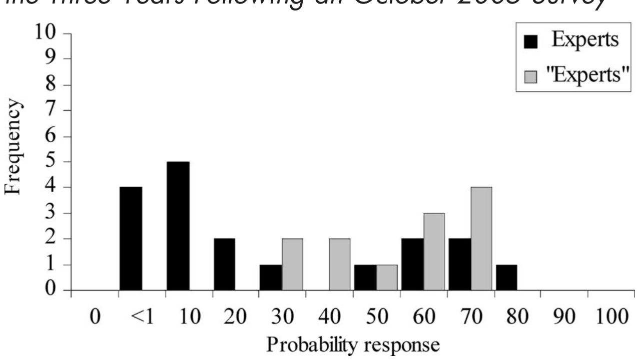
Table 3
Beliefs About Terrorism Risks

Belief statement	*M*	*SD*	Response distribution: Strongly opposed (%)	Slightly opposed (%)	Slightly support (%)	Strongly support (%)
Anthrax is easily spread from one person to another.	2.38	1.09	27.8	25.4	27.5	19.3
West Nile Virus is rarely fatal to people who get it.	2.46	0.99	19.3	33.4	29.9	17.4
Smallpox vaccine works, even if you get it after you've been exposed, as long as it is before you get sick.	2.46	0.81	12.1	37.6	42.2	8.1
If a dirty bomb went off, spreading radioactive material, you need to get away as fast as humanly possible.	3.50	.75	2.8	7.1	27.6	62.5
People will panic, rather than behave responsibly, if there is a "dirty bomb" spreading radioactive materials in their city.	3.13	0.83	4.1	16.7	41.1	38.1
Ordinary citizens behaved responsibly during the 2001 attacks.	3.49	0.69	2.1	5.0	34.8	58.1
If smallpox breaks out somewhere, we should quarantine the area.	3.34	0.74	1.4	11.7	38.0	48.9

Note. Scale anchored at 1 = strongly disagree; 4 = strongly agree. Respondents are a nationally representative U.S. sample.
Reprinted from "Evaluating the Success of Terror Risk Communications" by B. Fischhoff, R. M. Gonzalez, D. A. Small, and J. S. Lerner, 2003, *Biosecurity and Bioterrorism: Biodefense Strategy, Practice, and Science, 1*, p. 2. Copyright 2003 by Mary Ann Liebert, Inc., Publishers.

responses, such as their reported concern about terror risk factors (e.g., sticking out as an American) and nonterror travel risks (e.g., contracting an infectious disease), their travel risk thresholds (before cancelling a trip), and their general risk attitudes. Thus, despite receiving no organized communication about these terror risks, these travelers made seemingly reasonable risk judgments, consistent with their other beliefs, preferences, and feelings (Fischhoff, Bruine de Bruin, Perrin, & Downs, 2004).

Figure 3
Judgments of the Probability of the Avian Flu Virus (H5N1) Becoming Transmissible Among Humans in the Three Years Following an October 2005 Survey



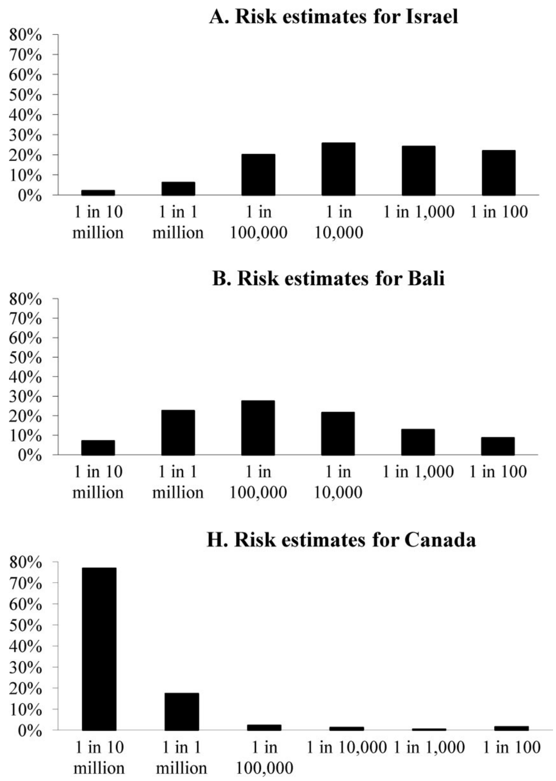
Note. The figure shows judgments by medical experts (dark bars) and nonmedical "experts" (gray bars) of "the probability that H5N1 will become an efficient human-to-human transmitter (capable of being propagated through at least two epidemiological generations of humans) sometime during the next 3 years." Median judgments: medical experts, 15%; nonmedical "experts," 60%. Reprinted from "Expert Judgments of Pandemic Influenza Risks" by W. Bruine de Bruin, B. Fischhoff, L. Brilliant, and D. Caruso, 2006, *Global Public Health, 1*, p. 184. Copyright 2006 by Taylor & Francis Group.

From Speculation to Investigation

Online surveys with self-selected samples (as in the travel risk study) are an imperfect form of evidence however involved respondents might be. So are surveys of experts invited to a meeting, even though systematically elicited expert judgments provide critical inputs to many risk assessments (Fischhoff, Atran, & Fischhoff, 2007; Fischhoff, Bruine de Bruin, Güvenc, Caruso, & Brilliant, 2006; Fischhoff & Chauvin, 2011; Morgan & Henrion, 1990; Morgan & Keith, 1995; O'Hagan et al., 2006). However, without sustained data collection, all we have is fragmentary evidence regarding judgments of terror risks and responses to communications. The judgments reported in Table 2 are from one of the few studies to revisit the same sample (see also Shambaugh et al., 2010). Comparisons found steep declines in judged terror risks from late 2001 to late 2002, appropriately correlated with individual respondents' experiences and observations (Fischhoff, Gonzalez, Lerner, & Small, 2005; Lerner, Small, & Fischhoff, 2003). The comparisons also revealed strong hindsight bias, such that respondents could not remember how great the risks had appeared a year earlier.

Without evidence, communicators must rely on intuition to select and convey the content of their communications. Figure 5 shows a representative result of such reliance. It shows two screen shots from www.ready.gov,

Figure 4
Judgments of the "Probability of Being Injured by Terrorism While Traveling" to Each of Three Destinations



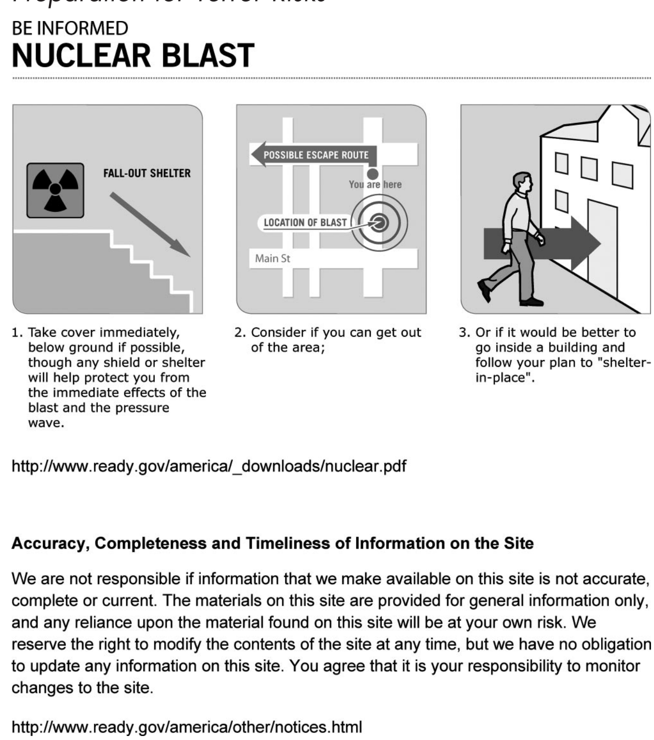
Note. Three panels reprinted from Figure 1 in "Travel Risks in a Time of Terror: Judgments and Choices" by B. Fischhoff, W. Bruine de Bruin, W. Perrin, and J. Downs, 2004, *Risk Analysis, 24,* p. 1032. Copyright 2004 by Society for Risk Analysis.

maintained by the U.S. Department of Homeland Security. The top portion of the figure has guidance on responding to a nuclear explosion, with each panel having seemingly obvious flaws. Panel 1assumes the existence of fall-out shelters and signs, despite their being neglected since the end of the Cold War. Panel 2 implies that people can outrun a blast. Panel 3 uses wording ("consider," "would it be better") that shifts decision-making responsibility to laypeople likely to want authoritative guidance. The bottom portion of the figure (from another screen) throws the top one (and everything else at the site) into question. It is not hard to imagine the bureaucratic processes that led to this disclaimer—and their indifference to users' concerns. Despite these flaws, these communications might, conceivably, still have conveyed useful information and built trust in the competence and caring of the officials who created them. Without empirical evaluation, there is no way of knowing.

Psychological research suggests several natural human tendencies that might explain why officials might rely on intuition, rather than research, even when research is inexpensive relative to the stakes riding on successful communication. One such tendency is exaggerating how well one communicates, thus making evaluation unnecessary. A second is unwittingly lacking empathy for others' circumstances and information needs (e.g., Epley, Keysar, Van-Boven, & Gilovich, 2004; Keysar, Lin, & Barr, 2003; Nickerson, 1999). A third is misreading historical events, not realizing, say, that the communication strategies (and communicators) that seemed so effective right after 9/11 also produced the miscommunications around the anthrax attacks and the World Trade Center clean-up (Thomas, 2003). A fourth is underestimating the public's ability to learn and make decisions, a tendency seen in the myth of panic and popular accounts of human frailty. Why try too hard if it seems that the public cannot handle or even understand the truth?

In order to overcome these natural barriers to effective communication, organizations need staff that can reveal and address their blindspots (see Table 1). They need psychologists who can study their audience's needs, design potentially effective communications, and evaluate their usefulness. They need subject-matter experts who can ensure the accuracy of their messages. They need risk and decision analysts who can identify the few most critical facts from the "firehoses" that

Figure 5
Two Communications From www.ready.gov, the Official U.S. Government Site for National Preparation for Terror Risks



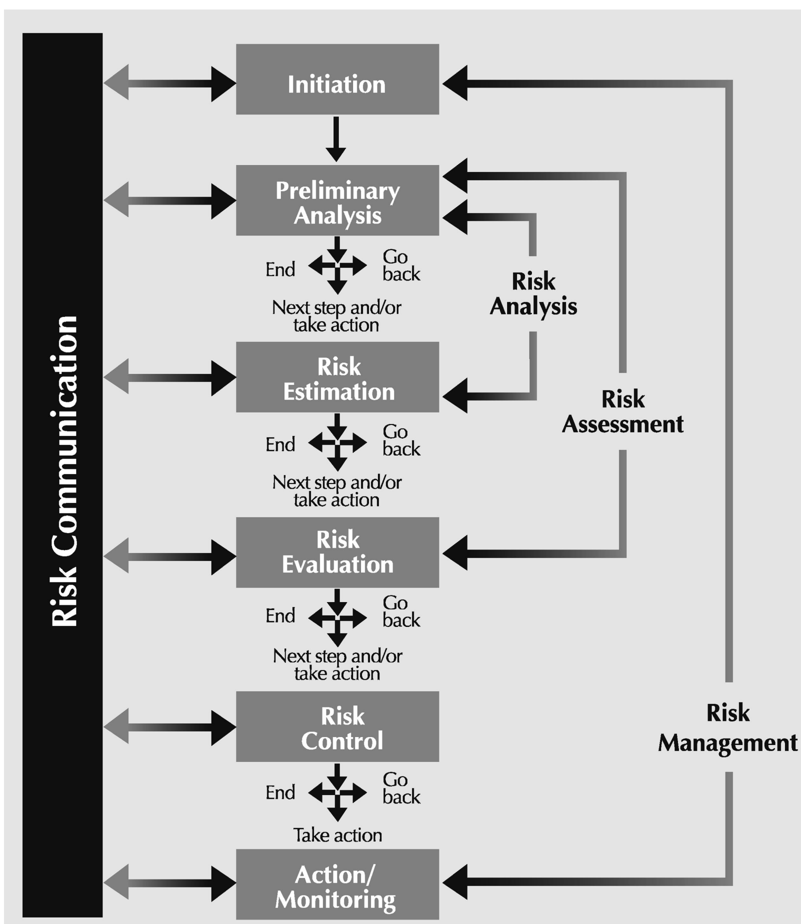
Note. Accessed January 28, 2011.

subject matter experts can open on them. They need communication specialists who can create the channels for staying in touch with their publics (National Research Council, 1989, 1996, 2008). They need leaders who can coordinate these diverse professionals, keeping them focused on their own areas of expertise. Those leaders must, for example, keep psychologists from distorting the facts of radiation physics when hoping to simplify them and keep physicists from drowning their audience in irrelevant facts when hoping to seize a teachable moment.

That leadership must also decide when to treat communication as a *public health* activity, designed to help its audiences, and when to treat it as a *public affairs* activity, designed to advance their own interests. Over time, organizations may need both kinds of communication, ones serving the public and themselves. At any one time, though, the two strategies are incompatible. Public health communications must address problems that politicians might prefer to hide. Public affairs communications naturally add spin, advancing favored facts and frames.

Psychology can support either strategy. Its research has long been a pillar of marketing and public relations. Recently, public health agencies have increasingly seen its value. The Centers for Disease Control and Prevention (2002) has incorporated psychologists and other social scientists in its emergency command post. The Canadian Standards Association's (1997/2002) risk management framework affords communication a central role, requiring psychological expertise to conduct surveys, design consultations, and evaluate performance (see Figure 6). The U.S. Food and Drug Administration (2009) has adopted a Strategic Plan for Risk Communication, with an agency-wide

Figure 6
Canadian Standards Association (1997/2002) Recommended Procedure for Managing Risks



Note. The middle of the figure shows a fairly standard sequential process of a risk management project, distinguished mainly by the four-way arrows between stages, requiring a kind of reality check whereby a process may not be completed unless satisfactory. The dark bar on the left shows a distinctive commitment to public involvement at all stages of the process, from Initiation to Action/Monitoring, with two-way arrows indicating that the public should both be heard and receive necessary information. Reprinted from "The Science and Practice of Risk Ranking" by B. Fischhoff and G. Morgan, 2009, *Horizons, 10,* p. 46. Copyright 2009 by the Government of Canada.

action plan that includes regular consultation with its statutory Risk Communication Advisory Committee.

Psychologists have limited ability to open these doors by themselves. Typically, organizations must be hurting badly enough from perceived miscommunication to look for help. Whether they look to psychological science will partly depend on their current staffing. Without some psychologists on staff, they may not seek scientific help or know where to find it, perhaps turning instead to consultants who promise to do the impossible (e.g., make the public love an organization however competent its performance). What psychologists can do is be ready when opportunities do arise. That means familiarizing themselves with the issues and institutions in a domain and getting to know some of the people in it. It means treating openings as opportunities to serve, not as chances to promote pet theories or methods. It means relishing the challenges of collaborating with people from unfamiliar disciplines (physicists, physicians, politicians) and of representing unfamiliar areas of their own discipline when they are the only psychologists on the scene. The rewards for these ventures may include meeting some unusual people, identifying some new phenomena worthy of basic research, and repaying some of our collective debt to the society that has supported us.

REFERENCES

Bostrom, A., Fischhoff, B., & Morgan, M. G. (1992). Characterizing mental models of hazardous processes: A methodology and an application to radon. *Journal of Social Issues, 48*(4), 85–100. doi:10.1111/j.1540-4560.1992.tb01946.x

Bouri, N., Norwood, A., & Sell, T. K. (2010). *Preparing to save lives and recover from a nuclear detonation: Implications for U.S. policy.* Pittsburgh, PA: Center for Biosecurity, University of Pittsburgh Medical Center.

Brandon, S. (2011). What role have psychologists played in national policy/agenda-setting post-9/11? *American Psychologist, 66,* 495–506. doi:10.1037/a0024818

Breakwell, G. (2007). *The psychology of risk.* Cambridge, England: Cambridge University Press.

Bruine de Bruin, W., Fischhoff, B., Brilliant, L., & Caruso, D. (2006). Expert judgments of pandemic influenza risks. *Global Public Health, 1,* 178–193. doi:10.1080/17441690600673940

Buddemeier, B., & Dillon, M. B. (2009). *Key response planning factors for the aftermath of nuclear terrorism* (LLNL-TR-410067). Livermore, CA: Lawrence Livermore National Laboratory.

Canadian Standards Association. (1997; reaffirmed 2002). *Risk management: Guideline for decision-makers.* (CAN/CSA-Q850). Ottawa, Ontario, Canada: Author.

Casman, E. A., & Fischhoff, B. (2008). Risk communication planning for the aftermath of a plague bioattack. *Risk Analysis, 28,* 1327–1342. doi:10.1111/j.1539-6924.2008.01080.x

Casman, E. A., Fischhoff, B., Palmgren, C., Small, M. J., & Wu, F. (2000). An integrated risk model of a drinking-water–borne Cryptosporidiosis outbreak. *Risk Analysis, 20,* 495–511. doi:10.1111/0272-4332.204047

Centers for Disease Control and Prevention. (2002). *Crisis and emergency risk communication.* Atlanta, GA: Author.

Dombroski, M., Fischhoff, B., & Fischbeck, P. (2006). Predicting emergency evacuation and sheltering behavior: A structured analytical approach. *Risk Analysis, 26,* 1675–1688. doi:10.1111/j.1539-6924.2006.00833.x

Environmental Protection Agency. (1986). *A citizen's guide to radon* (OPA-86–004). Washington, DC: U.S. Government Printing Office.

Epley, N., Keysar, B., VanBoven, L., & Gilovich, T. (2004). Perspective taking as egocentric anchoring and adjustment. *Journal of Personality and Social Psychology, 87,* 327–339. doi:10.1037/0022-3514.87.3.327

Fischhoff, B. (2007). Non-persuasive communication about matters of greatest urgency: Climate change. *Environmental Science & Technology, 41,* 7204–7208. doi:10.1021/es0726411

Fischhoff, B. (2009). Risk perception and communication. In R. Detels, R. Beaglehole, M. A. Lansang, & M. Gulliford (Eds.), *Oxford textbook of public health* (5th ed., pp. 940–952). Oxford, England: Oxford University Press.

Fischhoff, B., Atran, S., & Fischhoff, N. (2007). Counting casualties: A framework for respectful, useful records. *Journal of Risk and Uncertainty, 34,* 1–19. doi:10.1007/s11166-006-9001-6

Fischhoff, B., Bruine de Bruin, W., Güvenc, Ü., Caruso, D., & Brilliant, L. (2006). Analyzing disaster risks and plans: An avian flu example. *Journal of Risk and Uncertainty, 33,* 131–149. doi:10.1007/s11166-006-0175-8

Fischhoff, B., Bruine de Bruin, W., Perrin, W., & Downs, J. S. (2004). Travel risks in a time of terror. *Risk Analysis, 24,* 1301–1309. doi:10.1111/j.0272-4332.2004.00527.x

Fischhoff, B., & Chauvin, C. (Eds.). (2011). *Intelligence analysis: Behavioral and social scientific foundations.* Washington, DC: National Academies Press.

Fischhoff, B., Gonzalez, R., Small, D., & Lerner, J. (2003). Evaluating the success of terror risk communication. *Biosecurity and Bioterrorism: Biodefense Strategy, Practice, and Science, 1*(4), 255–258. doi:10.1089/153871303771861450

Fischhoff, B., Gonzalez, R. M., Lerner, J. S., & Small, D. A. (2005). Evolving judgments of terror risks: Foresight, hindsight, and emotion. *Journal of Experimental Psychology: Applied, 11,* 124–139. doi:10.1037/1076-898X.11.2.124

Fischhoff, B., & Morgan, M. G. (2009). The science and practice of risk ranking. *Horizons, 10*(3), 40–47.

Florig, H. K., & Fischhoff, B. (2007). Individuals' decisions affecting radiation exposure after a nuclear event. *Health Physics, 92,* 475–483. doi:10.1097/01.HP.0000255660.33000.a6

Gawande, A. (2007). *Better: A surgeon's notes on performance.* New York, NY: Henry Holt Books.

Glass, T. A., & Schoch-Spana, M. (2002). Bioterrorism and the people: How to vaccinate a city against panic. *Clinical Infectious Diseases, 34,* 217–223. doi:10.1086/338711

Hasher, L., & Zacks, R. T. (1984). Automatic processing of fundamental information: The case of frequency occurrence. *American Psychologist, 39,* 1372–1388. doi:10.1037/0003-066X.39.12.1372

Homann, S. G. (2003). Hotspot health physics codes 2.05 [Computer software]. Retrieved from http://www.llnl.gov/nai/technologies/hotspot/

Huddy, L., & Feldman, S. (2011). Americans respond politically to 9/11: Diverse psychological reactions to threat. *American Psychologist, 66,* 455–467. doi:10.1037/a0024894

Kahneman, D., & Lovallo, D. (1993). Timid choices and bold forecasts. *Management Science, 39,* 17–31. doi:10.1287/mnsc.39.1.17

Kaptan, G., & Fischhoff, B. (2010). Sticky decisions: Peanut butter in a time of *salmonella. Emerging Infectious Diseases, 16,* 900–904. doi:10.3201/eid1605.090854

Keysar, B., Lin, S., & Barr, D. J. (2003). Limits on theory of mind use in adults. *Cognition, 89.* 25–41. doi:10.1016/S0010-0277(03)00064-7

Lerner, J. S., Small, D. A., & Fischhoff, B. (2003). Effects of fear and anger on perceived risks of terrorism: A national field experiment. *Psychological Science, 14,* 144–150. doi:10.1111/1467-9280.01433

Löfstedt, R., & Boholm, Å. (Eds.). (2008). *Risk reader.* London, England: Earthscan.

Morgan, M. G., Fischhoff, B., Bostrom, A., & Atman, C. (2002). *Risk communication: A mental models approach.* New York, NY: Cambridge University Press.

Morgan, M. G., & Henrion, M. (1990). *Uncertainty: A guide to dealing with uncertainty in quantitative risk and policy analysis.* New York, NY: Cambridge University Press.

Morgan, M. G., & Keith, D. (1995). Subjective judgments by climate experts. *Environmental Science & Technology, 29,* 468–476. doi:10.1021/es00010a003

National Academies. (2004). *Radiological attack: Dirty bombs and other devices.* Washington, DC: National Academy of Sciences.

National Research Council. (1989). *Improving risk communication.* Washington, DC: National Academy Press.

National Research Council. (1996). *Understanding risk: Informing deci-*

sions in a democratic society. Washington, DC: National Academy Press.
National Research Council. (2008). *Public participation in environmental assessment and decision making.* Washington, DC: National Academies Press.
Nickerson, R. A. (1999). How we know—and sometimes misjudge—what others know: Imputing our own knowledge to others. *Psychological Bulletin, 125,* 737–759. doi:10.1037/0033-2909.125.6.737
O'Hagan, A., Buck, C. E., Daneshkhah, A., Eiser, J. R., Garthwaite, P. H., Jenkinson, D. J., . . . Rakow, T. (2006). *Uncertain judgements: Eliciting expert probabilities.* Chichester, England: Wiley. doi:10.1002/0470033312
Renn, O. (2008). *Risk governance.* London, England: Earthscan. doi:10.1007/978-1-4020-6799-0
Robinson, L. A. (2007). How U.S. government agencies value mortality risk reductions. *Review of Environmental Economics and Policy, 1,* 283–299. doi:10.1093/reep/rem018
Shambaugh, G., Matthew, R., Silver, R. C., McDonald, B., Poulin, M., & Blum, S. (2010). Public perceptions of traumatic events and policy preferences during the George W. Bush administration: A portrait of America in turbulent times. *Studies in Conflict & Terrorism, 33,* 55–91. doi:10.1080/10576100903488410
Slovic, P. (Ed.). (2001). *The psychology of risk.* London, England: Earthscan.
Slovic, P. (Ed.). (2010). *The feeling of risk.* London, England: Earthscan.
Tetlock, P. E., & Mellers, B. (2011). Intelligent management of intelligence agencies: Beyond accountability ping-pong. *American Psychologist, 66,* 542–554. doi:10.1037/a0024285
Thaler, R., & Sunstein, C. (2009). *Nudge: Improving decisions about health, wealth and happiness.* New Haven, CT: Yale University Press.
Thomas, P. (2003). *The anthrax attacks.* New York, NY: Century Foundation.
Tierney, K. J. (2003). Disaster beliefs and institutional interests: Recycling disaster myths in the aftermath of 9–11. In L. Clarke (Ed.), *Research in social problems and public policy: Vol. 11. Terrorism and disaster: New threats, new ideas* (pp. 33–51). New York, NY: Elsevier Science.
Tversky, A., & Kahneman, D. (1973). Availability: A heuristic for judging frequency and probability. *Cognitive Psychology, 5,* 207–232. doi:10.1016/0010-0285(73)90033-9
U.S. Department of Homeland Security. (n.d.). Emergency Supply List. Retrieved from http://www.ready.gov/america/_downloads/checklist.pdf
U.S. Department of Homeland Security, Science and Technology Advisory Committee. (2005). [Transcript of the open session of the November 8, 2005 meeting of the Homeland Security Science and Technology Advisory Committee]. Retrieved March 3, 2006 from http://www.dhs.gov/dhspublic/interapp/editorial/editorial_0427.xml and www.dhs.gov/dhspublic/interweb/assetlibrary/Minutes_Nov_8_05.pdf
U.S. Food and Drug Administration. (2009). *FDA's strategic plan for risk communication.* Retrieved from http://www.fda.gov/AboutFDA/ReportsManualsForms/ucm183673.htm
Wessely, S. (2005). Don't panic! Short and long-term psychological reactions to the new terrorism. *Journal of Mental Health, 14,* 1–6. doi:10.1080/09638230500048099