2

Thinking About Risks

> The American people have no doubt that more people die from coal dust than from nuclear reactions, but they fear the prospect of a nuclear reactor more than they do the empirical data that would suggest that more people die from coal dust, having coal-fired burners. They also know that more lives would be saved if we took that 25 percent we spend in the intensive care units in the last few months of the elderly's lives, that more children would be saved. But part of our culture is that we have concluded as a culture that we are going to rightly or wrongly, we are going to spend the money, costing more lives, on the elderly.... I think it's incredibly presumptuous and elitist for political scientists to conclude that the American people's cultural values in fact are not ones that lend themselves to a cost–benefit analysis and presume that they would change their cultural values if in fact they were aware of the cost–benefit analysis.[1]

> The nation is quickly buying up stocks of gas masks, shelves are being stripped of antibiotics, and bottled water may not be far behind. Many travelers have canceled trips by air and taken trains or cars instead, even across the country. New Yorkers fearful of an attack on the subways insist on riding in cars on traffic-choked streets. Doctors in Boston report that patients with minor ailments like colds and sore throats have been calling out of fear that they may have been sickened by a toxic chemical or lethal germ introduced by terrorists. Meanwhile, business at McDonald's and Haagen-Dazs is thriving. What does this say about how people respond to threats to their health and lives?[2]

1 Joseph Biden, Confirmation Hearings for Stephen G. Breyer, to be an Associate Justice of the United States Supreme Court, Senate Committee on the Judiciary, 103d Cong., 2d Sess. 42 (July 14, 1994) (Miller Reporting transcript).

2 Jane E. Brody, Don't Loss Sight of Real, Everyday Risks, New York Times, Oct. 9, 2001, at F6.

In this chapter I bring an understanding of ordinary thinking about risk in contact with the law of risk regulation. My central goal is to show how ordinary thinking goes wrong, and how the errors are especially important, and pernicious, in the design of public policy. I show that people's intuitions about risks are highly unreliable. Some of those intuitions do serve us well in ordinary life.[3] But even so, they lead to ineffective and even counterproductive law and policy. In the process of discussing this point, I offer a new argument for cost–benefit analysis. I suggest that cost–benefit analysis is best defended as a means of overcoming predictable problems in individual and social cognition. Cost–benefit analysis should be understood as a method for putting "on screen" important social facts that might otherwise escape private and public attention.

It would be fully possible to accept the cognitive points and to agree that people are likely to err in thinking about risks, while also rejecting cost–benefit analysis as a tool for policymakers. Certainly I do not mean to embrace the controversial and implausible proposition that all regulatory decisions should be made by aggregating private willingness to pay, as if economic efficiency is or should be the goal of all regulation. I will eventually attempt to produce an *incompletely theorized agreement* on a certain understanding of cost–benefit analysis – an agreement on a form of cost–benefit analysis to which many different people, with diverse and competing views, should be willing to subscribe. I will offer many more details in Chapter 5. For present purposes, the important point is that people tend to make many mistakes in thinking about risks. It would be extremely valuable to find correctives, perhaps above all by getting a better sense of the consequences of both risks and risk reduction.

A TALE OF TWO TABLES

Let us begin with two simple tables, Tables 2.1 and 2.2. It is well known that there is a great deal of variability in national expenditures per life saved. Consider Table 2.1, which has come to define many discussions of these problems.[4]

The particular numbers in this table should be taken with many grains of salt.[5] The table does not contain nearly all the benefits from regulation,

3 The point is emphasized in Gerd Gigenzerer et al., Simple Heuristics That Make Us Smart (Oxford: Oxford Univ. Press, 1999), and noted in much work involving heuristics and biases. There is a continuing debate over the extent to which heuristics, of the sort emphasized in this chapter, work well in ordinary life. I am not intending to take a stand on that debate here. My only claim is that the heuristics and biases that I discuss are an inadequate basis for public policy, and that a sensible government can do better.

4 Based on data from Office of Management and Budget, Budget of the United States Government Fiscal Year 1992 Pt 2, 370 table C-2 (Washington, D. C.: GPO, 1991).

5 See Lisa Heinzerling, Regulatory Costs of Mythic Proportions, 107 Yale L. J. 1981 (1998).

Table 2.1 Cost per life saved of selected regulations

Regulation	Agency	Cost Per Premature Death Averted ($ millions 1990)
Unvented space heater ban	CPSC	0.1
Aircraft cabin fire protection standard	FAA	0.1
Auto passive restraint/seat belt standards	NHTSA	0.1
Steering column protection standard	NHTSA	0.1
Underground construction standards	OSHA-S	0.1
Trihalomethane drinking water standards	EPA	0.2
Aircraft seat cushion flammability standard	FAA	0.4
Alcohol and drug control standards	FRA	0.5
Auto fuel-system integrity standard	NHTSA	0.5
Standards for servicing auto wheel rims	OSHA-S	0.5
Aircraft floor emergency lighting standard	FAA	0.6
Concrete & masonry construction standards	OSHA-S	0.6
Side-impact standards for autos (dynamic)	NHTSA	0.8
Children's sleepwear flammability ban	CPSC	0.8
Auto side door support standards	NHTSA	0.8
Low-altitude windshear equipment & training standards	FAA	1.3
Electrical equipment standards (metal mines)	MSHA	1.4
Trenching and excavation standards	OSHA-S	1.5
Traffic alert and collision avoidance (TCAS) systems	FAA	1.5
Hazard communication standard	OSHA-S	1.6
Arsenic/copper smelter	EPA	2.7
Grain dust explosion prevention standards	OSHA-S	2.8
Rear lap/shoulder belts for autos	NHTSA	3.2
Benzine NESHAP (original: fugitive emissions)	EPA	3.4
Ethylene dibromide drinking water standard	EPA	5.7
Benzene NESHAP (National Emission Standard for Hazardous Pollutants) (revised: coke byproducts)	EPA	6.1
Asbestos occupational exposure limit	OSHA-H	8.3
Benzene occupational exposure limit	OSHA-H	8.9
Electrical equipment standards (coal mines)	MSHA	9.2
Arsenic emission standards for glass plants	EPA	13.5
Ethylene oxide occupational exposure limit	OSHA-H	20.5
Arsenic/copper NESHAP	EPA	23.0
Hazardous waste listing for petroleum refining sludge	EPA	27.6
Cover/move uranium mill tailings (inactive sites)	EPA	31.7
Benzene NESHAP (revised: transfer operations)	EPA	32.9
Cover/move uranium mill tailings (active sites)	EPA	45.0
Acrylonitrile occupational exposure limit	OSHA-H	51.5
Coke ovens occupational exposure limit	OSHA-H	63.5
Lockout/tagout	OSHA-S	70.9
Asbestos occupational exposure limit	OSHA-H	74.0
Arsenic occupational exposure limit	OSHA-H	106.9
Diethylstilbestrol (DES) cattlefeed ban	FDA	124.8
1,2-Dichloropropane drinking water standard	EPA	653.0
Hazardous waste land disposal ban (1st 3rd)	EPA	4,190.4
Atrazine/alachlor drinking water standard	EPA	92,069.7

including those that fall short of mortalities averted (including illnesses averted, benefits for animals, and aesthetic and recreational gains). An adequate cost–benefit analysis would certainly take those benefits into account. There is good reason to focus on "life years saved" rather than "lives saved"; other things being equal, a regulation that protects small children is far more attractive than a regulation that saves elderly people who will die shortly in any event. We will also see that the table depends on many contentious assumptions, above all involving the appropriate discount rate, meaning the treatment of future benefits; modest changes in the discount rate can greatly reduce the expenditures and the disparities.

But at the very least, Table 2.1 creates a presumption that the current system of regulation suffers from serious misallocation of resources. It also suggests that with better allocations, we could obtain large gains. Recall the finding that it would be possible to save the same number of lives that we now save with tens of billions of dollars left over – and that better priority-setting could save 60,000 lives, and 636,000 life-years, annually at the same price.[6] Here too the particular numbers are too crude to be taken seriously, but the general point – that resources are being badly misallocated – is unquestionably correct.

What is the source of the misallocations? Interest-group power undoubtedly plays a substantial role: Well-organized groups are able to obtain measures in their interest or to fend off measures that would harm them, but poorly organized ones typically fail. Indeed, cost–benefit analysis might be defended partly as a corrective to interest-group power, operating as it might as a kind

[6] See Tammy O. Tengs & John D. Graham, The Opportunity Costs of Haphazard Social Investments in Life-Saving, in Risks, Costs, and Lives Saved: Getting Better Results from Regulation 167, 172–4, Robert W. Hahn, ed. (New York: Oxford Univ. Press, 1996).

Table 2.2 Rating health risks

Public	EPA Experts
1. Hazardous waste sites	Medium-to-low
2. Exposure to worksite chemicals	High
3. Industrial pollution of waterways	Low
4. Nuclear accident radiation	Not ranked
5. Radioactive waste	Not ranked
6. Chemical leaks from underground storage tanks	Medium-to-low
7. Pesticides	High
8. Pollution from industrial accidents	Medium-to-low
9. Water pollution from farm runoff	Medium
10. Tap water contamination	High
11. Industrial air pollution	High
12. Ozone layer destruction	High
13. Coastal water contamination	Low
14. Sewage-plant water pollution	Medium-to-low
15. Vehicle exhaust	High
16. Oil spills	Medium-to-low
17. Acid rain	High
18. Water pollution from urban runoff	Medium
19. Damaged wetlands	Low
20. Genetic alteration	Low
21. Nonhazardous waste sites	Medium-to-low
22. Greenhouse effect	Low
23. Indoor air pollution	High
24. X-ray radiation	Not ranked
25. Indoor radon	High
26. Microwave oven radiation	Not ranked

Note: Medium-to-low means between medium and low.

of technocratic check on measures that would do little good or even produce net harm (and also on measures that do much less good than they should).[7] But officials are, of course, responsive not only to interest groups but also to general public pressures, and thus part of the answer must lie in the distinctive judgments of ordinary people, who do not assess risks through a well-informed cost–benefit lens. Indeed, divergences between expert and lay assessments of risks have been demonstrated in many places. Consider the comparison in Table 2.2.[8]

[7] Of course it is possible that the content of the cost–benefit test will reflect interest-group power.

[8] Reprinted by permission from Stephen G. Breyer, Breaking the Vicious Circle: Toward Effective Risk Regulation 21 (Cambridge, Mass.: Harvard Univ. Press, 1993).

The EPA itself has found that EPA policies are responsive not to expert judgments but to lay assessments of risks.[9] EPA policies track ordinary judgments extremely well.

If we put Tables 2.1 and 2.2 together, we can suggest a general hypothesis. The government currently allocates its limited resources poorly, and it does so partly because it is responsive to ordinary judgments about the magnitude of risks. A government that could insulate itself from misinformed judgments could save thousands of lives and billions of dollars annually. Let us attempt to be more specific about the cognitive problems that help account for current problems.

PROBLEMS AND INTUITIONS

It is obvious that people, including government officials, often lack risk-related information. They might not know much about the nature and magnitude of the risks at issue, and they might know little about the various consequences of risk reduction. The public demand for regulation is often based on misunderstandings of facts. But why, exactly, might people's judgments about risk and risk regulation go badly wrong?

THE AVAILABILITY HEURISTIC

The first problem is purely cognitive: the use of the *availability heuristic* in thinking about risks. It is well established that people tend to think that events are more probable if they can recall an incident of their occurrence.[10] Consider the fact that people typically think that more words, on any given page, will end with the letters "ing," than have "n" as the second-to-last letter (though a moment's reflection shows that this is not possible).[11] With respect to risks, judgments are typically affected by the availability heuristic. For example, whether people will buy insurance for natural disasters is greatly affected by recent experiences. If floods have not occurred in the immediate past, people who live on flood plains are far less likely to purchase insurance. In the aftermath of an earthquake, insurance for earthquakes rises sharply – but it declines steadily from that point, as vivid memories recede.

[9] See id.

[10] See Amos Tversky & Daniel Kahneman, Judgment Under Uncertainty: Heuristics and Biases, in Judgment Under Uncertainty: Heuristics and Biases 3, 11, Daniel Kahneman, Paul Slovic & Amos Tversky, eds. (Cambridge: Cambridge Univ. Press, 1982) (describing the availability heuristic).

[11] Amos Tversky & Daniel Kahneman, Extensional Versus Intuitive Reasoning: The Conjunction Fallacy in Probability Judgment, 90 Psychol. Rev. 293, 295 (1983).

Do people know which risks led to many deaths, and which risks lead to few? They do not. In fact they make huge blunders. In one study, people were told the annual number of deaths from motor vehicle accidents in the United States (at the time about 50,000) and then were asked to estimate the number of deaths from forty other causes of death.[12] In another study, people were given two causes of death and asked to say which produced more fatalities. People tended to make large mistakes, and when they did so, the availability heuristic was partly responsible. "In keeping with availability considerations, overestimated items were dramatic and sensational whereas underestimated items tended to be unspectacular events which claim one victim at a time and are common in non-fatal form."[13] Specifically, people significantly overestimated highly publicized causes of death, including tornadoes, cancer, botulism, and homicide. By contrast, they underestimated the number of deaths from stroke, asthma, emphysema, and diabetes. At the same time, people tend to think that the number of deaths from accidents is higher than the number of deaths from disease, whereas the opposite is true. In the same vein, people mistakenly believe that more people die from homicides than from suicides. Availability can also lull people into complacency, as when certain risks, not easily accessible, seem invisible, and what is out of sight is effectively out of mind.

These points suggest that highly publicized events are likely to lead people to be exceedingly fearful of statistically small risks. Much of the concern with nuclear power undoubtedly stems from its association with memorable events, including Hiroshima, Chernobyl, and Three Mile Island. As we shall see, emotions play a large role here; if people can visualize the "worse case," they are likely to be quite alarmed, and assessments of probabilities will be crowded out by fear. Public officials, no less than ordinary people, are prone to use the availability heuristic; in a democracy, officials, including lawmakers, will be highly reactive to public alarm.

If people are extremely concerned about the risk of airplane accidents, we should expect aggressive regulation of airlines, perhaps to the point of diminishing returns. If people are worried about abandoned hazardous waste dumps, we might well expect a large amount of resources to be devoted to cleaning them up, even if the risks are relatively small.[14] Similar problems will

[12] See Paul Slovic, The Perception of Risk pp. 106–7 (London: Earthscan, 2000).

[13] See id. p. 107.

[14] For evidence, see James Hamilton & W. Kip Viscusi, Calculating Risks: The Spatial and Political Dimensions of Hazardous Waste Policy (Cambridge, Mass.: MIT Press, 1999); Timur Kuran & Cass R. Sunstein, Availability Cascades and Risk Regulation, 51 Stan. L. Rev. 683 (1999).

appear in courts, with juries and judges taking "phantom risks" quite seriously.[15] There is also a lesson here about how to attract public attention to a risk: *Make a vivid example of its occurrence highly salient to the public.* This way of proceeding, far more than statistical analysis, is likely to activate public concern. Unfortunately, terrorists appear to understand this lesson very well.

To the extent that people lack information, or base their judgments on mental shortcuts that produce errors, a highly responsive government is likely to blunder. Cost–benefit analysis is a natural corrective, above all because it focuses attention on the actual effects of regulation, including, in some cases, the existence of surprisingly small benefits from regulatory controls. To this extent, cost–benefit analysis should not be taken as undemocratic but, on the contrary, should be seen as a means of fortifying democratic goals, by ensuring that government decisions are responsive to well-informed public judgments. Note that I have not suggested that a democratic government must refuse to act if the monetized costs exceed the monetized benefits. The only point is that an accounting of the costs and benefits, both qualitative and quantitative, can overcome public ignorance. If the public wants to proceed after it has received that accounting, nothing here suggests that it is prohibited from doing so.

INTUITIVE TOXICOLOGY

Are ordinary people toxicologists? Paul Slovic et al colleagues have uncovered the content of "intuitive toxicology" by comparing how experts (professional toxicologists) and ordinary people think about the risks associated with chemicals.[16] The result is a fascinating picture. It is not clear that any identifiable heuristics are at work in intuitive toxicology. But it is clear that people are using mental shortcuts, and that these lead to errors.

Consider the views of toxicologists and ordinary people on the following kinds of propositions:

(a) There is no safe level of exposure to a cancer-causing agent.
(b) If you are exposed to a carcinogen, then you are likely to get cancer.
(c) If a scientific study produces evidence that a chemical causes cancer in animals, then we can be reasonably sure that the chemical will cause cancer in humans.

[15] See Peter Huber et al., Phantom Risk: Scientific Influence of the Law, 425–8 (Cambridge, Mass.: MIT Press, 1999) (discussing scientifically unsupportable outcomes involving "traumatic cancer" and harm to immune systems); id. at 137–46 (discussing lawsuits with unclear scientific basis).

[16] See Slovic, supra note 12 in Chapter 2, pp. 285–98, from which I borrow throughout this section.

(d) The land, air, and water around us are, in general, more contaminated now than ever before.
(e) Natural chemicals, as a rule, are not as harmful as man-made chemicals.
(f) Residents of a small community (30,000 people) observed that several malformed children had been born there during each of the past few years. The town is in a region where agricultural pesticides have been in use during the last decade. It is very likely that these pesticides were the cause of the malformations.
(g) All use of prescription drugs must be risk-free.

Ordinary people agree with such statements, by pluralities or even majorities. In contrast, toxicologists disagree with such statements, usually by overwhelming majorities. What are ordinary people thinking? Can we discern some structure to their judgments? Three beliefs seem to be playing a large role. *First*, many people believe that risk is an "all or nothing" matter. Something is either safe or dangerous, and there is no middle ground. *Second*, many people are committed to a belief in the benevolence of nature. They think that the products of human beings, and human activities, are more likely to be dangerous than the products of natural processes. *Third*, many people subscribe to the "zero risk" mentality, at least in some domains. Such people believe that it is both possible and appropriate to abolish risk entirely, a belief that appears closely connected with the notion that risk is a matter of "all or nothing."

Experts believe that all three beliefs are false. Moreover, it seems clear that with respect to risks, experts are thinking far more sensibly than are ordinary people. Why do people think this way? It might well be that at least some of these ideas work well in most contexts in which nonspecialists find themselves. People want, for example, to know whether an activity is "safe," not to know about the statistical probability of harm; and the excessively simple category of "safe" can tell them essentially what they need to know. The problem is that ideas of this kind misfire in contexts in which regulatory choices, and some daily decisions, have to be made. Of course, ordinary people do not have the time to investigate the statistics, and nonspecialists may do well to rely on such principles. But policymakers should do a good deal better.

To be sure, experts do not entirely agree among themselves. Most interestingly, toxicologists employed by industry are far more optimistic about chemical risks than toxicologists employed by government or academic institutions; there is also a large "affiliation bias" so that people tend to believe what their institution would want them to believe. But the differences among toxicologists are dwarfed by the differences between toxicologists and ordinary people. We should conclude that people's social role will move their judgments in predictable directions and that experts are likely to be biased if they are working

with someone having a stake in the outcome – but also that even acknowledging this point, experts are, on many fundamental issues, in basic accord with one another.

Cost–benefit analysis can be an important corrective to intuitive toxicology. People tend to think that if a substance is carcinogenic, it should be banned. But what if this particular carcinogen produces little harm at low levels, or perhaps even benefits? And what if the result of the ban would be to increase, by hundreds of dollars, the annual water bill faced by poor people? People may think that it is risky to tamper with nature; but what if genetically modified food is cheaper, more nutritious, and safer than the alternatives? One of the primary virtues of cost–benefit analysis is that it can weaken the hold of intuitive toxicology, giving people a real sense of the consequences of different courses of action.

AGGRAVATING SOCIAL INFLUENCES: SOCIAL CASCADES

The availability heuristic and intuitive toxicology do not, of course, operate in a social vacuum. They interact with emphatically social processes, and in particular with informational and reputational forces. When one person says, through words or deeds, that something is or is not dangerous, he creates an *informational externality*.[17] A signal by some person A will provide relevant data to others. When there is little private information, such a signal may initiate an *informational cascade*, with significant consequences for private and public behavior, and with possibly distorting effects on regulatory policy. I shall discuss these points in some detail in Chapter 4; for now, a brief outline will be useful.

Imagine that A says that abandoned hazardous waste sites are dangerous, or that A initiates protest activity because such a site is located nearby. B, otherwise skeptical or in equipoise, may go along with A; C, otherwise an agnostic, may be convinced that if A and B share the relevant belief, the belief must be true; and it will take a confident D to resist the shared judgments of A, B, and C. The result of these set of influences can be social cascades, as hundreds, thousands, or millions of people come to accept a certain belief simply because of what they think other people believe.[18] There is nothing fanciful to the idea. Cascade effects help account for the existence of widespread public concern

[17] See Andrew Caplin & John Leahy, Miracle on Sixth Avenue: Information Externalities and Search, 108 Econ. J. 60 (1998).

[18] See David Hirshleifer, The Blind Leading the Blind: Social Influence, Fads, and Informational Cascades, in The New Economics of Human Behavior 188, Mariano Tommasi & Kathyrn Ierulli, eds. (Cambridge: Cambridge Univ. Press, 1995).

about abandoned hazardous waste dumps (not the most serious environmental hazard), and in more recent years, they spurred excessive public fears of the pesticide Alar, of risks from anthrax, and of dangers of shootings in schools in the aftermath of the murders in Littleton, Colorado. Such effects recently helped produce massive dislocations in beef production in Europe in connection with "mad cow disease"; they are currently giving rise to European fear of genetic engineering of food.

On the reputational side, cognitive effects may be amplified as well. If many people are alarmed about some risk, you may not voice your doubts about whether the alarm is merited, simply in order not to seem obtuse, cruel, or indifferent. And if many people believe that a certain risk is trivial, you may not disagree through words or deeds, lest you appear cowardly or confused. The result of these forces can be cascade effects, mediated by the availability heuristic. Such effects can produce a public demand for regulation, even though the relevant risks are trivial. At the same time, there may be little or no demand for regulation of risks that are, in fact, quite large in magnitude. Self-interested private groups can exploit these forces, often by using the availability heuristic. Consider the fact that European companies have tried to play up fears of genetically engineered food as a way of fending off American competition – a reason for special concern in light of the likelihood that genetically engineered food might be a huge boon for poor nations.

These are tales of excessive and insufficient concern with risk. At the individual level, risk-taking behavior is also a product, much of the time, of similar forces. People often take risks, even foolish ones, simply because other people are doing the same thing. Suppose that Johnson is unsure whether to smoke, or drive drunk, or use dangerous drugs; if other people are doing these things, Johnson might choose to do so as well. The choice to take the relevant risks might be based on informational influences; if everyone else is smoking, how foolish can it be to smoke? Or the choice might be based on reputational considerations; if everyone else thinks that it is right to smoke, then your reputation might be enhanced if you smoke, and damaged if you fail to smoke. Cigarette companies are entirely aware of these points. An executive at R. J. Reynolds emphasized, "If a majority of one's closest associates smoke cigarettes, then there is strong psychological pressure, particularly as a young person, to identify with the group, follow the crowd, and avoid being out of phase with the group's value system even though, paradoxically, the group value system may esteem individuality. This provides a large incentive to begin smoking."[19]

[19] Quoted in Jon Hanson & Douglas Kysar, The Joint Failure of Economic Theory and Legal Regulation, in Smoking: Risk, Perception, and Policy 229, 255, Paul Slovic, ed. (New York: Sage 2001).

There is a close associated between cascade effects and *group polarization*. Group polarization is the typical result of deliberation, which moves people toward in a more extreme point in the direction that they were already heading. People who tend to think that global warming is a nonexistent problem, fabricated by environmentalists to promote their own parochial ends, are likely to think, after discussion with one another, that this is entirely true. People who fear that genetic engineering of food will cause severe agricultural damage, or dangers to human beings, might well be led, by discussion, to think that genetic engineering of food should be banned. Group polarization helps explain why some people, in some communities, become terrified of tiny risks (electromagnetic fields, in some areas; crimes, in others), while some people, in some communities, remain indifferent to significant risks (skin cancer, indoor air pollution). I will say much more about social effects of this sort in Chapter 4.

If government is deciding what to do, cost–benefit analysis has a natural role in these circumstances. If that analysis is made relevant to decision, it can counteract cascade effects induced by informational and reputational forces, especially when the availability heuristic is at work. The effect of cost–benefit analysis is to subject a public demand for regulation to a kind of technocratic scrutiny, to ensure that the demand is not rooted in myth, and to ensure as well that government is regulating risks even when the public demand (because insufficiently informed) is low. And here too there is no democratic problem with the inquiry into consequences; a governmental effort to "cool" popular reactions is hardly inconsistent with democratic ideals. Similarly, there is nothing undemocratic about a governmental effort to divert resources to serious problems that have not been beneficiaries of cascade effects.

SYSTEMIC EFFECTS AND "HEALTH–HEALTH TRADEOFFS"

Often people focus on small pieces of complex problems, and causal changes are hard to trace. A decision to impose fuel economy standards on new cars may cause a "downsizing" of the fleet, and in that way increase risks to life. A decision to ban asbestos may cause manufacturers to use less safe substitutes. A decision to regulate nuclear power may increase the demand for coal-fired power plants, with harmful environmental consequences. Regulation of tropospheric ozone may control the health dangers of ozone, but ozone has various benefits as well, including protection against cataracts and skin cancer; hence regulation of ozone may cause health problems comparable to those that it reduces.[20] Indeed,

[20] See Randall Lutter & Christopher Wolz, UV-B Screening by Tropospheric Ozone: Implications for the NAAQS, 31 Env. Sci. & Tech. 142A, 144A (1997) (estimating that the EPA's

regulation of ozone will increase electricity prices, and because higher electricity prices will deprive poor people of air conditioning or lead them to use it less, such regulation may harm or literally kill people.

These are simply a few examples of situations in which a government agency is inevitably making "health–health tradeoffs" in light of the systemic effects of one-shot interventions. Indeed, any regulation that imposes high costs will, by virtue of that fact, produce some risks to life and health, since "richer is safer."[21] A virtue of cost–benefit analysis is that it tends to overcome people's tendency to focus on parts of problems, by requiring them to look globally at the consequences of apparently isolated actions. I will discuss these issues in detail in Chapter 6.

DANGERS ON-SCREEN, BENEFITS OFF-SCREEN

Why are people so concerned about the risks of nuclear power, when experts tend to believe that the risks are quite low – lower, in fact, than the risks from competing energy sources, such as coal-fired power plants, which produce relatively little public objection? Why do they believe that small risks from pesticides should be regulated, even if comparatively small risks from X-rays are quite tolerable?

Suggestive answers come from research suggesting that for many activities that pose small risks but that nonetheless receive public concern, people perceive low benefits as well as high risks.[22] For example, nuclear power itself is seen as a low-benefit, high-risk activity. Similar findings appear for some activities

new ozone NAAQS could cause 25 to 50 more melanoma skin cancer deaths and increase the number of cataract cases by 13,000 to 28,000 each year). See also Ralph L. Keeney & Kenneth Green, Estimating Fatalities Induced by Economic Impacts of EPA's Ozone and Particulate Standards 8 (Reason Public Policy Institute, Policy Study No. 225, June 1997) (calculating that if attainment of the new standards costs $10 billion annually, a number well within EPA's estimated cost range, it will contribute to 2,200 premature deaths annually). On the general phenomenon, see Graham & Wiener, supra note 32 in Chapter 1.

21 John D. Graham, Bei-Hung Chang, & John S. Evans, Poorer Is Riskier, 12 Risk Analysis 333, 333–5 (1992); Frank B. Cross, When Environmental Regulations Kill: The Role of Health-Health Analysis, 22 Ecol. L. Q. 729 (1995); Ralph L. Keeney, Mortality Risks Induced by the Costs of Regulations, 8 J. Risk & Uncertainty 95 (1994); Aaron Wildavsky, Richer Is Safer, 60 Pub. Interest 23 (1980); Aaron Wildavsky, Searching for Safety 59–75 (New Brunswick, N. J.: Transaction Books, 1988).

22 See Ali Siddiq Alhakami & Paul Slovic, A Psychological Study of the Inverse Relationship Between Perceived Risk and Perceived Benefit, 14 Risk Analysis 1085, 1088 (1994).

that have in fact a relatively high risk: a judgment of low risk accompanies a judgment of high benefits. The very fact that activities are known to have high benefits skews judgment in their favor, and hence makes people understate the costs as well.

The obvious conclusion is that sometimes people favor regulation of some risks because the underlying activities are not seen to have compensating benefits. Thus for some activities, tradeoffs are not perceived at all. Dangers are effectively on-screen, but benefits are off-screen. Note that this is not because such activities do not, in fact, have compensating benefits. It is because of a kind of perceptual illusion, a cognitive problem. Consider in this regard Howard Margolis's basic account of the different judgments of experts and ordinary people.[23] Margolis thinks that in some cases, ordinary people are alert to the hazards of some activity but not to its benefits, which are cognitively off-screen. In such cases, people will tend to think, "better safe than sorry," and they will have a highly negative reaction to the risk. In such cases, they will demand aggressive and immediate regulation. In other cases, the benefits of the activity, but not the hazards, will be very much on people's minds – in which case they will tend to think, "nothing ventured, nothing gained."[24] In such cases, they will think that regulators are overzealous, even fanatics. In still other cases – in Margolis' view, the cases in which observers are being most sensible – both benefits and risks will be on-screen, and people will assess risks by comparing the benefits with the costs.[25]

It is reasonable to think that for experts, benefits and costs are usually on-screen, and that when ordinary people are much more alarmed than experts, it is sometimes because the risks are apparent but the benefits are not. How else are we to make sense of the fact that the very small risks associated with X-rays do not occasion much concern, while the very small risks associated with pesticides and herbicides frequently appear on the list of most feared risks? A sensible conjecture is that people know that on balance, a world with X-rays is safer, and better, than a world without them. For pesticides and herbicides, by contrast, the benefits seem far less tangible, if they are visible at all. It is safe to predict that if people were told, by a reliable source, that eliminating pesticides would lead to serious health problems – for example, because pesticide-free fruits and vegetables carried special dangers[26] – the perceived risk of pesticides would decline dramatically. Indeed, I predict that if people were informed that

23 Howard Margolis, Dealing with Risk, 75–92 (Chicago: Chicago Univ. Press, 1997).

24 Id. at 91–92.

25 Id. a 73–79.

26 See the discussion of organic food in Alan McHughen, Pandora's Picnic Basket (Oxford: Oxford Univ. Press, 2000).

eliminating pesticides would lead to a significant rise in the price of applies and oranges, the perceived risk would go down as well.

Margolis offers a nice example to support this prediction. The removal of asbestos from schools in New York City was initially quite popular, indeed demanded by parents, even though experts believed that the risks were statistically small. (As it happens, the risk of a child getting cancer from asbestos insulation was about one-third the risk of being struck by lightning.) But when it emerged that the removal would cause schools to be closed for a period of weeks, and when the closing caused parents to become greatly inconvenienced, parental attitudes turned right around, and asbestos removal seemed like a really bad idea. When the costs of the removal came on-screen, parents thought much more like experts, and the risks of asbestos seemed like the risks of X-rays: statistically small and on balance worth incurring.

An important factor here is *loss aversion*. People tend to be loss averse, which means that a loss from the status quo is seen as more undesirable than a gain is seen as desirable.[27] In the context of risk regulation, the consequence is that any newly introduced risk, or any aggravation of existing risks, is seen as a serious problem, even if the accompanying benefits (a gain from the status quo and hence perceived as less salient and less important) are considerable.[28] Thus when a new risk adds danger, people may focus on the danger itself and not on the benefits that accompany the danger. And an important problem here is that in many cases where dangers are on-screen and benefits off-screen, the magnitude of the danger is actually quite low. Of course, it is possible that a new risk is worse than an old risk, perhaps because it is larger in degree, perhaps because people will have a hard time in adjusting to it. The problem is that loss aversion operates in an automatic, insufficiently reflective manner so that preoccupation with new risks cannot possibly be justified in these terms.

[27] See Richard H. Thaler, The Psychology of Choice and the Assumptions of Economics, in Quasi Rational Economics 137, 143, Richard H. Thaler, ed. (New York: Russell Sage Foundation, 1991) (arguing that "losses loom larger than gains"); Daniel Kahneman, Jack L. Knetsch & Richard H. Thaler, Experimental Tests of the Endowment Effect and the Coase Theorem, 98 J. Pol. Econ. 1325, 1328 (1990); Colin Camerer, Individual Decision Making, in The Handbook of Experimental Economics 665–70, John H. Kagel & Alvin E. Roth, eds. (Princeton, N. J.: Princeton Univ. Press, 1995).

[28] For some policy implications of loss aversion, see Jack L. Knetsch, Reference States, Fairness, and Choice of Measure to Value Environmental Changes, in Environment, Ethics, and Behavior: The Psychology of Environmental Valuation and Degradation 52, 64–5, Max H. Bazerman, David M. Messick, Ann E. Tenbrunsel & Kimberly A. Wade-Benzoni, eds. (San Francisco: New Lexington Press, 1997).

Cost–benefit analysis can be a corrective here by placing the various effects on-screen.

EMOTIONS, THE AFFECT HEURISTIC, AND ALARMIST BIAS

Thus far the discussion has focused on individual and social *cognition*. Indeed, most psychological work on risk has been highly cognitive in orientation, asking whether mental heuristics produce errors, and how people frequently depart from what is generally considered to be rational behavior. But something is missing in thinking about perceived risks only in these terms. With respect to risks, many of our ordinary ways of speaking suggest strong emotions: panic, hysteria, terror.[29] Vivid mental pictures of widespread death or catastrophe can drive a demand for risk regulation. Consider, for example, the motivations of those who press for regulation of airplane safety in the aftermath of an airplane crash – even though such regulation may increase travel risks on balance (by driving up the price of flying and causing a shift to driving, the more dangerous form of transportation).[30] How do people's *feelings* affect their reactions to risks?

Return to the remarkable finding mentioned earlier: When asked to assess the risks and benefits associated with certain items, people tend to think that risky activities contain low benefits, and that beneficial activities contain low risks. In other words, people are likely to think that activities that seem dangerous do not carry benefits; it is rare that they will see an activity as *both* highly beneficial and quite dangerous or as *both* benefit-free and danger-free. This is extremely odd. Why don't people think, more of the time, that some activity is both highly beneficial and highly risky? Why do they seem to make a kind of general, gestalt-type judgment, one that drives assessment of both risks and benefits? Aware that risk and benefit are "distinct concepts," the psychologist Paul Slovic thinks that "affect" comes first and helps to "direct" judgments of both risk and benefit.[31] Hence Slovic suggests an "affect heuristic," by which people have an emotional, all-things-considered reaction to certain processes and products, and that heuristic operates as a mental shortcut for a more careful evaluation.

[29] See George Loewenstein et al., Risk As Feelings, 127 Psych. Bull. 267 (2001).

[30] See Robert W. Hahn, The Economics of Airline Safety and Security: An Analysis of the White House Commission's Recommendations, 20 Harv. J. L. & Pub. Policy 791 (1997).

[31] See, for example, Paul Slovic, supra note 12 in Chapter 2, at 413–28; Paul Slovic et al., The Affect Heuristic, in Intuitive Judgment: Heuristics and Biases, Tom Gilovich et al., eds. (New York: Cambridge Univ. Press, 2002).

Consider one of the most interesting tests of the role of the affect heuristic.[32] The test is designed to provide new information about the *risk* associated with some item and then to see if the information altered people's judgments about the *benefit* associated with it – and also to provide new information about the benefit of some item and to test whether that information would alter people's judgments about the accompany risk. The motivation for this study is simple. If people's judgments were purely cognitive, information about the great *benefits* of (say) food preservatives should not produce a judgment that the *risks* are low – just as information about the great risks of (say) natural gas should not make people think that the benefits are low.

Strikingly, information about benefits alters judgments about risks, and information about risks alters judgments about benefits. When people learn about the low risks of an item, they are moved to think that the benefits are high, and when they learn about the high benefits of an item, they are moved to think that the risks are low. It seems that people assess products and activities through affect, and that information that improves people's affective response will improve their judgments of all dimensions of those products and activities. When presented with a risk, people have a general emotional attitude to it – hence an "affect" – and this general attitude operates as a heuristic, much affecting people's judgments about both benefits and dangers. The point is further supported by the finding that when people are forced to make decisions under time pressure, the inverse relationship between benefits and risks is even more clearly established.[33] When people have little time, affect seems to do a lot of the work. If people like an activity or a product, they see high benefits and low risks, whereas dislike produces a judgment of low benefits and high risks.

It is important to be careful with the relevant categories here. There is no sharp distinction between "cognition" and "emotion."[34] Emotions are generally the products of beliefs, and hence an emotional reaction to risk – terror, for example – is generally mediated by judgments.[35] But this is not always true; sometimes the operation of the brain allows intense emotional reactions with minimal cognitive activity. Some scientific work suggests that the brain has special sectors for emotions, and that some types of emotions, including some

[32] See id.

[33] See id.

[34] See Dan M. Kahan & Martha C. Nussbaum, Two Conceptions of Emotion in the Criminal Law, 96 Colum. L. Rev. 269 (1996); Jon Elster, Alchemies of the Mind: Rationality and the Emotions (Cambridge: Cambridge Univ. Press, 1999).

[35] See Martha Nussbaum, Upheavals of Thought (New York: Cambridge Univ. Press, 2001); Elster, supra note 34 in Chapter 2.

fear-type reactions, can be triggered before the more cognitive sectors become involved at all.[36] Whether or not this is so, the judgments that fuel fear-type emotions are not always reliable, especially when probability is ignored.

We need not venture into controversial territory to urge that some risks seem to produce extremely sharp, largely visceral reactions. These reactions are sometimes largely impervious to argument. Indeed, experience with "mass panics" has shown exactly this structure, as assurances based on statistical evidence have little effect in the face of vivid images of what might go wrong.[37] "If someone is predisposed to be worried, degrees of unlikeliness seem to provide no comfort, unless one can prove that harm is absolutely impossible, which itself is not possible."[38] Some fears even seem to have a genetic foundation; consider, as a possible example, fear of snakes, which appears in people who have no reason to think that snakes are dangerous. Perhaps more to the point, existing experiments suggest that when it comes to risk, a key question is whether people can imagine or visualize the "worst case" outcome – and that surprisingly little role is played by the stated probability that that outcome will occur.[39] In other words, people's reactions to risks are often based mostly on the badness of the outcome and the vividness of that outcome rather than on the probability of its occurrence. Consider also these points:

1. When people discuss a low-probability risk, their concern rises even if the discussion consists mostly of apparently trustworthy assurances that the likelihood of harm really is infinitesmal.[40]
2. If people are asked how much they will pay for flight insurance for losses resulting from "terrorism," they will pay more than if they are asked how much they will pay for flight insurance from all causes.[41]
3. People show "alarmist bias." When presented with competing accounts of danger, they tend to move toward the more alarming account.[42]

[36] See Joseph LeDoux, The Emotional Brain: The Mysterious Underpinnings of Emotional Life (New York: Simon & Schuster, 1996).

[37] See the discussion of Love Canal in Timur Kuran & Cass R. Sunstein, Availability Cascades and Risk Regulation, 51 Stan. L. Rev. 683, 691–8 (1999).

[38] See John Weingart, Waste Is a Terrible Thing To Mind 362 (Newark, N. J.: Center for Public Issues, 2001).

[39] See Yuval Rottenstreich and Christopher Hsee, Money, Kisses, and Electric Shocks: On the Affective Psychology of Risk, 12 Psych. Sci. 185, 186–8 (2001).

[40] See Ali Siddiq Alha kami & Slovic, supra note 22 in this Chapter.

[41] See George Loewenstein et al, supra note 29 in this Chapter at 275.

[42] W. Kip Viscusi, Alarmist Decisions With Divergent Risk Information, 107 Econ. J. 1657, 1657–9 (1997).

4. Visualization or imagery matters a great deal to people's reactions to risks. When an image of a bad outcome is easily accessible, people will become greatly concerned about a risk, holding probability constant.[43]
5. If the potential outcome of a gamble has a great deal of associated affect (a kiss with a favorite movie star, an electric shock), its attractiveness or unattractiveness is remarkably insensitive to changes in probability, even changes as large as from .99 to .01.[44]

A possible conclusion is that, with respect to risks, vivid images and concrete pictures of disaster can "crowd out" other kinds of thoughts, *including the crucial thought that the probability of disaster is really small.* With respect to hope, those who operate gambling casinos and state lotteries play on the emotions in the particular sense that they conjure up palpable pictures of victory and easy living. With respect to risks, insurance companies and environmental groups do exactly the same. With respect to products of all kinds, advertisers try to produce a good affect to steer consumers into a certain direction, often through the use of appealing celebrities, through cheerful scenes, or through the creation of an association between the product and the consumer's preferred self-image.

The role of cost–benefit analysis is straightforward here. Just as the Senate was designed to have a "cooling effect" on the passions of the House of Representatives, so cost–benefit analysis might ensure that policy is driven not by hysteria or alarm but by a full appreciation of the effects of relevant risks and their control. If the hysteria survives an investigation of consequences, then the hysteria is fully rational, and an immediate and intensive regulatory response is entirely appropriate. Nor is cost–benefit analysis, in this setting, only a check on unwarranted regulation. It can and should serve as a spur to regulation as well. If risks do not produce visceral reactions, partly because the underlying activities do not yield vivid mental images, cost–benefit analysis can show that they nonetheless warrant regulatory control. The elimination of lead in gasoline is a case in point.[45]

An additional lesson follows: If government is seeking a method to ensure that people will take a more rational approach to risk, it might well attempt to appeal to their emotions. With respect to a cigarette smoking, abuse of alcohol, reckless driving, and abuse of drugs, this is exactly what government occasionally attempts to do. It should be no surprise that some of the most effective efforts to control cigarette smoking appeal to people's emotions, by making them feel

[43] See Paul Slovic et al., Violence Risk Assessment and Risk Communication, 24 Law and Human Behavior 271 (2000).

[44] See Rottenstreich and Hsee, supra note 39 in Chapter 2.

[45] See Economic Analyses at EPA, supra note 19 in Chapter 1.

that if they smoke, they will be dupes of the tobacco companies or imposing harms on innocent third parties.[46] I will return to this point in Chapter 10.

THE PROPORTIONALITY EFFECT

Suppose that 200 million people face a statistically small risk, so that government intervention would save a quite small percentage of those 200 million people – say, one in a million. Now suppose that 1,000 people face a statistically large risk, so that government intervention would save a nontrivial percentage of those 1,000 – say, one in a hundred. Evidence suggests that people would be far more inclined to support the second intervention than the first; people "worry more about the proportion of risk reduced than about the number of people helped."[47] A moment's reflection should show that the intuitive inclination is not easy to defend. In the cases just given, the first intervention would save 200 lives, whereas the second would save just 10. On what theory should the government prefer the second? It is not easy to answer this question, but people generally seek to save a high proportion of people in the relevant population, and focus less than they might on absolute savings of lives. Indeed the proportionality effect seems to explain the fact that people are willing to pay an enormous amount to protect an identifiable victim, such as a child trapped in a well – but much less to protect "statistical lives," as when a hundred or more people, not identifiable in advance, will die as a result of exposure to carcinogens.[48]

A striking study of the proportionality effect asked people how much they were willing to pay to reduce existing risks by 20 percent, and compared the answers to actual government practice.[49] The upshot of the study is that both absolute numbers and proportionality are important, and that people's intuitions map onto actual policy choices. Not surprisingly, the study found that people are willing to spend more to reduce absolutely larger risks. For example, the mean willingness to pay was $161 to reduce by 20 percent 10,000 deaths from automobiles per year, whereas the mean willingness to pay was merely $46 to reduce by 20 percent 40 deaths from aviation each year. But at the same time, the proportionality effect plays a large role, as demonstrated by the fact that

[46] Lisa Goldman & Stanton Glantz, Evaluation of Antismoking Advertising Campaigns, 279 JAMA 772 (1998).

[47] See Jonathan Baron, Thinking and Deciding 500–2 (Cambridge: Cambridge Univ. Press, 3d ed., 2000).

[48] See K. E. Jenni & George Loewenstein, Explaining the Identifiable Victim Effect, 14 J. Risk & Uncertainty 235 (1997).

[49] See T. L. McDaniels, Comparing Expressed and Revealed Preferences for Risk Reduction, 8 Risk Analysis 593 (1988).

per life saved, people's willingness to pay is much higher for the smaller risks, with a national willingness to pay $103 million per life saved in the context of aviation, but just $1.3 million per life saved in the context of automobiles. All this is survey evidence. But actual government expenditures show the same effect. Government does not allocate its resources to save as many lives as possible but shows a willingness to spend far more, per life saved, when the risk is faced by a relatively small population. It is reasonable to think that the proportionality effect accounts for many of the anomalies shown in Table I.I.

Of course, there are some complexities here. Interest group pressures, and not merely intuitions, are an important factor behind government practice. When a small population faces a risk, perhaps it will be well-organized and be in a position to press vigorously for governmental help. In addition, there may be a sound moral principle at work, and not merely a confused intuition. It is reasonable to think that government should care, not only about the total number of people at risk, but also about the statistical danger faced by particular people. Perhaps everyone has a right, under normal circumstances, not to be subject to a risk of death of, say, I in 100. Perhaps it is much worse for 10,000 people to face a fatality risk of I in 100 than for 2 million people to face a fatality risk of I in 100,000, even though more people will die in the later case. I do not mean to resolve the theoretical complexities here. The only point is that the proportionality effect seems to operative as an automatic, unreflective intuition, and it almost certainly helps to produce policies that no one, after reflection, would support. A chief advantage of cost–benefit analysis is that it promotes that very reflection, by drawing attention to the actual numbers and ensuring that if people really do not want to increase the absolute number of lives saved, they will know that this is what they are doing.

SEPARATE EVALUATION AND INCOHERENCE

Suppose that you are asked to say, without reference to any other problem, how much you would be willing to pay to protect certain threats to coral reefs. Now suppose that you are asked to say, without reference to any other problem, how much you would pay to protect against skin cancer among the elderly. Suppose, finally, that you are asked to say how much you would be willing to pay to protect certain threats to coral reefs and how much you would be willing to pay to protect against skin cancer among the elderly. Empirical evidence suggests that people's answers to questions, taken in isolation, are very different from their answers to questions when they are asked to engage in cross-category comparisons.[50] It

[50] See Cass R. Sunstein, Daniel Kahneman, David Schkade & Ilana Ritov, Predictably Incoherent Judgments, p. 54 Stan. L. Rev. (forthcoming 2002).

appears that when people assess problems in isolation, they do so by reference to other problems in the same basic category – and that this intuitive process is dramatically altered when people are explicitly told to assess problems from other categories as well. The result of assessing individual problems, taken in isolation, is to produce what people would themselves consider a form of incoherence.

The forms of regulatory spending shown in Table I.I undoubtedly reflect, in part, the kinds of irrationality that follow from judgments that are made without close reference to other problems from different categories. Incoherence is the natural result of the relevant cognitive processes. The argument for a form of cost–benefit analysis is straightforward: It operates as a built-in corrective to some of the distortions that come from taking problems in isolation. The point applies to "contingent valuation" assessments, but it operates more broadly with respect to expenditure decisions that otherwise risk incoherence, simply by virtue of the fact that they operate without looking at other problems, including those from other categories.

GENERAL IMPLICATIONS

Two arguments are now in place. The first is that for a variety of identifiable reasons, people make mistaken judgments about risks. Their intuitions lead them astray. To be sure, some of the heuristics that people use are well-suited for daily life, especially for busy people who do not have the time or inclination to investigate the details. But government should do a good deal better, and it is not likely to do so if it is simply responding to what people fear and do not fear. The second argument is that cost–benefit analysis can operate not as a rule for decision but as a useful tool, helping to correct the various risks to which all of us are susceptible.

In this light, it is true but obvious to say that people lack information and that their lack of information can lead to an inadequate or excessive demand for regulation, or a form of "paranoia and neglect."[51] What is less obvious is that predictable features of cognition will lead to a demand for regulation that is unlikely to be based on the facts. When people ask for regulation because of fears fueled by availability cascades, and when the benefits from the risk-producing activity are not registering, it would be highly desirable to create filters on their requests. When interest groups exploit cognitive mechanisms to create unwarranted fear or diminish concern with serious problems, it is desirable to have institutional safeguards. When people fail to ask for regulation for related

[51] See John D. Graham, Making Sense of Risk: An Agenda for Congress, in Risks, Costs, and Lives Saved: Getting Better Results from Regulation 183, Robert W. Hahn, ed. (New York: Oxford Univ. Press, 1996).

reasons, it would be desirable to create a mechanism by which government might nonetheless act if the consequences of action would be desirable.

A caveat: It is entirely possible that the public demand for regulation will result from something other than cognitive errors, even if the relevant risk seems low as a statistical matter. Interest groups are exceedingly important. As we have seen, they use their power to produce regulation that they favor. Sometimes they enlist the very forces discussed here. To say the least, moral judgments are exceedingly important as well. People may think, for example, that it is especially important to protect poor children from a certain risk in a geographically isolated area, and they may be willing to devote an unusually large amount to ensure that protection. What seems to be a cognitive error may turn out, on reflection, to be a judgment of value, and a judgment that can survive reflection. I will return to this point in the next chapter. For the moment, note two simple points. Whether an error is involved is an empirical question, subject, at least in principle, to empirical testing. And nothing in cost–benefit analysis would prevent people from devoting resources to projects that they consider worthy, even if the risk is relatively low as a statistical matter.

THE PSYCHOLOGICAL LOGIC OF TERRORISM: A CONCLUDING NOTE

People's mistakes in thinking about risks bear a great deal on catastrophes in general and on terrorism in particular. Indeed, terrorism has an unmistakable psychological logic, and we can bring many of my themes together if we identify that logic.

I have emphasized that people tend to use the availability heuristic, in accordance with which probability is measured by asking whether a readily available example comes to mind. In the aftermath of a terrorist act, and for a period thereafter, the act is likely to be readily available – and thus to make people think that another such act is likely, whether or not it is in fact. The result is that one or two highly publicized incidents will have a significant and potentially huge impact on both thought and behavior. In these ways, terrorist acts are no different from floods, earthquakes, and other catastrophes, all of which have immediate effects. In the aftermath of the attacks of September 11, 2001, many Americans were afraid to travel in airplanes and even to appear in public places. If we know how people think about risks, we will find this level of fear entirely unsurprising.

People also show disproportionate fear of risks that seem unfamiliar and hard to control (a point discussed in more detail in Chapter 3). A new risk is likely to receive far more attention than is warranted by the sheer numbers. A large disparity between reactions to old risks and new risks characterizes both

individual judgment and law itself, which treats new hazards far more aggressively than old ones. For individual judgments, the disparity may result partly from the fact that people have become accustomed to existing risks, and hence are less disturbed by them than the data may warrant. But for both individuals and societies, serious problems can emerge from the disproportionate fear of risks that seem unfamiliar and hard to control. For present purposes, the key point is that the risks associated with terrorism are likely to seem new, unfamiliar, and apparently hard to control – and a terrorist act will therefore produce widespread and intense public fear.

I have also suggested that people are prone to *probability neglect*, especially when their emotions are intensely engaged. If a bad outcome is very vivid, people are not likely to think much about whether it is likely to come to fruition. When probability neglect is at work, people's attention is focussed on the bad outcome itself, and they are inattentive to the fact that it is unlikely to occur. Almost by definition, an act of terrorism will trigger intense fear, and hence people will focus on the awfulness of the potential outcomers, not on their probabilities.

All these forces are likely to be aggravated by social influences. After an act of terrorism, people will be talking to one another about that act, and cascades of fear will undoubtedly develop. It is almost inevitable that baseless rumors will spread rapidly and widely. In these circumstances, it should be unsurprising that the harms and costs of a single terrorist act can be felt for a long time and reflect "ripple effects" far beyond the act itself.[52] The attacks of September 11 are an obvious case in point. A comprehensive account will take a long time to produce, but consider, for illustrative purpose, the following facts and projections, developed shortly after those attacks: New York City was expected to forfeit between $1 billion and $3 billion in lost revenue; global airline losses were projected to exceed $10 billion; total "big company" layoffs were about 200,000, with British Airways laying off 12.5 percent of its employees and American Airlines and Boeing each laying off at least 20,000 people; car rental companies were projected to lose 50 to 60 percent of their business with in the months following the attacks.[53] Of course this is just the beginning: the ripple effects of the attacks – financial, material, and psychological – extend to countless domains.

All these points suggest that acts of terrorism show an acute appreciation of the psychological phenomena I have discussed. Of course, it is difficult to do any kind of cost–benefit analysis of measures to reduce the risks of terrorism, especially because of the level of uncertainty involved. But at least we can say that

[52] See Paul Slovic, supra note 12 in Chapter 2, at 232–45.

[53] See Cass R. Sunstein, The Laws of Fear, 115 Harv. L. Rev. 1119, 1130–21 (2002) for support and discussion.