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Probability Neglect: Emotions, Worst Cases, and Law

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Abstract

In some domains, people focus on the goodness or badness of an outcome, without giving sufficient thought to the likelihood that the outcome will actually come to fruition. Variations among small probabilities often seem not to matter at all. Neglect of probabilities is especially likely when strong emotions are triggered by a risk; in such cases, people's concern does not greatly vary despite large variations in the probability of harm. Experimental evidence, involving electric shocks and arsenic, supports this claim, as does real-world evidence, involving responses to abandoned hazardous waste dumps, the pesticide Alar, and anthrax. The resulting "probability neglect" has many implications for law and policy. It helps to explain the enactment of certain legislation, in which government, no less than ordinary people, suffers from that form of neglect. To avoid the problems associated with probability neglect, institutional constraints should be developed to ensure against policies based on ungrounded fears. When people are neglecting the fact that the probability of harm is small, government should generally attempt to inform people, rather than cater to their excessive fear. But when information will not help, government should respond, at least if analysis suggest that the benefits outweigh the costs. The reason is that fear, even if it is excessive, is itself a significant problem, and can create additional significant problems.

"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."[1]

"[A]ffect-rich outcomes yield pronounced overweighting of small probabilities . . . ."[2]

"On Sept. 11, Americans entered a new and frightening geography, where the continents of safety and danger seemed forever shifted. Is it safe to fly? Will terrorists wage germ warfare? Where is the line between reasonable precaution and panic? Jittery, uncertain and assuming the worst, many people have answered these questions by forswearing air travel, purchasing gas masks and radiation detectors, placing

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[1] See John Weingart, Waste Is A Terrible Thing To Mind 362 (2001).
[2] Yuval Rottenstreich and Christopher Hsee, Money, Kisses, and Electric Shocks: On the Affective Psychology of Risk, 12 Psych Science 185, 188 (2001).

frantic calls to pediatricians demanding vaccinations against exotic diseases or rushing out to fill prescriptions for Cipro, an antibiotic most experts consider an unnecessary defense against anthrax."[3]

I. Preface: Terrorism's Aftermath

The particular emphasis of this essay is on how people sometimes pay too little attention to the issue of probability in thinking about risks, and in particular about how strong emotions can lead people to neglect entirely the probability that a risk will come to fruition. I started writing the essay a few days before the terrorist attacks on Washington, DC and New York City on September 11, 2001. It goes without saying that in the immediate aftermath of those attacks, people became exceedingly frightened. Many people were saying, "you cannot be safe anywhere." They were especially afraid to fly. In response to the attacks, new security measures at airports were imposed at airports. There was a significant reduction in flying. One reason was simple fear. Another reason was the increased inconvenience (and to that extent cost, monetary and otherwise) of flying. Many people drove who would have flown; many others stayed at home.

For those who study the topic of risk regulation, there are many things to say about this state of affairs. First, safety is a matter of degree; it is foolish to worry, as people seemed to be doing, about whether they are "safe" or "not safe." As a statistical matter, most people, in most places (not excluding airports), were not at significantly more risk after the attacks than they were before.[4] Second, the result of the new security measures might have been to increase deaths on balance.[5] It is entirely possible that the new measures saved no lives at all. In addition, any substitution of driving for flying is likely to cause deaths, because driving is a less safe method of transportation.[6] Perhaps hundreds of lives, on balance, will ultimately be lost as a result of the new security measures.[7] Third, the costs of the new measures might well outweigh the benefits. As noted, there might be no benefits at all. Once monetized, the various costs are likely to be huge, undoubtedly in the billions. The sensible technocrat asks: Should we not, therefore, reject at least some of the new security measures, on the ground that they fail both health-health balancing and cost-benefit balancing?

It is not at all clear that the sensible technocrat is wrong. But things are not so obvious. People were afraid to fly, and they demanded stringent security measures. Indeed few people publicly objected to them; it is hard to find a single person who was willing to launch a public objection on technocratic grounds. (It is an interesting question whether people objected to them privately and were silencing themselves, and if so

[3] Erica Goode, Rational and Irrational Fears Combine in Terrorism's Wake, The New York Times, Oct. 2, 2001.
[4] At least this is clear in hindsight; it was much less clear at the time.
[5] See Robert W. Hahn, The Economics of Airline Safety, 20 Harv. L. & Pub. Policy 791 (1997).

[6] Id.
[7] Id.

exactly why.[8]) Perhaps fewer people would fly, and more people would die, without those measures. This too is a technical question. But the demand for stringent security measures itself reflected the fact that people would have felt distressed, or upset, or fearful if government did not respond. A failure to respond would itself have imposed costs. One point seems clear: An effort to assess the costs of airplane crashes, and terrorism, will be ludicrously incomplete if it does not take account of the consequences of emotional reactions, which are themselves costs, and which will impose significant additional costs. I flew myself, about a week after the attacks, and while I believed that that the probability of danger was very low, I was not at all comfortable about flying, and the night before the flight was pretty miserable.

II. Risks, Numbers, and the Implicit (Behavioral) Rationality of Risk Regulation

On the conventional view of rationality, probabilities matter a great deal to reactions to risks, and emotions, as such, are not assessed independently; they are not taken to play a distinctive role.[9] Of course people might be risk-averse or risk-inclined. It is possible, for example, that people will be willing to pay $100 to eliminate a 1/1000 risk of losing $900. But analysts generally believe that variations in probability should matter, so that there would be a serious problem if people were willing to pay *both* $100 to eliminate a 1/1000 risk of losing $900 *and* $100 to eliminate a 1/100,000 risk of losing $900. And analysts do not generally ask, or care, whether risk-related dispositions are a product of emotions or something else.

Looking purely at cognition, we are able to see that much risk-related behavior is fully rational, and that people's reactions to risks, and their demand for governmental response, are an outgrowth of standard cognitive processes. It makes sense, for example, to think that people who are wealthy will be willing to pay more for risk reduction than people who are poor.[10] It also makes sense to suggest that if medical advances have reduced certain risks, people will be more willing to run those risks, simply because the expected consequences are less serious.[11] If doctors can make accidents far less dangerous than they were in earlier periods, people are more likely to risk having accidents. It makes sense too to suggest that when people are likely to live long lives, they will, other things being equal, demand more risk reduction, simply because they have more to gain from it.[12] These claims are based on conventional accounts of rationality. But reactions to risk, and the demand for risk regulation, are often quasi-rational, in the sense that they reflect some of the findings of behavioral economics.[13] Hence risk regulation often shows an implicit <u>behavioral</u> rationality, even if we limit the inquiry to cognition. While my emphasis here will be on probability neglect and its

[8] See Timur Kuran, Private Truths, Public Lies (1997), for an account.
[9] See, e.g., Richard Posner, Economic Analysis of Law ch. 1 (5th ed. 1999); J. Von Neumann and O. Morgenstern, Theory of Games and Economic Behavior (1944).
[10] The point is emphasized in the context of the global warming debate in Indur Goklany, The Precautionary Principle (2001).
[11] See Jason Johnson, U. Pa L Rev, forthcoming.
[12] See id.
[13] For an overview, see Richard Thaler, Quasi-Rational Economics (1993).

connection to the emotions, it will be helpful to offer a brief overview of some more general points about quasi-rationality, risk, and risk regulation.

A. Decision Under Uncertainty

In thinking about risks, people rely on certain heuristics, and they also show identifiable biases.[14] The heuristics-and-biases program is often seen as an attack on the conventional view of rationality. In a way it is, but the program also has a cognitive focus, designed to establish how people proceed under conditions of uncertainty. The central question is: When people do not know about the probability associated with some risk, how do they think?

It is clear that lacking statistical information, people rely on certain heuristics, or rules of thumb, which serve to simply their inquiry.[15] Of these rules of thumb, the availability heuristic is most important for purposes of understanding law.[16] Thus "a class whose instances are easily retrieved will appear more numerous than a class of equal frequency whose instances are less retrievable."[17] Tversky and Kahneman demonstrate the point with a simple study showing people a list of well-known people of both sexes, and asking them whether the list contains more names of women or more names of men. In lists in which the men were especially famous, people thought that the list had more names of men, whereas in lists in which the women were the more famous, people thought that the list had more names of women.

This is a point about how familiarity can affect the availability of instances. But salience is important as well. "For example, the impact of seeing a house burning on the subjective probability of such accidents is probably greater than the impact of reading about a fire in the local paper."[18] So too, recent events will have a greater impact than earlier ones. The point helps explain much risk-related behavior. For example, whether people will buy insurance for natural disasters is greatly affected by recent experiences.[19] If floods have not occurred in the immediate past, people who live on flood plains are far less likely to purchase insurance.[20] In the aftermath of an earthquake, insurance for earthquakes rises sharply – but it declines steadily from that point, as vivid memories recede.[21] Note that the use of the availability heuristic, in these contexts, is hardly irrational.[22] Both insurance and precautionary measures can be expensive, and what has

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[14] See Daniel Kahneman, Paul Slovic, and Amos Tversky, Judgment Under Uncertainty: Heuristics and Biases (1982).
[15] See id.
[16] See Amos Tversky and Daniel Kahneman, Judgment Under Uncertainty: Heuristics and Biases, in id. at 3, 11-14.
[17] Id. at11.
[18] Id.
[19] Paul Slovic, The Perception of Risk 40 (2000).
[20] Id.
[21] Id.
[22] Kahneman and Tversky emphasize that the heuristics they identify "are highly economical and usually effective," but also that they "lead to systematic and predictable errors." See Amos Tversky and Daniel Kahneman, Judgment Under Uncertainty: Heuristics and Biases, in Judgment and Decision Making: A Interdisciplinary Reader 38, 55 (Hal Arkes and Kenneth Hammond). Gerd Gigenzer, among others, has

happened before seems, much of the time, to be the best available guide to what will happen again. Imperfectly informed people might do well to rely on the availability heuristic. The problem is that the availability heuristic can lead to serious errors of fact, in terms of both excessive fear and neglect. It is sensible to think that the lax security measures at airports, before the terrorist attacks in September 2001, had a great deal to do with the lack of cognitively available incidents in recent years, which lulled people into a false sense of immunity.

An understanding of heuristics will help with the prescriptive, positive, and normative tasks of law.[23] For example, a salient event is likely to have a large behavioral impact; it may even lead to the enactment of legislation.[24] There is thus 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.[25] The availability heuristic does not provide a simple explanation of the crazy-quilt pattern of modern regulation, whose content undoubtedly has a great deal to do with interest-group pressures. But the current situation of "paranoia and neglect" [26] can be explained partly by reference to the fact that Public officials, no less than ordinary people, are prone to use the availability heuristic.[27] And in a democracy, officials, including lawmakers, will be reactive to public alarm. 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.[28] Similar problems will appear in courts, with juries and judges taking "phantom risks" quite seriously.[29] Notice that all this can be said without saying a word about emotions; what is involved here is an emphasis on the purely cognitive factors involved in decisions under uncertainty.

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emphasized that some heuristics can work extremely well, see Gerd Gigerenzer et al., Simple Heuristics That Make Us Smart (1999); Gerd Gigerenzer, Adaptive Thinking: Rationality in the Real World (2000), and used this point as a rejoinder to those who stress the errors introduced by heuristics and biases. For a helpful recent discussion, see Kahneman and Frederick, supra note. I do not mean to take a stand on the resulting debates. Even if many heuristics mostly work well in daily life, a sensible government can do much better than to rely on them.

[23] See Christine Jolls et al., A Behavioral Approach to Law and Economics, 50 Stan. L. Rev. 1471, 1474 (1998).

[24] See Timur Kuran and Cass R. Sunstein, Availability Cascades and Risk Regulation, 51 Stan. L. Rev. 683 (1999).

[25] As we shall soon see, there is a relationship between the availability heuristic and the important role of emotions, or affect, in the assessment of risks.

[26] See John Graham, Making Sense of Risk, in Risks, Costs, and Lives Saved: Getting Better Results from Regulation 183, 183 (Robert Hahn ed. 1996).

[27] See Roger Noll and James Krier, Some Implications of Cognitive Psychology for Risk Regulation, 19 J Legal Stud 747, 749-60 (1990); Timur Kuran and Cass R. Sunstein, Availability Cascades and Risk Regulation, 51 Stan L Rev 683, 691-703 (1999).

[28] For evidence, see James Hamilton and W. Kip Viscusi, Calculating Risks (1999); Timur Kuran and Cass R. Sunstein, supra note, at 693-98.

[29] See Phantom Risk, supra note, at 425-28 (discussing scientifically unsupportable outcomes involving "traumatic cancer" and harm to immune systems); id. at 137-46 (discussing lawsuits with unclear scientific basis).

B. Decision Under Risk

The cognitive emphasis of the heuristics-and-biases program can be found as well in prospect theory, a departure from expected utility theory that explains decision under risk.[30] For present purposes, what is most important is that prospect theory offers an explanation for simultaneous gambling and insurance.[31] When given the choice, most people will reject a certain gain of X in favor of a gamble with an expected value below X, if the gamble involves a small probability of riches. At the same time, most people prefer a certain loss of X to a gamble with an expected value less than X, if the gamble involves a small probability of catastrophe.[32] If expected utility theory is taken as normative, then people depart from the normative theory of rationality in giving excessive weight to low-probability outcomes when the stakes are high. Indeed we might easily see prospect theory as acknowledging a form of probability neglect. But in making these descriptive claims, prospect theory does not pretend to offer precise predictions about how variations in probability will affect judgments. Nor does it set out a special role for emotions. This is not a puzzling oversight, if it counts as an oversight at all. For many purposes, what matters is what people choose, and it is unimportant to know whether their choices depend on cognition or emotion, whatever may be the difference between these two terms.

Prospect theory has several implications for risk-related behavior and risk regulation. It predicts that losses with more alarm than foregone gains, and hence the new risk/old risk disparity, a much-lamented feature of risk regulation, should be no surprise.[33] Other things being equal, prospect theory also predicts that government should devote a great deal of attention to low-probability risks of disaster, buying "insurance" even in situations in which it is not fully rational to do so. This appears to be the observed pattern in environmental law.[34] Of course there are many confounding variables in the real world of risk regulation, and prospect theory cannot predict the whole range of governmental responses to risk.

C. Emotions

Thus far I have been discussing cognitive mechanisms for handling decision under uncertainty and risk. No one doubts, however, that in many domains, people do not think much about variations in probability, and that emotions have a large effect on judgment and decisionmaking.[35] Would a group of randomly selected people pay more to reduce a 1/100,000 risk of getting a gruesome form of cancer than another, similar such group would pay to reduce a 1/200,000 risk of getting that form of cancer? Would

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[30] See Daniel Kahneman and Amos Tversky, Prospect Theory: An Analysis of Decision Under Risk, in Choices, Values, and Frames 17 (Daniel Kahneman and Amos Tversky eds. 2001).
[31] Id. at 14-15.
[32] A lucid discussion, with applications to litigation, is Chris Guthrie, Framing Frivolous Litigation, 67 U. Chi. L. Rev. 163 (2000).
[33] Peter Huber, The Old-New Division in Risk Regulation, 69 Va L Rev 1025 (1983).
[34] See Tammy Tengs et al.
[35] George Loewenstein, Risk As Feelings, 127 Psych Bull 267 (2001); Eric Posner, Law and the Emotions, 89 Geo. L. J. 1977, 1979-84 (2001).

the latter group pay twice as much? With some low-probability events, anticipated and actual emotions, triggered by the best-case or worst-case outcome, help to determine choice. Those who buy lottery tickets, for example, often fantasize about the goods associated with a lucky outcome.[36] With respect to risks of harm, many of our ordinary ways of speaking suggest strong emotions: panic, hysteria, terror. People might refuse to fly, for example, not because they are currently frightened, but because they anticipate their own anxiety, and they want to avoid it. It is well known that people often decide as they do because they anticipate their own regret.[37] The same is true for fear. Knowing that they will be afraid, people may refuse to travel to the Israel or South Africa, even if they would much enjoy seeing those nations and even if they believe, on reflection, that their fear is not entirely rational. Recent evidence is quite specific.[38] It suggests that people's neglect of significant differences in probability extreme when the outcome is "affect rich" – when it involves not simply a serious loss, but one that produces strong emotions, including fear.[39]

Drawing on and expanding this evidence, I will emphasize a general phenomenon here: In political and market domains, people often focus on the goodness or badness of the outcome in question, and pay (too) little attention to the probability that a good or bad outcome will occur. In such cases, people fall prey to what I will call probability neglect, which is properly treated as a form of quasi-rationality.[40] Probability neglect is especially large when people focus on the worst possible case or otherwise are subject to strong emotions. When such emotions are at work, people do not give sufficient consideration to the likelihood whether the worst case will occur. This is quasi-rational because, from the normative point of view, it is not fully rational to treat a 1% chance of X as equivalent, or nearly equivalent, to a 99% chance of X, or even a 10% chance of X. Because people suffer from probability neglect, and because neglecting probability is not fully rational, the phenomenon I identify casts additional doubt on the widespread idea that ordinary people have a kind of "richer rationality" superior to that of experts.[41] Most of the time, experts are concerned principally with the number of lives at stake,[42] and for that reason they will be closely attuned, as ordinary people are not, to the issue of probability.

By drawing attention to probability neglect, I do not mean to suggest that most people, most of the time, are indifferent to large variations in the probability that a risk will come to fruition. Large variations can and often do make a difference – but when emotions are engaged, the difference is less than standard theory predict. Nor do I mean

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[36] Philip Cook and Charles T. Clotfelter, Selling Hope (1991).
[37] G. Loomes and R. Sugden, Regret Theory: An Alternative Theory of Rational Choice Under Uncertainty, 92 Ec. Journal 805 (1982).
[38] See Yuval Rottenstreich and Christopher Hsee, Money, Kisses, and Electric Shocks: On the Affective Psychology of Probability Weighting, supra, at 186-88; Loewenstein et al., supra, at 276-78.
[39] Id.
[40] For the term, see Richard Thaler, Quasi-Rational Economics (1993).
[41] See Clayton Gillette and James Krier, Risk, Courts, and Agencies, 138 U Pa L Rev 1027, 1061-1085 (1990) (defending the idea of competing rationalities). I do not mean to deny that some of the time, ordinary people care, rationally, about values that experts disregard. All I mean to suggest is that insofar as people focus on the badness of the outcome but not on its likelihood, they are thinking less clearly than experts, who tend to focus on the statistical deaths at stake.
[42] See Paul Slovic, The Perception of Risk 113 (2001).

to suggest that probability neglect is impervious to circumstances. If the costs of neglecting probability are placed "on screen," then people will be more likely to attend to the question of probability.[43] In this light it is both mildly counterintuitive and reasonable, for example, to predict that people would be willing to pay less, in terms of dollars and waiting time, to reduce low-probability risks of an airplane disaster if they are frequent travellers. An intriguing study finds exactly that effect.[44] Finally, market pressures are highly likely to dampen the effect of probability neglect, ensuring that (say) risks of 1/10,000 are treated very differently from risks of 1/1,000,000, even if individuals, in surveys, show relative insensitivity to such differences. Acknowledging all this, I mean to emphasize three central points. First, differences in probability will often affect behavior less than they should, or than conventional theory would predict. Second, private behavior, even when real dollars are involved,[45] can display insensitivity to the issue of probability, especially when emotions are intensely engaged. Third, and most important, the demand for government intervention can be greatly affected by probability neglect, so that government may end up engaging in extensive regulation precisely because intense emotional reactions are making people relatively insensitive to the (low) probability that dangers will ever come to fruition.

It is not at all clear how the law should respond to this form of quasi-rationality. At first glance, we might think that if people are neglecting probability, government and law at least should not – that the tort system, and administrators, should pay a great deal of attention to probability in designing institutions. I will suggest that at a minimum, an understanding of probability neglect will help to understand how government and law might accomplish shared social goals. If government wants to insulate itself from probability neglect, it will create institutions designed to ensure that genuine risks, rather than tiny ones, receive the most concern. Such institutions will not require agencies to discuss the worst-case scenario.[46] And if government is attempting to increase public concern with a genuine danger, it should not emphasize statistics and probabilities, but should instead draw attention to the worst case scenario. If government is attempting to decrease public concern with a risk that has a tiny probability of coming to fruition, it may be ineffective if it emphasizes the issue of probability; indeed, it may do better if it changes the subject or stresses instead the affirmative social values associated with running the risk.[47]

An understanding of probability neglect will also help us to make better predictions about the public "demand" for law. When a bad outcome is highly salient and triggers strong emotions, government will be asked to do something about it, even if the probability of the bad outcome is low. An understanding of probability neglect also helps

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[43] Compare Howard Margolis, Dealing With Risk (1996) (emphasizing that when ordinary people differ from experts, it is often because ordinary people do not see the tradeoffs involved).

[44] See Matthew Harrington (unpublished manuscript).

[45] Consider here the expenditure of large sums of money on state lotteries, sums that result in part from vivid mental images of good outcomes; consider also the fact that some people are willing to spend significant sums to avoid risks that have a very low probability of coming to fruition.

[46] See Edward Fitzgerald, The Rise and Fall of Worst Case Analysis, 18 Dayton L Rev 1 (1992).

[47] Consider the fact that President Bush, in encouraging Americans to fly in the aftermath of the 9/11 attack, enphasized not the low probability of terrorism, but his view that flying would be a patriotic act.

show why jurors, and ordinary officials, are not likely to be much moved by a showing that before the fact, the harm was not likely to occur. For many people, what matters is that the harm occurred, not that it was unlikely to do so before the fact.

For law, the most difficult questions seem to be normative in character. Should government take account of variations in the probability that harms will occur? Should government respond to intense fears that involve statistically remote risks? When people suffer from probability neglect, should law and policy do the same thing? If it can, it seems clear that government should attempt to educate and inform people, rather than capitulating to unwarranted public fear. On the other hand, public fear, however unwarranted, may be intractable, in the sense that it is impervious to efforts at reassurance. And if public fear is intractable, it will cause serious problems, because fear is itself extremely unpleasant, and because fear is likely to influence conduct, producing (for example) wasteful and excessive private precautions. If so, a governmental response, via regulatory safeguards, would appear to be justified if the benefits, in terms of fear reduction, justify the costs.

III. Probability Neglect: The Basic Phenomenon

I will emphasize that when it comes to risk, a key question is whether people can imagine or visualize the "worst case" outcome.[48] When the worst case produces intense fear, little role is played by the stated probability that that outcome will occur.[49] An important function of strong emotions is thus to drive out quantitative judgments, including judgments about probability, by making the best case or the worst case seem highly salient.[50] But it is important to note that probability neglect is more general. A great deal of evidence shows that whether or not emotions are involved, people are relatively insensitive to differences in probabilities, at least when the relevant probabilities are low.

A. Insensitivity to Variations Among Low Probabilities

Do people care about probability at all? Of course they do; a risk of 1/100,000 is a significantly less troublesome than a risk of 1/1,000. But many people, much of the time, show a remarkable unwillingness to attend to the question of probability. Several studies show that when people are seeking relevant information, they often do not try to learn about probability at all. One study, for example, finds that in deciding to purchase warranties for consumer products, people do not spontaneously point to the probability of needing repair as a reason for the purchase.[51] Another study finds that those making

[48] Loewenstein et al., supra note, at 275-76.
[49] See Loewenstein, supra note; Yuval Rottenstreich and Christopher Hsee, Money, Kisses, and Electric Shocks: On the Affective Psychology of Probability Weighting, supra, at 186-88. The availability heuristic is obviously relevant here, interacting in interesting ways with affect.
[50] For a general argument that strong emotions can drive out other considerations, see George Loewenstein, A Visceral Account of Addiction, in Smoking: Risk, Perception, and Policy 188, 189-95 (Paul Slovic ed. 2001)
[51] Robin Hogarth and Howard Kunreuther, Decision Making Under Ignorance, 10 J Risk and Uncertainty 15 (1995).

hypothetical risky managerial decisions rarely ask for data on probabilities.[52] Perhaps these findings reflect people's implicit understanding that in these settings, the relevant probability is "low, but not zero," and that finer distinctions are unhelpful, partly because they are too complicated to try to unpack. (What does a risk of 1 in 100,000 really mean? How different is it, for an individual, than a risk of 1 in 20,000, or 1 in 600,000?) And indeed, many studies find that significant differences in (low) probabilities have little impact on decisions. This finding is in sharp conflict with the standard view of rationality, which suggests that people's willingness to pay for small risk reductions ought to be nearly proportional to the size of the reduction.[53] In an especially striking study, Kunreuther and his coauthors found that mean willingness to pay insurance premiums did not vary among risks of 1 in 100,000, 1 in 1 million, and 1 in 10 million.[54] They also found basically the same willingness to pay for insurance premiums for risks ranging from 1 in 650, to 1 in 6300, to 1 in 68,000.[55]

The study just described involved a "between subjects" design; subjects considered only one risk, and the same people were not asked to consider the several risks at the same time. Low probabilities are probably not terribly meaningful to most people, but people would know that a 1/100,000 risk is worse than 1/1 million risk. This is an example of what Hsee calls the problem of "evaluability."[56] For most people, most of the time, it is very difficult to evaluate a low probability, and hence isolated decisions will pick up small or no variations between people's assessments of very different risks.

But several studies have a "within subjects" design, and even here, differences in low probabilities have little effect on decisions. An early study examined people's willingness to pay (WTP) to reduce travel fatality risks. The central finding was that the mean WTP to reduce fatality risk by 7/100,000 was merely 15% higher than the mean WTP to reduce the risk by 4/100,000.[57] A later study found that for serious injuries, WTP to reduce the risk by 12/100,000 was only 20% higher than WTP to reduce the same risk by 4/100,000.[58] These results are not unusual. Lin and Milon attempted to elicit people's willingness to pay to reduce the risk of illness from eating oysters.[59] There was little sensitivity to variations in probability of illness.[60] A similar study found little change in WTP across probability variations involving exposure to pesticides residues on fresh

[52] O. Hoberet al., Active Information Search and Complete Information Presentation, 95 Acta Psychologica 15 (1997).
[53] Phaedra Corso et al., Valuing Morality Risk Reduction: Using Visual Aids to Improve the Validity of Contingent Valuation, 23 J. Risk and Uncertainty 165, 166-68 (2001).
[54] Howard Kunreuther et al., Making Low Probabilities Useful, 23 J Risk and Uncertainty 103, 107 (2001).
[55] Id. at 108-09.
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[57] Jones Lee et al. The Value of Safety: Results of a National Survey, 95 Ec J. 49 (1985).
[58] Jones Lee et al., Valuing the Prevention of Non-Fatal Road Injuries, 47 Oxford Economic Papers 676 (1995).
[59] Lin and Milon, Contingent Valuation of Health Risk Reductions for Shellfish Products, in Valuing Food Safety and Nutrition 83 (J.A. Caswell ed. 1995).
[60] Id.

produce.[61] A similar anomaly was found in a study involving hazardous wastes, where WTP actually decreased as the stated fatality risk reduction decreased.[62]

There is much to say about the general insensitivity to significant variations within the category of low-probability events. It would be difficult to produce a rational explanation for this insensitivity; recall the standard suggestion that WTP for small risk reductions should be roughly proportional to the size of the reduction.[63] Why don't people think in this way? An imaginable explanation is that in the abstract, most people simply do not know how to evaluate low probabilities. A risk of 7/100,000 seems "small"; a risk of 4/100,000 also seems "small."[64] These figures can be evaluated better if they are placed in the context of one another. Everyone would prefer a risk of 4/100,000 to a risk of 7/100,000, and joint evaluation improves evaluability, which would otherwise be extremely difficult.[65] But even when the preference is clear, both risks seem "small," and hence it is not at all clear that a proportional increase in WTP will follow. As noted, most of the studies described above were "within subjects" rather than "between subjects" and hence evaluability was promoted by the process of comparison. As suggested by the findings of Kunreuther and his coauthors, it is likely that in a between-subjects design, WTP to eliminate a risk of 4/100,000 would be about the same as WTP to eliminate a risk of 7/100,000, simply because the small difference would not matter when each risk is taken in isolation.

Note also that the studies just described involve contingent valuation, not real-world choices. A significant question is whether and when actual behavior, in consumer choice or political judgment, shows a general neglect of differences among low probabilities. In labor markets, for example, are risks of 4/100,000 compensated at about the same level as risks of 7/100,000? This would be a serious market failure. I am aware of no data on the question.[66] But we might expect that risk markets will reduce the problem of neglect, if only because some number of people will appreciate the relevant differences, and drive wage and prices in the appropriate direction. Consider an analogy: Most people probably do not know whether the right price for many consumer items is what it now is, or 120% or 80% of what it now is. Small price differences ($1? $10? $30?) would not matter to most consumers, at least for expensive products, and a consumer survey might well suggest that a modest increase or decrease in price would have no effect on most people. But lower priced products will sell more, and hence markets will pick up differences that do not matter to, or even register for, most consumers. Perhaps risk markets work in the same way.

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[61] Y.S Eom, Pesticide Residue Risk and Food Safety Valuation: A Random Utility approach, 76 Am. J. of Agric. Economics 760 (1994).
[62] V. K. Smith and W. H. Desvouges, An Empirical Analysis of the Economic Value of Risk Changes, 95 J Polit Economy 89 (1987).
[63] Phaedra Corso et al., Valuing Morality Risk Reduction: Using Visual Aids to Improve the Validity of Contingent Valuation, 23 J. Risk and Uncertainty 165, 166-68 (2001).
[64] Kunreuther et al., supra note, at 105.
[65] Christopher Hsee, Attribute Evaluability, in Choices, Values, and Frames, supra, at 543.
[66] W. Kip Viscusi, Fatal Tradeoffs (1992), reports a number of studies showing a wage premium for risky jobs, and these studies suggest, though they do not prove, that differences in low probabilities will be reflected in wages.

Quite apart from the effects of markets, some imaginative studies attempt to overcome probability neglect through visual aids[67] or through providing a great deal of information about comparison scenarios located on a probability scale.[68] Without these aids, it is not so surprising that differences in low probabilities do not much matter to people. For most of us, most of the time, the relevant differences – between, say, 1/100,000 and 1/1,000,000 – are not pertinent to our decisions, and by experience we are not well-equipped to take those differences into account.

I now turn from the general neglect of differences in low probabilities to the particular role of strong emotions in crowding out any assessment of probability, both low and less low. My central claim is that when strong emotions are involved, large-scale variations in probabilities will matter little – even when the variations unquestionably matter when emotions are not triggered. More generally, probability neglect is dramatically heightened when emotions are involved. The point applies to hope as well as fear; vivid images of good outcomes will crowd out consideration of probability too.[69] Lotteries are successful partly for this reason.[70] But the subject here is fear rather than hope.

B. A Simple Demonstration

The basic point has received its clearest empirical confirmation in a striking study of people's willingness to pay to avoid electric shocks.[71] The central purpose of the study was to test the relevance of probability in "affect rich" decisions. The experiment of central importance here attempted to see whether varying the probability of harm would matter more, or less, in settings that trigger strong emotions than in settings that seem relatively emotion-free. In the "strong emotion" setting, participants were asked to imagine that they would participate in an experiment involving some chance of a "short, painful, but not dangerous electric shock."[72] In the relatively emotion-free setting, participants were told that the experiment entailed some chance of a $20 penalty. Participants were asked to say how much they would be willing to pay to avoid participating in the relevant experiment. Some participants were told that there was a 1% chance of receiving the bad outcome (either the $20 loss or the electric shock); others were told that the chance was 99%; and still others were told that the chance was 100%.

The central result was that variations in probability affected those facing the relatively emotion-free injury, the $20 penalty, far more than they affected people facing the more emotionally evocative outcome of an electric shock. For the cash penalty, the

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[67] See Corso et al., supra.
[68] Howard Kunreuther et al., Making Low Probabilities Useful, 23 J Risk and Uncertainty 103 (2001)
[69] See Yuval Rottenstreich and Christopher Hsee, Money, Kisses, and Electric Shocks: On the Affective Psychology of Probability Weighting, supra, at 176-88
[70] See Phillip Cook, Selling Hope (1993).
[71] Yuval Rottenstreich and Christopher Hsee, Money, Kisses, and Electric Shocks: On the Affective Psychology of Probability Weighting, supra, at 176-88.

[72] Id. at 181.

difference between the median payment for a 1% chance and the median payment for a 99% chance was predictably large and indeed consistent with the standard model: $1 to avoid a 1% chance, and $18 to avoid a 99% chance.[73] For the electric shock, by contrast, the difference in probability made little difference to median willingness to pay: $7 to avoid a 1% chance, and $10 to avoid a 99% chance![74] Apparently people will pay a significant amount to avoid a small probability of a hazard that is affectively-laden – and the amount that they will pay will not vary greatly with changes in probability.

C. A More Complex Demonstration

To investigate the role of probability and emotions in responses to risk, I conducted an experiment asking about one hundred University of Chicago law students to describe their maximum willingness to pay to reduce levels of arsenic in drinking water. The questions had a high degree of realism. They were based on actual choices confronting the Environmental Protection Agency, involving cost and benefit information within the ballpark of actual figures used by the agency itself.[75]

Participants were randomly sorted into four groups, representing the four conditions in the experiment. In the first condition, people were asked to state their maximum willingness to pay to eliminate a cancer risk of one in 1,000,000.[76] In the second condition, people were asked to state their maximum willingness to pay to eliminate a cancer risk of one in 100,000. In the third condition, people were asked the same question as in the first, but the cancer was described in vivid terms, as "very gruesome and intensely painful, as the cancer eats away at the internal organs of the body." In the fourth condition, people were asked the same question as in the second, but the cancer was described in the same terms as in the third condition. In each condition, participants were asked to check off their willingness to pay among the following options: $0, $25, $50, $100, $200, $400, and $800 or more. Notice that the description of the cancer, in the "highly emotional" conditions, was intended to add little information, consisting simply of a description of many cancer deaths, though admittedly some participants might well have thought that these were especially horrific deaths.

The central hypothesis was that the probability variations would matter far less in the highly emotional conditions than in the less emotional conditions. More specifically, it was predicted that differences in probability would make little or no difference in the highly emotional conditions -- and that such variations would have real importance in the less emotional conditions. This prediction was meant to describe a substantial departure from expected utility theory, which predicts that an ordinary, risk-averse person should be willing to pay more than 10X to eliminate a risk that is ten times more likely than a risk that he is willing to pay X to eliminate.[77] It was also expected that the ten-fold

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[73] Id.
[74] Id.
[75] See Cass R. Sunstein, The Arithmetic of Arsenic, Georgetown L.J (forthcoming).
[76] Note that the phrasing of the question ensures that participants would think of the reduction of the risk to zero, rather than to some fraction of what it was before. People are willing to pay far more to eliminate risks than to reduce them, even if the savings are identical. See Kahneman and Tversky, supra note.
[77] See Corso et al., supra.

difference in probabilities – between 1/100,000 and 1/1,000,000 – would not, in either condition, generate a ten-fold difference in willingness to pay.

Here are the results in tabular form:

	Unemotional description, median (mean in parentheses)	**Emotional description, median (mean in parentheses)**
1/100,000	$100 ($194.44)	$100 ($241.30)
1/1,000,000	$25 ($71.25)	$100 ($132.95)

In short, the central hypothesis was confirmed. In the highly emotional condition with a 1/100,000 risk, the median willingness to pay was $100. In the highly emotional condition with a 1/1,000,000 risk, the median WTP was exactly the same. In sharp contrast, variations in probability made a significant difference in the less emotional conditions. For a 1/100,000 risk, the median WTP was $100. But for a 1/1,000,000 risk, it was merely $25. If we investigate the means, the central finding is reduced but in the same ballpark: The difference in probability had a far greater impact in the less emotional condition (an increase from $71.25 to $194.44, or about 180%, as opposed to an increase from $132.95 to $241.30, or about 80%).

From this experiment, there are several other noteworthy findings. By itself, the highly emotional description of the cancer had a substantial effect on WTP, holding probability constant. For the 1/1,000,000 risk, the emotional description increased median WTP fourfold, from $25 to $100, and nearly doubled the mean, from $71.25 to $132.95. For the 1/100,000 risk, the median stayed constant ($100), but the mean was significantly affected, rising from $194.44 to $241.30.[78] At the same time, and basically consistent with other work on probability neglect, varying the probability had a relatively weak effect on WTP in both conditions. In the emotional conditions, the tenfold increase in the risk had no effect on the median and did not even double the mean, which increased merely from $132.95 to $241.30. In the less emotional conditions, that tenfold increase moved the median from $25 to $100, while moving the mean from $71.25 to $194.44. It is noteworthy that in this experiment, the relatively sophisticated participants in the study showed far more susceptibility to probability information than in the studies, described above, by Kunreuther et al.; but even so, the susceptibility was far less than conventional (normative) theory would predict.[79]

Indeed, the effect of the more emotional description of the outcome was essentially the same as the effect of the tenfold increase in its probability. My principal emphasis, however, is on the fact that when the question was designed to trigger

[78] This relatively small effect might be a product of the fact that the less emotional description did, after all, involve a cancer death, which is known to produce strong reactions. See Richard Revesz, Environmental Regulation, Cost-Benefit Analysis, and the Discounting of Human Lives, 99 Col L Rev 941 (1999). A more pronounced effect might be expected if the death was simply described as a death.
[79] See id.

especially strong emotions, variations in probability had little effect on WTP, far less of an effect than when the question was phrased in less emotional terms. This is the kind of probability neglect that I am emphasizing here.

D. Other Evidence

Probability neglect, when strong emotions are involved, has been confirmed in many studies.[80] Consider, for example, experiments designed to test levels of anxiety in anticipation of a painful electric shock of varying intensity, to be administered after a "countdown period" of a stated length. In these studies, the stated intensity of the shock had a significant effect on physiological reactions. But the probability of the shock had no effect. "Evidently, the mere thought of receiving a shock was enough to arouse subjects, and the precise likelihood of being shocked had little impact on their arousal level."[81] A related study asked people to provide their maximum buying prices for risky investments, which contained different stated probabilities of losses and gains of different magnitudes.[82] Happily for the standard theory, maximum buying prices were affected by the size of losses and gains and also by probabilities. (Note that for most people, this experiment did not involve an affect-rich environment.) But – and this is the key point -- reported feelings of worry were not much affected by probability levels.[83] In this study, then, probability did affect behavior, but it did not affect emotions. The point has independent importance: Worry is an individual loss, even if it does not affect behavior.[84] And in most of the cases dealt with here, intense emotions drive out concern with probability, and hence both behavior and worry are affected.

It should not be surprising, in this light, that visualization or imagery matters a great deal to people's reactions to risks.[85] When an image of a bad outcome is easily accessible, people will become greatly concerned about a risk, holding probability constant.[86] Consider the fact that when 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.[87] The evident explanation for this peculiar result is that the word "terrorism" evokes vivid images of disaster, thus crowding out probability judgments. Note also that when people discuss a low-probability risk, their concern rises even if the discussion consists mostly of

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[80] For an overview see George Loewenstein et al., Risk As Feelings, 127 Psych Bulletin 267, 276 (2001).
[81] Id.
[82] Id.
[83] Id.
[84] Note a converse point: Anticipated gain is a social benefit, even if its likelihood is low. If people receive substantial benefits from anticipating winning the lottery, there is a point in favor of having lotteries, even if almost everyone loses – at least if the pain of the loss does not outweigh the pleasure o ant
[85] See Paul Slovic et al., Violence Risk Assessment and Risk Communication, 24 Law and Human Behavior 271 (2000).
[86] See Loewenstein et al., supra, at 275-76.
[87] See E.J. Johnson et al., Framing, Probability Distortions, and Insurance Decisions, 7 H. Risk and Uncertainty 35 (1993).

apparently trustworthy assurances that the likelihood of harm really is infinitesmal.[88] The reason is that the discussion makes it easier to visualize the risk and hence to fear it. Note that if probability neglect is involved, this is not a point about the availability heuristic, which leads not to neglect probability, but answer the question of probability by substituting a hard question (what is the statistical risk?) with an easy question (do salient examples readily come to mind?).[89] My point here is not that visualization makes an event seem more probable (though this is also often true), but that visualization makes the issue of probability less relevant or even irrelevant. In theory, the distinction between use of the availability heuristic and probability neglect should not be obscure. In practice, of course, it will often be hard to know whether the availability heuristic or probability neglect is driving behavior.

Emotional reactions to risk, and probability neglect, also account for "alarmist bias."[90] When presented with competing accounts of danger, people tend to move toward the more alarming account.[91] In the key study, W. Kip Viscusi presented subjects with information from two parties, industry and government. Some subjects were given low-risk information from government, and high-risk information from industry; other subjects were given high-risk information from government, and low-risk information from industry. The basic result was that people treated "the high risk information as being more informative."[92] This pattern held regardless of whether the low risk information came from industry or from government. Thus people show "an irrational asymmetry: respondents overweight the value of a high risk judgement."[93] If the discussion here is correct, one reason is that the information, whatever its content, makes people focus on the worst case. There is a lesson for policy here: It might not be helpful to present people with a wide range of information, containing both assuring and less assuring accounts.

The most sensible conclusion is that with respect to risks of injury of harm, 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.[94] "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."[95] With respect to hope, those who operate gambling casinos and state lotteries are well-aware of the underlying mechanisms. They play on people's emotions in the particular sense that

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[88] See A.S. Alkahami and Paul Slovic, A Psychological Study of the Inverse Relationship Bteween Perceived Risk and Perceived Benefit, 14 Risk Analysis 1086, 1094-94 (1994).
[89] See Amos Tversky and Daniel Kahneman, Availability: A Heuristic for Judging Frequency and Probability, 5 Cognitive Psychology 207 (1973).
[90] W.Kip Viscusi, Alarmist Decisions With Divergent Risk Information, 107 Ec. Journal 1657, 1657-59 (1997)
[91] Id.
[92] Id. at 1666.
[93] Id at 1668.
[94] It would be tempting to venture a sociobiological explanation for probability neglect. While plausible, such an explanation would be highly speculative: We could imagine sociobiological explanations both for probability neglect and for intense concern with probability. I emphasize empirical evidence here, not theoretical accounts.

[95] See Weingart, supra note 1, at 362.

they conjure up palpable pictures of victory and easy living. With respect to risks, insurance companies and environmental groups do exactly the same. The point explains "why societal concerns about hazards such as nuclear power and exposure to extremely small amounts of toxic chemicals fail to recede in response to information about the very small probabilities of the feared consequences from such hazards."[96]

E. Probability Neglect and "Rival Rationality"

When it comes to risk, why do experts disagree with ordinary people? Many people think that the reason lies in the fact that ordinary people have a "rival rationality."[97] On this view, experts are concerned with statistics, and above all with the number of lives at stake. By contrast, ordinary people are concerned with a range of qualitative factors that can make certain risks a special cause of concern. People care, for example, about whether risks are voluntarily incurred, potentially controllable, inequitably distributed, especially dreaded, and so forth. For those who believe that ordinary people display a rival rationality, experts seem obtuse, fixated as they are on the "bottom line" numbers.

There is undoubtedly some truth in the idea that ordinary people consider factors that the numbers alone will obscure. If the costs of risk-avoidance are especially high, government should make special efforts to reduce the relevant risk; if a risk is concentrated among poor people, or members of a disadvantaged group, government should be particularly concerned. But it is most doubtful that the idea of rival rationality can explain all or even most of the disagreement between experts and ordinary people. When people are far more concerned than experts about shark attacks, or nuclear power, or terrorism, probability neglect is a large part of the reason. This point is closely connected with the suggestion that an "affect heuristic" helps explain people's concern, or lack of concern, with certain risks.[98] When people have a strong negative affect toward a process or product – arsenic or nuclear power – they are not likely to think much about the question of probability, and hence they will overreact from the normative standpoint. Here there is irrationality, not a rival rationality. And when people have a strong positive affect toward a process or product – in some communities, for example, alcohol or cigarettes, or herbal cures, or organic foods – they are not likely to think of the risks, even though the probability of harm is not low. Here too there is irrationality. My suggestion, then, is that probability neglect offers a new if partial explanation for the division between experts and ordinary people in thinking about social hazards – one that raises fresh doubts about claims of rival rationality.

F. Notes on the Media and on Heterogeneity

From what has been said thus far, it should be clear that news sources can do a great deal to trigger fear, simply by offering examples of situations in which the "worst

[96] See Paul Slovic et al., The Affect Heuristic, forthcoming in Intuitive Judgment: Heuristics and Biases (Tom Gilovich et al. eds, forthcoming), unpublished manuscript at 11.
[97] See Paul Slovic, The Perception of Risk (2001).
[98] See Slovic, supra note.

case" has actually come to fruition. For crime, the point is well established.[99] Media coverage of highly unusual crimes makes people fearful of risks that they are most unlikely to face.[100] When newspapers and magazines are emphasizing deaths from anthrax or mad cow disease, we should expect a significant increase in public concern, not only because of the operation of the availability heuristic, but because people will not naturally make sufficient adjustments from the standpoint of probability. In fact there is a large warning here. If newspapers, magazines, and news programs are stressing certain harms from remote risks, people's concern is likely to be out of proportion to reality. Significant changes should therefore be expected over time.[101] Across nations, it is also easy to imagine substantial differences, in social fear, if small initial differences are magnified as a result of media influences.[102]

It is also true that individuals and even societies differ in their susceptibility to probability neglect. Though experiments have not been conducted on the precise point, it is clear that some people take probability information into account even when the context ordinarily engages human emotions. It also seems clear that some people neglect probability information much of the time, focussing insistently on the worst case (or for that matter the best). The arsenic experiment, mentioned above, displays a great deal of individual heterogeneity in taking account of probability.[103] Those who are peculiarly insensitive to probability information are likely to do poorly in many domains, including economic markets; those who are unusually attentive to that information are likely to do well for just that reason. Perhaps there are demographic differences here; it is well-known that some groups are less concerned about most risks than are others,[104] and that the difference in concern may stem, in part, from the fact that some groups are less likely to neglect probability.

On the social level, institutions can make a great deal of difference in decreasing or increasing susceptibility to probability neglect. Highly responsive democratic institutions, automatically translating public fear into law, will neglect probabilities when emotions are running high. A more deliberative democracy would attempt to create institutions that have a degree of immunity from short-turn public alarm.[105] Cost-benefit analysis might, for example, serve as a check on regulation that would accomplish little good, or less good than is justified by the facts.[106] The point raises the general question of the relationship between probability neglect and law.

IV. Law

If emotionally charged outcomes produce intense reactions even though they are highly unlikely to occur, how might our understanding of law be improved? To answer

[99] See Joel Best, Random Violence: How We Talk About New Crimes and New Victims (1999).
[100] Id.
[101] See the account of fears of criminal violence in id.
[102] See the discussion of multiple equilibria in Kuran and Sunstein, supra note, at 743-46.
[103] Unpublished data on file, University of Chicago Law School.
[104] See Slovic, supra note, at 396-402.
[105] See Kuran and Sunstein, supra note; Cass R. Sunstein, Risk and Reason (forthcoming 2002).
[106] Matthew Adler and Eric Posner, Rethinking Cost-Benefit Analysis, 109 Yale LJ 167 (1999).

this question, it is important to separate law's prescriptive, positive, and normative tasks.[107] With prescriptive analysis, we seek to find effective ways to achieve shared goals; positive analysis attempts to explain why law takes the form that it does; normative analysis explores what law should do. I take these up in sequence.

A. Prescriptions: Obtaining Agreed-Upon Goals

Suppose that government is seeking to lead people to achieve goals on which there is a social consensus. Government might, for example, want to encourage people to avoid large risks and to worry less over small risks. If so, it would do well to attempt not to provide information about probabilities, but to appeal to people's emotions and to attend to the worst case. With respect to the risks on which it wants people to focus, government should use vivid images of alarming scenarios. For 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 that if they smoke, they will be dupes of the tobacco companies or imposing harms on innocent third parties – and they do so especially by providing vivid images of illness or even death.[108]

Because of probability neglect, it should not be terribly difficult to trigger public fear (terrorism is effective in part for exactly that reason). But there are serious ethical issues here. Government ought to treat its citizens with respect[109]; it should not treat them as objects to be channeled in government's preferred directions. Perhaps government ought not to manipulate or to trick them, by taking advantage of their limitations in thinking about risk. A skeptic might think that the use of worst-case scenarios, or dramatic images of harm, consists of unacceptable manipulation. While I cannot fully resolve the issue here, the charge seems to me unwarranted. So long as the government is democratically accountable, and attempting to discourage people from running genuinely serious risks, there should be no objection in principle. Those who want people to run risks, for economic or other purposes, use similar techniques,[110] and government should probably be permitted to meet fire with fire. Democratic accountability is important because it is a check on manipulative behavior; if government is manipulating people in an objectionable way, citizens are likely to rebel. Of course the issue is not simple. In the context of state lotteries, state governments use dramatic images of "easy street" in order to lead people to spend money for tickets whose actuarial value is effectively zero, and this strategy, exploiting probability neglect in the domain of hope, does raise ethical issues.[111] My suggestion is only that if government wants people not to run risks, it is likely to do well if it appeals to their emotions.

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[107] See Christine Jolls et al., A Behavioral Approach to Law and Economics, 50 Stan L Rev 1471, 1474 (1998).

[108] See Lisa Goldman and Stanton Glantz, Evaluation of Antismoking Advertising Campaigns, 279 Journal of the American Medical Association 772 (1998).

[109] See the discussion of the publicity condition in John Rawls, A Theory of Justice (1971), a condition that raises some questions about any governmental effort to enlist probability neglect in its preferred directions.

[110] See Smoking (Paul Slovic ed. 2001).

[111] See Philip Cook and Charles T. Clotfelter, Selling Hope (1991).

There is also a striking asymmetry between increasing fear and decreasing it. If people are now alarmed about a low-probability hazard, is there anything that government can do to provide assurance and to dampen concern? This is an unanswered question. The only clear point is that if government is unlikely to be successful if it simply emphasizes the low probability that the risk will occur. There appears to be no evidence that any particular strategy will succeed. But the best approach seems to be simple: change the subject. We have seen that discussions of low-probability risks tend to heighten public concern, even if those discussions consist largely of reassurance. Perhaps the most effective way of reducing fear of a low-probability risk is simply to discuss something else and to let time do the rest. Of course media attention can undermine this approach.

As I have suggested, institutional safeguards might well be the best way of ensuring against the harmful consequences of probability neglect. The Office of Information and Regulatory Affairs, within the Office of Management and Budget, monitors agency action to ensure that it is directed against significant problems.[112] A general requirement of cost-benefit balancing should provide a check on regulations that cannot be grounded in objective fact.[113] If government wants to protect itself against the pattern of "paranoia and neglect"[114] that now characterizes regulatory policy, analytic requirements and institutional checks will provide a start.

B. Positive Analysis: What Drives the Demand For Law?

If probability neglect characterizes individual judgment under certain circumstances, might government and law be neglecting probability under those same circumstances? There is good reason for an affirmative answer. In the domain of risk regulation as elsewhere, public officials are highly responsive to the public demand for law. If people insist on government protection against risk, government is likely to provide that protection. If people show unusually strong reactions to low-probability catastrophes, government is likely to act accordingly. Of course interest groups are involved as well. When their self-interest is at stake, we should expect them to exploit people's emotions, in particular by stressing the worst case.

In the environmental area, for example, there has been an intense debate about whether the National Environmental Policy Act requires agencies to discuss the worst-case scenario in environmental impact statements.[115] Environmental groups sought to ensure discussion of that scenario.[116] They did so in part to stimulate public concern, with the knowledge that the worst case might well have a great deal of salience, even if it is highly unlikely. If the account here is correct, the environmental groups were entirely rational in arguing on behalf of worse case analysis, for that form of analysis would help

[112] For an overview, see http://www.whitehouse.gov/omb/inforeg/regpol.html
[113] See Kuran and Sunstein, supra note.
[114] John D. Graham, Making Sense of Risk: An Agenda for Congress, in Risks, Benefits, and Lives Saved 183, 183, Robert Hahn ed. (New York: Basic Books, 1996).
[115] See Robertson v. Methow Valley Citizens Council, 490 US 332 (1989); Robert Percival et al., Environmental Regulation 903-04 (3d ed. 2000).
[116] See Edward Fitzgerald, The Rise and Fall of Worst Case Analysis, 18 Dayton L Rev 1 (1992).

promote their political goals. For its part, the government originally required discussion of the worst case; but during the Reagan Administration, it changed in its mind, with the apparent understanding that people are too likely to overreact. The Reagan era shift was a fully rational approach to quasi-rationality, meant to protect against the kinds of distortions that can come from probability neglect. Hence the current approach, upheld by the Supreme Court,[117] requires consideration of low-probability events, but only if they are not entirely remote and speculative.

A good deal of legislation and regulation can be explained partly by reference to probability neglect when emotions are running high. In this space, I cannot demonstrate the point rigorously, especially because many mechanisms contribute to the regulatory responses. I have indicated that it is difficult to know, in particular cases, whether the availability heuristic is leading to an inflated judgment of probability, or whether probability is instead being neglected. I have also noted that interest groups often exploit heuristics and biases, not excluding probability neglect, and hence public choice accounts are compatible with accounts that emphasize probability neglect. But consider a few examples[118]:

- In the aftermath of the adverse health effects allegedly caused by abandoned hazardous waste in Love Canal, the government responded with an aggressive program for cleaning up abandoned hazardous waste cites, without examining the probability that illness would actually occur. In fact little was accomplished by early efforts to assure people of the low probability of harm.[119] When the local health department publicized controlled studies showing little evidence of adverse effects, the publicity did not dampen concern, because the numbers "had no meaning."[120] In fact the numbers seemed to aggravate fear, insofar as they discussed the problem at all: "One woman, divorced and with three sick children, looked at the piece of paper with numbers and started crying hysterically: 'No wonder my children are sick. Am I doing to die? What's going to happen to my children?'"[121] Questions of this sort contributed to the enactment of new legislation to control abandoned hazardous waste sites, legislation that did not embody careful consideration of the probability of significant health or environmental benefits.[122] Even now, the government does not take much account of the probability of significant harm in making clean-up decisions.[123]
- During a highly publicized campaign designed to show a connection between Alar, a pesticide, and cancer in children, the public demand for action was not

[117] Id.
[118] The catalogue in Aaron Wildavsky, But Is It True (1997), offers many illustrations of inadequately founded health and safety scares, many of which might be analyzed in the terms used here,
[119] See Timur Kuran and Cass R. Sunstein, Availability Cascades and Risk Regulation, 51 Stan. L. Rev. 683, 691-98 (1999).
[120] Lois Marie Gibbs, Love Canal: The Story Continues 25 (1998).
[121] Id.
[122] See Kuran and Sunstein, supra note; James Hamilton and W. Kip Viscusi, Calculating Risks (2000).
[123] See Hamilton and Viscusi, supra note (discussing lack of government interest in size of population affected).

much affected by the EPA's cautionary notes about the low probability of getting that disease.[124]

- In the fall of 2001, vivid images of shark attacks created a public outcry about new risks for ocean swimmers.[125] Consider the fact that a NEXIS search found no fewer than 940 references to shark attacks between August 4, 2001, and September 4, 2001,[126] with 130 references to "the summer of the shark."[127] This was so notwithstanding the exceedingly low probability of a shark attack, and the absence of any reliable evidence of an increase in shark attacks in the summer of 2001.[128] Predictably, there was considerable discussion of new legislation to control the problem,[129] and eventually such legislation was enacted.[130] Public fear seemed relatively impervious to the fact that the underlying risk was tiny.
- Jury behavior is not likely to be greatly affected by assurance that the risk was unlikely to come to fruition, even if the issue of probability is legally relevant.[131] In cases involving low-probability risks of emotionally gripping harms, it should be relatively easy to convince jurors to offer high damage awards. Litigators therefore do well to try to engage jurors' emotions by pointing to the worst case. There is a strong implication here for the law of negligence: Even if the law asks the jury to balance the benefits of the defendant's action against the costs, the jury is likely to disregard the issue of probability if its attention is focussed on an outcome that triggers strong

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[124] See Robert Percival et al., supra note, at 524.

[125] See Howard Kurtz, Shark Attacks Spark Increased Coverage, Washington Post On-Line, Sept. 5, 2001, available at http://www.washingtonpost.com/wp-dyn/articles/A44720-2001Sep5.html: "A maritime expert said on last night's 'NBC Nightly News' that more people die from bees, wasps, snakes or alligators than from shark attacks. But there's no ratings in bees. Unpleasant little critters, but not scary-looking enough.With 'Jaws' music practically playing in the background, the media have turned this into the Summer of the Shark. Never mind that the number of attacks has actually dropped since last year. They're here, they're nasty and they could be coming to a beach near you."

[126] NEXIS search, Sept. 4, 2001. In fact Time Magazine offered a widely discussed cover story on sharks and shark attacks under a screaming cover entitled, Summer of the Shark, see Terry McCarthy, Why Can't We Be Friends?; A horrific attack raises old fears, but new research reveals surprising keys to shark behavior, Time Magazine, July 30, 2001, at p. 34. The story itself suggested that the probability of being attacked by a shark is about 1/30 the probability of being struck by lightning. Id.

[127] NEXIS search, Sept. 4, 2001.

[128] For data on shark attacks, see http://www.flmnh.ufl.edu/fish/Sharks/ISAF/ISAF.htm. The cite offers comparative risk data, showing, for example, that while there were 18 shark injuries and deaths in the United States in 1996, there were 10,000 injuries and deaths from buckets and pails, over 1,500 injuries and deaths from toilet bowl products, and over 198,000 injuries and deaths from nails, tacks, screws, and bolts.

[129] See Maya Bell, DIVERS DEFEND COURTING THE FISH SO MANY FEAR; A WAVE OF RECENT SHARK ATTACKSHAS BROUGHT SOUTH FLORIDA SHARK-FEEDING GROUPS UNDER STATE SCRUTINY; MAKING FRIENDS WITH THE TOOTHY TERRORS DESTROYS THEIR AVERSION TO PEOPLE AND ENCOURAGES AGGRESSION, OTHER EXPERTS SAY, THE ORLANDO SENTINEL, p. A1, August 29, 2001,

[130] See Florida commission bans shark feeding, November 1, 2001, posted: 2:20 PM EST (1920 GMT), available at http://www.cnn.com/2001/TRAVEL/NEWS/11/01/shark.feeding.ap/index.html

[131] See Phantom Risk: Scientific Inference and the Law (Kenneth Foster et al. eds 2000).

emotions. Along the same lines, an understanding of probability neglect helps explain the finding, in both experimental and real-world settings, that juries do not respond favorably to a demonstration that the defendant performed a cost-benefit analysis before proceeding, even if the analysis places a high value on human life.[132] The reason is that jurors will be focussing on the badness of the outcome, not the low (ex ante) probability that it would have occurred.

- The anthrax scare of October, 2001 was based on exceedingly few incidents. Only four people died of the infection; only about a dozen others fell ill. The probability of being infected was exceedingly low. Nonetheless, fear proliferated, with people focussing their attention on the outcome rather than the low probability of the harm. The government responded accordingly, investing massive resources in ensuring against anthrax infections. Private institutions reacted the same way, asking people to take extraordinary care in opening the mail even though the statistical risks were tiny (see appendix for an example). To say this is not to suggest that extensive precautions were unjustified in this case. Private and public institutions faced an unknown probability of a major health problem, and it was appropriate to respond. My point is that public fear was disproportionate to its cause, and that the level of response was disproportionate too.

C. Normative Issues: Capitulating to Fear?

For law, the hardest questions might well be normative ones: How should law and government respond to a quasi-rational public panic, based on an intense emotional reaction to a low-probability risk? Let us distinguish two possible positions. The technocrat would want to ignore public irrationality, and to respond to risks if and to the extent that they are real. The populist would want to respond to public concerns, simply because they are public concerns. In my view, both positions are far too simple, though the populist is closer to the mark.

Suppose that people are greatly concerned about a risk that has a small or even miniscule probability of occurring -- shark attacks, or anthrax in the mail, or terrorism on airplanes. If government is confident that it knows the facts, and if people are far more concerned than the facts warrant, should the government respond, via regulation, to their concerns? Or should it ignore them, on the ground that the concerns are irrational? Consider the individual analogy first. Even if people's fear is itself irrational, it might well be rational for them to take account of that fear in their behavior. If I am afraid to fly, I might decline to do so, on the ground that my fear will make the experience quite dreadful (not only while flying but in anticipating it). At the same time, the fear itself might be irrational, and I might even recognize that fact. If the fear exists, but if I cannot eliminate it, the most rational decision might be not to fly. So too at the social level. Suppose, for example, that people are afraid of arsenic in drinking water, and that they demand steps to provide assurance that arsenic levels will not be hazardous. Suppose too that the risks from existing levels of arsenic are infinitesmal. Is it so clear that government should refuse to do what people want it to do? The fear is by hypothesis real.

[132] See W. Kip Viscusi, Corporate Risk Analysis: A Reckless Act?, 52 Stan. L. Rev. 547 (2000).

If people are scared that their drinking water is "not safe," they are, simply for that reason, experiencing a significant loss. In many domains, widespread fear helps produce an array of additional problems. It may, for example, make people reluctant to engage in certain activities, such as flying on airplanes or eating certain foods. The resulting costs can be extremely high.[133] Why shouldn't government attempt to reduce fear, just as it attempts to produce other gains to people's well-being?

Compare in this regard the issue of hope. State governments encourage people to purchase lottery tickets, and in doing so they call people's attention to the best-case outcome, with vivid images of the great riches that are available to the victors. The analysis here suggests that governments are taking advantage of probability neglect to manipulate people into paying what is, in effect, a regressive tax. But it would be possible to respond that hope is itself a subjective good, and that those who buy lottery tickets, with the best case firmly in view, are able to enjoy life more than they would if they simply calculated the discounted value of the tickets. Certainly lottery tickets give people far more than they would get by paying the same amount in taxes. If this argument is plausible, because hope is an independent good, to be encouraged even if it is quasi-rational, then perhaps fear too should be reduced, because it is an independent bad even if it is quasi-rational.

The simplest answer here is that if government is able to inform and educate people, it should do that instead. It should not waste resources on steps that will do nothing other than to reduce fear. But the simplest answer is too pat. Whether information and education will work is an empirical question on which we lack definitive evidence. If these do not work, government should respond, just as individuals do, to fears that are quasi-rational, but real and by hypothesis difficult to eradicate. Suppose, for example, that government could cheaply undertake a procedure that would reduce a tiny risk to zero – and equally important, be seen to reduce the relevant risk to zero. It seems clear that government should take this step, which may be more effective, and less expensive, than education and information. Recall that fear is a real social cost, and it is likely to lead to other social costs.[134] If, for example, people are afraid to fly, the economy will suffer in multiple ways; so too if people are afraid to send or to receive mail. The reduction of even baseless fear is a social good.

Even if it is clear that government should respond, many questions remain. How and how much should government respond? The answer must depend in large part on the extent of the fear and the cost of the response. If people are extremely fearful, a substantial response is of course easier to justify; if the cost of response is very high, a

[133] The mad cow disease scare is an example, producing many millions of dollars in losses.

[134] My point here is not that all subjective perceptions and losses should be counted in law. Many people, for example, like to discriminate on the basis of race and sex, and they suffer a genuine loss, for which they might be willing to pay, as a result of the legal prohibition on discrimination. I do not believe that their loss should be counted, though I cannot defend the point here. See Matthew Adler and Eric Posner, Implementing Cost-Benefit Analysis When Preferences Are Distorted, in Cost-Benefit Analysis 269 (Matthew Adler and Eric Posner eds. 2001), for a helpful discussion. Although the fear discussed in the text is not fully rational, it cannot be said to be invidious or vicious, and hence cannot be "impeached" in the same way as discriminatory preferences.

refusal to respond might well make sense. With this point, the analysis of appropriate action becomes similar to the analysis in many other settings. We need to know how much good, and how much harm, would be done by the action in question. A special difficulty here consists in the problem of quantifying and monetizing fear and its consequences, a problem that has yet to be seriously engaged in the relevant literature.[135]

V. What's an Emotion?

Thus far I have been writing as if there is a clear distinction between cognition and emotion. But actually the distinction is complex and contested.[136] In the domain of risks, and most other places, emotional reactions are usually based on thinking; they are hardly cognition-free. When a negative emotion is associated with a certain risk – pesticides or nuclear power, for example – cognition is playing a central role. In fact there are large debates about whether an emotion is a form of thought, or whether thoughts are necessary and sufficient conditions for emotions, or whether emotions is a sense precede or outrun cognition.[137] But it is clear that no simple line can be drawn between emotions and cognition in most social domains. Whatever they are, emotions can lead us astray; but the same is true for math, biology, and animal experiments.

There are several ways to make progress here. Some research suggests that the brain has special sectors for emotions, and that some types of emotions, including some fear-type reactions (my emphasis here), can be triggered before the more cognitive sectors become involved at all.[138] Those who hear sudden, unexplained noises are fearful before they are able to identify the source of the noise.[139] People who have been given intravenous injections of procaine, which stimulates the amygdala, report panic sensations.[140] In research with human beings, electrical stimulation of the amygdala leads to reported feelings of fear and foreboding, even without any reason for these things, leading people to say, for example, that they feel as if someone were chasing them.[141] It is not true, however, that fear in human beings is generally pre-cognitive or noncognitive, and even if it is in some cases, it is not clear that noncognitive fear would be triggered by most of the risks faced in everyday human lives.

For purposes of the analysis here, it is not necessary to say anything especially controversial about the nature of the emotion of fear. I do think that when that emotion is involved, some kind of arousal is necessary; we would not say that someone is really

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[135] For a good overview, see W. Kip Viscusi, Rational Risk Regulation (2000).
[136] For varying views, see Ronald deSousa, The Rationality of Emotion (1993); Jon Elster, Alchemies of the Mind (1999); Martha Nussbaum, Upheavals of Thought (2001).
[137] See id.
[138] See Joseph LeDoux, The Emotional Brain (1996).
[139] R.B. Zajonc, On the Primacy of Affect, 39 Am Psych 117 (1984); R.B. Zajonc, Feeling and Thinking: Preferences Need No Inferences, 35 Am Psych 151 (1980).
[140] Servan-Schreiber and Perlstein, Selective Limbic Activation and its Relevance to Emotional Disorders, 12 Cognition & Emotion 331 (1998).
[141] J. Panksepp, Mood Changes, in Handbook of Clinical Neurology (P.J. Vinken et al. eds. 1985).

afraid without some kind of arousal.[142] But if people have a negative reaction to the prospect of electric shocks, or flying, or anthrax, thinking is emphatically involved. The only suggestion is that when emotions are intense, calculation is less likely to occur, or at least that form of calculation that involves assessment of risks in terms of not only the badness but also the probability of the outcome. That point is sufficient for my arguments here.

VI. Conclusion

In this Essay, my central claim has been that the probability of harm is often neglected when people's emotions are activated, especially if people are thinking about the worst-case scenario. If that scenario is vivid and easy to visualize, large-scale changes in thought and behavior are to be expected. The point may be stronger in political than in market domains, at least if the costs of neglecting probability are not in the minds of those who are engaged in probability neglect. The general phenomenon helps to explain public overreaction to highly publicized, low-probability risks, including those posed by abandoned hazardous waste dumps, nuclear waste disposal, and anthrax. Because rational people focus on the probability as well as the severity of harm, probability neglect is a form of quasi-rationality.

It follows that if a private or public actor is seeking to produce public attention to a neglected risk, it is best to provide vivid, even visual images of the worst that might happen. It also follows that government regulation, affected as it is by the public demand for law, may well neglect probability too. At first glance, the government should not respond if the public is demanding attention to a statistically miniscule risk, and doing so simply because people are visualizing the worst that can happen. The best response is information and education. But public fear is itself an independent concern, and it can represent a high cost in itself and lead to serious associated costs, often in the form of "ripple effects." If public fear cannot be alleviated without risk reduction, then government should engage in risk reduction, at least if the relevant steps are justified by an assessment of costs and benefits.[143]

[142] See Elster, supra note (urging that emotions and especially fears are accompanied by arousal); but see Nussbaum, supra note (denying that claim).
[143] I have not said anything here about the difficult issue of how to monetize public fear.

Appendix A

The following provides the experimental materials for the study described in part IIIB.

Assume that you live in an area whose drinking water contains 50 parts per billion of arsenic. Assume also that at this level of arsenic, 1 in 100,000 people who drink this water over a period of years will die of cancer. The Environmental Protection is considering whether to reduce the permissible level of arsenic in drinking water from 50 to 5 parts per billion, which would essentially eliminate the cancer risk. What is the most that you would be willing to pay, in increases in annual water bills, for this reduction?

1) 0
2) $25
3) $50
4) $100
5) $200
6) $400
7) $800 or more

Assume that you live in an area whose drinking water contains 50 parts per billion of arsenic. Assume also that at this level of arsenic, 1 in 1,000,000 people who drink this water over a period of years will die of cancer. The Environmental Protection is considering whether to reduce the permissible level of arsenic in drinking water from 50 to 5 parts per billion, which would essentially eliminate the cancer risk. What is the most that you would be willing to pay, in increases in annual water bills, for this reduction?

3) 0
4) $25
3) $50
4) $100
5) $200
6) $400
7) $800 or more

Assume that you live in an area whose drinking water is contaminated by 50 parts per billion of arsenic, a known carcinogen. Assume also that this level of arsenic will kill 1 in 100,000 people who drink this water over a period of years. Assume finally that the death from arsenic-induced cancer is very gruesome and intensely painful, as the cancer eats away at internal organs of the body. The Environmental Protection is considering whether to reduce the permissible level of arsenic in drinking water from 50 to 5 parts per billion, which would essentially eliminate the cancer risk. What is the most that you would be willing to pay, in increases in annual water bills, for this reduction?

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1) 0
2) $25
3) $50
4) $100
5) $200
6) $400
7) $800 or more

Appendix B

The following memorandum consists of a memorandum sent to a university community in the midst of the anthrax threat. I include it here not because it is idiosyncratic, but because it captures a kind of "best practices" approach at the time. Note the breadth of the concern, calling on people to wear latex gloves while opening mail and including in the category of "suspicious mail" anything from "someone unfamiliar to you" (a large percentage of the mail received by most people), and advising those in receipt of such mail to notify the police, to isolate the mail, and to leave the area.

Re: **Updated Procedures for Handling Mail Suspected of Anthrax Contamination**

In light of recent events in which the United States mail was used to distribute anthrax, we recommend that you follow the up-dated guidelines below when handling mail.

General Mail Handling

- Be observant for suspicious envelopes or packages.
- Open all mail with a letter opener or method that is least likely to disturb contents.
- Open packages/envelopes with a minimum amount of movement.
- Do not blow into envelopes.
- Do not shake or pour out contents.
- Keep hands away from nose, and mouth while opening mail.
- Wash hands after handling mail.
- We also recommend that you wear latex gloves when opening mail.
  (If you are allergic to latex, hypoallergenic gloves are available).

What constitutes suspicious mail or parcels?

The mail or parcel is considered suspicious when it is/has:

- a powdery substance on the outside;
- excessive postage, tape, a handwritten or poorly typed address, incorrect titles, or titles with no names, or misspelling of common words;
- unexpected or from someone unfamiliar to you;
- from a foreign country and is not expected;
- addressed to someone no longer with the organization or otherwise outdated;
- no return address, or has one that cannot be verified as legitimate;
- an unusual weight, given its size, or is lopsided or oddly shaped;
- marked with restrictive language, such as "Personal " or "Confidential";
- protruding wires, strange odors or stains;
- a postmark that does not match the return address.

What should I do if I receive suspicious mail or a suspicious parcel?

- Do not handle the mail or parcel.
- Notify your supervisor immediately.
- Make sure that the suspicious mail or parcel remains isolated.
- Leave the area of the suspicious mail or parcel and do not let others into the area until appropriate authorities have indicated that it is safe to do so.
- Ensure that each person who touched the suspicious mail or parcel washes his or her hands with soap and water.
- List all persons who have touched the suspicious mail or parcel.