

Risk as Analysis and Risk as Feelings: Some Thoughts about Affect, Reason, Risk, and Rationality

Paul Slovic,^{1,2*} Melissa L. Finucane,³ Ellen Peters,^{1,2} and Donald G. MacGregor¹

Modern theories in cognitive psychology and neuroscience indicate that there are two fundamental ways in which human beings comprehend risk. The “analytic system” uses algorithms and normative rules, such as probability calculus, formal logic, and risk assessment. It is relatively slow, effortful, and requires conscious control. The “experiential system” is intuitive, fast, mostly automatic, and not very accessible to conscious awareness. The experiential system enabled human beings to survive during their long period of evolution and remains today the most natural and most common way to respond to risk. It relies on images and associations, linked by experience to emotion and affect (a feeling that something is good or bad). This system represents risk as a feeling that tells us whether it is safe to walk down this dark street or drink this strange-smelling water. Proponents of formal risk analysis tend to view affective responses to risk as irrational. Current wisdom disputes this view. The rational and the experiential systems operate in parallel and each seems to depend on the other for guidance. Studies have demonstrated that analytic reasoning cannot be effective unless it is guided by emotion and affect. Rational decision making requires proper integration of both modes of thought. Both systems have their advantages, biases, and limitations. Now that we are beginning to understand the complex interplay between emotion and reason that is essential to rational behavior, the challenge before us is to think creatively about what this means for managing risk. On the one hand, how do we apply reason to temper the strong emotions engendered by some risk events? On the other hand, how do we infuse needed “doses of feeling” into circumstances where lack of experience may otherwise leave us too “coldly rational”? This article addresses these important questions.

KEY WORDS: Rationality; risk analysis; risk perception; the affect heuristic

1. INTRODUCTION

Risk in the modern world is confronted and dealt with in three fundamental ways. *Risk as feelings* refers to our fast, instinctive, and intuitive reactions to danger. *Risk as analysis* brings logic, reason, and scientific deliberation to bear on hazard management. When our ancient instincts and our modern scientific

analyses clash, we become painfully aware of a third reality—*risk as politics*. Members of the Society for Risk Analysis are certainly familiar with the scientific approach to risk, and Slovic (1999) has elaborated the political aspect. In the present article we will examine what recent research in psychology and cognitive neuroscience tells us about the first dimension, “risk as feelings,” an important vestige of our evolutionary journey.

That intuitive feelings are still the predominant method by which human beings evaluate risk is cleverly illustrated in a cartoon by Garry Trudeau (Fig. 1). Trudeau’s two characters decide whether to greet one

¹ Decision Research, Eugene, OR, USA.

² University of Oregon.

³ Kaiser Permanente Center for Health Research, HI, USA.

* Address correspondence to Paul Slovic, Decision Research, 1201 Oak Street, Eugene, OR 97401; pslovic@darkwing.uoregon.edu.

Street Calculus



Fig. 1. Street calculus.

Copyright © 1994 by Garry Trudeau. Reprinted with permission.

another on a city street by employing a systematic analysis of the risks and risk-mitigating factors. We instantly recognize that no one in such a situation would ever be this analytical, even if his or her life was at stake. Most risk analysis is handled quickly and automatically by what we shall describe later as the “experiential” mode of thinking.

2. BACKGROUND AND THEORY: THE IMPORTANCE OF AFFECT

Although the visceral emotion of fear certainly plays a role in risk as feelings, we shall focus here on a

“faint whisper of emotion” called *affect*. As used here, “affect” means the specific quality of “goodness” or “badness” (1) experienced as a feeling state (with or without consciousness) and (2) demarcating a positive or negative quality of a stimulus. Affective responses occur rapidly and automatically—note how quickly you sense the feelings associated with the stimulus word “treasure” or the word “hate.” We argue that reliance on such feelings can be characterized as “the affect heuristic.” In this article, we trace the development of the affect heuristic across a variety of research paths followed by us and many others. We also discuss some of the important practical implications resulting from ways that this heuristic impacts the way we

perceive and evaluate risk and, more generally, the way it effects all human decision making.

2.1. Two Modes of Thinking

Affect also plays a central role in what have come to be known as dual-process theories of thinking, knowing, and information processing (Chaiken & Trope, 1999; Kahneman & Frederick, 2002; Sloman, 1996). As Epstein (1994) observed:

There is no dearth of evidence in every day life that people apprehend reality in two fundamentally different ways, one variously labeled intuitive, automatic, natural, non-verbal, narrative, and experiential, and the other analytical, deliberative, verbal, and rational. (p. 710)

Table I, adapted from Epstein, further compares these modes of thought. One of the main characteristics of the experiential system is its affective basis. Although analysis is certainly important in some decision-making circumstances, reliance on affect and emotion is a quicker, easier, and more efficient way to navigate in a complex, uncertain, and sometimes dangerous world. Many theorists have given affect a direct and primary role in motivating behavior (Barrett & Salovey, 2002; Clark & Fiske, 1982; Forgas, 2000; Le Doux, 1996; Mowrer, 1960; Tomkins, 1962, 1963; Zajonc, 1980). Epstein's (1994) view on this is as follows:

The experiential system is assumed to be intimately associated with the experience of affect, . . . which refer[s] to subtle feelings of which people are often unaware. When a person responds to an emotionally significant event . . . the experiential system automatically searches its memory banks for related events, including their emotional accompaniments . . . If the activated feelings are pleasant, they motivate actions and thoughts anticipated to reproduce the feelings. If the feelings are

unpleasant, they motivate actions and thoughts anticipated to avoid the feelings. (p. 716)

Whereas Epstein labeled the right side of Table I the "rational system," we have renamed it the "analytic system," in recognition that there are strong elements of rationality in both systems. It was the experiential system, after all, that enabled human beings to survive during their long period of evolution. Long before there was probability theory, risk assessment, and decision analysis, there were intuition, instinct, and gut feeling to tell us whether an animal was safe to approach or the water was safe to drink. As life became more complex and humans gained more control over their environment, analytic tools were invented to "boost" the rationality of our experiential thinking. Subsequently, analytic thinking was placed on a pedestal and portrayed as the epitome of rationality. Affect and emotions were seen as interfering with reason.

The importance of affect is being recognized increasingly by decision researchers. A strong early proponent of the importance of affect in decision making was Zajonc (1980), who argued that affective reactions to stimuli are often the very first reactions, occurring automatically and subsequently guiding information processing and judgment. If Zajonc is correct, then affective reactions may serve as orienting mechanisms, helping us navigate quickly and efficiently through a complex, uncertain, and sometimes dangerous world. Important work on affect and decision making has also been done by Isen (1993), Janis and Mann (1977), Johnson and Tversky (1983), Kahneman *et al.* (1998), Kahneman and Snell (1990), Loewenstein (1996), Loewenstein *et al.* (2001), Mellers (2000), Mellers *et al.* (1997), Rottenstreich and Hsee (2001), Rozin *et al.* (1993), Schwarz and Clore (1988), Slovic *et al.* (2002), and Wilson *et al.* (1993).

Table I. Two Modes of Thinking: Comparison of the Experiential and Analytic Systems

Experiential System	Analytic System
1. Holistic	1. Analytic
2. Affective: pleasure-pain oriented	2. Logical: reason oriented (what is sensible)
3. Associationistic connections	3. Logical connections
4. Behavior mediated by "vibes" from past experiences	4. Behavior mediated by conscious appraisal of events
5. Encodes reality in concrete images, metaphors, and narratives	5. Encodes reality in abstract symbols, words, and numbers
6. More rapid processing: oriented toward immediate action	6. Slower processing: oriented toward delayed action
7. Self-evidently valid: "experiencing is believing"	7. Requires justification via logic and evidence

Damasio (1994), a neurologist, presented one of the most comprehensive and dramatic theoretical accounts of the role of affect and emotion in decision making. In seeking to determine “what in the brain allows humans to behave rationally,” Damasio argued that thought is made largely from images, broadly construed to include perceptual and symbolic representations. A lifetime of learning leads these images to become “marked” by positive and negative feelings linked directly or indirectly to somatic or bodily states. When a negative somatic marker is linked to an image of a future outcome, it sounds an alarm. When a positive marker is associated with the outcome image, it becomes a beacon of incentive. Damasio hypothesized that somatic markers increase the accuracy and efficiency of the decision process and their absence, observed in people with certain types of brain damage, degrades decision performance.

We now recognize that the experiential mode of thinking and the analytic mode of thinking are continually active, interacting in what we have characterized as “the dance of affect and reason” (Finucane *et al.*, 2003). While we may be able to “do the right thing” without analysis (e.g., dodge a falling object), it is unlikely that we can employ analytic thinking rationally without guidance from affect somewhere along the line. Affect is essential to rational action. As Damasio (1994) observes:

The strategies of human reason probably did not develop, in either evolution or any single individual, without the guiding force of the mechanisms of biological regulation, of which emotion and feeling are notable expressions. Moreover, even after reasoning strategies become established . . . their effective deployment probably depends, to a considerable extent, on a continued ability to experience feelings. (p. xii)

2.2. The Affect Heuristic

The feelings that become salient in a judgment or decision-making process depend on characteristics of the individual and the task as well as the interaction between them. Individuals differ in the way they react affectively, and in their tendency to rely upon experiential thinking (Gasper & Clore, 1998; Peters & Slovic, 2000). As will be shown in this article, tasks differ regarding the evaluability (relative affective salience) of information. These differences result in the affective qualities of a stimulus image being “mapped” or interpreted in diverse ways. The salient qualities of real or imagined stimuli then evoke im-

ages (perceptual and symbolic interpretations) that may be made up of both affective and instrumental dimensions.

The mapping of affective information determines the contribution stimulus images make to an individual’s “affect pool.” All of the images in people’s minds are tagged or marked to varying degrees with affect. The affect pool contains all the positive and negative markers associated (consciously or unconsciously) with the images. The intensity of the markers varies with the images.

People consult or “sense” the affect pool in the process of making judgments. Just as imaginability, memorability, and similarity serve as cues for probability judgments (e.g., the availability and representativeness heuristics, Kahneman *et al.*, 1982), affect may serve as a cue for many important judgments (including probability judgments). Using an overall, readily available affective impression can be easier and more efficient than weighing the pros and cons of various reasons or retrieving relevant examples from memory, especially when the required judgment or decision is complex or mental resources are limited. This characterization of a mental shortcut has led us to label the use of affect a “heuristic” (Finucane *et al.*, 2000).

3. EMPIRICAL SUPPORT FOR THE AFFECT HEURISTIC

Support for the affect heuristic comes from a diverse set of empirical studies, only a few of which will be reviewed here.

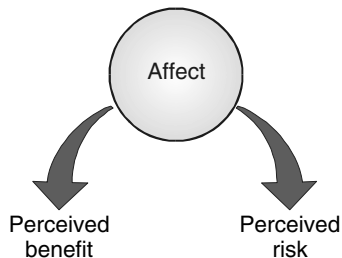
3.1. Early Research: Dread and Outrage in Risk Perception

Evidence of risk as feelings was present (though not fully appreciated) in early psychometric studies of risk perception (Fischhoff *et al.*, 1978; Slovic, 1987). Those studies showed that feelings of dread were the major determiner of public perception and acceptance of risk for a wide range of hazards. Sandman, noting that dread was also associated with factors such as voluntariness, controllability, lethality, and fairness, incorporated these qualities into his “outrage model” (Sandman, 1989). Reliance on outrage was, in Sandman’s view, the major reason that public evaluations of risk differed from expert evaluations (based on analysis of hazard, e.g., mortality statistics).

3.2. Risk and Benefit Judgments

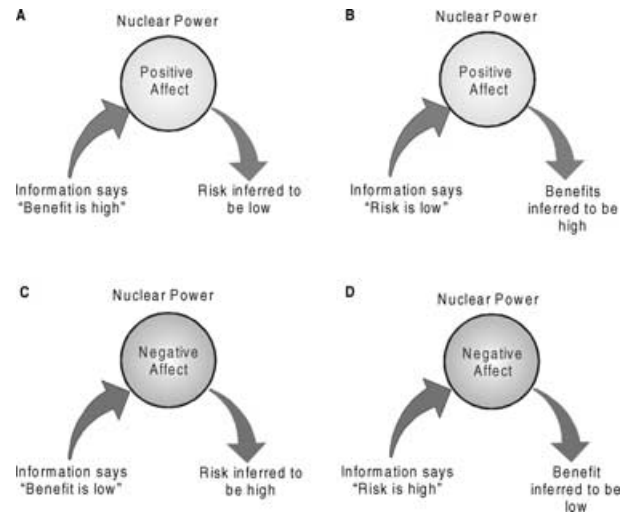
The earliest studies of risk perception also found that, whereas risk and benefit tend to be positively correlated in the world, they are negatively correlated in people's minds (and judgments, Fischhoff *et al.*, 1978). The significance of this finding for the affect heuristic was not realized until a study by Alhakami and Slovic (1994) found that the inverse relationship between perceived risk and perceived benefit of an activity (e.g., using pesticides) was linked to the strength of positive or negative affect associated with that activity as measured by rating the activity on bipolar scales such as *good/bad*, *nice/awful*, *dread/not dread*, and so forth. This result implies that people base their judgments of an activity or a technology not only on what they *think* about it but also on how they *feel* about it. If their feelings toward an activity are favorable, they are moved toward judging the risks as low and the benefits as high; if their feelings toward it are unfavorable, they tend to judge the opposite—high risk and low benefit. Under this model, affect comes prior to, and directs, judgments of risk and benefit, much as Zajonc proposed. This process, which we have called “the affect heuristic” (see Fig. 2), suggests that, if a general affective view guides perceptions of risk and benefit, providing information about benefit should change perception of risk and *vice versa* (see Fig. 3). For example, information stating that benefit is high for a technology such as nuclear power would lead to more positive overall affect that would, in turn, decrease perceived risk (Fig. 3A).

Finucane *et al.* (2000) conducted this experiment, providing four different kinds of information designed to manipulate affect by increasing or decreasing perceived benefit or by increasing or decreasing perceived risk for each of three technologies. The pre-



Source: Finucane *et al.* (2000).

Fig. 2. A model of the affect heuristic explaining the risk/benefit confounding observed by Alhakami and Slovic (1994). Judgments of risk and benefit are assumed to be derived by reference to an overall affective evaluation of the stimulus item.



Source: Finucane *et al.* (2000).

Fig. 3. Model showing how information about benefit (A) or information about risk (B) could increase the positive affective evaluation of nuclear power and lead to inferences about risk and benefit that coincides affectively with the information given. Similarly, information could make the overall affective evaluation of nuclear power more negative as in C and D, resulting in inferences about risk and benefit that are consistent with this more negative feeling.

dictions were confirmed. Because by design there was no apparent logical relationship between the information provided and the nonmanipulated variable, these data support the theory that risk and benefit judgments are influenced, at least in part, by the overall affective evaluation (which was influenced by the information provided). Further support for the affect heuristic came from a second experiment by Finucane *et al.* finding that the inverse relationship between perceived risks and benefits increased greatly under time pressure, when opportunity for analytic deliberation was reduced. These two experiments are important because they demonstrate that affect influences judgment directly and is not simply a response to a prior analytic evaluation.

Further support for the model in Fig. 2 has come from two very different domains—toxicology and finance. Slovic *et al.* (1997) surveyed members of the British Toxicological Society and found that these experts, too, produced the same inverse relation between their risk and benefit judgments. As expected, the strength of the inverse relation was found to be mediated by the toxicologists' affective reactions toward the hazard items being judged. In a second study, these same toxicologists were asked to make a “quick intuitive rating” for each of 30 chemical items (e.g.,

benzene, aspirin, second-hand cigarette smoke, dioxin in food) on an affect scale (bad-good). Next, they were asked to judge the degree of risk associated with a very small exposure to the chemical, defined as an exposure that is less than 1/100th the exposure level that would begin to cause concern for a regulatory agency. Rationally, because exposure was so low, one might expect these risk judgments to be uniformly low and unvarying, resulting in little or no correlation with the ratings of affect. Instead, there was a strong correlation across chemicals between affect and judged risk of a very small exposure. When the affect rating was strongly negative, judged risk of a very small exposure was high; when affect was positive, judged risk was small. Almost every respondent (95 out of 97) showed this negative correlation (the median correlation was -0.50). Importantly, those toxicologists who produced strong inverse relations between risk and benefit judgments in the first study also were more likely to exhibit a high correspondence between their judgments of affect and risk in the second study. In other words, across two different tasks, reliable individual differences emerged in toxicologists' reliance on affective processes in judgments of chemical risks.

In the realm of finance, Ganzach (2001) found support for a model in which analysts base their judgments of risk and return for unfamiliar stocks upon a global attitude. If stocks were perceived as good, they were judged to have high return and low risk, whereas if they were perceived as bad, they were judged to be low in return and high in risk. However, for familiar stocks, perceived risk and return were positively correlated, rather than being driven by a global attitude.

3.3. Judgments of Probability, Relative Frequency, and Risk

The affect heuristic has much in common with the model of "risk as feelings" proposed by Loewenstein *et al.* (2001) and with dual process theories put forth by Epstein (1994), Sloman (1996), and others. Recall that Epstein argues that individuals apprehend reality by two interactive, parallel processing systems. The *rational* system is a deliberative, analytical system that functions by way of established rules of logic and evidence (e.g., probability theory). The *experiential* system encodes reality in images, metaphors, and narratives to which affective feelings have become attached.

To demonstrate the influence of the experiential system, Denes-Raj and Epstein (1994) showed that, when offered a chance to win \$1 by drawing a red jelly bean from an urn, individuals often elected to draw from a bowl containing a greater absolute number, but a smaller proportion, of red beans (e.g., 7 in 100) than from a bowl with fewer red beans but a better probability of winning (e.g., 1 in 10). These individuals reported that, although they knew the probabilities were against them, they *felt* they had a better chance when there were more red beans.

We can characterize Epstein's subjects as following a mental strategy of "imagining the numerator" (i.e., the number of red beans) and neglecting the denominator (the number of beans in the bowl). Consistent with the affect heuristic, images of winning beans convey positive affect that motivates choice.

Although the jelly bean experiment may seem frivolous, imagining the numerator brings affect to bear on judgments in ways that can be both nonintuitive and consequential. Slovic *et al.* (2000) demonstrated this in a series of studies in which experienced forensic psychologists and psychiatrists were asked to judge the likelihood that a mental patient would commit an act of violence within six months after being discharged from the hospital. An important finding was that clinicians who were given another expert's assessment of a patient's risk of violence framed in terms of relative frequency (e.g., "of every 100 patients similar to Mr. Jones, 10 are estimated to commit an act of violence to others") subsequently labeled Mr. Jones as more dangerous than did clinicians who were shown a statistically "equivalent" risk expressed as a probability (e.g., "Patients similar to Mr. Jones are estimated to have a 10% chance of committing an act of violence to others").

Not surprisingly, when clinicians were told that "20 out of every 100 patients similar to Mr. Jones are estimated to commit an act of violence," 41% would refuse to discharge the patient. But when another group of clinicians was given the risk as "patients similar to Mr. Jones are estimated to have a 20% chance of committing an act of violence," only 21% would refuse to discharge the patient. Similar results have been found by Yamagishi (1997), whose judges rated a disease that kills 1,286 people out of every 10,000 as more dangerous than one that kills 24.14% of the population.

Follow-up studies showed that representations of risk in the form of individual probabilities of 10% or 20% led to relatively benign images of one person, unlikely to harm anyone, whereas the "equivalent"

frequentistic representations created frightening images of violent patients (e.g., “Some guy going crazy and killing someone”). These affect-laden images likely induced greater perceptions of risk in response to the relative-frequency frames.

Although frequency formats produce affect-laden imagery, story and narrative formats appear to do even better in that regard. Hendrickx *et al.* (1989) found that warnings were more effective when, rather than being presented in terms of relative frequencies of harm, they were presented in the form of vivid, affect-laden scenarios and anecdotes. Sanfey and Hastie (1998) found that compared with respondents given information in bar graphs or data tables, respondents given narrative information more accurately estimated the performance of a set of marathon runners. Furthermore, Pennington and Hastie (1993) found that jurors construct narrative-like summations of trial evidence to help them process their judgments of guilt or innocence.

Perhaps the biases in probability and frequency judgment that have been attributed to the availability heuristic (Tversky & Kahneman, 1973) may be due, at least in part, to affect. Availability may work not only through ease of recall or imaginability, but because remembered and imagined images come tagged with affect. For example, Lichtenstein *et al.* (1978) invoked availability to explain why judged frequencies of highly publicized causes of death (e.g., accidents, homicides, fires, tornadoes, and cancer) were relatively overestimated and underpublicized causes (e.g., diabetes, stroke, asthma, and tuberculosis) were underestimated. The highly publicized causes appear to be more affectively charged, that is, more sensational, and this may account both for their prominence in the media and their relatively overestimated frequencies.

3.4. Proportion Dominance

There appears to be one generic information format that is highly evaluable (e.g., highly affective), leading it to carry great weight in many judgment tasks. This is a representation characterizing an attribute as a proportion or percentage of something, or as a probability.

Proportion or probability dominance was evident in an early study by Slovic and Lichtenstein (1968) that had people rate the attractiveness of various two-outcome gambles. Ratings of a gamble's attractiveness were determined much more strongly by the probabilities of winning and losing than by the mone-

tary outcomes. This basic finding has been replicated many times (Goldstein & Einhorn, 1987; Ordóñez & Benson, 1997).

Slovic *et al.* (2002) tested the limits of this probability dominance by asking one group of subjects to rate the attractiveness of a simple gamble (7/36, win \$9), on a 0–20 scale and asking a second group to rate a similar gamble with a small loss (7/36, win \$9; 29/36, lose 5¢) on the same scale. The data were anomalous from the perspective of economic theory, but expected from the perspective of the affect heuristic. The mean response to the first gamble was 9.4. When a loss of 5¢ was added, the mean attractiveness jumped to 14.9 and there was almost no overlap between the distribution of responses around this mean and the responses for the group judging the gamble that had no loss.

Slovic also performed a conjoint analysis where each subject rated one of 16 gambles formed by crossing four levels of probability (7/36, 14/36, 21/36, 28/36) with four levels of payoff (\$3, \$6, \$9, \$12 in one study and \$30, \$60, \$90, \$120 in another). He found that, although subjects wanted to weight probability and payoff relatively equally in judging attractiveness (and thought they had done so), the actual weighting was 5–16 times greater for probability than for payoff.

We hypothesize that these curious findings can be explained by reference to the notion of affective mapping. According to this view, a probability maps relatively precisely onto the attractiveness scale, because it has an upper and lower bound and people know where a given value falls within that range. In contrast, the mapping of a dollar outcome (e.g., \$9) onto the scale is diffuse, reflecting a failure to know whether \$9 is good or bad, attractive or unattractive. Thus, the impression formed by the gamble offering \$9 to win with no losing payoff is dominated by the rather unattractive impression produced by the 7/36 probability of winning. However, adding a very small loss to the payoff dimension puts the \$9 payoff in perspective and thus gives it meaning. The combination of a possible \$9 gain and a 5¢ loss is a *very attractive* win/lose ratio, leading to a relatively precise mapping onto the upper part of the scale. Whereas the imprecise mapping of the \$9 carries little weight in the averaging process, the more precise and now favorable impression of (\$9 – 5¢) carries more weight, thus leading to an increase in the overall favorability of the gamble.

Proportion dominance surfaces in a powerful way in a very different context, the life-saving

interventions studied by Baron (1997), Fetherstonhaugh *et al.* (1997), Friedrich *et al.* (1999), and Jenni and Loewenstein (1997). These studies found that, unless the number of lives saved is explicitly comparable from one intervention to another, evaluation is dominated by the proportion of lives saved (relative to the population at risk), rather than the actual number of lives saved.

The results of our life-saving study (Fetherstonhaugh *et al.*, 1997) are important because they imply that a specified number of human lives may not carry precise affective meaning, similar to the conclusion we drew about stated payoffs (e.g., \$9) in the gambling studies. The gambling studies suggested an analogous experiment with life saving. In the context of a decision pertaining to airport safety, we asked people to evaluate the attractiveness of purchasing new equipment for use in the event of a crash landing of an airliner. In one condition, subjects were told that this equipment affords a chance of saving 150 lives that would be in jeopardy in such an event. A second group of subjects was told that this equipment affords a chance of saving 98% of the 150 lives that would be in jeopardy. We predicted that, because saving 150 lives is diffusely good, hence only weakly evaluable, whereas saving 98% of something is clearly very good, support for purchasing this equipment would be much greater in the 98% condition. We predicted that other high percentages would also lead to greater support, even though the number of lives saved was fewer. The results, reported in Slovic *et al.* (2002), confirmed these predictions (see Fig. 4).

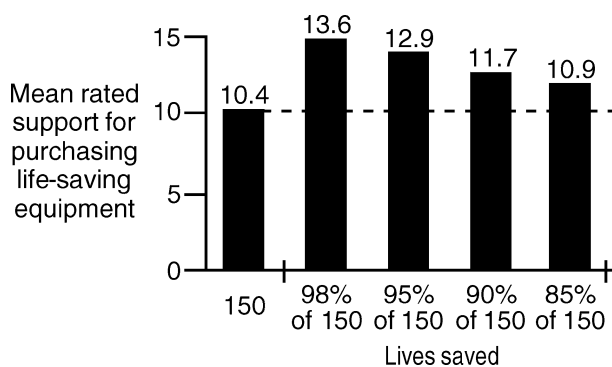


Fig. 4. Saving a percentage of 150 lives received higher support than saving 150 lives (Slovic *et al.*, 2002). © 2002 Cambridge University Press. Reprinted with permission.

3.5. Insensitivity to Probability

Outcomes are not always affectively as vague as the quantities of money and lives that were dominated by proportion in the above experiments. When consequences carry sharp and strong affective meaning, as is the case with a lottery jackpot or a cancer, the opposite phenomenon occurs—variation in probability often carries too little weight. As Loewenstein *et al.* (2001) observe, one's images and feelings toward winning the lottery are likely to be similar whether the probability of winning is one in 10 million or one in 10,000. They further note that responses to uncertain situations appear to have an all or none characteristic that is sensitive to the *possibility* rather than the *probability* of strong positive or negative consequences, causing very small probabilities to carry great weight. This, they argue, helps explain many paradoxical findings such as the simultaneous prevalence of gambling and the purchasing of insurance. It also 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. Support for these arguments comes from Rottenstreich and Hsee (2001) who show that, if the potential outcome of a gamble is emotionally powerful, its attractiveness or unattractiveness is relatively insensitive to changes in probability as great as from 0.99 to 0.01.

3.6. Affect and Insurance

Hsee and Kunreuther (2000) demonstrated that affect influences decisions about whether to purchase insurance. In one study, they found that people were willing to pay twice as much to insure a beloved antique clock (that no longer works and cannot be repaired) against loss in shipment to a new city than to insure a similar clock for which "one does not have any special feeling." In the event of loss, the insurance paid \$100 in both cases. Similarly, Hsee and Menon (1999) found that students were more willing to buy a warranty on a newly purchased used car if it was a beautiful convertible than if it was an ordinary-looking station wagon, even if the expected repair expenses and cost of the warranty were held constant.

4. FAILURES OF THE EXPERIENTIAL SYSTEM

Throughout this article, we have portrayed the affect heuristic as the centerpiece of the experiential

mode of thinking, the dominant mode of risk assessment and survival during the evolution of the human species. But, like other heuristics that provide efficient and generally adaptive responses but occasionally get us into trouble, reliance on affect can also mislead us. Indeed, if it was always optimal to follow our affective and experiential instincts, there would have been no need for the rational/analytic system of thinking to have evolved and become so prominent in human affairs.

There are two important ways that experiential thinking misguides us. One results from the deliberate manipulation of our affective reactions by those who wish to control our behaviors (advertising and marketing exemplify this manipulation). The other results from the natural limitations of the experiential system and the existence of stimuli in our environment that are simply not amenable to valid affective representation. The latter problem is discussed below.

Judgments and decisions can be faulty not only because their affective components are manipulable, but also because they are subject to inherent biases of the experiential system. For example, the affective system seems designed to sensitize us to small changes in our environment (e.g., the difference between 0 and 1 deaths) at the cost of making us less able to appreciate and respond appropriately to larger changes further away from zero (e.g., the difference between 500 and 600 deaths). Fetherstonhaugh *et al.* (1997) referred to this insensitivity as “psychophysical numbing.” Albert Szent-Gyorgi put it another way: “I am deeply moved if I see one man suffering and would risk my life for him. Then I talk impersonally about the possible pulverization of our big cities, with a hundred million dead. I am unable to multiply one man’s suffering by a hundred million.”

Similar problems arise when the outcomes that we must evaluate are visceral in nature. Visceral factors include drive states such as hunger, thirst, sexual desire, emotions, pain, and drug craving. They have direct, hedonic impacts that have a powerful effect on behavior. Although they produce strong feelings in the present moment, these feelings are difficult if not impossible to recall or anticipate in a veridical manner, a factor that plays a key role in the phenomenon of addiction (Loewenstein, 1999):

Unlike currently experienced visceral factors, which have a disproportionate impact on behavior, delayed visceral factors tend to be ignored or severely underweighted in decision making. Today’s pain, hunger, anger, etc. are palpable, but the same sensations anticipated in the future receive little weight. (p. 240)

4.1. The Decision to Smoke Cigarettes

Cigarette smoking is a dangerous activity that takes place one cigarette at a time, often over many years and hundreds of thousands of episodes. The questionable rationality of smoking decisions provides a dramatic example of the difficulty that experiential thinking faces in dealing with outcomes that change very slowly over time, are remote in time, and are visceral in nature.

For many years, beginning smokers were portrayed as “young economists,” rationally weighing the risks of smoking against the benefits when deciding whether to initiate that activity (Viscusi, 1992), analogous to the “street calculus” being spoofed in Fig. 1. However, recent research paints a different picture. This new account (Slovic, 2001) shows young smokers acting experientially in the sense of giving little or no conscious thought to risks or to the amount of smoking they will be doing. Instead, they are driven by the affective impulses of the moment, enjoying smoking as something new and exciting, a way to have fun with their friends. Even after becoming “regulars,” the great majority of smokers expect to stop soon, regardless of how long they have been smoking, how many cigarettes they currently smoke per day, or how many previous unsuccessful attempts they have experienced. Only a fraction actually quit, despite many attempts. The problem is nicotine addiction, a visceral condition that young smokers recognize by name as a consequence of smoking but do not understand experientially until they are caught in its grip.

The failure of the experiential system to protect many young people from the lure of smoking is nowhere more evident than in the responses to a survey question that asked smokers: “If you had it to do all over again, would you start smoking?” More than 85% of adult smokers and about 80% of young smokers (ages 14–22 years) answered “no” (Slovic, 2001). Moreover, the more individuals perceive themselves to be addicted, the more often they have tried to quit, the longer they have been smoking, and the more cigarettes they are currently smoking per day, the more likely they are to answer “no” to this question.

The data indicate that most beginning smokers lack the experience to appreciate how their future selves will perceive the risks from smoking or how they will value the tradeoff between health and the need to smoke. This is a strong repudiation of the model of informed rational choice. It fits well with the findings indicating that smokers give little conscious thought to risk when they begin to smoke. They

appear to be lured into the behavior by the prospects of fun and excitement. Most begin to think of risk only after starting to smoke and gaining what to them is new information about health risks.

These findings underscore the distinction that behavioral decision theorists now make between decision utility and experience utility (Kahneman, 1994; Kahneman & Snell, 1992; Loewenstein & Schkade, 1999). Utility predicted or expected at the time of decision often differs greatly from the quality and intensity of the hedonic experience that actually occurs.

5. MANAGING EMOTION, REASON, AND RISK

Now that we are beginning to understand the complex interplay between emotion, affect, and reason that is wired into the human brain and essential to rational behavior, the challenge before us is to think creatively about what this means for managing risk. On the one hand, how do we apply reason to temper the strong emotions engendered by some risk events? On the other hand, how do we infuse needed “doses of feeling” into circumstances where lack of experience may otherwise leave us too “coldly rational?”

5.1. Can Risk Analysis Benefit from Experiential Thinking?

The answer to this question is almost certainly yes. Even such prototypical analytic exercises as proving a mathematical theorem or selecting a move in chess benefit from experiential guidance. The mathematician senses whether the proof “looks good” and the chess master gauges whether a contemplated move “feels right,” based upon stored knowledge of a large number of winning patterns (de Groot, 1978). Analysts attempting to build a model to solve a client’s decision-making problem are instructed to rely upon the client’s sense of unease about the results of the current model as a signal that further modeling may be needed (Phillips, 1984). A striking example of failure because an analysis was devoid of feeling was perpetrated by Philip Morris. The company commissioned an analysis of the costs to the Czech government of treating diseased smokers. Employing a very narrow conception of costs, the analysis concluded that smokers benefited the government by dying young. The analysis created so much hostility that Philip Morris was forced to issue an apology (*New York Times*, 2001).

Elsewhere we have argued that analysis needs to be sensitive to the “softer” values underlying such qualities as dread, equity, controllability, etc. that drive people’s concerns about risk, as well as to degrees of ignorance or scientific uncertainty. A blueprint for doing this is sketched in the Academy report *Understanding Risk: Decision Making in a Democratic Society* (National Research Council, 1996). Invocation of the “precautionary principle” (Wiener, 2002) represents yet another approach to overcoming the limitations of what some see as overly narrow technical risk assessments.

Someone once observed that “Statistics are human beings with the tears dried off.” Our studies of psychophysical numbing demonstrate the potential for neglect of statistical fatalities, thus raising the question: “How can we put the tears back on?” There are attempts to do this that may be instructive. Organizers of a rally designed to get Congress to do something about 38,000 deaths a year from handguns piled 38,000 pairs of shoes in a mound in front of the Capitol. After September 11, many newspapers published biographical sketches of the victims, a dozen or so each day until all had been featured. Writers and artists have long recognized the power of the written word to bring meaning to tragedy. *The Diary of Anne Frank* and Elie Weisel’s *Night* certainly bring home the meaning of the Holocaust more powerfully than the statistic, “six million dead.”

5.2. How Can an Understanding of “Risk as Feeling” Help Us Cope with Threats from Terrorism?

Research by Rottenstreich and Hsee (2001) demonstrates that events associated with strong feelings can overwhelm us even though their likelihood is remote. **Because risk as feeling tends to overweight frightening consequences, we need to invoke risk as analysis to give us perspective on the likelihood of such consequences.** For example, when our feelings of fear move us to consider purchasing a handgun to protect against terrorists, our analytic selves should also heed the evidence showing that a gun fired in the home is 22 times more likely to harm oneself or a friend or family member than to harm an unknown, hostile intruder.

In some circumstances, risk as feeling may outperform risk as analysis. A case in point is a news story dated March 27, 2002 discussing the difficulty of screening 150,000 checked pieces of baggage at Los Angeles International Airport. The best analytic

devices, utilizing X-rays, computers, and other modern tools, are slow and inaccurate. The solution—rely upon the noses of trained dogs.

Some species of trouble, such as terrorism, greatly strain the capacity of quantitative risk analysis. Our models of the hazard-generating process are too crude to permit precise and accurate predictions of where, when, and how the next attacks might unfold. What is the role of risk analysis when the stakes are high, the uncertainties are enormous, and time is precious? Is there a human equivalent of the dog's nose that can be put to good use in such circumstances, relying on instinctual processing of affective cues, using brain mechanisms honed through evolution, to enhance survival? What research is needed to train and test experiential risk analysis skills?

6. CONCLUSION

It is sobering to contemplate how elusive meaning is, due to its dependence upon affect. Thus the forms of meaning that we take for granted and upon which we justify immense effort and expense toward gathering and disseminating “meaningful” information may be illusory. We cannot assume that an intelligent person can understand the meaning of and properly act upon even the simplest of numbers such as amounts of money or numbers of lives at risk, not to mention more esoteric measures or statistics pertaining to risk, unless these numbers are infused with affect.

Contemplating the workings of the affect heuristic helps us appreciate Damasio's contention that rationality is not only a product of the analytical mind, but of the experiential mind as well. The perception and integration of affective feelings, within the experiential system, appears to be the kind of high-level maximization process postulated by economic theories since the days of Jeremy Bentham. These feelings form the neural and psychological substrate of utility. In this sense, the affect heuristic enables us to be rational actors in many important situations. But not in all situations. It works beautifully when our experience enables us to anticipate accurately how we will like the consequences of our decisions. It fails miserably when the consequences turn out to be much different in character than we anticipated.

The scientific study of affective rationality is in its infancy. It is exciting to contemplate what might be accomplished by future research designed to help humans understand the affect heuristic and employ it beneficially in risk analysis and other worthy endeavors.

ACKNOWLEDGMENTS

This article received a Best Paper Award at the 2002 Annual Meeting of the Society for Risk Analysis. Research for this article was supported by Grants SES-02413131, SES-0112158, and SES-0111941 from the National Science Foundation.

REFERENCES

- Alhakami, A. S., & Slovic, P. (1994). A psychological study of the inverse relationship between perceived risk and perceived benefit. *Risk Analysis*, 14(6), 1085–1096.
- Barett, L. F., & Salovey, P. (Eds.). (2002). *The Wisdom in Feeling*. New York: Guilford.
- Baron, J. (1997). Confusion of relative and absolute risk in valuation. *Journal of Risk and Uncertainty*, 14(3), 301–309.
- Chaiken, S., & Trope, Y. (1999). *Dual-Process Theories in Social Psychology*. New York: Guilford.
- Clark, M. S., & Fiske, S. T. (Eds.). (1982). *Affect and Cognition*. Hillsdale, NJ: Lawrence Erlbaum.
- Damasio, A. R. (1994). *Descartes' Error: Emotion, Reason, and the Human Brain*. New York: Avon.
- de Groot, A. D. (1978). *Thought and Choice in Chess*. New York: Monton.
- Denes-Raj, V., & Epstein, S. (1994). Conflict between intuitive and rational processing: When people behave against their better judgment. *Journal of Personality and Social Psychology*, 66, 819–829.
- Epstein, S. (1994). Integration of the cognitive and the psychodynamic unconscious. *American Psychologist*, 49, 709–724.
- Fetherstonhaugh, D., Slovic, P., Johnson, S. M., & Friedrich, J. (1997). Insensitivity to the value of human life: A study of psychophysical numbing. *Journal of Risk and Uncertainty*, 14(3), 282–300.
- Finucane, M. L., Alhakami, A., Slovic, P., & Johnson, S. M. (2000). The affect heuristic in judgments of risks and benefits. *Journal of Behavioral Decision Making*, 13, 1–17.
- Finucane, M. L., Peters, E., & Slovic, P. (2003). Judgment and decision making: The dance of affect and reason. In S. L. Schneider & J. Shanteau (Eds.), *Emerging Perspectives on Judgment and Decision Research* (pp. 327–364). Cambridge, UK: Cambridge University Press.
- Fischhoff, B., Slovic, P., Lichtenstein, S., Read, S., & Combs, B. (1978). How safe is safe enough? A psychometric study of attitudes toward technological risks and benefits. *Policy Sciences*, 9, 127–152.
- Forgas, J. P. (Ed.). (2000). *Feeling and Thinking: The Role of Affect in Social Cognition*. Cambridge, UK: Cambridge University Press.
- Friedrich, J., Barnes, P., Chapin, K., Dawson, I., Garst, V., & Kerr, D. (1999). Psychophysical numbing: When lives are valued less as the lives at risk increase. *Journal of Consumer Psychology*, 8, 277–299.
- Ganzach, Y. (2001). Judging risk and return of financial assets. *Organizational Behavior and Human Decision Processes*, 83, 353–370.
- Gasper, K., & Clore, G. L. (1998). The persistent use of negative affect by anxious individuals to estimate risk. *Journal of Personality and Social Psychology*, 74(5), 1350–1363.
- Goldstein, W. M., & Einhorn, H. J. (1987). Expression theory and the preference reversal phenomena. *Psychological Review*, 94, 236–254.
- Hendrickx, L., Vlek, C., & Oppewal, H. (1989). Relative importance of scenario information and frequency information in the judgment of risk. *Acta Psychologica*, 72, 41–63.

- Hsee, C. K., & Menon, S. (1999). *Affection Effect in Consumer Choices*. Unpublished study, University of Chicago.
- Hsee, C. K., & Menon, S. (2000). The affection effect in insurance decisions. *Journal of Risk and Uncertainty*, 20, 141–159.
- Isen, A. M. (1993). Positive affect and decision making. In M. Lewis & J. M. Haviland (Eds.), *Handbook of Emotions* (pp. 261–277). New York: Guilford Press.
- Janis, I. L., & Mann, L. (1977). *Decision Making*. New York: Free Press.
- Jenni, K. E., & Loewenstein, G. (1997). Explaining the “identifiable victim effect.” *Journal of Risk and Uncertainty*, 14(3), 235–258.
- Johnson, E. J., & Tversky, A. (1983). Affect, generalization, and the perception of risk. *Journal of Personality and Social Psychology*, 45, 20–31.
- Kahneman, D. (1994). New challenges to the rationality assumption. *Journal of Institutional and Theoretical Economics*, 150, 18–36.
- Kahneman, D., & Frederick, S. (2002). Representativeness revisited: Attribute substitution in intuitive judgment. In T. Gilovich, D. Griffin, & D. Kahneman (Eds.), *Heuristics and Biases: The Psychology of Intuitive Judgment* (pp. 49–81). New York: Cambridge University Press.
- Kahneman, D., Schkade, D., & Sunstein, C. R. (1998). Shared outrage and erratic awards: The psychology of punitive damages. *Journal of Risk and Uncertainty*, 16, 49–86.
- Kahneman, D., Slovic, P., & Tversky, A. (Eds.). (1982). *Judgment Under Uncertainty: Heuristics and Biases*. New York: Cambridge University Press.
- Kahneman, D., & Snell, J. (1990). Predicting utility. In R. M. Hogarth (Ed.), *Insights in Decision Making* (pp. 295–310). Chicago: University of Chicago.
- Kahneman, D., & Snell, J. (1992). Predicting a changing taste. *Journal of Behavioral Decision Making*, 5, 187–200.
- Le Doux, J. (1996). *The Emotional Brain*. New York: Simon & Schuster.
- Lichtenstein, S., Slovic, P., Fischhoff, B., Layman, M., & Combs, B. (1978). Judged frequency of lethal events. *Journal of Experimental Psychology: Human Learning and Memory*, 4, 551–578.
- Loewenstein, G. F. (1996). Out of control: Visceral influences on behavior. *Organizational Behavior and Human Decision Processes*, 65, 272–292.
- Loewenstein, G. F. (1999). A visceral account of addiction. In J. Elster & O.-J. Skog (Eds.), *Getting Hooked: Rationality and Addiction* (pp. 235–264). London: Cambridge University Press.
- Loewenstein, G. F., & Schkade, D. (1999). Wouldn't it be nice? Predicting future feelings. In E. Diener, N. Schwartz, & D. Kahneman (Eds.), *Well-Being: The Foundations of Hedonic Psychology* (pp. 85–105). New York: Russell Sage Foundation.
- Loewenstein, G. F., Weber, E. U., Hsee, C. K., & Welch, E. S. (2001). Risk as feelings. *Psychological Bulletin*, 127(2), 267–286.
- Mellers, B. A. (2000). Choice and the relative pleasure of consequences. *Psychological Bulletin*, 126(6), 910–924.
- Mellers, B. A., Schwartz, A., Ho, K., & Ritov, I. (1997). Decision affect theory: Emotional reactions to the outcomes of risky options. *Psychological Science*, 8, 423–429.
- Mower, O. H. (1960). *Learning Theory and Behavior*. New York: John Wiley & Sons.
- National Research Council. Committee on Risk Characterization. (1996). *Understanding Risk: Informing Decisions in a Democratic Society*. Washington, DC: National Academy Press.
- New York Times. (2001). Philip Morris issues apology for Czech study on smoking. *New York Times*, July 27, C12.
- Ordóñez, L., & Benson, L., III. (1997). Decisions under time pressure: How time constraint affects risky decision making. *Organizational Behavior and Human Decision Processes*, 71(2), 121–140.
- Pennington, N., & Hastie, R. (1993). A theory of explanation-based decision making. In G. Klein, J. Orasano, R. Calderwood, & C. E. Zsombok (Eds.), *Decision Making in Action: Models and Methods* (pp. 188–204). Norwood, NJ: Ablex.
- Peters, E., & Slovic, P. (2000). The springs of action: Affective and analytical information processing in choice. *Personality and Social Psychology Bulletin*, 26, 1465–1475.
- Phillips, L. D. (1984). A theory of requisite decision models. *Acta Psychologica*, 56, 29–48.
- Rottenstreich, Y., & Hsee, C. K. (2001). Money, kisses and electric shocks: On the affective psychology of probability weighting. *Psychological Science*, 12(3), 185–190.
- Rozin, P., Haidt, J., & McCauley, C. R. (1993). Disgust. In M. Lewis & J. M. Haviland (Eds.), *Handbook of Emotions* (pp. 575–594). New York: Guilford.
- Sandman, P. (1989). Hazard versus outrage in the public perception of risk. In V. T. Covello, D. B. McCallum, & M. T. Pavlova (Eds.), *Effective Risk Communication: The Role and Responsibility of Government and Nongovernment Organizations* (pp. 45–49). New York: Plenum Press.
- Sanfey, A., & Hastie, R. (1998). Does evidence presentation format affect judgment? An experimental evaluation of displays of data for judgments. *Psychological Science*, 9(2), 99–103.
- Schwarz, N., & Clore, G. L. (1988). How do I feel about it? Informative functions of affective states. In K. Fiedler & J. Forgas (Eds.), *Affect, Cognition, and Social Behavior* (pp. 44–62). Toronto: Hogrefe International.
- Sloman, S. A. (1996). The empirical case for two systems of reasoning. *Psychological Bulletin*, 119(1), 3–22.
- Slovic, P. (1987). Perception of risk. *Science*, 236, 280–285.
- Slovic, P. (1999). Trust, emotion, sex, politics, and science: Surveying the risk-assessment battlefield. *Risk Analysis*, 19(4), 689–701.
- Slovic, P. (2001). Cigarette smokers: Rational actors or rational fools? In P. Slovic (Ed.), *Smoking: Risk, Perception, and Policy* (pp. 97–124). Thousand Oaks, CA: Sage.
- Slovic, P., Finucane, M. L., Peters, E., & MacGregor, D. G. (2002). The affect heuristic. In T. Gilovich, D. Griffin, & D. Kahneman (Eds.), *Heuristics and Biases: The Psychology of Intuitive Judgment* (pp. 397–420). New York: Cambridge University Press.
- Slovic, P., & Lichtenstein, S. (1968). Relative importance of probabilities and payoffs in risk taking. *Journal of Experimental Psychology Monograph*, 78(3, Pt. 2), 1–18.
- Slovic, P., MacGregor, D. G., Malmfors, T., & Purchase, I. F. H. (1997). *Influence of Affective Processes on Toxicologists' Judgments of Risk*. Unpublished Study. Eugene, OR: Decision Research.
- Slovic, P., Monahan, J., & MacGregor, D. M. (2000). Violence risk assessment and risk communication: The effects of using actual cases, providing instructions, and employing probability vs. frequency formats. *Law and Human Behavior*, 24(3), 271–296.
- Tomkins, S. S. (1962). *Affect, Imagery, and Consciousness: Vol. 1. The Positive Affects*. New York: Springer.
- Tomkins, S. S. (1963). *Affect, Imagery, and Consciousness: Vol. 2. The Negative Affects*. New York: Springer.
- Tversky, A., & Kahneman, D. (1973). Availability: A heuristic for judging frequency and probability. *Cognitive Psychology*, 5, 207–232.
- Viscusi, W. K. (1992). *Smoking: Making the Risky Decision*. New York: Oxford University Press.
- Wiener, J. B. (2002). Precaution in a multirisk world. In D. J. Paustenbach (Ed.), *Human and Ecological Risk Assessment: Theory and Practice* (pp. 1509–1531). New York: John Wiley & Sons.
- Wilson, T. D., Lisle, D. J., Schooler, J. W., Hodges, S. D., Klaaren, K. J., & LaFleur, S. J. (1993). Introspecting about reasons can reduce post-choice satisfaction. *Personality and Social Psychology Bulletin*, 19(3), 331–339.
- Yamagishi, K. (1997). When a 12.86% mortality is more dangerous than 24.14%: Implications for risk communication. *Applied Cognitive Psychology*, 11, 495–506.
- Zajonc, R. B. (1980). Feeling and thinking: Preferences need no inferences. *American Psychologist*, 35, 151–175.