

Chapter 3

The Role of Feelings in Perceived Risk

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Abstract This chapter provides an overview of key conceptualizations of and evidence for the role of feelings in perceived risk. Influence from feelings in judgment and decision making was first recognized nearly three decades ago. More recent work has developed models that generalize the mechanisms by which feelings operate. Feelings may play multiple roles in judgment and decision processes, including providing information, enabling rapid information processing, directing attention to relevant aspects of the problem, facilitating abstract thought and communication, and helping people to determine social meaning and to act morally. Feelings may be anticipated or experienced immediately and either integral (attached) to mental representations of the decision problem or incidental (unrelated), arising from moods or metacognitive processes. A rich repertoire of psychological concepts related to risk, such as appraisal and memory, can be used to help explain the mechanisms by which affect and analysis might combine in judgment and decision making. Phenomena such as psychophysical numbing, probability neglect, scope insensitivity, and the misattribution of incidental affect all provide empirical support, albeit fragmented, for the important influence of feelings. Future research needs to utilize multiple dependent variables and methodological approaches to provide convergent evidence for and development of more sophisticated descriptive and predictive models. An additional direction for future research is to develop tools that help risk communicators and risk managers to address complex, multidimensional risk problems.

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Introduction

The study of the role of feelings in risk judgments began with a focus on regret and disappointment theories within an economic framework (Bell 1982; Loomes and Sugden 1982) and experimental manipulations of mood (Johnson and Tversky 1983; Isen and Geva 1987). Nearly three decades later, researchers have amassed considerable evidence recognizing the importance of feelings in shaping risk perceptions. Numerous approaches have been used to capture and explicate feelings-based processes in a wide variety of domains. Research has moved on from establishing that feelings play a role, to developing models that generalize the mechanisms by which risk perceptions are influenced (Pham 2007; Slovic 2010). This chapter provides an overview of key conceptualizations of and evidence for the role of feelings in risk judgments. An intentionally wide-ranging use of the term “feelings” is employed to include studies of affect, emotion, and mood, reflecting the diverse theories and methods that comprise this field of research.

Conceptualizations

Dual-Process Theories: Recognizing Reliance on Feelings

Neoclassical economics asserts that individuals, over time and in aggregate, process risk information only in a way that maximizes expected utility (von Neumann and Morgenstern 1947). From this perspective, judgments are based on a utilitarian balancing of risks and benefits and feelings are only a byproduct of the cognitive process. That is, emotions such as fear, dread, anger, hope, or relief are experienced *after* the risk–benefit calculation is complete.

More recently, dual-process theories have conceptualized perceptions of and responses to risk as typically reflecting two, interacting, information-processing systems (Damasio 1994; Epstein 1994; Slovic 1996; Kahneman 2003; Bechara and Damasio 2005). The “analytic” system reflects the slow, deliberative analysis we apply to assessing risk and making decisions about how to manage hazards. The “experiential system” reflects fast, intuitive, affective reactions to danger. “Affective reactions” refer to a person’s positive or negative feelings about specific objects, ideas, images, or other target stimuli. Feelings may also reflect emotions (intense, short-lived states of arousal accompanied by expressive behaviors, specific action tendencies, and conscious experiences, usually with a specific cause, Forgas 1992) and moods (feelings with low intensity, lasting a few minutes or several weeks, often without specific cause, Isen 1997). From the dual-process perspective, feelings that arise from or amidst the experiential mode of thinking are influential during judgment and decision-making processes (Schwarz and Clore 1988).

Reliance on feelings in the process of evaluating risk has been termed “the affect heuristic” (Finucane et al. 2000a). Feelings provide potentially useful inputs

to judgments and decisions, especially when knowledge about the events being considered is not easily remembered or expressed (Damasio 1994). Many theorists have also given feelings a direct and primary role in motivating and regulating behavior (Mowrer 1960; Zajonc 1980; Damasio 1994; Isen 1997; Kahneman 2003; Pham 2007). Positive feelings act like a beacon of incentive, motivating people to act to reproduce those feelings, whereas negative feelings motivate actions to avoid those feelings.

Since recognizing the importance of feelings, scholars have attempted to clarify the nature and timing of their influence on risk perceptions. Distinguishing the impact of specific emotional states is of concern because the desirability of the impact may be a function of the intensity, valence, and appraisal content of the emotion. For instance, Lerner and Keltner (2001) have shown that fearful people express pessimistic risk estimates and risk-averse choices, whereas angry people express optimistic risk estimates and risk-seeking choices. Similarly, the importance of anticipated regret and disappointment has been demonstrated by Zeelenberg et al. (2000) and Connolly and Butler (2006). The timing of feelings is also critical. In analyses of the time course of decisions, Loewenstein and Lerner (2003) distinguish between anticipated emotions (beliefs about one's future emotional states that might ensue after particular outcomes) and immediate emotions (experienced when making a decision, thereby exerting an influence on the choice process). (For similar distinctions see Kahneman 2000.) Loewenstein and Lerner further identified two types of immediate emotions, namely, integral emotions (caused by the decision problem itself, such as feelings about a target stimulus or available options) and incidental emotions (caused by factors unrelated to the decision problem at hand, such as mood or cognitive fluency); see also Bodenhausen (1993) and Pham (2007). Empirical demonstrations of the influence of integral and incidental feelings on a wide variety of judgments and decisions are reviewed below.

In sum, early models of judgment and decision making emphasized cognitive aspects of information processing and viewed feelings only as a byproduct of the cognitive process. More recent models, however, give feelings a direct and primary role in motivating and regulating behavior in response to risk. Feelings may be anticipated or immediate and either integral to the decision problem or incidental, arising from moods or metacognitive processes. Identifying the role of feelings and how they interact with cognitive processes is the current focus of scientific inquiry for many researchers.

Functional Frameworks: Identifying the Roles of Feelings

In recent work, Peters (2006) proposed a framework to capture four roles that feelings play in judgment and decision processes. The first role is to provide information about the target being evaluated. Based on prior experiences relevant to choice options (integral affect) or the result of less relevant and ephemeral states (incidental affect), feelings act as information to guide the judgment or decision

process (Slovic et al. 2002). The second role is as a spotlight. The extent or type of feelings (e.g., weak vs. strong or anger vs. fear) focuses the decision maker's attention on certain kinds of information, making it more accessible for further processing. Third, feelings may operate as a motivator of information processing and behavior, influencing approach-avoidance tendencies (Frijda et al. 1989; Zeelenberg et al. 2008). Incidental mood states may also motivate people to act in a way that maintains a positive mood (Isen 2000). A fourth role is to serve as a common currency in judgments and decisions, allowing people to compare disparate events and complex arguments on a common underlying dimension (Cabanac 1992). Integrating good and bad feelings is easier than trying to integrate multiple incommensurate values and disparate logical reasons. A similar functional framework has been proposed by Pfister and Böhm (2008), who emphasize the role of feelings in providing information, directing attention to relevant aspects of the problem, and enabling rapid information processing.

An additional function of feelings, according to Pfister and Böhm (2008), is to generate commitment to implementing decisions, thus helping people to act morally, even against their short-term self-interest. Roeser (2006, 2009, 2010) also highlights the importance of emotions in providing moral knowledge about risks and that emotions are needed to correct immoral emotions. Kahan (2008) describes emotion as providing "a perceptive faculty uniquely suited to discerning what stance toward risk best coheres with a person's values." In his cultural evaluator theory, Kahan regards emotion as entering into risk judgments as a way of helping people to evaluate the social meaning of a particular activity against a background of cultural norms and to express the values that define their identities. When people draw on their feelings to judge risk, they form an attitude about what it would mean for their cultural worldviews for society to agree that the risk is dangerous and worthy of regulation. Kahan distinguishes the role of feelings not as a heuristic but as unique in enabling a person to identify a stance that is "expressly rational" for someone with commitment to particular worldviews. Consistent with his theory, Kahan et al. (2007) found that the impact of affect relative to other influences (such as gender, race, or ideology) was significantly larger among people who knew a modest or substantial amount about nanotechnology. This contrasts with the heuristic perspective in which affect is expected to play a larger role when someone lacks sufficient information to form a coherent judgment.

Finally, feelings may help to facilitate abstract thought and communication (Finucane and Holup 2006). Feelings help people to think abstractly because they link abstract concepts (e.g., good, bad) to the physical or sensory world. Without such links, judgments are slower and less accurate. One subtle demonstration of the link between affect and analytic thought is research showing that positive words are evaluated faster and more accurately when presented in white font, whereas negative words are evaluated faster and more accurately when presented in black font, despite the brightness manipulation being orthogonal to the valence of the words (Meier et al. 2004). Similarly, Meier and Robinson (2004) showed that people assign "goodness" to objects high in visual space and "badness" to objects low in visual space. Linking abstract concepts to physical or sensory

experiences helps the analytic system to interpret the meaning of stimuli so that they can be incorporated in cognitive calculus.

In sum, several roles of feelings in judgments and decisions about risk have been identified. Additional roles may be articulated as diverse disciplines apply their perspectives. Which role dominates in any particular judgment or decision is likely to be a function of multiple factors (e.g., task demands, time pressure, preferred decision style, social norms).

Clarifying the Relationship Between Feelings-Based and Cognitive Processes

Despite recognition that feelings-based and cognitive processes represent interdependent systems in decision making (Damasio 1994; Epstein 1994; Sloman 1996; Kahneman 2003; Bechara and Damasio 2005), theory and research to date have struggled to convey the exact nature of the relationship. The cognitive origins of behavioral decision theory may have encouraged people to assume that the domain of feelings is qualitatively different and functionally separate from the domain of cognition. Such distinction is reflected in the dichotomies often portrayed in this field, such as irrational emotions disturbing rational cognitions, intuitive feelings dominating deliberate thinking, and hot affect overwhelming cold logic (Pfister and Böhm 2008). However, overlapping commonalities in the systems have been noted also. For instance, the processing of experiences may be involved in both affective and analytic approaches. Johnson and Lakoff (2002; Lakoff and Johnson 1999) point out that even our most abstract thinking (mathematics, for example) is based on our “embodied” experiences. They describe how the locus of experience, meaning, and thought is the ongoing series of physical interactions with our changing environment. Our embodied acts and experiences are an important part of our conceptual system and in making sense of what we experience.

Clarifying the mechanisms by which feelings and cognitions are related and integrated in human judgment and decision making is a critical next step in understanding perceived risk. Finucane and Holup (2006) recommend expanding and linking the risk-as-analysis and risk-as-feelings approaches by adopting a “risk-as-value” model. This model emphasizes that responses to risk result from a combination of analysis and affect that motivates individuals and groups to achieve a particular way of life. Derived from dual-process theories, the risk-as-value model implies that differences in perceived risk may arise from differences in the analytic or affective evaluation of a risk or the way these evaluations are combined. As research moves from simply describing variance to predicting it, having multiple potential loci for such variation with different substantive interpretations will be useful. The risk-as-value model does not posit a specific rule for combining affective and analytic evaluations, although traditional information integration rules (adding, averaging, multiplying) may be applicable in some contexts. When

the implications of both affective and analytic evaluations are congruent, the processes may be more likely to combine additively. However, incongruence may result in greater emphasis on analytic or affective processing, depending on an array of task, decision-maker, or context variables (e.g., analysis may be increased if it is viewed as more reliable, but may be attenuated under time pressure).

The relationship between affective and analytic processes may be more fully explained by drawing on the rich repertoire of empirically tested concepts related to the psychology of risk, such as appraisal and memory. Lerner and Keltner's (2000) appraisal-tendency theory suggests that emotions arise from but also elicit specific cognitive appraisals. For instance, fear arises from and evokes appraisals of uncertainty and situational control, whereas anger is associated with appraisals of certainty and individual control (Lerner and Keltner 2001). Lerner et al. (2003) showed that anger evokes more optimistic beliefs about risks such as terrorism, whereas fear evokes greater pessimism about risks. Weber and Johnson's (2006) preferences-as-memory framework highlights how risk judgments are made by retrieving relevant (cognitive and affective) knowledge from memory. Framing normatively equivalent information positively or negatively (e.g., 90 % lives saved vs. 10 % lives lost) influences preferences because the different descriptions prime different representations in memory (predominantly positively or negatively valenced). Also drawing on modern concepts of memory representation, retrieval, and processing, Reyna and colleagues (Reyna and Brainerd 1995; Reyna et al. 2003) have proposed a dual-process model called fuzzy-trace theory (FTT). FTT posits that people form two kinds of mental representations. The first, verbatim representations are detailed and quantitative. The second, gist representations, provide only a fuzzy trace of experience in memory. People tend to rely primarily on gist, which captures the meaning of experience, including the emotional meaning. FTT differs from other dual-process models by placing intuition at the highest level of development, viewing fuzzy intuitive processes as more advanced than precise analytic processes (Reyna 2004).

In sum, the mechanisms by which feelings and cognitions are combined in judgment and decision making need to be clarified. Studies from a wide range of disciplines, including cognitive and social psychology, emotion and motivation, economics, decision research, and neuroscience, need to be integrated to develop models that explicitly specify possible causal constructs or variables that influence reactions to risk, allow for individual and group differences in these variables or in the relationships between them, and generalize across risk domains and contexts. Such model-based research can broaden our understanding of risk perceptions specifically and of basic psychological phenomena more generally.

Empirical Support

This section briefly reviews empirical support for the role of feelings in risk judgments and decisions. Although the empirical literature seems fragmented and sometimes inconsistent, evidence for the influence of emotion, affect, and mood is compelling.

Integral Feelings as a Proxy for Value

Early evidence of the role of feelings in risk perceptions came from studies showing that “dread” was the major driver of public acceptance of risk in a wide range of contexts, including environmental hazards such as pesticides, coal burning (pollution), and radiation exposure from nuclear power plants (Fischhoff et al. 1978). This observation led to many studies looking at how risk judgments are influenced by feelings that are integral (attached) to mental representations of hazardous activities, technologies, or events (Loewenstein et al. 2001; Slovic et al. 2002). In the first paper published on the affect heuristic, Finucane et al. (2000a) demonstrated that providing information about benefit (e.g., of nuclear power) changed perceptions of risk and vice versa. They also showed that whereas risk and benefit (e.g., of natural gas, chemical fertilizers) tend to be positively correlated across hazards in the world, they are negatively correlated in people’s judgments. Moreover, this inverse relationship between perceived risks and benefits increased greatly under time pressure, a situation in which opportunity for analytic deliberation was reduced. Although subconscious cognitive processes cannot be ruled out entirely, these results support the notion that in the process of judging risk, people may rely on feelings as a source of information about whether or not they are at risk and how they should respond.

Underpinning processes such as the affect heuristic are images, to which positive or negative feelings become attached through learning and experience. Images include perceptual representations (pictures, sounds, smells) and symbolic representations (words, numbers, symbols) (Damasio 1999). In an influential series of studies using the Iowa Gambling Task, Damasio, Bechara, and colleagues (Bechara et al. 1994; Damasio 1994; Bechara et al. 1997) proposed that in normal individuals, emotional responses evoked by objects are stored with memory representations (images) as somatic markers of these objects’ value (for challenges to the original interpretation, however, see Maia and McClelland 2004; Fellows and Farah 2005). Other research suggests that more vivid, emotionally gripping images of harm are more salient than emotionally sterile images, making those risks more likely to be noticed, recalled, and responded to (Hendrickx et al. 1989; Sunstein 2007). One explanation for this vividness effect may be that initial affective responses to an object seem to trigger a confirmatory search for information that supports the initial feelings (Pham et al. 2001; Yeung and Wyer 2004), possibly increasing the subjective coherence of judgments based on affect (Pham 2004). Another explanation may relate to the inherently strong drive properties of integral feelings, which motivate behavior and redirect action if necessary (Frijda 1988).

A simple method for studying the relationship between affect, imagery, and perceived risk is called affective image analysis, a structured form of word association and content analysis (Slovic et al. 1991; Benthin et al. 1995; Finucane et al. 2000b; Jenkins-Smith 2001; Satterfield et al. 2001). This method allows researchers to examine the distribution of different (sometimes conflicting) meanings of risk across people and to identify and explain those images that carry

a strongly positive or negative emotional charge. For instance, Finucane et al. (2000a) asked study participants to free associate to the phrase “blood transfusions.” Associations included “HIV/AIDS,” “hemophilia,” “gift giving,” and “life saving.” Participants were then asked to rate each of their associations on a scale from bad (−3) to good (+3); these ratings were correlated with a number of other measures, such as acceptability of having a transfusion and sensitivity to stigmatization in other risk settings. Affective image analysis was also used in a US national survey by Leiserowitz (2006), who found that holistic negative affect and image affect were significant predictors of global warming risk perceptions, explaining 32 % of the variance. Holistic negative affect was also predictive of support for national policies to address global warming, but less predictive than worldviews and values. A content analysis of affective imagery associated with “global warming” revealed that the phrase evoked negative connotations for almost all respondents, but that the most dominant images referred to impacts that were psychological or geographically distant, generic increases in temperature, or a different environmental problem.

In sum, integral affective responses are feelings elicited by real, perceived, or imagined images of the object of judgment or decision. These feelings are predictive of a variety of behavioral responses to risk. Evaluation and choice processes are more likely to be influenced by vivid, emotionally gripping images than pallid representations, possibly because strong feelings trigger a confirmatory information search or strong drive states.

Psychophysical Numbing

Considerable evidence suggests that affective responses follow the same psychophysical function that characterizes our sensitivity to a range of perceptual stimuli (e.g., brightness, loudness). In short, people’s ability to detect changes in a physical stimulus decreases as the magnitude of the stimulus increases. Known as Weber’s law, the just-noticeable change in a stimulus is a function of a fixed percentage of the stimulus. That is, to notice a change, only a small amount needs to be added to a small stimulus, but a large amount needs to be added to a large stimulus (Stevens 1975). Our cognitive and perceptual systems are designed to detect small rather than large changes in our environment. Fetherstonhaugh et al. (1997) demonstrated this same phenomenon of psychophysical numbing (i.e., diminished sensitivity) in the realm of feelings by evaluating people’s willingness to fund alternative life-saving medical treatments. Study participants were asked to indicate the number of lives a hypothetical medical research institute would have to save to merit a \$10 million grant. Nearly two-thirds of participants raised their minimum benefit requirements to warrant funding when the at-risk population was larger. A median value of 9,000 lives needed to be saved when 15,000 were at risk, compared with a median of 100,000 lives when 290,000 were at risk. In other words, 9,000 in the smaller population seemed more valuable than saving ten times

as many lives in the larger population. Psychophysical numbing or proportional reasoning effects have been demonstrated also in other studies (Baron 1997; Friedrich et al. 1999).

In striving to explain when feelings are most influential in judgments about saving human lives, several researchers have explored the “identifiable victim effect” (Jenni and Loewenstein 1997; Kogut and Ritov 2005; Small and Loewenstein 2005). For instance, Small et al. (2007) asked participants to indicate how much they would donate to a charity after being shown either statistical information about the problems of starvation in Africa (“statistical victims”) or a photograph of a little girl in Africa and a brief description of the starvation challenges she faces (“identifiable victim”). Results showed that the mean donation (\$2.83) for the identifiable victim was more than twice the mean donation (\$1.17) for the statistical victim, as might be expected given the affectively engaging nature of the photograph of the identifiable victim. Most interestingly, however, when participants were shown both statistical and identifiable information simultaneously, the mean donation was \$1.43. When jointly evaluating statistics and an individual victim, the reason for donating seems to become less compelling, possibly because the statistics diminish reliance on affective reactions during decision making. Small et al. also measured feelings of sympathy toward the cause (the identified or statistical victims). The correlation between these feelings and donations was strongest when people faced the identifiable victim.

In a follow-up study by Small et al. (2007), participants were either primed to feel (“Describe your feelings when you hear the word ‘baby’”) or to deliberate (“If an object travels at five feet per minute, how many feet will it travel in 360 s?”). Relative to the feelings prime, priming deliberative thinking reduced donations to the identifiable victim. There was no discernible difference of the two primes on donations to statistical victims, as would be expected because of the difficulty in generating feelings for such victims. Similarly, Hsee and Rottenstreich (2004) demonstrated that priming analytic evaluation led to more scope sensitivity and affective evaluation led to more scope insensitivity when participants were asked how much they would be willing to donate to help save endangered pandas. In their study, the number of pandas was represented in an affect-poor manner (i.e., as large dots) or an affect-rich manner (i.e., with a cute picture). The dots were related to a fair degree of scope sensitivity (mean donations were greater for four pandas than one), whereas pictures were related to scope insensitivity (mean donations for four versus one panda were almost identical). This scope insensitivity violates logical rationality, suggesting that inherent biases in the affective system can lead to faulty judgments and decisions.

In sum, the affective system seems designed to be most sensitive to small changes at the cost of making us less able to respond appropriately to larger changes further away from zero. Consequently, we may fail to respond logically to humanitarian and environmental crises.

Nonintuitive Consequences

Integral affect may lead decision makers astray in several other ways. One example is the phenomenon of “probability neglect”—the failure of people to adjust their decisions about the acceptability of risks to changes in information about their probability. Loewenstein et al. (2001) observed that responses to uncertain situations appear to have an all-or-none characteristic, sensitive to the possibility of strong negative or positive consequences and insensitive to their probability. That is, strong feelings tend to focus people on outcomes rather than probabilities. Rottenstreich and Hsee (2001) demonstrated that while people were willing to pay more to avoid a high than a low probability of losing \$20, they were not willing to pay more to avoid a high than a low probability of receiving an electric shock (a prospect rich in negative affect). Another example comes from Denes-Raj and Epstein’s (1994) jellybeans experiment. When given a chance to draw a winning red bean either from a small bowl containing a single red bean and nine white beans (10 % chance of winning) or from a larger bowl containing nine red beans and 91 white beans (9 % chance of winning), people tend to choose to draw from the larger bowl, even though the probability of winning is greater with the small bowl. The more abstract notion of probability (the distribution of beans in a random draw process) is less influential than the affective response people have to the concrete representations of objects (seeing multiple red beans). One interpretation of these results is that integral affect provides a largely categorical approach to assessing value. That is, objects are categorized in terms of their significance for well-being, regardless of their probability or magnitude.

The emerging field of neuroeconomics provides convergent evidence for the nonintuitive consequences of integral affect (Trepel et al. 2005). Using methods such as functional magnetic resonance imaging, researchers have examined brain activity in areas known to process affective information. For instance, examining the neurobiological substrates of dread, Berns et al. (2006) showed that when people are confronted with the prospect of an impending electric shock, regions of the pain matrix (a cluster of brain regions activated during a pain experience) are activated. This finding suggests that people not only dislike experiencing unpleasant outcomes, they also dislike waiting for them. Contrary to tenets of economic theory, people seem to derive pain (and pleasure) directly from information, rather than from any material outcome that the information might lead to. Anticipating future outcomes in this way can have a major impact on intertemporal choices (decisions that involve costs and benefits that extend over time). While an economic account of intertemporal choice predicts that people generally want to expedite pleasant outcomes and delay unpleasant ones (Loewenstein 1987), an affective account predicts that people may prefer to defer pleasant outcomes when waiting is pleasant or to expedite unpleasant outcomes when waiting is frustrating or produces dread.

Another nonintuitive feature of feelings-based judgments is that they tend to be more relativistic or reference-dependent than are reason-based judgments. That is,

affective responses are often not based on the object or outcome in isolation, but in relation to other objects or outcomes (Mellers 2000). Winning \$10 in a gamble will elicit greater pleasure if the alternative outcome is losing \$5 rather than only \$1. This finding is also consistent with work on the evaluability principle. Hsee (1996) asked people to assume they were music majors looking for a used music dictionary. Participants were shown two dictionaries and asked how much they would be willing to pay for each. Dictionary A had 10,000 entries and was like new, whereas dictionary B had 20,000 entries but also had a torn cover. In a joint-evaluation condition, willingness to pay was higher for B, presumably because of its greater number of entries. However, when one group of participants evaluated only A and another group evaluated only B, the mean willingness to pay was much higher for A, presumably because without a direct comparison, the number of entries was hard to evaluate whereas the defects attribute was easy to translate into a precise good/bad response. Wilson and Arvai (2006) have extended this work to show that in some contexts, enhanced evaluability may not be sufficient to deflect attention away from the affective impressions of the choice pair and toward other decision-relevant risk information, a behavior they call affect-based value neglect.

In sum, strong feelings can lead people to ignore probabilities and magnitudes, possibly because in some situations integral affect can provide only a categorical and reference-dependent approach to valuation. Risk theory and practice will benefit from further explorations of the conditions under which feelings influence attention to and use of different types of information.

Misattribution of Incidental Feelings

In addition to studies focusing on integral feelings, a large number of studies have shown that affective states unrelated to the judgment target (incidental feelings) may influence judgments and decisions (Schwarz and Clore 1983; Isen 1997). An early study by Johnson and Tversky (1983) demonstrated that experimental manipulation of mood (induced by a brief newspaper report on a tragic event such as a tornado or flood) produced a pervasive increase in frequency estimates for many undesirable events, regardless of the similarity between the report and the estimated risk. More recently, Västfjäll et al. (2008) showed that eliciting negative affect in people by asking them to think about a recent major natural disaster (the 2004 tsunami) influenced judgments when the affect was considered relevant (e.g., the perceived risk of traveling to areas affected by the disaster), but also when it was not relevant (e.g., developing gum problems).

In a classic study, Schwarz and Clore (1983) demonstrated that people reported higher levels of life satisfaction when they were in a good mood as the result of being surveyed on a sunny day than people who were in a bad mood as a result of being surveyed on a rainy day. People incorrectly attributed their incidental moods as a reflection of how they felt about their personal lives. In general, the misattribution of incidental feelings to attentional objects tends to distort beliefs in an assimilative fashion. However, research suggests that the influence of incidental

affect is neither stable nor unchangeable. Rather, it is a constructive process in which the decision maker needs to determine whether their feelings are a reliable and relevant source of information (Pham et al. 2001; Clore and Huntsinger 2007). For instance, Schwartz and Clore were able to reduce the influence of mood on participants' judgments of well-being with a simple reminder about the cause of their moods (e.g., sunny vs. cloudy weather), presumably triggering people to question the diagnostic value of the affective reaction for the judgment. Importantly, the manipulation changed the diagnostic value of the affective reaction, not the affective reaction itself (Schwarz 2004). Västfjäll et al. (2008) also demonstrated that manipulating the ease with which examples of disasters come to mind can influence risk estimates. Asking participants who had been reminded of the 2004 tsunami to list few (vs. many) natural disasters led to more pessimistic outlooks (measured via an index averaging judgments of the likelihood of positive and negative events), presumably because listing many natural disasters rendered incidental affect relatively less diagnostic for judgments.

Incidental affective states have been shown also to influence the nature of information processing most likely to occur. Negative mood states generally promote a more analytic form of information processing, whereas positive moods generally promote a less systematic, explorative form of processing. From an evolutionary perspective, negative moods may highlight a discrepancy between a current and desired state, signaling a need to analyze the environment carefully (Higgins 1987). Positive moods, on the other hand, may encourage variety seeking in order to build future resources (Fredrickson 1998). Empirical findings are not entirely consistent, however. Both positive and negative moods have been related to increased and decreased systematic processing (Isen and Geva 1987; Mackie and Worth 1989; Schwarz 1990; Baron et al. 1992; Gleicher and Petty 1992; Wegener and Petty 1994; Isen 1997).

In sum, incidental feelings may influence risk judgments and decisions. The diagnostic value of the feelings depends on the context. Fortunately, people can be primed to examine the diagnostic value of their feelings. Incidental feelings may also influence the extent to which individuals engage in systematic processing, although the exact nature of this relationship remains unclear.

Generalizations

Several generalizations can be made about the role of feelings in risk judgments. First, feelings in the form of emotions, affect, or mood can have a large impact on how risk information is processed and responded to. The multiple ways in which feelings influence risk judgments and decisions likely relate to several functions of feelings: providing information, focusing attention, motivating behavior, enabling rapid information processing, generating commitment to outcomes to help people act morally, and facilitating abstract thought and communication. Other functions

may be identified with more in-depth explorations from diverse disciplinary perspectives on the relationship between feelings and perceived risk.

Feelings that are integral to objects are often interpreted as signals of the value of those objects, motivating people to approach or avoid accordingly. Assessments of value based on integral affect differ from cognitive assessments in that the feelings tend to be more categorical, reference dependent, and sensitive to vivid imagery. Consequently, judgments based on integral feelings may be insensitive to scale (probability or magnitude) and myopic, emphasizing immediate hedonic consequences (positive or negative) over future consequences. The influence of specific characteristics of feelings (e.g., valence, intensity) on judgment processes needs further investigation.

Milder incidental feelings that are unrelated to the judgment target are also influential in judgment processes. In seeking information to inform their judgments, people tend to use whatever is available to them at the time and sometimes misattribute their mood states or metacognitive experiences as a reaction to the target. A variety of interventions can help people discern the diagnostic value of feelings.

Further Research

Since empirical studies are designed in a specific theoretical and methodological context, no single study can fully answer the complex question of how feelings affect risk perceptions. However, to address the fragmented and sometimes inconsistent findings reported to date, future research needs to work to provide converging evidence for the role of feelings in judgment and decision processes. Converging evidence will be obtained by looking at multiple dependent variables and by using multiple methodological approaches to test alternative explanations of results (Weber and Hsee 1999). Though methods and measures for studying affect may be unfamiliar to many risk researchers, a wealth of tools exist in diverse disciplines studying the form and function of feelings. An interdisciplinary effort including physiological, neurological, psychological, sociological, and other approaches can be used to examine the interplay of affective and analytic processes in risk judgments, to yield the fullest understanding of risk reactions.

Future research also needs to explore new (e.g., qualitative) understandings of how affective and analytic processes (and their interactions) are best represented. A growing body of ethicists and social scientists have criticized purely quantitative approaches as ill-equipped to reflect public conceptualizations of the complex, multidimensional, and often nonmonetary qualities of risks being faced (Stern and Dietz 1994; Prior 1998; Satterfield and Slovic 2004; Finucane and Satterfield 2005; Roeser 2010). Likewise, the seemingly categorical, reference-dependent nature of the affective system may require new approaches to fully explicate nonintuitive consequences of feelings on risk judgments.

Another direction for future research is to evaluate the ecological validity of feelings. Adopting a Brunswikian (Brunswik 1952) approach, Pham (2004) suggests examining (a) the correlation between integral feelings elicited by objects and these objects' true criterion value (the ecological validity of feelings), and (b) the correlation between other available proxies of value and the object's criterion value (the ecological validity of alternative bases of evaluation). The ecological validity of incidental feelings could be examined in a similar fashion.

Finally, in a more practical realm, future research needs to help risk communicators and risk managers to determine the most effective tools for presenting and processing risk information. For instance, research will help to make risk estimates more accurate and risk mitigation behaviors more timely if it informs us of how to make abstract probabilities meaningful, reduce the gap between anticipated and experienced affect, facilitate the integration of non-commensurate metrics, or engage ethical assessments. Practitioners from diverse fields such as health care services, food safety, terrorism prevention, environmental resource management, and disaster preparedness would benefit from a systematic translation of the rich body of research into practice. Tools that account for the role of feelings in a way that facilitates efficient yet sound decision making will enhance our ability to successfully regulate risks.

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