Understanding Public Risk Perception and Responses to Changes in Perceived Risk

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Function of Risk Perception

Homo sapiens is a complex organism, designed to function in complex and changing environments and to satisfy a great variety of often contradictory goals. We need to procure sustenance and shelter on a regular basis, which require action and confidence, but at the same time ensure safety and survival, which require protection and caution. Actions are often triggered, at least initially, by emotional responses to situations as much as by analytic evaluations, which include the proverbial emotions of greed vs. fear, or subjective states of confidence vs. caution, which give rise opportunity/novelty seeking vs. retreat to the known and familiar. In many situations it is the perception of an imminent threat that triggers a switch from exploration and opportunity seeking to self-protective behavior.

While change and adaptation to change is necessary and inevitable, it is also effortful and scary, and so we show a strong status quo bias (Samuelson & Zeckhauser, 1988). It requires a strong motivator for us to overcome this status quo bias, which comes in the form of a strong affective signal that business-as-usual is no longer an option, which at an analytic level may be coded as an increase in perceived risk. Bracha and Weber (2012) argue that the human need for predictability and control is central to a psychological account of confidence as well as perceptions of risk, fear, and panics. Confidence in a system, a technology or a financial market, results when people, citizens or investors, believe they understand how things work, which leads to a sense of predictability (Einhorn, 1986) and a perception of low risk (Weber, Siebenmorgen, & Weber, 2005). A feeling of control legitimizes opportunity seeking, i.e., reaping benefits while avoiding catastrophic losses. In those situations, existing risks are often underestimated, i.e., given less attention and weight than their probability warrants (Hertwig et al., 2004). Bracha and Weber (2012) argue that events that destroy this sense of predictability and perceived control trigger rapid and drastic shifts in the perception of risk, often resulting in panics. Behavior at the individual level includes retreat to safe and familiar choice options (be they investment vehicles or technologies) to minimize exposure to perceived danger until a new account/model of how things work has been established. Such behavior at the individual level triggers in turn an expert assessment at the regulatory level to (a) examine prior evaluations of risk levels based on the new information (the triggering accident or crisis) and correct it, if found inaccurate, or (b) diagnose a regime change and identify its causes.

Individual Risk Perception

Uncertainty refers to a state in which decision makers are unable to predict what exactly will happen if they engage in a given action. The degree of this uncertainty can vary, with endpoints on a continuum that ranges from partial to full information about outcomes and their probabilities (Knight, 1921). In economics this is represented by the probability distribution over future states of the world, where “decision under risk” refers to decision made when the probability distribution over future states of the world is
known and “decision under uncertainty” or “ambiguity” refers to decisions made when this probability distribution is unknown. The less is known about future probability distributions of outcomes based on past experience, i.e., the greater the degree of uncertainty, the more room there is for individual and situational differences in the assessment of existing risk, i.e., differential attention to either the upside potential of an uncertain outcome distribution (wishful thinking or optimism) or the downside potential (precaution or pessimism) (Weber, 2010).

**Risk as a Feeling**

In contrast to the economic or engineering mathematical assessments of likelihood and severity of events, psychology depicts risk perception as an intuitive assessment of such events and their consequences. Popular uses of the term risk often also refer to either the probability of an aversive event (the risk of rain) or its severity (value at risk), rather than some combination of the two. Evidence from cognitive, social, and clinical psychology indicates that risk perceptions are influenced by associative processes—connections between objects or events contiguous in space or time, resembling each other, or having some causal connection (Hume, 1748)—and affective processes—processes influenced by emotions—and these influence risk perception as much or even more than analytic processes (Weber, 2010).

Kahneman (initially in his Nobel address (2003) and more extensively in his recent book (2011)) has captured decades of behavioral research by characterizing two modes of thinking, called System 1 and System 2. The associative and affective processes that give rise to intuitive perceptions of risk are typical of System 1 thinking, which operates automatically and quickly with no effort or voluntary control, and is available to everyone from an early age. Analytic assessments of risk, on the other hand, are typical of System 2 processes, which work by algorithms and rules such as probability calculus, Bayesian updating, and formal logic. System 2 processes must be taught explicitly and require conscious effort and control, and thus operates more slowly. Even though these two processing systems do not map cleanly onto distinct regions of the brain and they often operate cooperatively and in parallel (Weber & Johnson, 2009), Kahneman (2011) argues convincingly that the distinction between System 1 and 2 helps to make clear the tension between automatic and largely involuntary processes and effortful and more deliberate processes in the human mind. Psychological research over the past decade has documented the prevalence of System 1 processes in the intuitive assessment of risk, depicting them as essentially effort-free inputs that orient and motivate adaptive behavior, especially under conditions of uncertainty (Finucane et al. 2000; Loewenstein et al. 2001; Peters et al. 2006).

**Psychological Risk Dimensions**

Puzzled by the American public’s perception of the riskiness of nuclear power that did not coincide with engineering or public safety estimates of morbidity or mortality risks associated with nuclear-generated vs. other (carbon-based) sources of power, the nuclear power industry commissioned several psychologists in the 1970s to investigate this discrepancy. Slovic and colleagues identified two psychological risk dimensions that influence people’s intuitive perceptions of health and safety risks in ways common across numerous studies in multiple countries and that explain differences between the risk perceptions of members of the general public vs. those of technical experts (Slovic,
The first dimension, *dread risk*, captures emotional reactions to hazards like nuclear reactor accidents, or nerve gas accidents. That is, things that make people anxious because of a perceived lack of control over exposure to these events and because their consequences may be catastrophic. The second dimension, *unknown risk*, refers to the degree to which a risk (e.g., DNA technology) is seen as new, with a perceived lack of control due to unforeseeable consequences. Responsiveness to these factors shows that the human processing system maps both the severity and the uncertainty component of the risk of future events into affective responses and represents risk as a feeling rather than as a statistic (Loewenstein et al., 2001), consistent with System 1 processing.

The fact that *dread* and the *unknownability* of a risk increase risk perception provides an explanation for the moderating effect of familiarity on the perceptions of the risk of a hazard or risky choice option, holding objective information about the probability distributions of possible outcomes constant (e.g., Weber, Siebenmorgen, & Weber, 2005). Knowing a certain product, game, person, or environment, gives rise to the feeling of familiarity. Empirical research shows that familiarity does not only breed liking, it also breeds greater comfort, i.e., reduces dread and feelings of risk, and it increases the feeling of control (Weber et al., 2005). This association can be legitimate, but it may also be spurious, as when a stock has a familiar name or is of a local firm (see Huberman 2001; for a survey see Barberis and Thaler 2003), but it can also be a result of personal experience with the risky option (e.g., 20 years of working in a nuclear power plant).

**Detecting Changes in Risk**

Detecting changes in risk can be challenging for multiple reasons. The fact that humans habituate to changes in magnitude or intensity makes gradual change very hard to detect. Weber's Law (1834) specifies the magnitude of a just noticeable difference (JND) for sensory perception and finds that the increase in magnitude necessary to perceive a JND is proportional to the starting value, meaning that greater increments are necessary to detect increases at higher levels.

People’s default mental model, at least during periods of stability, is one of perseverance of conditions, meaning that people require a very strong signal to believe that there has been a regime change, i.e., that conditions have changed to either regime with greater or lesser risks.

Few events are deterministic, and the fact that outcomes are often probabilistic makes the detection of regime changes more difficult, as a more negative or positive outcome than expected can also be simply an extreme draw from the distribution of outcomes under the old regime. People’s expectations of change (or stability) are important in their ability to detect trends in probabilistic environments, as illustrated by a historic climate example (Kupperman, 1982, reported in Weber, 1997). English settlers who arrived in North America in the early colonial period assumed that climate was a function of latitude. Newfoundland, which is south of London, was thus expected to have a moderate climate. Despite repeated experiences of far colder temperatures and resulting deaths and crop failures, colonists clung to their expectations based on latitude, and generated ever more complex explanations for these deviations from expectations. In another example, farmers in Illinois were asked to recall salient growing season temperature or
precipitation statistics for seven preceding years (Weber, 1997). Farmers who believed that their region was undergoing climate change recalled temperature and precipitation trends consistent with this expectation, whereas farmers who believed in a constant climate, recalled temperatures and precipitations consistent with that belief. Similarly, Leiserowitz and colleagues (2008) found that differences in political ideology between segments of the U.S. population, associated with beliefs about climate stability shape climate change perceptions.

Social Amplification of Risk
Social, institutional, and cultural processes have been shown to amplify public responses to the risk (Kasperson et al., 1988). Such amplification by scientists or engineers who communicate the risk assessment, news media, interpersonal networks, and other groups and institutions occur in the transfer of information about the risk and in the protective response mechanisms of society (Weinstein et al., 2000; Taylor, 1983). Evidence from the health literature, the social psychological literature, and the risk communication literature suggests that these social and cultural processes serve to modify perceptions of risk in ways that can both augment or decrease response in ways that are presumably socially adaptive.

Fundamental worldviews also shape how people select some risks for attention and ignore others. Douglas and Wildavsky (1982) identified five distinct “cultures” (labeled hierarchical, individualist, egalitarian, fatalist, and hermitic, respectively) that are said to differ in their patterns of interpersonal relationships in ways that affect perceptions of risk. Hierarchists tend to perceive industrial and technological risks as opportunities and thus less risky, whereas egalitarians see them as threats to their social structure (Dake, 1991). Leiserowitz (2006) provides evidence for the value of this approach to understanding group differences in the US in their perceptions of climate change risks. Other researchers trace differences in risk perceptions to differences in fundamental value priorities, following the work of Schwartz (1992) or in worldviews such as the New Ecological Paradigm (Dunlap & Van Liere, 1984).

Individual Action and Choice under Risk and Uncertainty
Perception of risk or detection of changes in risk are not an end in themselves, but are signals presumably meant to motivate protective action, which often means changes from business as usual. Different models of risky choice put a different emphasis on the role of perceptions of risk. Neither objective nor subjective risk perception plays any role in expected utility theory (von Neumann & Morgenstern, 1944/47), the ruling normative model of risky choice in economics, nor in its widely-known behaviorally more descriptive psychological version, prospect theory (Kahneman & Tversky, 1979). However, the risk—return framework of finance provides such a role. Markowitz (1952) proposed to model people’s willingness to pay (WTP) for risky option $X$ as a tradeoff between the option’s return $V(X)$ and its risk $R(X)$, with the assumption that people will try to minimize level of risk for a given level of return:

$$WTP(X) = V(X) - bR(X).$$
Traditional risk—return models in finance equate $V(X)$ with the EV of option $X$ and $R(X)$ with its variance. Model parameter $b$ describes the precise nature of the tradeoff between the maximization of return and minimization of risk and serves as an individual difference index of risk aversion. This model is widely used in finance, e.g., in the Capital Asset Pricing Model (CAPM; Sharpe, 1964).

Behavioral extensions of this normative risk—return framework (Sarin & Weber, 1993) question the equating of risk with outcome variance. Psychological studies have examined the perception of risk, both directly—by assessing people’s judgments or rankings of the riskiness of risky options and modeling these, often using axiomatic measurement models—and indirectly—by inferring the best fitting metric of riskiness from observed choices under the assumption of risk—return tradeoffs (see Weber, 2001). These studies are unanimous in their verdict that the variance or standard deviation of outcomes fails to account for perceived risk, i.e., for the intuitive feeling of being at risk that people can quantify by judging riskiness of different choice options or action alternatives, e.g., on a scale from 0 to 100. Risk judgments deviate from the variance or standard deviation of possible choice outcomes for a variety of reasons. First, deviations above and below the mean contribute symmetrically to the mathematically defined variance, whereas perceptions of riskiness tend to be affected far more by downside variation (e.g., Luce & Weber, 1985). Second, variability in outcomes is perceived relative to average returns. A standard deviation of $\pm$ $100$ is huge for a risky option with a mean return of $50$ and amounts to rounding error for a risky option with a mean return of $1M$. The coefficient of variation (CV), defined as the standard deviation (SD) that has been standardized by dividing by the EV:

$$CV(X) = \frac{SD(X)}{EV(X)},$$

provides a relative measure of risk, i.e., risk per unit of return. The most important implication of using the CV as a measure of perceived risk for the current discussion is the fact that increases in risk will be harder to detect, the larger the average level of existing risk is, following Weber’s (1834) psychophysical law. The CV is used in many applied domains and provides a vastly superior fit to the risk taking data of foraging animals and people who make decisions from experience, as discussed in the next section (Weber, Shafir, Blais, 2004). Weber et al. (2004) show that simple reinforcement learning models that describe choices in such learning environments predict behavior that is proportional to the CV and not the variance.

**Decisions from description vs. from experience**

There are important differences in the way people make decisions when information about uncertain choice options comes from repeated personal experience rather than a statistical (numeric or graphic) description of possible outcomes and their likelihood (Weber, Shafir, Blais, 2004). This distinction between learning about risk and risky outcome distributions from experience versus from description has received much attention because ostensibly the same information about events and their likelihoods can lead to very different perceptions and actions (Hertwig et al., 2004), which in turn is the result of the engagement of different psychological processes. Learning from repeated personal experience involves the System 1 associative and affective processes described above, that are fast and automatic—the same processes involved in risk perception—
while learning from statistical descriptions requires analytic processing and cognitive effort. Possibly for this reason, when given the choice between attending to information provided in the form of statistical summaries or to information provided by personal experience, personal experience is more likely to capture a person’s attention, and its impact dominates statistical information, even though the latter is often far more reliable (Erev & Barron, 2005).

There is evidence that individuals draw different lessons from experience than from description, especially when small-probability events are involved. Decisions from description are described well by prospect theory (Kahneman & Tversky, 1979; Tversky & Kahneman, 1992), which is based on hundreds of studies of choices between described one-shot risky options, typically money lotteries. In such choices, decision makers tend to overweight the impact of small probability events, especially when such events have large positive or negative valence (e.g., a .001 chance of making $5M, or a .005 chance of brain damage as the side effects of vaccinating against measles). In contrast, decisions from experience follow classical reinforcement learning that gives recent events more weight than distant events (Weber, Shafir, & Blais, 2004). Such updating is adaptive to dynamic environments where circumstances might change. Because rare events (e.g., large financial losses) have a smaller probability of having occurred recently, they tend (on average) to have a smaller impact on the decision than their objective likelihood of occurrence would warrant. When they do occur, however, they have a much larger impact on related decisions than warranted by their probability. This makes learning and decisions from experience more volatile across respondents and past outcome histories than learning and decisions from description (Yechiam, Barron, & Erev, 2004). These reinforcement learning models and their predicted more volatile responses to small probability risks seem to describe the general public’s dynamic and fluctuating reactions to small probability risks far better than rational choice models or their psychological extensions like prospect theory.

**Regulatory Responses**

Culture, including its social structures and formal or informal institutions, can be seen as a way of extending individual capabilities and/or correcting for existing individual-level problems or biases (Ostrom, 1990; Boyd & Richerson, 1985). Given human finite attention and processing capacity and the resulting tendency to allocate scarce capacity to decisions and events close in time and space (Weber & Johnson, 2009), human society has developed a division of labor whereby different individual or social problems that require longer time horizons or greater attention are assigned to designated professional groups, who are charged with developing the required professional knowledge and expertise and with using their available attention to monitor opportunities as well as risks within their designated sphere. Thus epidemiologists and medical researchers are in charge of health risks, climatologists in charge of climate risks, and so on. Similarly, government agencies like the Department of Health or the EPA are designated to take action on behalf of and in the interest of their citizens in their designated domain, in situations where individual knowledge, interest, or attention is deemed inadequate or where individual action would be insufficient to address social problems, as in common
pool resource dilemmas.

Domain-specific regulatory oversight of different sources of risks to individual citizens and the social collective (i.e., some divide and conquer strategy) is as good an idea at the social level as it is at the individual level (Clemens, 1997). At the individual level, it is very hard to keep some (let alone an optimal level of) attention on all possible sources of risk. Instead, as worry increases about one type of risk, concern about other risks has been shown to go down, as if people had only so much capacity for worry or a finite pool of worry (Weber, 2006). Illustrations of the finite pool of worry effect are provided by the observation that increases in the concern of the U.S. public about terrorism post 9/11 resulted in decreased concern about other issues such as restrictions of civil liberties as well as climate change (Leone & Anrig, 2003), or that the 2008 financial crisis reduced concern about climate change and environmental degradation (Pew Research Center, 2009).

Regulatory guidance and oversight in areas of important societal risks is needed from a behavioral decision theoretical perspective not only to supplement individual perceptions of risk, but also to supplement individual action. Weber (1997) coined the phrase *single action bias* for the following phenomenon observed in contexts ranging from medical diagnosis to farmers’ reactions to climate change. Decision makers are very likely to take a single action to reduce a risk that they are concerned about, but are much less likely to take additional steps that would provide incremental protection or risk reduction. The single action taken is not necessarily the most effective one, nor is it the same for different decision makers. Regardless of which single action was taken first, decision makers tend not to take further action, presumably because the first action reduces the feeling of worry or vulnerability. Weber (1997) found that farmers who showed concern about global warming in the early 1990s were likely to change either something in their production practice (e.g., irrigate), their pricing practice (e.g., ensure crop prices through the futures market), or lobbied for government interventions (e.g., ethanol taxes), but hardly ever engaged in more than one of those actions, even though a portfolio of protective actions might have been advisable. The fear of climate change seemed to set a “flag” that some action was required, but remained in place only until one such action was taken, i.e., any single protective action had the effect of taking down the “impending danger flag.” While such behavior might have served us well in our evolutionary history where single actions generally sufficed to contain important risks, in more complex environments where a portfolio of risk management actions is advised, purely affect-driven, single-action biased responses may not be sufficient. Hansen, Marx, and Weber (2004) found evidence for the single-action bias in farm practices that can be interpreted as protective actions against climate change and/or climate variability. Thus farmers who indicated that they had the capacity to store grain on their farms were significantly less likely to indicate that they used irrigation or that they had signed up for crop insurance, even though all three actions in combination would provide greater protection against climate risks.

The relationship between public and technocratic perceptions of risk as well as responses to risks or to perceived changes in risk is complex. Weber and Stern (2012) describe
some of the differences between the risk assessment by scientists and nonscientists. Scientists use multiple methods to guard against error in their assessment of causal relationships and uncertainty, including observations and experiments, systematic observation and measurement, mathematical models that incorporate theories and observational data and are tested against new data, systems of checking measurements and peer-reviewing research studies to catch errors, and scientific debate and deliberation about the meaning of the evidence, with special attention given to new evidence that calls previous ideas into question. Scientific communities sometimes organize consensus processes such as those used in the IPCC and NRC studies to clarify which conclusions are robust and which remain in dispute. Although these methods do not prevent all error, the scientific methods clarify the unresolved issues and allow for continuing correction of error. Nonscientists' ways of perceiving risks and responding to risk and uncertainty, briefly reviewed above, leave them more vulnerable to systematic misunderstanding. Personal experience can easily mislead (Weber, 1997), mental models of causal relationships can be too simple or wrongly applied (Bostrom et al., 1994), judgment can be driven more by affect, values, and worldviews than by evidence (Slovic, 1987), and attention and response can be very selective and incomplete (Weber & Johnson, 2009).

In situations where expert and public perceptions of risk disagree, the way in which the two perceptions affect each other is also complex and typically does not follow a rational model of influence. In other words, while one would expect that people would let their personal perception of risk be informed and influenced by the more comprehensive and systematic expert risk assessment, which they have at least indirectly commissioned, public and media attention and response to risk is typically is more swayed by far less diagnostic personal exposure and memorable events than by statistical summaries or theoretical arguments or models (Weber, 2006; Weber & Stern, 2012). At the same time, regulatory bodies often need to respond to public perceptions or changes in public perceptions of risk, even when domain experts disagree with these assessment, because public fear, even when unfounded, has negative consequences for public health and creates barriers to responses or non-responses that might be advocated by technical experts.

**Causes of Changes in Perceived Risk**

There appears to be some asymmetry in the mechanisms and thus the speed with which perceptions of perceived risk change in the direction of decreased vs. increased risks. Perceived risk tends to decrease slowly and steadily, in a continuous fashion, as people fail to experience adverse consequences when engaging in potentially risky activities or when being exposed to potentially risky environments. The mechanism for such decreases in perceived riskiness is the absence of negative feedback in decisions from experience and the increasing familiarity with the sources of potential risk. Familiarity not only breeds liking (and increased choice), but also decreased perceptions of risk (Weber, Siebenmorgen, & Weber, 2005).

Increases in perceived risk, on the other hand, tend to be far more rapid and not gradual. Major accidents or financial, public health, or other crises can send a strong signal that
prior assessments of risk were too low, either as the result of insufficient information about existing dangers or because the “regime” has changed. Such increases in perceived risk tend to occur by emotional, rather than analytic pathways, supporting the notion that risk is a feeling, rather than a statistic (Loewenstein et al., 2002). Perceived risk increases when the ability to predict and control outcomes in probabilistic environments is put into question.

The need for control is a basic human need (Maslow, 1954). Persistent failures to do so can lead to depression and learned helplessness (Seligman, 1975), while having a sense of control is associated with better health (Plous, 1993). The illusion of control refers to the human tendency to believe we can control or at least influence outcomes, even when these outcomes are the results of chance events. For example, individuals often believe they can control the outcome of rolling dice in a game of craps—throwing the dice hard for large numbers and softly for low numbers (Langer, 1975). Outside of the casino, most outcomes require a combination of skill and chance, but the illusion of control also gets people to overestimate their degree of control over adverse consequences in such situations, believing for example that driving is safer means of transportation than air travel, contrary to accident statistics (Slovic, 1987).

The illusion of control is more commonly found in familiar situations and in situation associated with the exercise of skill, e.g., situations that provide involvement in the choice and competition (Langer & Roth, 1975), and in stressful and competitive situations, including financial trading (Fenton O’Creevy et al., 2003). Social psychologists argue that the illusion of control is adaptive, since it motivates people to persist at tasks when they might otherwise give up and because there is evidence that it is more common in mentally healthy than in depressed individuals (Taylor & Brown, 1978).

New and complex environments or technologies are potential threats, and we manage the perceived risks by forming a mental model of how the new technology and/or environment works. This model gets tested by repeated exposure, i.e., by sampling these risky options and by observing resulting outcomes and consequences. The absence of negative consequences and the occurrence of essentially predicted outcomes make us confident in our understanding of how things work and our ability to control adverse consequences. Both complexity and riskiness of these new technologies or environments may be underestimated in the face of positive feedback.

Events suggesting that existing mental models might be incomplete or faulty and that beliefs of control are therefore illusory—when individuals or groups realize that they can no longer predict and hence control important (financial, social, or technological) events and outcomes in their lives— trigger rapid and drastic shifts in the perception of risk, often resulting in panics. Such emotional reactions can be seen as an adaptive early warning system, evolution’s way to jolt us out of our habitual way of doing things, counteracting our strong status-quo bias (Samuelson & Zeckhauser, 1988).

Black swan events, i.e., the occurrence of something previously considered outside of the plausible range of events, are a signal that our current mental model of the risky or uncertain processes is inadequate or faulty. Hence a reassessment of risks and benefits of
different choice options is necessary and short-term protective action may be required. Such a fear or panic reaction in response to a signal indicating that we do not have a correct model of how things work and hence are not able to control consequences essentially reactivates the second psychological risk dimension, discussed above, fear of the unknown, which previously may have been assuaged by repeated personal successful experience with the risky choice options.

Increased perceptions of risk, an aversive emotion, motivate us to turn away from newly dangerous new technologies or environments and to turn to the old and familiar, whether this means embracing a known technology like coal-generated power with its known risks of climate-changing emissions, or moving from mortgage-backed security to holding gold. Just as social processes amplify individual responses and reactions during periods of perceived control and (over)confidence, social processes also amplify the perceived loss of control and feelings of panic (Kasperson et al., 1988).

Reactions to Changes in Perceived Risk

People’s reactions to events that indications that some activity entails much greater risk than they previously assumed, will depend at least in part on the attribution of this change in perceived risk, i.e., whether it is seen as an indication of a regime shift (i.e., that something important in the environment has changed) or as an indication that existing knowledge and control over the potential risk is smaller than previously assumed. The distinction between regime shifts (something changing in the external environment that may or may not have been predictable) and the revelation of incomplete or faulty mental models of the situation is of course not clear cut, but more on a continuum, as a complete and omniscient mental model of the situation would anticipate multiple regimes as well as the reasons and timing of regime shifts.

In addition to the withdrawal to known and safe choice options discussed above, in either situation a response to insufficient knowledge about the situation and inadequate appreciation of its risk or its complexity (including the existence of regime changes) will be a public request for safe guards on the one hand and additional research into the existing risk, until better predictive models are in place. If trust has not been irreplaceably lost as the result of the triggering accident or crisis, the general public will turn to the regulatory bodies to which it has outsourced vigilance and action in this particular content domain to provide the necessary remedial research and regulation. If trust has been lost, other more general institutions come into play, like investigating commissions staffed by trusted organizations like national academies.

Examples

Technology Risk: Nuclear Power

Nuclear power accidents provide a good example of the type of event that leads to a rapid step-function increase in perceived risk, as the result of a perceived loss of control over possible adverse catastrophic consequences. The American public’s opposition to
nuclear power in the late 1950s triggered the investigation of psychological risk dimensions discussed above. That is, the nuclear power industry commissioned psychologists to explain why public risk perceptions of nuclear power generation (compared to other fuels like coal) were so different from engineering estimates. Presumably it was the better understanding of the sources of these public fears that led to greater public acceptance of nuclear power, and during the 1970s the number of reactors under construction increased continuously. The Three Mile Island accident in 1978, a partial nuclear meltdown, put a halt to that, despite the fact that only small amounts of radioactive gases and radioactive iodine were released into the environment (International Atomic Energy Association, 2008). Public fears about insufficient understanding and control over a dangerous and complex technology was expressed and amplified by the media who used sorcerer’s apprentice story lines in movies like “The China Syndrome.” The 1986 Chernobyl accident reinforced concern about gaps in our understanding of the risks of the technology, and the recent Fukushima Daiichi accident showed that existing backup plans to provide coolant to reactor cores had dangerous gaps under conditions of natural disasters in the form of tsunamis. Regulatory and political reactions to the most recent nuclear power accident remain to be seen in most countries, but at least in one major Western democracy, namely Germany, it has lead to a public decision to phase out nuclear power by 2022, and countries like Japan, Switzerland, and Italy have announced reductions in their reliance on nuclear power generation (Christian Science Monitor, June 7, 2011).

**Financial Risk: 2008 Subprime Mortgage Crisis**

The 2008 subprime mortgage crisis is an example of an unexpected regime change. Prior to the crisis, US investors widely believed that real-estate prices would or could never fall, a belief that had been supported by over 30 years of steady and most recently quite dramatic real estate price increases ([http://www.census.gov/const/uspriceann.pdf](http://www.census.gov/const/uspriceann.pdf)). Once this belief and the resulting models were challenged by empirical events to the contrary, panic resulted. When real-estate prices started to fall in 2007/2008, the worst financial crisis since the great depression emerged.

**Medical Risks: Hormone Replacement Therapy**

Hormone replacement therapy was a widely used medical intervention for menopausal women in the US, designed to decrease the risks of coronary heart disease and osteoporosis, but with possible increases the risk of breast cancer, with a $3.3 billion market in 2001. The perceived risk of hormone replacement therapy increased drastically following the results of a randomized control clinical trial by the Women’s Health Initiative of the National Institute of Health in 2002, which showed reduced incidence of colorectal cancer and bone fractures, but also larger incidence of breast cancer, heart attacks, and strokes, concluding that the benefits did not outweigh the risks. This assessment was confirmed in a large national study done in the UK in 2004. The number of women taking hormone replacement therapy has dropped steeply as a result. NIH’s Women’s Health Initiative and the United States Preventive Task Force have drastically reduced recommendations for such therapy.
Conclusions
This paper proposes a psychological account of perceived risk and changes in the perception of risk that fits into the tradition of providing psychological motives for economic behavior and applying dual process theory, where System 1 associative, motivational, and emotional processes (e.g., wishful thinking or fear) influence and often compete with System 2 analytic processes. At both the individual and collective level this results in responses that are overly influenced by recent events and thus too volatile compared to a rational analysis of encountered situations.
References


