"Risk as Feelings" and "Perception Matters:" Psychological contributions on risk, risk taking and risk management

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One of the reasons the Wharton Risk Center whose 30th anniversary we are celebrating has been so successful is that it has been opportunistically eclectic in the theory and methods it has adopted to shed light on real-world risk management challenges. Under the energetic and wise leadership of Howard Kunreuther, the Center has combined the descriptive theories and insights of psychology with the normative frameworks of economics long before it became fashionable to do so (e.g., Johnson et al., 1993). My own career as a psychologist working at the intersection of cognitive psychology and economics has had a very similar mission, and thus it is no surprise that Howard and I get along so well!

In this article, I will provide a brief summary of my contributions to the topic of risk, which have had the goals of (a) building descriptive theory and models about human perceptions of risk and actions in the face of risk and uncertainty, (b) applying these psychological theories and insights to explain economic puzzles, and (c) to design choice environments that capitalize on human strengths and minimize the impacts of human shortcomings to help people achieve their long-term goals in domains that range from pension savings (Weber, 2004a) to climate change (Kunreuther et al., 2014; Kunreuther & Weber, 2014; Patt & Weber, 2014).

What is Risk?

Different communities interpret the concept of "risk" in different ways. For the general public, risk often refers to adverse consequences ("risk of rain"). Economics, statistics, and engineering use the term to refer to the unpredictability of outcomes, as summarized in the standard deviation or variance of possible outcomes of an event or action around the expected value. This makes risk a quantity that can be assessed objectively and that is an unvarying attribute of the risky choice option (Weber & Johnson, 2009). Psychology treats risk as a psychological construct, a subjective experience or impression that may differ between individuals and situations in ways that go beyond probability and outcomes levels (Weber & Milliman, 1997) but involve feelings of dread, vulnerability, catastrophic potential, and uncontrollability (Slovic et al., 2004). Below I will review modifications that my research and that of others has made to standard views of risk as a statistic and follow that with a summary of the evidence I and others have provided for risk as a subjective feeling. As we will see, one main insight

has been that risk perception is contextual and, in particular, relative (to one or more reference points) (Weber, 2004b).

Risk as a Statistic. Metrics like the variance or standard deviation of outcomes quantify the degree to which the outcomes of an action are unpredictable, the definition of risk in economics, finance, and many engineering contexts. An upside of these metrics is that they integrate information about both the likelihood of different outcomes and their extremity, i.e., the degree to which they deviate from the expected value. One downside of measuring unpredictability this way is the fact that variance and standard deviation weigh upside and downside variability the same. This does not coincide with people's perceptions of riskiness in many situations, where downside variability is seen as contributing to risk, but upside variability does not, because upside increases in unpredictability also increase outcomes (Weber, 1988). The conjoint expected risk measure by Luce and Weber (1985), derived from a set of desirable axioms about perceptions of risk, keeps the advantages of the variance metric, but decomposes variability into an upside and downside component that can be differentially weighed. It also provides separate weights (model parameters) for the probability of positive or negative outcomes (i.e., outcomes above or below the expected value) in their own right (aside from their contribution to the positive or negative semi-variance), again reflecting empirical observations in many contexts that show that people value the probability of "winning" and dislike the probability of "losing" in their own right, aside from the actual values of wins or losses (Weber, 1988).

Using variance or standard deviation as a metric of unpredictability does not predict observed judgments of risk in another important way, namely by failing to capture the relative nature of people's perceptions of variability and risk (Weber, 2004b). Building on classical psychophysics, in particular Weber's law (E.H. Weber, 1834/1978) dating back almost 200 years, and on more recent insights about neuronal adaptation (Tobler & Weber, 2013), it should not be a surprise that variability and risk is perceived proportionally to the expected value of a risky option (Weber, 2004b). As a simple demonstration, the risk of a 50:50 lottery that results in either a win of $150 or a loss of $50 will seem large, while the same deviation (+/- $100) around an expected value of $1 million dollars is completely negligible. This makes the coefficient of variation, which divides the standard deviation by the expected value and thus measures variability per unit of return, a far more descriptive metric of perceived riskiness (Weber, Shafir, & Blais, 2004).

Risk as feelings. Risk as feelings, a phrase coined by Hsee and Weber (1997) and popularized in a subsequent literature review by this title by Loewenstein, Weber, Hsee, and Welch (2001), refers to the fact that perceptions of risk are driven by emotional responses just as much or more than by a rational accounting of unpredictability of outcomes or likelihood and magnitude of loss. Such feelings include the psychological risk dimensions first documented by Fischhoff and colleagues (1981; Slovic et al., 2004), which include feelings of dread, vulnerability, catastrophic potential, and uncontrollability. Studies that have assessed the perception of riskiness in financial decisions using both a more rational assessment of expected volatility or a less well-

defined assessment of subjective feelings of risk (Weber, Siebenmorgen, Weber, 2005; Weber, Weber, & Nosic 2014) find that it is the latter and not the former that predict people's decisions.

To Take Risks or To Manage Risks?

While in some contexts, perceptions of risk are a variable of interest in their own right (resulting, for example, in anxiety or stress that may have negative health implications), in most contexts they are simply an intermediate construct to explain behavior and decisions in environments of risk and uncertainty. One basic distinction between different actions in such contexts is to (a) take existing risks as a given and to select among available action alternatives that differ in objective or subjective risk as well as returns as a result of one's appetite for risk and (b) to try and modify existing levels of risk to adjust them to one's appetite for risk. Whereas "risk taking" is the typical behavior studied by decision researchers, a classic study of risk taking among Canadian and American managers in the 1980s found that managers often denied "taking" risks, but instead saw it as their responsibility to "manage" risks (MacCrimmon & Wehrung, 1986). Clearly the distinction between taking and managing risks hinges on the perceived degree of control available to decision makers to modify the current or future consequences of available response options.

To Take Risks. To explain why people take on different amounts of risk, economics as well as psychology have introduced the concept of risk attitude. Traditionally in economics, risk attitude is inferred as a parameter directly from people's risky choices, under the assumption that the decision maker maximizes expected utility and particular functional forms that map objective value to subjective utility (see e.g., Weber & Johnson, 2007). In this expected utility framework, a concave utility function is indication of risk aversion, whereas a convex function describes risk seeking.

As an alternative, the risk--return framework of risk-taking in finance sees risk taking as a compromise between the desire for returns and the minimization of risks, where differences in one's appetite for risk resulting in different tradeoffs. Weber and Milliman (1997) generalized this framework by allowing risks and returns to be subjective impressions, as discussed above, rather than the variance and expected value of the outcome distribution of the risky choice option. This opens multiple avenues for two decision makers to differ in their degree of risk taking. They could perceive either the risks or the returns of choice options to be different, while having the same attitude towards perceived risk (i.e., the same tradeoff coefficient between the two). Only when their perceptions of risks and returns agree, would observed differences in risk taking be an indication of differences in attitude towards (perceived) risk. This generalized risk—return framework also provide a mechanism to explain widely observed differences in risk taking by the same decision maker in different domains.

The DOmain SPEcific Risk Taking (DOSPERT) scale (dospert.org; Weber, Blais, & Betz, 2002) grew out of the psychological risk—return framework and its empirical support (Figner & Weber, 2011). It provides respondent with risky behaviors in five

different domains (financial, health/safety, recreational, ethical, and social), for which they rate the likelihood they would engage in the behavior, as well as the perceived riskiness and expected returns of these activities. The scale differentially predicts real-world risk taking in specific domains (Hanoch, Johnson, & Wilke, 2006), has been translated into multiple languages, and is emerging as the best predictor of real world risk taking across a broad range of applications (see dospert.org), including real world financial decisions that underlie people's credit-worthiness (FICO) scores (Li et al., 2015).

The Columbia Card Task (CCT) (columbiacardtask.org; Figner et al., 2009) is a "gamefied" assessment tool that captures risk taking in dynamic environments, where risk and return levels change over time. The CCT presents respondents with multiple rounds of a card game, in which cards can be turned over, with "good" cards resulting in point gains, but the first "bad" card resulting in a point loss and the termination of the round. By varying the gain and loss amounts as well as relative frequency of good and bad cards across rounds, performance on the CCT can be decomposed into gain and loss sensitivity as well as attitude towards risk. Use of the CCT has allowed for more incisive diagnoses of the sources of changes in risk taking across the life span (Figner et al., 2009; VanDuijvenvoorde et al., 2015),

To Manage Risks. Managing risks, for example the societal risk of global climate change over the 21st century, involves the careful evaluation of a broad range of current and future decisions, made under high degrees of risk and uncertainty and with consequences over a long temporal and spatial range, from upfront and virtually certain costs in economic growth and physical comfort for developed countries to highly uncertain benefits to future generations in far away countries that can be predicted only with great imprecision. Recent efforts have been made to inform bodies like the UN Intergovernmental Panel on Climate Change (IPCC) and the policy users of their assessment reports about modes of human information processing and choice under risk and uncertainty that deviate from and complement the rational-economic model (Kunreuther et al., 2014). Broadening the considered range of human motivation and human cognition has important implications for public policy (Weber, 2006, 2013). Specific examples of implications of bounded rationality and broadened human objective functions have for climate change risk management have been provided by Howard, myself, and others (e.g., Kunreuther & Weber, 2014; Patt & Weber, 2014).

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