PEPPERDINE UNIVERSITY

The Journal of Entrepreneurial Finance

Volume 16
Issue 2 *Spring 2013*

Article 1

December 2013

Operationalizing a Behavioral Finance Risk Model: A Theoretical and Empirical Framework

Rassoul Yazdipour
California State University, Fresno

William P. Neace
Health Care Excel

Recommended Citation

Yazdipour, Rassoul and Neace, William P. (2013) "Operationalizing a Behavioral Finance Risk Model: A Theoretical and Empirical Framework," *The Journal of Entrepreneurial Finance*: Vol. 16: Iss. 2, pp. 1-32.
DOI: https://doi.org/10.57229/2373-1761.1000
Available at: https://digitalcommons.pepperdine.edu/jef/vol16/iss2/1

THE JOURNAL OF ENTREPRENEURIAL FINANCE VOLUME 16, NO. 2 (SPRING 2013) **1-32**

Operationalizing a Behavioral Finance Risk Model: A Theoretical and Empirical Framework

Rassoul Yazdipour, Ph.D.
California State University and
The Academy of Behavioral Finance & Economics

William P. Neace, Ph.D.
Health Care Excel

ABSTRACT

To keep up with the rather fast-growing interest in the discipline of Behavioral Finance and Economics – caused in part by the new realities of the post-2008 world, and the realities prevailing over three decades before and leading up to that year– there is a discernible need for the production of new generations of testable and yet more realistic models and theories as guides for financial and economic decision makers everywhere. The present work is one such attempt in that direction. This writing first improves upon a recently developed, and real-life-inspired, Behavioral Finance Risk Model (Yazdipour, 2011) and then offers a specific methodology for testing it.

JEL Classification: D81, G39, M13
Keywords: Behavioral Finance, Behavioral Economics, Risk and uncertainty, Risk Model

I. Introduction and a Review of the Literature

A REVIEW OF THE LITERATURE ON PERCEIVED RISK provides the needed backdrop for presenting the Behavioral Finance Risk Model (BFRM) as presented and used in this writing. Both the extant literature and the related methodologies will be discussed as follows.

 ISSN: 1057-2287.
This article is reprinted from the Journal of Behavioral Finance & Economics, Vol.3

A. The Literature on Perceived Risk

Early literature examining perceived risk suggested that risk is multidimensional (e.g., Bauer, 1967; Bettman, 1973; Cunningham, 1967; Roselius, 1971; Jacoby & Kaplan, 1972; Zikmund & Scott, 1973). As such, *perceived risk* may be distinguished from traditional economic conceptualizations of *risk* as a statistical property (e.g., as outcome probability or variance of a probability distribution over outcomes) within the dominant Expected Utility framework (e.g., Johnson, 2004; Froot, Scharfstein, & Stein, 1993; Ganzach, 2000; Jorgensen & Kirschenheiter, 2003; Mitchell, 1999; Weber, Anderson, & Birnbaum, 1992). Many scholars have treated risk as a perception rather than as an objective statistical property, and have defined it in terms of peoples' reports about the "riskiness" associated with given choice alternatives or their evaluations of "riskiness" for a given set of behaviors (e.g., Ganzach, Ellis, Pazy, & Ricci-Siag, 2008; Pollatsek & Tversky, 1970; Sitkin & Weingart, 1995; Weber, Blais, & Betz, 2002; Weber & Milliman, 1997; for a thorough discussion of risk as perception, see Olsen, in press). Although there is no universally agreed upon definition of perceived risk in the literature (see Mitchell, 1999, for a review of definitions of perceived risk in the consumer behavior literature, and Conchar, Zinkhan, Peters, & Olavarrieta, 2004, for a broad review of definitions of perceived risk across the marketing, psychological, finance, economics, and related literatures), it can be generally conceived of as a psychological property associated with three common but not mutually exclusive elements of a decision situation. The first element is uncertainty over outcomes, which may be represented by notions of "chance," or by objective or subjective probability estimates. The second element is importance of the consequences, and is closely related to the third element, which is the potential for loss or perception of unpleasant consequences associated with a set of choice alternatives (e.g., Bettman, 1973; Conchar et al., 2004; Cunningham, 1967; Kogan & Wallach, 1964; Peter & Tarpey, 1975; Swait & Erdem, 2007; Mitchell, 1999; Weber et al., 2002; Ganzach, 2000; Ganzach et al., 2008).

An influential line of research in the area of perceived health and technological risks further solidified perceived risk as a psychological variable through the formulation of a set of seven "psychological risk dimensions" (Slovic, 1987; Slovic, Fischhoff, & Lichtenstein, 1986). In contrast to traditional economic risk conceptualizations, the psychological risk dimensions incorporate more global evaluations of choice alternatives in what some researchers consider to be a top-down evaluation process of forming perceptions and making judgments in general (e.g.,

Bargh, 1997; Ledoux, 2000; Zajonc, 1998). Among Slovic's (1987) seven psychological risk dimensions are items related to an affective evaluation of risky prospects, such as "dread" (degree to which negative consequences of the risky prospect are feared or anxiety-provoking), and "catastrophic potential" (perceived worse-case disaster severity of the risky prospect).

More recently, a number of researchers have further explored the affective nature of judgment and choice (e.g., Bechara, Damasio, & Damasio, 2000; Kahneman, 2003; Loewenstein, Weber, Hsee, & Welch, 2001; Mellers, Schwartz, Ho, & Ritov, 1997), and provide substantial evidence for an affect-based evaluative component in judging perceived risk. Findings such as the perceived negative relationship between risk and benefit (Finucane, Alhakami, Slovic, & Johnson, 2000; Ganzach, 2000; Slovic, Finucane, Peters, & MacGregor, 2004), and the relative insensitivity of judgments to outcome probabilities for emotionally powerful stimuli (Rottenstreich & Hsee 2001) are seen as evidence for an "Affect Heuristic" (Slovic, Finucane, Peters, & MacGregor, 2002) in which risk judgments proceed from a global assessment of a prospect as "good or bad."

A related line of research argues that uncertainty produces an elevated level of negative affect, or "psychological discomfort," and that decision-makers are motivated to reduce their discomfort by taking actions to reduce inherent uncertainty in the situation (Neace, Deer, Michaud, & Bolling, 2011). Thus, in addition to three common elements of perceived risk, some scholars have added controllability, manageability, and confidence in estimates of the extent to which uncertainty can be controlled or otherwise managed through the acquisition of information or the application of skill/experience (e.g., March & Shapira, 1987; Baird & Thomas, 1985; Sitkin & Weingart, 1995; Sitkin & Pablo, 1992). Choices may then follow from a desire to reduce uncertainty (e.g., Cho & Lee, 2006; Huber et al., 2001; Lipshitz & Strauss, 1997; Neace, Deer, & Barnard, 2010) in order to reach and maintain an individual level of comfort with it (Konopka & Ackley, in press), suggesting individual differences in perceived risk tolerance.

Indeed, an impressive body of evidence indicates that risk perception is not a stable trait across people or situations, further distinguishing it from traditional statistical definitions offered by the EU framework. Risk perception has been found to differ from individual to individual, for the same individual across different situations, across different contexts and domains, in different problem frames, and across cultures (Bontempo, Bottom, & Weber, 1997; Cooper, Wu, & Dunkelberg, 1988; Ferguson &

Gallagher, 2007; Holtgrave & Weber, 1993; MacCrimmon & Wehrung, 1990; Sitkin & Weingart, 1995; Weber, 1988; Weber et al., 1992; Weber et al., 2002). For example, Weber et al. (2002) found that the degree of risk taking was domain specific, and that people's behaviors were not consistently risk-seeking or risk-averse across financial, health and safety, recreational, ethical, and social decisions. They suggested that risk perception is a state rather than a trait characteristic, and that it is moderated by one's *risk attitude* (i.e., individual difference characteristic in risk tolerance).

Similarly, Sitkin & Weingart (1995) posited that risk perception is mediated by *risk propensity*, which they define as an individual difference characteristic in level of risk tolerance that can be modified and changed through experience. Blais and Weber (2006) attributed differences in risk taking behavior across different domains to differences in perceived risk rather than to differences in risk attitude. The importance of distinguishing between risk perception and risk attitude/risk propensity is highlighted by Cooper et al. (1988), who found that entrepreneurs were more optimistic in their risk perception than were managers but that the two groups did not differ in terms of their risk preferences. These results are consistent with Brockhaus' (1982) findings that both entrepreneurs and managers exhibited a preference for tasks that had moderate levels of risk.

The preceding literature review suggests that "perceived risk" is a multidimensional psychologically-based construct whose elements reflect some aspects of traditional conceptualizations of risk as a statistical property but contains other elements that cannot be represented by objectively derived statistical measures. Indeed, the evidence suggests that "objective" risk often exists independently of its subjective evaluation as "perceived" risk (e.g., Conchar et. al., 2004; Slovic et al., 1986; Mitchell, 1999). Behavioral responses to risky prospects also follow from assessments that are derived from evaluations of "riskiness" in terms of the potential controllability and management of risk (whether real or imagined) geared toward risk reduction, and from more global affective evaluations (dread, catastrophic potential, level of discomfort with uncertainty, etc.) that transcend traditional tenets of "rationality." Moreover, risk perception is not a stable construct but one that varies across individuals, contexts, and cultures. Having outlined some of the variables that define perceived risk, we next turn our attention to methods by which it has been modeled in the literature.

II. The Literature on Modeling Perceived Risk

Most early models of perceived risk have generally attempted to decompose it into its more basic components, and were focused primarily on aspects of uncertainty of choice consequences (including loss potential, potential for negative consequences) and choice importance (e.g., Bettman, 1973; Cunningham, 1967; Horton, 1976; Kogan & Wallach, 1964; Lanzetta & Driscoll, 1968), or were based on more traditional economic considerations in terms of minimizing risk or maximizing return (e.g., Levy & Markowitz, 1979; Peter & Tarpey, 1975). In contrast, Coombs (1975) conceptualized choice behavior in terms of trade-offs between perceived risks and perceived returns among risky prospects. He theorized that people have a non-zero risk tolerance threshold, and that they will prefer options that come closest to their threshold rather than always acting rationally by seeking options that minimize risk in accordance with classical economic theory.

Following Coombs' line of reasoning, Luce (1980) proposed several axiomatic models of financial risk perception that culminated in the Conjoint Expected Risk (CER) model (Luce & Weber, 1986). According to the CER, perceived risk is a linear weighted combination of the probability of zero gain/loss (i.e., of breaking even), the probability of a gain, the probability of a loss, the conditional expectation of a gain, and the conditional expectation of a loss. The conditional expectancies are each raised to unique non-zero exponential coefficients in order to capture individual differences in risk perception. Subsequent research on the CER using the standard lottery paradigm indicated that the power parameters were often close to unity, thus allowing for a simpler specification of the CER model (e.g., Holtgrave & Weber, 1993; Weber, 1988). Notice that the CER models perceived risk within a risk-return framework in which the decision maker considers both gains and losses (as well as their conditional expectancies) when assessing the riskiness of prospects. Although more complex than many of its predecessors, the CER maintains consistency with earlier models in terms of uncertainty (characterized as probability) and importance of consequences (which is implied by the conditional expectancy terms that carry a "harm" or "benefit" interpretation regarding one's financial status quo).

An alternate to the axiomatic approach taken by Luce (1980; Luce & Weber, 1986) in modeling perceived risk in the financial domain is the psychometric approach taken by Slovic and colleagues (Slovic, 1987; Slovic et al., 1986) to model perceived risk in the health and technological domains. Their approach consisted of using

psychophysical scaling and multivariate analysis techniques to produce quantitative risk perception representations. Although both models were well-supported by empirical findings within their intended domains, subsequent research examined whether the two approaches could be combined to model perceived risk across domains. The earliest attempt was taken by Holtgrave and Weber (1993), who were interested in determining whether the CER model, the Slovic and colleague's Psychological Risk Dimension model (hereinafter referred to as the PRD model), or a hybrid CER-PRD model would best capture people's risk perceptions in both the financial and health domains. Both the CER model and the PRD model characterize perceived risk as a linear combination of variables. As mentioned above, the CER model represents perceived financial risk as a (weighted) linear combination of 5 variables representing uncertainty over outcomes and conditional expectancies for gains/losses. As such, the CER model represents the more rational, rule-based components of perceived risk developed in the axiomatic measurement tradition (see Weber, 2001 for a review). The PDR model characterizes perceived health/technological risk as a linear function of seven psychological risk dimensions (voluntariness, dread, control, knowledge, catastrophic potential, novelty, equity) developed using a psychometric paradigm. In contrast to the CER model, the PRD model encompasses a more affective set of perceived risk components.

Holtgrave & Weber (1993) tested three models on data in which participants were asked to rate a combined list of financial risks (e.g., investing 20% of savings in a blue-chip stock, investing in one ounce of a precious metal) and health risks (e.g., riding a bicycle 1 mile daily in an urban area, living near a nuclear power plant) on the 5 CER dimensions and the 7 PRD dimensions. Holtgrave and Weber's (1993) results indicated that a hybrid risk perception model that incorporates both objective risk variables (outcomes and related probabilities/expectancies) and more affectively-laden variables (in particular, dread) provided the best fit for risk perception in both the financial and health domains. Their model parameters were estimated using multiple regression analysis, with best fitting model exhibiting the largest R^2 value.

Holtgrave and Weber (1993) were the first to show that perceived risk consisted of both objective information as well as an emotional component. Their findings are also in line with subsequent research documenting that risk perception is influenced as much or more so by affect as by rule-based processing (Loewenstein et al., 2001; Mellers et al., 1997).

In more recent research, Koonce, McAnally, and Mercer (2005) examined how financial statements containing mandatory disclosures about risks and uncertainties

impact the risk perception among potential investors (a sample of MBA graduate students). The authors developed and tested a model that combines EU-based variables (probabilities and outcomes) with Slovic et al.'s (1986) psychological risk dimensions. Their results show direct effects of loss outcome information on perceived risk judgments, and further indicated that the psychological risk dimension variables explained a significant amount of variance in risk perception over-and-above what is accounted for by traditional risk variables. This finding was replicated and extended to a more "context rich" disclosure scenario, and showed that disclosure of loss information had both direct and indirect effects on perceived risk. Analysis with structural equation modeling indicated that the indirect effect of loss information occurred through the psychological risk dimension "dread" from the PRD.

As noted previously, it is also important to consider individual differences in risk attitude when modeling perceived risk. In accounting for domain differences in preference for engaging in a risky behavior (e.g., investing 10% of income in government bonds, not wearing sunscreen, telling a friend that his/her significant other made a pass at you, etc.), Weber et al. (2002) decomposed preference into two components: Perceived risk and attitude toward risk. This decomposition provides for different ways in which a particular outcome domain (e.g., financial, health and safety, social, etc.) can influence choice preference through two different but not mutually-exclusive processes: (1) evaluating perceived risk for choice alternatives (i.e., trade-offs on perceived benefits vs. perceived harms), and (2) assessing one's preference for the risk involved with each choice alternative (an individual differences characteristic in one's general positive or negative attitude toward risk). Multiple regression analysis indicated that differences in perceived risk led to inconsistent risk-taking vs. risk-averse preferences, while tended to remain stable across domains. These findings were later replicated by Blais and Weber (2006) using a more sophisticated multi-level modeling approach to isolate the influence of individual differences in risk perception on risk taking behavior.

Regardless of the measurement model used to operationalize perceived risk (axiomatic as in Luce's 1980 and Luce & Weber's 1986 work, or based on psychometric techniques as in Slovic et al.'s, 1986 work), researchers have generally taken a regression approach to decomposing perceived risk into its more basic components. For example, Bettman (1973) specified a series of regression models based on decomposing perceived risk into components related to inherent risk (uncertainty over whether a consumer can make a satisfactory brand choice within a given product

class) and handled risk (degree to which inherent uncertainty can be reduced through the amount and usability of information about brands in a given product class). He found that additive regression models explained more variability in perceived risk than did multiplicative models, in line with other contemporary findings supporting a linear modeling approach (e.g., Horton, 1976; Lansetta & Driscoll, 1968; Peter & Tarpey, 1975). Later researchers continued to decompose the elements of perceived risk using the general linear modeling approach in the form of multiple regression, multi-level modeling, or structural equation modeling (e.g., Holtgrave & Weber, 1993; Koonce et al., 2005; Weber et al., 2002).

This review of modeling perceived risk leads to the conclusion that perceived risk can be characterized as a linear combination of variables. As such, the modeling approach used in the literature has been based on some aspect of the general linear model (e.g., multiple regression), or more sophisticated but related linear combination models (multi-level modeling, structural equation modeling). Such models allow researchers to estimate the relative contributions of different theoretic variables in explaining perceived risk. Moreover, individual differences in risk perception, which are important to explaining why the same person may exhibit risk averse behavior in one domain but appear to be risk seeking in another domain (Blais & Weber, 2006; Weber et al., 2002), or for examining differences in risk perception between entrepreneurs and managers (Cooper et al., 1988), can be easily incorporated into models within these statistical frameworks.

The next section first provides the operational definition of the constructs in the proposed theoretic behavioral risk model derived from the informed vantage point provided by our preceding literature review.

A. Application- Using Financial Decision Making at its Most Basic Level: The Decision to Enter a Business Venture1

The theoretic behavioral finance risk model that is the basis of the present work can be stated as follows:

$$TPR = RR \pm BR \tag{1}$$

[1] This section is mainly built and further expanded upon R. Yazdipour (2011).

TPR represents the Total Perceived Risk in any given business venture. RR is Resident Risk and represents an objective estimate of risk inherent in any business transaction, is largely estimable from previous data, and therefore, is mathematically tractable. On the other hand, BR, or Behavioral Risk, is a subjective measure of risk based upon psychological assessments of risk or uncertainties that are unrelated to statistical properties such as considerations of importance, evaluation of consequences, and loss potential/unpleasant outcomes. Other theoretical influences on behavioral risk are the well-known biases in subjective probability assessment notion of psychological discomfort produced by risk (e.g., Kahneman, Slovic & Tversky, 1982), as well as more recent evidence for the influence of Affect (e.g., Slovic, et al's "Affect Heuristic;" Neace et al's (2011)).

The objective of the modeling task here is to decompose TPR into its constituent elements as defined in above; and determine (1) which element is weighed more heavily in risk assessments of entry/seed funding decisions, (2) what the relative contribution is of the set of items used to measure RR and BR to perceptions of the total risks assessed in evaluating a given business opportunity, and (3) what differences between entrepreneurs and venture capitalists might there be in the manner in which RR and BR combine to represent TPR. To achieve these goals, the constructs in the theoretic model must be operationalized and that is the main objective of this writing.

1. A Behavioral Risk Model

The approach that we have taken in further developing the proposed risk model in this section is one of going back to the basics and building an intuitive and practical risk model from ground zero. In the present context, our ground zero is defined by making the most basic economic decision of starting a new business venture by an entrepreneur. Such an approach allows us to get a better handle on the whole decision making process and the related mental and cognitive efforts that go into a single decision by an individual. An individual who is not bounded by any corporate or institutional limitation and her/his main concern is her/his own well-being. This also means such a theoretic construct is free of any form of Agency relation. This is an important distinction because almost all the traditional finance's risk theories and models have been developed with highly complex agents, markets, and institutions in mind. That way, many often unrealistic assumptions must be introduced into any analysis; but worse, we could not focus on and learn from the decision making process

at its most critical level- the level of an individual. And let's not forget that ALL *final* decisions at *any* corporate or institutional level are in fact *made by one individual*. The behavioral finance literature has recognized such a reality – eg Group Think – in order to arrive at more rigorous models and theories.

With this brief background in mind, we now continue with our risk modeling efforts in this section.

2. Perception Asymmetry

We introduce the Perception Asymmetry as a counterpart to standard finance theory's Information Asymmetry as described in below. But before defining and further discussing the proposed phenomenon, it would be helpful if we first refresh our memory regarding the Prospect Theory and the Affect Heuristic.

According to Prospect Theory (PT), there are two distinct phases to each decision- an initial phase called Editing or Framing; and a second phase called Evaluation phase. The editing phase includes a number of operations that simplify decision problems before they are sent for evaluation. Options are evaluated via the Value Function so that a final decision can be made regarding the decision problems under consideration.

According to Affect theory, subjective impressions of "goodness" or "badness" can act as a heuristic, capable of producing fast perceptual judgments. For example, stocks perceived as "good" are judged to have *low* risks and *high* returns and stocks perceived as "bad" are judged to have *low* returns and *high* risks.

By building upon the Prospect Theory and the Affect heuristic as just mentioned, and using our example of entrepreneurs and venture capitalists for illustration, we propose that the perceptions of both entrepreneurs and venture capitalists, and consequently their judgments, will be shaped by the triple effects of:

1. The Prospect Theory's editing operations which include Coding, Combination, Segregation, and Cancellation,
2. The Prospect Theory's value function where "probability weights" are assigned, and
3. The Affect heuristic's capability of producing perceptual judgments.

In addition to above, the working of the brain would add the fourth effect; but for now we will limit our coverage to the key psychological phenomena[2].

We now define Perception Asymmetry as the situation under which a perception gap exists for at least one party to a transaction. More specifically, in case of our present discussion, we define Perception Asymmetry (PA) as the situation under which a perception gap exists between an entrepreneur and a venture capitalist (VC) regarding the same business opportunity, its gain and loss potentials, and consequently the opportunity's perceived value. Furthermore, the only situation in which such a gap will not exist is when both the entrepreneur and the VC in question share the same psyche; something that is not physically possible.

We suspect the proposed imbalance would help create a better understanding for both parties regarding each other's views on a transaction like a seed funding deal. Such an understanding may minimize the perception asymmetry and consequently bring the parties closer to a mutually beneficial decision and ultimately conclusion of a deal.

III. Resident Risks and Behavioral Risks: Toward a Behavioral Finance Risk Model

Some behavioral finance scholars, especially Slovic and Olsen, have advocated that risk is not "something out there". By that, they mean risk is not an evidence-based phenomenon like standard deviation, beta, or other variations thereof that can be measured and used in financial decision making[3]. Put differently, risk does not exist "out there" so that we a) observe it, b) measure and analyze it, and c) use it as an input in our Expected Utility (EU)-based calculations. Slovic (1987) attributes business risk to individual survival risk where he says, "Humans have an additional capability that allows them to alter their environment as well as respond to it. This capacity both

---

[2] We are not specifically discussing other heuristics and biases for two main reasons. First, the Prospect Theory and Affect cover most, if not all, of such heuristics and biases. Second, given this is a preliminary framework, we'd rather to stay on the central issues to prevent any confusion.

[3] Needless to say that the standard finance theory definitions of risk have no relevance at all to a great majority of entrepreneurial finance problems where there is little or no historical data "out there" to be measured in the first place! For example, in case of startups almost all the data are projected data and are contained in a highly guarded Business Plan.

creates and reduces risk"[4]. He further adds that the "concept risk means different things to different people"[5]. Moreover, as we will see in this chapter, affect plays one of the most important roles in the perception of risk by individuals[6]. For example if a person has a positive affect regarding a given venture, she/he may perceive the risk in that venture much less than the risks perceived by other individuals with a lower level of affect for the same exact venture under otherwise the same exact circumstances.

Olsen specifically states that, "all risk that is acted upon must be perceived risk because perception is based upon sensory data. We can only sense the 'real world' because we have no other way of being informed."[7] This effectively means risk is a phenomenon that is created in our psyche- the "in here" risk versus the "out there risk" phrase that we use in this chapter.

However, and especially from a more applied point of view, we argue that risks and uncertainties are not completely perceived "in here" either (in our psyche). This can be seen clearly when we break down the notion of total risk and uncertainty into its components and discuss "Resident Risks" below. We then believe the truth about the sources of risks probably lie somewhere between "out there" and "in here". To get our discussion started, we define risk and uncertainty as follows.

Total (Perceived) Risk and Uncertainty = "Resident Risks" + or – "Behavioral Risks"

A. Resident Risk: Risk as the "Other Side of a Business Opportunity Coin"

First note that due to the nature of the topic, we use the terms risk and uncertainty interchangeably throughout this writing. Second, for simplicity and illustration we use the decision to launch a business venture, a business opportunity, as an example. Now think of "Resident Risks" as the type of risks that actually *reside* in, or are native to, a given business opportunity; without which the opportunity would be

---

[4] Slovic, Paul, Science, Vol 236, 1987, p 280. Emphasis is ours.
[5] Ibid, p 283
[6] According to Olsen (2011), culture, including trust, is another source of risk. However, in this writing we will limit our discussions to the factors stated in above.
[7] See chapter 4, Olsen.

riskless. (Riskless in the sense of a short-term U.S. Treasury Bill.) In other words, in our example, risk is the "other side of a *business opportunity coin"*. That is, such risk gets created when an individual enters a venture; a business opportunity.

We especially use the coin analogy to make the point that Resident Risk (RR) automatically comes with any selected and implemented business opportunity; just like throwing a coin that comes with it known odds of success/fail. Of course, measuring success/failure rates in business are much more complicated; but still doable. Another analogy for the definition is water and the wetness of water. That is, one cannot exist without the other; and you know if you throw yourself in the water, you will get wet, and the odds are 100% in your favor! Just like tossing a coin with well-defined outcomes, we can also define the possible outcomes in a launch decision. For example, success can mean reaching $5M sales in three years and failure can mean not reaching that sales threshold by the third year.

Additionally, dissecting Total Perceived Risk as such has another theoretical and empirical advantage. It allows us to have a significant portion of the total risk measurable and concentrate on its elusive component- the behavioral risk component.

B. Determinants of Resident Risk

In anticipation of making the resident risk component operational and consequently measurable, we can proceed as follows. Imagine yourself as an entrepreneur who has not only found a unique business opportunity, but has also developed a non-working prototype of her product and wants to launch the business by first perfecting the prototype and then mass producing and selling the finished product. She also needs capital to do all the above. You may also imagine yourself at the other side of the transaction and as a venture capitalist who is considering funding such an entrepreneur. Given this background, we can list and define the following factors as the key determinants of residual risk.

a. Commercialization and Technology risk factor- the risk of taking an opportunity or a prototype and turning it into a fully functional product or service that consumers will pay to use it,
b. Market risk factor - whether or not a profitable and sustainable market will emerge for the envisioned product/service,

c. Management risk factor - whether or not the entrepreneur behind the opportunity and her team will succeed in executing the envisioned business strategies
d. Financing risk factor - whether or not the entrepreneur and her team can raise the needed capital on a timely basis to execute the envisioned business strategies, and finally,
e. Macro risk factors- including regulatory risks, environmental risks, etc.

The above risks certainly exit "out there" in and around *any* business opportunity. However, they do *not* exist in vacuum as there must be a real asset in the physical world to contain such native risks. And that is exactly why we refer collectively to these risks as Resident Risks.[8]

C. Behavioral Risks

The "Behavioral Risk" component is mainly shaped by the editing, evaluating, and affect processes as described earlier in this chapter. As shown by the risk equation, behavioral risks can either increase or decrease the total risk. The increase part seems very intuitive by the standards of the traditional finance; although that is not the case for the decrease part as it can easily be ignored as a behavioral "anomaly"! To a behavioral economist however, the decrease is a result of the affect heuristic.

Furthermore, according to the proposed risk framework and the theories behind it – Prospect Theory and Affect Heuristic – the behavioral risk portion of the total risk is our own creation. In other words, when we consider a set of opportunities for evaluation and final selection, we automatically, and possibly unknowingly, *construct* a portion of the risks that involve all those opportunities. Given the current state of brain technology, this is the type of risk that is very hard, if not impossible, to quantify.

---

[8] Resident Risks can become *the only* risks, and therefore the only *"real" risks*, if we take all the heuristics out of the simple equation suggested in this section. In such a case, Total Risk is equivalent to the Total Risk under standard finance paradigm, and measurable. But again, to take the behavioral risk component out is equivalent to assuming a "mind of God" for a normal earth-bound human being.

D. Behavioral Risk Processes

Although discussion on making the behavioral risk component operational is well above and beyond the present writing; however we can still list and describe the four underlying processes that produce it as follows.

a. Framing processes
b. Evaluation processes
c. Affective processes, and
d. Other non-Affect processes like Overconfidence, Availability, Anchoring, etc.

All the above processes are as described in this chapter.

IV. Operationalizing the Proposed Behavioral Finance Risk Model

A. A Literature Review on Operationalizing Perceived Risk in General

Although many operational definitions of perceived risk have been used in the extent literature depending upon the content and context of a decision situation (e.g., Conchar et. al., 2004, Mitchell, 1999), the most common manner of soliciting peoples' opinions of risk has been through rating perceptions of the "riskiness" of a given choice set or behavior. Some of the more representative examples of measuring perceived risk in the finance, economic, and psychological literatures are shown in Table 1.

Table 1. *Some representative operational definitions of perceived risk from the finance, economics, and psychology literatures.*

Article	Operational Definition of Perceived Risk
Bettman (1973)	Ratings for each item (typical grocery products) on a scale (-8 to +8) in a paired-comparison procedure asking which item in the pair would be more risky to shop for in an imaginary store (no brand names used) or their usual store (with brand labels on products).
Peter & Tarpey (1975)	7-point semantic differential scales on rating loss probability (automobile purchase preference) of 6 risk facets.

Holtgrave & Weber (1993)	rated overall riskiness of activities (health, financial) on a 1 to 100 scale.
Sitkin & Weingart (1995)	Four 7-point scales asking participants to rate characteristics of a given scenario with anchors "significant opportunity"/"significant threat"; loss potential/gain potential; positive/negative; and success likelihood with anchors very unlikely/very likely.
Weber & Milliman (1997)	"gut level" assessment of how risky X is (in 5 relevant domains) on a 5-point scale with anchors of "not at all risky" to "extremely risky."
Ganzach (2000)	"how risky" X is on a 9-point scale with anchors of very low and very high (where X is one of 30 international stock portfolios).
Weber et al. (2002); Blais & Weber (2006)	ratings on a scale of 500 to 600 for how risky each given choice was (used pairs of lotteries differing in expected gains/losses).
Koonce et al. (2005)	Overall, how risky is [particular financial item being rated] to the company on a 0 (no risk) to 100 (high risk) scale.
Ferguson & Gallagher (2007)	Two 7point scales assessing personal outcome effectiveness ("how effective do you think" with anchors of not very to very effective) and procedural risk ("how risky do you perceive" with anchors not at all to very risky) for a health behavior (flu shot).
Ganzach et al. (2008)	"how risky" X is on a 7-point scale with anchors of low risk, high risk (8 "investment" prospects)

Of primary importance in developing models of risk perception is to obtain a valid and reliable measure of it. To that end, Gonzach et al. (2008) assessed the construct validity of risk perception measures and concluded that single-item measures more accurately captured the construct of "risk perception" than did multiple-item measures, which tend to confound risk perception with related concepts (such as the attractiveness of a prospect or with expected return). Other research also disentangles the concepts of risk perception from judgments of attractiveness indicating that they are two distinct psychological constructions (Weber et al., 1992). As mentioned earlier, it is also important to measure risk perception without confounding it with risk attitude/propensity (e.g., Sitkin & Weingart, 1995; Weber et al., 2002; Blais & Weber,

2006). Thus, based on these psychometric findings, we adopt a single-item measure of *Total Perceived Risk* for purposes of operationalizing the main construct of our behavioral risk model, an example of which appears in Table 2 at the end of this section. The following discussion moves toward the operational definition of the other two constructs of which Total Perceived Risk is theorized to be composed, *Resident Risk* and *Behavioral Risk*.

Resident risk captures the more traditional decision theoretic components of risk, such as outcomes and their associated probabilities, or outcome variance over a probability distribution. It is an "objective" component of Total Perceived Risk, and is readily operationalized as a probability of success/failure for a given business venture, or as the variability of successes/failures over an entire class of similar business ventures from pre-existing data sources. Probabilities (whether considered alone or in combination with outcomes to form expectancies) are common to many models of perceived risk (Bettman, 1973; Cunningham, 1967; Kogan & Wallach, 1964; Peter & Ryan, 1976; Peter & Tarpey, 1975; Stone & Winter, 1987; Ganzach, 2000; Ganzach et al., 2008; Luce, 1980, Luce & Weber, 1986; Holtgrave & Weber, 1993; Koonce et al., 2005). As such, Resident Risk is deemed an important theoretical aspect of perceived risk though it does not completely define it.

Aside from considerations of objective risk measures are those that tap into the more subjective, psychologically-grounded measures of risk, which we have chosen to label "Behavioral Risk." Scholars of perceived risk recognized the need to incorporate non-statistical risk measures in their theories due to the general dissatisfaction with Expected Utility models and their variants in adequately capturing choice behavior (e.g., Kahneman & Tversky, 1979; Schoemaker, 1982; Luce, 2003; Weber, 1994). Behavioral risk can be further partitioned into its more basic components derived from our earlier review of the literature. These components represent aspects of a given business venture, such as importance of entering into/providing funding for a given business opportunity, the potential (perceived) gain/loss associated with entry/funding decisions, and the potential for adverse or negative consequences associated with entry/funding decisions. Each of these aspects can be measured on 100-point scales with appropriate anchors for low and high levels of the construct being assessed (e.g., for importance of entering into X business venture, 1 = not at all important and 100 = extremely important. See Table 2 for other examples). In addition to these common elements of perceived risk, we add Affective variables, such as those provided by Slovic and colleagues (Slovic, 1987; Slovic et al., 1986; Slovic et al., 2002), and a

psychological discomfort variable (Neace et al., in press) representing the degree to which uncertainty in a business venture impacts the decision maker's level of comfort with risk. Lastly, we propose that behavioral risk assessments are, in part, separable from one's general risk attitude (Blais & Weber, 2006; Cho & Lee, 2006; Sitkin & Weingart, 1995; Weber et al., 2002), and include a measure of risk attitude under the Behavioral Risk category in order to capture individual differences in risk tolerance.

Table 2 that follows presents examples of items and their operational definitions for constructs in our theoretical Behavioral Finance Risk Model. The variables are categorized broadly as those related to Resident Risk, and those related to Behavioral Risk. Under the *Resident Risk* category are objective probability estimates for success/failure for a particular business venture within a given industry. Such data are available from leading market and business industry sources. In addition, estimates of variability in business venture success within a given industry can be derived from the same objective data.

The Behavioral Risk category is composed of the following measures in the order that they appear in Column 1 of Table 2: Importance (adapted from Bettman, 1973), the Conjoint Expected Risk or CER model variables (adapted from Luce & Weber, 1986), which include measures of uncertainty over outcomes (maintaining the status quo, potential for gain, potential for loss), and conditional expectancies related to gains and losses. In addition, the Behavioral Risk category contains the 7 variables from the Psychological Risk Dimension or PRD model (adapted from Koonce et al., 2005) that capture a more global and affective evaluation of a given business opportunity, which are, in part, related to the affect heuristic (Slovic et al., 2002). Also included under Behavioral Risk is a measure of psychological discomfort to capture the degree to which uncertainty regarding a business opportunity creates a state of increased physiological arousal that is experienced as unpleasant (as theorized by Neace et al., in press, and for which empirical evidence has recently been obtained by Neace et al., 2010).

Finally, in order to separate the influence of individual differences in risk perception from one's overall risk attitude (viz. Weber et al., 2002), we include a risk attitude variable in our operational behavioral risk model.

Table 2. *Examples of measurement items to assess the Total Perceived Risk, Resident Risk, and Behavioral Risk constructs of the proposed Behavioral Finance Risk Model.*

Construct	Operational Definition of Construct
Total Perceived Risk	Overall, how risky is [entering into/providing funding for] X business opportunity? 1 = not at all risky, 100 = extremely risky
Resident Risk	
Probability	Various success probabilities associated with business ventures across different industries, measured from objective sources. An intuitive data source would be historical data from the venture capital industry regarding success/failure statistics for say new ventures in a given industry. Such data also contains profile of entrepreneurs that further help the testing process.
Variability	Various success/failure rates associated with business ventures across different industries, measured from objective sources just like above. Actual variance estimates from data.
Behavioral Risk	
Importance of ROI	How important is achieving a satisfactory return on your investment to your [decision to enter/provide funding for X business opportunity]? 1 = not at all important, 100 = extremely important
Importance of investment	How much of an investment are you willing to make (in terms of time, money, other resources) in deciding to [enter/provide funding] for X business opportunity? 1 = very little, 100 = very much
Potential to maintain the status quo	What do you think your chances are of breaking even if you decide [to enter/provide funding] for X business opportunity? 1 = very unlikely, 100 = extremely likely
Potential for positive outcome	What do you think your chances are of getting a positive return on your investment if you decide [to enter/provide funding] for X business opportunity? 1 = very unlikely, 100 = extremely likely
Potential for	What do you think your chances are of experiencing a loss on

negative outcome	your investment if you decide [to enter/provide funding] for X business opportunity? 1 = very unlikely, 100 = extremely likely
Conditional expectation of a positive outcome	Suppose your decision to [enter/provide seed funding for] results in an overall gain to investors. How large a gain would you expect in this situation? 1 = very small, 100 = very large
Conditional expectation of a negative outcome	Suppose your decision to [enter/provide seed funding for] results in an overall loss to investors. How large a loss would you expect in this situation? 1 = very small, 100 = very large
Voluntariness	How likely is it that you would voluntarily decide to [enter/provide seed funding for] X business opportunity without knowing the level or risk involved? 1 = involuntary, 100 = completely voluntary
Dread	How likely is it that you would dread (feel fear, or worry excessively) about the potential for negative consequences from your decision to [enter/provide seed funding for] X business opportunity? 1 = very unlikely, 100 = extremely likely
Control	How much do you believe your skill and diligence allow you to have control over potentially negative consequences of your decision to [enter/provide seed funding for] X business opportunity? 1 = very difficult to control, 100 = very easy to control
Knowledge	How knowledgeable are you about the precise risks associated with your decision to [enter/provide seed funding] for X business opportunity? 1 = not at all knowledgeable, 100 = extremely knowledgeable
Catastrophic potential	How likely is it that your decision to [enter/provide seed funding for] X business opportunity will end in a worse-case financial disaster? 1 = very unlikely, 100 = extremely likely
Novelty	How much do you believe the risks associated in your decision to [enter/provide seed funding for] X business opportunity are ones that are unfamiliar to you, as opposed to risks that you are familiar with? 1 = very unfamiliar, 100 = very familiar
Equity	How likely do you think it is that any outcomes (good or bad) from your decision to [enter/provide seed funding for] X business opportunity will be fairly distributed? 1 = very unlikely, 100 = extremely likely

Psychological Discomfort	Derived measure from SAM affect and SAM arousal scales, producing a scale of 1 to 18, with higher values indicating more psychological discomfort. Details in Neace et al., 2010.
Risk Attitude	In general, what is your attitude toward taking risks such as [entering/investing in] new business opportunities? 1 = not at all positive about taking business risks, 100 = very positive about taking business risks

B. Empirical Test of the Proposed Behavioral Finance Risk Model

1. Background

Before we discuss the empirical model proposed in this writing, what follows provides a rather brief background on our efforts in such regard.

First, Yazdipour (2011) suggested Lewis' "Principal Principle" – which is a theory linking credence (belief in evidence) to chance (the probabilistic nature of the evidence) – as a possible candidate for testing the Behavioral Risk Model as discussed in the present writing. However, we learned that after a thorough discussion of some common mistakes associated with using the "Principal Principle", Meacham (2010) had presented a methodology that was robust to the errors of previous "Principal Principle" presentations. While interesting and rigorous, the "Principal Principle" is more in line with Bayesian belief updating than it is in capturing the nature of the behavioral risk model as proposed above.

Second, alternate operationalization is also available from recent work by Hsee and Rottenstreich (2004, see also Rottenstreich & Hsee, 2001), who examined the role of affect in risk perception, coupled with the hypothesized behavior of individuals as outlined in Yazdipour (2011, p. 20) and that we paraphrase below (please note the decision to enter any venture can only be signified by committing the needed investment or funds and that is why we use entry and funding interchangeable at times) :

1. Final entry/funding decisions are based on perceived gains and losses (relative to an initial reference point W = initial wealth state) stemming from an

evaluation of the value for each given business opportunity in a set of such business opportunities;
2. The level of "comfort" about the perceived risks inherent in each business opportunity under consideration.

Such judgments and decisions are theorized to be shaped by prospect theory's editing functions (coding, combination, segregation, and cancellation), prospect theory's value function (particularly the subjective weight given to probabilities of success/failure and how they are assigned), and affective theories which address the issue of perceptual judgments.

The Proposed Testing Model

Given above, what follows then is an operationalization of the conceptual model suggested in Equation 1 based upon consideration of the various factors that influence perceived risk. Specifically,

$$R = V^{(1-\alpha)}A^{\alpha}C \quad (2)$$

Reading Equation 2 from left to right, R is the Total (Perceived) Risk in any given business opportunity, V is the value function from prospect theory (Kahneman & Tversky, 1979), A is an Affective intensity parameter, C is a Comfort (or homeostasis) parameter, and α is an Affective focus coefficient bounded by 0 and 1.

V captures the perceived value of a given choice in business opportunities based upon a behavioral assessment of their resident risk (through its decision weight parameter, π), and is therefore sensitive to well-established cognitive biases (such as framing effects, overconfidence, etc.). The *V* parameter models decision weights in the valuation of a choice in business opportunities as a function of different levels of probabilities, p:

$V = \pi(p)v(x) + \pi(1-p)v(y)$, where p is taken as a measure of Resident Risk in Equation 1 and as defined early on in this work.

A captures the hypothesized Affective component associated with a choice in a set of business opportunities. This parameter of the model captures affective elements of the decision process, and is therefore sensitive to effects influenced by such elements

as how the decision maker "feels" about each business opportunity, and how such feelings influence perceived riskiness, as posited by the Affect Heuristic and other affective theories.

C captures the decision maker's level of comfort with the perceived risks for a given set of business opportunities, which models the associated uncertainty-induced psychological discomfort from Neace (2010). *C* is assumed to vary from individual to individual, and can be used to model individual differences in thresholds for how much discomfort can be tolerated for a given choice (i.e., homeostasis) as posited by Konopka and Ackerly (2011).

Finally, α provides a measure of the extent to which a decision maker is focusing on affective or cognitive components associated with a given choice among business opportunities. It is bounded by 0 (no focus on affective element) and 1 (complete focus on affect at the expense of cognitive processing).

Model's Predictions

The model in Equation 2 is able to make some predictions that are in line with the hypotheses about the behavior of both entrepreneurs and venture capitalists presented by Yazdipour (2011). In particular, consider the model's predictions at the extremes of the affective focus coefficient, α:

When $\alpha = 0$, R = VC. Here, the model predicts that the risk assessed for a given business opportunity is a function of V from prospect theory weighted by the degree of comfort the decision maker has with uncertainty or risk inherent in the venture. This model might well reflect the fact that venture capitalists are mostly concerned with evaluating the Resident Risks in choosing whether to provide seed funding for a particular business opportunity, as well as their individual level of comfort with such uncertainty.

At the other extreme, when $\alpha = 1$, R = AC, reflecting that the risk assessed for a given business opportunity is a function of Affective intensity of the venture, weighted by the degree of Comfort the decision maker has with its associated risk. This model might well reflect that entrepreneurs are more passionate in their assessments of risk associated with a given business venture, focusing more on the Affective than the cognitive aspects of the situation. As such, their choice of which business opportunity to pursue is less affected by cognitive (or "rational") assessment of resident risk and more in line with their affective assessment of the potential for success.

In between these two extremes, the model predicts that total perceived risk varies as a function of value (which is based upon an assessment of resident risks), affect, and the degree to which the decision maker is focus of the affective components over more careful cognitive assessments of a set of business opportunities. Moreover, the model proposes that perceived risk is, in part, a function of how comfortable the decision maker is about one business venture compared to other such opportunities. Thus, the model yields testable predictions about the differences in the assessment of Resident Risk vs. emotional aspects between entrepreneurs and venture capitalists, as hypothesized by Yazdipour (2011).

The model may also help to close the "perceptual gap" that is hypothesized to exist between entrepreneurs and venture capitalists (the *perceptual asymmetry* introduced by Yazdipour, 2011, p 16) by examining differences in an opportunity's perceived value as a function of resident risk (probability of success/failure), affect, and individual thresholds for how much discomfort for uncertainty/risk can be tolerated between entrepreneurs and venture capitalists who are evaluating the same business opportunity.

In general, the model's prediction begins with a baseline established by prospect theory, and suggests that the concavity or convexity of the S-shaped value function will become more or less extreme due to adding parameters for affective intensity and degree of comfort. The model's predictions can be tested against a purely rational model (given by classical expected value theory), as well as against predictions made by prospect theory (that is, in the absence of considerations for affect and comfort-levels for risk).

V. Conclusion and Summary

The testable Behavioral Finance Risk Model as advanced in Equation 2 builds upon the Prospect Theory via parameter V, by considering how Affect influences perceived risk via parameter A, and by incorporating the need for the decision maker to reach a manageable level of Comfort with the involved uncertainties via parameter C. Additionally, the model's three variables can be readily operationalized as discussed in the present work. The techniques used to model value (V) from various tests of prospect theory can be used to operationalize that component of the proposed model. Affect parameter, A, can be measured using operational definitions from tests of the Affect Heuristic, and the Comfort parameter, C, has an operational definition derived

from recent empirical research and mentioned in this work. The Affective intensity parameter, α, is a free parameter that can be estimated from data.

Regarding the nature and type of actual data, the venture capital industry in the USA is the prime source for collecting the needed data for testing the model proposed in the present work. Some suggestions were made in the paper in this regard.

REFERENCES

Baird, I. S., & Thomas, H. (1985). Toward a contingency model of strategic risk taking. *Academy of Management Review, 10*, 230–243.

Bargh, J. A. (1997). The automaticity of everyday life. In R. S. Wyer, Jr. (Ed.), *The automaticity of everyday life: Advances in social cognition, vol. 10*. Mahwah, NJ: Erlbaum.

Bauer, R. A. (1967). Consumer behavior as risk taking. In D. F. Cox (Ed.), *Risk taking and information handling in consumer behavior*, Boston, MA: Graduate School of Business Administration, Harvard University.

Bechara, A., Tranel, D., & Damasio, A. R. (2000). Poor judgment in spite of high intellect: Neurological evidence for emotional intelligence. In R. Bar-On, and J. D. Parker (Eds.), *The handbook of emotional intelligence: Theory, development, assessment, and application at home, school, and in the workplace* (pp. 192–214). San Francisco, CA: Jossey-Bass.

Bettman, J. R. (1973). Perceived risk and its components: A model and empirical test. *Journal of Marketing Research, 10*, 184–190.

Blais, A-R., & Weber, E. U. (2006). A domain-specific risk-taking (DOSBERT) scale for adult populations. *Judgment and Decision Making, 1*, 33–47.

Bontempo, R. N., Bottom, W. P., & Weber, E. U. (1997). Cross-cultural differences in risk perception: A model-based approach. *Risk Analysis, 17*, 479–488.

Brockhaus, R. H. (1982). The psychology of the entrepreneur. In C. A. Kent, D. L. Sexton, & K. G. Vesper (Eds.), *The encyclopedia of entrepreneurship*. Englewood Cliffs, NJ: Prentice Hall.

Cho, J., & Lee, J. (2006). An integrated model of risk and risk-reducing strategies. *Journal of Business Research, 59*, 112–120.

Conchar, M. P., Zinkhan, G. M., Peters, C., & Olavarrieta, S. (2004). An integrated framework of the conceptualization of consumers' perceived-risk processing. *Academy of Marketing Science Journal, 32*, 418–436.

Coombs, C. H. (1975). Portfolio theory and the measurement of risk. In M. F. Kaplan, & S. Schwartz (Eds.). *Human judgment and decision*. New York, NY: Academic Press.

Cooper, A. C., Woo, C. Y., & Dunkelberg, W. C. (1988). Entrepreneurs' perceived chances of success. *Journal of Business Venturing, 3*, 97–108.

Cunningham, S. M. (1967). The major dimensions of perceived risk. In D. F. Cox (Ed.), *Risk taking and information handling in consumer behavior*, Boston, MA: Graduate School of Business Administration, Harvard University.

Ferguson, E., & Gallagher, L. (2007). Message framing with respect to decisions about vaccination: The roles of frame valence, frame method, and perceived risk. *British Journal of Psychology, 98*, 667–680.

Finucane, M. L., Alhakami, A., Slovic, P., & Johnson, S. M. (2000). The affect heuristic in judgments of risks and benefits. *Journal of Behavioral Decision Making, 13*, 1–17.

Froot, K., Scharfstein, D., & Stein, J. (1993). Risk management: Coordinating corporate investment and financing policies. *Journal of Finance, 48*, 1629–1658.

Ganzach, Y. (2000). Judging risk and return of financial assets. *Organizational Behavior and Human Decision Processes, 83*, 353–370.

Ganzach, Y., Ellis, S., Pazy, A., & Ricci-Siag, T. (2008). On the perception and operationalization of risk perception. *Judgment and Decision Making, 3*, 317–324.

Hsee, C. K., & Rottenstreich, Y. (2004). Music, pandas, and muggers: On the affective psychology of value. *Journal of Experimental Psychology: General, 133*, 23–30.

Holtgrave, D. R., & Weber, E. U. (1993). Dimensions of risk perception for financial and health risks. *Risk Analysis, 13*, 553–558.

Horton, R. L. (1976). The structure of decision risk: Some further progress. *Journal of the Academy of Marketing Science, 4*, 694–706.

Huber, O., Beutter, C., Montoya, J., & Huber, O. W. (2001). Risk-defusing behavior: Towards an understanding of risky decision making. *European Journal of Cognitive Psychology, 13*, 409–426.

Jacoby, J., & Kaplan, L. (1972). The components of perceived risk. In M. Venkatesan (Ed.), *Proceedings of the 3rd annual conference of the Association for Consumer Research* (pp. 382–393). Chicago, IL: Association of Consumer Research.

Johnson, E. J. (2004). Rediscovering risk. *Journal of Public Policy and Marketing, 23*, 2–6.

Jorgensen, B., & Kirschenheiter, M. (2003). Discretionary risk disclosures. *Accounting Review, 78*, 449–469.

Kahneman, D. (2003) A prospective on judgment and choice. *American Psychologist, 58*, 697–720.

Kahneman, D., Slovic, P., & Tversky, A. (1982). *Judgment under uncertainty: Heuristics and biases*. New York, NY: Cambridge University Press.

Kahneman, D., & Tversky, A. (1979). Prospect theory: An analysis of decision under risk. *Econometrica, 47*, 263–291.

Kogan, N., & Wallach, M. A. (1964). Risk taking: A study in cognition and personality. New York, NY: Holt, Reinhart, & Winston.

Konopka & Ackley (2011) Contributions of Neuroscience to Financial Decision Making– In R. Yazdipour (Ed.), *Advances in Entrepreneurial Finance: With Application from Behavioral Finance and Economics*, Springer.

Koonce, L., McAnally, M. L., & Mercer, M. (2005). How do investors judge the risk of financial items? *Accounting Review, 80*, 221–241.

Lanzetta, J. T., & Driscoll, J. M. (1968). Effects of uncertainty and importance on information search in decision making. *Journal of Personality and Social Psychology, 10*, 479–486.

Ledoux, J. E. (2000). Emotion circuits in the brain. *Annual Review of Neuroscience, 23*, 155–184.

Lipshitz, R., & Strauss, O. (1997). Coping with uncertainty: A naturalistic decision-making analysis. *Organizational Behavior and Human Decision Processes, 69*, 149–163.

Loewenstein, G. F., Weber, E. U., Hsee, C. K., & Welch, N. (2001). Risk as feelings. *Psychological Bulletin, 127*, 267–286.

Luce, R. D. (1980). Several possible measures of risk. *Theory and Decision, 12*, 217–228.

Luce, R. D., & Weber, E. U. (1986). An axiomatic theory of conjoint expected risk. *Journal of Mathematical Psychology, 30*, 188–205.

MacCrimmon, K. R., & Wehrung, D. A. (1990). Characteristics of risk taking executives. *Management Science, 36*, 422–435.

March, J. G., & Shapiro, Z. (1987). Managerial perspectives on risk. *Management Science, 33*, 1404–1418.

Mellers, B. A., Schwartz, A., Ho, K., & Ritov, I. (1997). Decision Affect Theory: Emotional reactions to the outcomes of risky options. *Psychological Science, 8*, 423–429.

Meacham, C. J. G. (2010). Two mistakes regarding the principal principle. *British Journal for the Philosophy of Science, 61*, 407–431.

Mitchell, V-W. (1999). Consumer perceived risk: Conceptualizations and models. *European Journal of Marketing*, 33, 163–195.

Neace, W. P., Deer, K., & Barnard, J. (September, 2010). *The impact of uncertainty-induced psychological discomfort on choice preference: Testing a novel theory of decision making under uncertainty*. Paper presented at the Annual Meeting of the Academy of Behavioral Finance, Chicago, IL.

Neace, W. P., Deer, K., Michaud, S., & Bolling, L. (2011). Uncertainty is psychologically uncomfortable: A proposed theoretic framework for studying judgments and decision-making under uncertainty and risk. In R. Yazdipour (Ed.), *Advances in Entrepreneurial Finance: With Application from Behavioral Finance and Economics*, Springer.

Olsen, R. A. (2011). Financial Risk Perceptions: A Behavioral Perspective. In R. Yazdipour (Ed.), *Advances in Entrepreneurial Finance: With Application from Behavioral Finance and Economics*, Springer.

Peter, J. P., & Ryan, M. J. (1976). An investigation of perceived risk at the brand level. *Journal of Marketing Research, 13*, 184–188.

Peter, J. P., & Tarpey, L. X., Sr. (1975). A comparative analysis of three consumer decision strategies. *Journal of Consumer Research, 2*, 29–37.

Pollatsek, A., & Tversky, A. (1970). A theory of risk. *Journal of Mathematical Psychology, 7*, 540–553.

Roselius, E. (1971). Consumer rankings of risk reduction methods. *Journal of Marketing, 35*, 56–61.

Rottenstreich, Y., & Hsee, C. K. (2001). Money, kisses, and electric shocks: On the affective psychology of risk. *Psychological Science, 12*, 185–190.

Schoemaker, P. J. H. (1982). The expected utility model: It's variants, purposes, evidence and limitations. *Journal of Economic Literature, 20*, 529–563.

Schwarz, N. (2002). Feelings as information: Moods influence judgments and processing
strategies. In T. Golovich, D. Griffin, & D. Kahneman (Eds.), *Heuristics and biases: The psychology of intuitive judgment*, (pp. 534-547). New York, NY: Cambridge University Press.

Sitkin, S. B., & Pablo, A. L. (1992). Reconceptualizing the determinants of risk behavior. *Academy of Management Review, 17*, 9–38.

Sitkin, S. B., & Weingart, L. R. (1995). Determinants of risky decision making behavior: A test of the mediating role of risk perceptions and propensity. *Academy of Management Journal, 38*, 1573–1592.

Slovic, P. (1987). Perceptions of risk. *Science, 236*, 280–285.
Slovic, P., Funucane, M. L., Peters, E., & MacGregor, D. G. (2002). The affect heuristic. In T. Gilovich, D. Griffin, & D. Kahneman (Eds.), *Heuristics and biases: The psychology of intuitive judgment*. New York, NY: Cambridge University Press.

Slovic, P., Finucane, M. L., Peters, E., & MacGregor, D. G. (2004). Risk as analysis and risk as feelings: Some thoughts about affect, reason, risk, and rationality. *Risk Analysis, 24*, 311–322.

Slovic, P., Fischhoff, B., & Lichtenstein, S. (1986). The psychometric study of risk perception. In V. T. Covello, J. Menkes, & J. Mumpower (Eds.), Risk evaluation and management. New York, NY: Plenum Press.

Stone, R. N., & Winter, F. W. (1987). Risk: Is it still uncertainty times consequences? In R. W. Belk and others (Eds.), *Proceedings of the American Marketing Association*. Chicago, IL.

Weber, E. U. (1988). A descriptive measure of risk. *Acta Psychologia, 69*, 185–203.

Weber, E. U. (1994). From subjective probabilities to decision weights: The effect of asymmetric loss functions on the evaluation of uncertain outcomes and events. *Psychological Bulletin, 115*, 228–242.

Weber, E. U. (2001). Decision and choice: Risk, empirical studies. In N. J. Smelser & P. B. Baltes (Eds.), *International encyclopedia of the social and behavioral sciences*. Oxford, UK: Elsevier Science, Ltd.

Weber, E. U., Anderson, C. J., & Birnbaum, M. H. (1992). A theory of perceived risk and attractiveness. *Organizational Behavior and Human Decision Processes, 52*, 492–523.

Weber, E. U., Blais, A-R., & Betz, N. E. (2002). A domain-specific risk-attitude scale: Measureing risk perceptions and risk behaviors. *Journal of Behavioral Decision Making, 15*, 263–290.

Weber, E. U., & Milliman, R. (1997). Perceived risk attitudes: Relating risk perception to risky choice. *Management Science, 43*, 122–143.

Yazdipour, R. (2011). A Behavioral Finance Approach to Decision Making in Entrepreneurial Finance. In R. Yazdipour (Ed.), *Advances in Entrepreneurial Finance: With Application from Behavioral Finance and Economics*, Springer.

Zajonc, R. B. (1998). Emotions. In D. T. Gilbert, S. T. Fiske, & G. Linczey (Eds.), *Handbook of Social Psychology (4th ed.)*. New York, NY: Oxford University Press.

Zikmund, W. G., & Scott, J. E. (1973). A multivariate analysis of perceived risk, self-confidence, and information sources. In S. Ward & P. Wright (Eds.), *Advances in consumer research, proceedings of the 4th annual conference of the Association for Consumer Research* (pp. 406–416). Chicago, IL: Association of Consumer Research.