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Rassoul Yazdipour  
California State University, Fresno

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## Decision Making in Entrepreneurial Finance: A Behavioral Perspective<sup>1</sup>

Rassoul Yazdipour, Ph.D.  
California State University, Fresno

**Abstract** Central questions in entrepreneurship and entrepreneurial finance are briefly discussed and case is made for the need for applying the behavioral finance theories and models to better understand the decision making dynamics that is involved at each stage of the entrepreneurial process. By dissecting a venture's total risk into a "Resident Risk" component and a "Behavioral Risk" component, attempt is made in this writing to introduce a preliminary risk model for evaluating key entrepreneurial decisions like the decision to launch and fund a new venture . Although the focus here is on individual decision making under highly uncertain entrepreneurial environments, but the suggested risk framework and the related discussions can be extended to decision making processes in all other uncertain environment.

### Introduction

Generally speaking, the following three functions make up the whole entrepreneurial process.

1. Entry/Seed Funding Decisions,
2. Financing/Investment Decisions, and
3. Growth/Exit Decisions.

Additionally, regardless of one's association with either of the two finance paradigms, traditional finance or behavioral finance, uncertainty and return remain to be the determining factors in all the three decision problems listed in above<sup>2</sup>.

Moreover, although the traditional finance and economic theories have had some successes in providing some solutions to the last two problems, but they have had little to say on how entrepreneurs decide to start a new venture and how investors select such ventures for investment purposes<sup>3</sup>. By design, the dominant traditional theory, the Agency Theory, can not make any predictions regarding firm entry or exit issues. Furthermore, such paucity of research on the

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<sup>1</sup> A version of this article will appear in Rassoul Yazdipour (ed). 2010. *Advances in Entrepreneurial Finance: With Applications from Behavioral Finance*. New York. Springer.

<sup>2</sup> In this article, and especially where both traditional and behavioral finance paradigms are discussed, we intentionally use the terms risk and uncertainty interchangeably. As will be seen soon, some leading scholars have shifted the whole notion and source of risk and uncertainty away from evidence-based risk, as defined by statistical tools, to perception-based uncertainty.

<sup>3</sup> Two points should be mentioned in here:

- a. I use the word "some" because as will be seen in this writing, traditional finance models such as Agency Theory continue to have their own shortcomings in explaining and predicting behavior. For details see Bitler, et, al, 2009 and Kaplan and Kaplan and Stromberg, 200; and
- b. On related research we have to mention Camerer and Lovallo's work (1999) where they use overconfidence to explain failure.

subject should not be surprising at all because in the standard finance and economic theory, problems have to be definable in mathematical terms to be considered for any type of analysis and application. The rational construct assumes that economic agents- investors, managers of all kind, and entrepreneurs- are “capable of understanding vastly complex puzzles and conduct endless instantaneous optimizations”<sup>4</sup>. Also the standard finance theory has built its whole foundation after a human brain that in H.A. Simon’s words “... serves, perhaps, as a model of the mind of God, but certainly not as a model of the mind of man”<sup>5</sup>. Therefore, to the traditional financial economists, uncertainty – a mainly *perceptual* and *personal* phenomenon – does not fall in such a category and therefore cannot be operationalized in any “meaningful” way.

The behavioral finance approach is important because the traditional finance has remained silent on the first issue, and the Agency Theory (financial contracting), which is effectively the only theory that is applicable to issues in entrepreneurial finance, has produced mixed empirical results<sup>6</sup>.

On the other hand, over the past 30 years or so psychologists, and more recently neuroscientists, have helped us to better understand the human decision making processes; and more specifically, how we as individuals perceive risk and uncertainty and how we take the required actions at the judgment time<sup>7</sup>. Scientific breakthroughs in those fields have also given rise to the new subfield of behavioral finance<sup>8</sup>. It is through such behavioral lenses that we believe attempts should be made to address the three central questions listed in above. Our main focus in this article involves the application of behavioral finance and economic theories to the least explored of such three decisions; i.e., the Entry/Seed Funding decisions. Given we first need to communicate with each other in this rather unfamiliar territory, attempts are made in this writing to introduce some new concepts – which include “Perception Asymmetry”, “Resident Risk”, and a behavioral risk model – that as complements to the existing concepts and tools could be used in any discussion on decision making under risk and uncertainty.

Part 2 provides a brief background on the decision problems that entrepreneurs and their financial backers, venture capitalists or VCs, face in the course of their business. Part 3 discusses some new concepts along with an attempt to provide a preliminary behavioral risk model; believing that if we better understand the uncertainties that are involved in and around the problems, we will have a better chance of providing more effective solutions to them. Part 4 summarizes the article and provides some suggestions for future research.

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<sup>4</sup> James Montier, 2007, p. xiii

<sup>5</sup> H. A Simon, page 34, 1982

<sup>6</sup> See for example Bitler, et al, 2009

<sup>7</sup> The most authoritative work advanced in this regard is Kahneman and Tversky’s Prospect Theory which is presented as an alternative to the Expected Utility theory and is outlined in this section and the Apx . Another equally significant work is Slovic, et al’s (2002) and Finucane, et al, (2000) Affect Heuristic which is also outlined in this section and the Apx.

<sup>8</sup> For a comprehensive review of the key issues in Behavioral Finance, see Richard H. Thaler’s *Advances in Behavioral Finance*, Volumes I and II, 1993 and 2005.

## **2. The Entry/Seed Funding Decisions: Problems and Existing Solutions Central Questions in a Launch Decision**

As said in above, our main focus in here is on the application of behavioral finance and economic theories to entry/seed funding decisions; jointly defined as launch decisions. Such decisions involve two separate but related decisions by both an entrepreneur and a VC. The reason for discussing and analyzing the two decisions together is a practical necessity. That is, the decision to enter a business by an entrepreneur alone does not mean much; unless, she can convince a VC to fund her startup. With this in mind, there are two central questions that both entrepreneurs and VCs face in a launch decision.

- a. What are the decision processes for entrepreneurs in a launch decision, and what are the decision criteria in that regard?
- b. What are the decision processes for venture capitalists in investing in a launch, and what are the decision criteria in that regard?

### **Venture Capital Markets**

In free enterprise systems, the role of efficient capital markets is to facilitate the flow of funds between the suppliers and the demanders of capital. Well functioning capital markets also insure that funds are raised and invested at competitive and reasonable rates. Operational transparency is among the most important requirements for the smooth working of such markets. Efficient market mechanisms certainly support innovation, job creation, economic development, and business growth. Inefficient capital markets will have the opposite effects. In the U.S. and other free market economies, transparent and public capital markets which serve large corporations have played such a role with unprecedented success in history.

However, markets for venture capital are certainly not among the well-functioning capital markets. This is true even in the U.S., the birthplace of venture capital. The opaqueness of these markets is the main reason behind their operational inefficiency. Naturally, such inefficiency translates into increased levels of risk and uncertainty, and consequently increased costs of doing business for small and entrepreneurial companies which such markets serve.

### **Traditional Finance and Economics' Response to Launch Decisions**

To resolve the problems that arise in the opaque venture capital markets that we just described, traditional finance theory has offered a relatively large body of literature and theories that are based on the classical Principal-Agent and Information Asymmetry theories. Under one version of the Information Asymmetry (IA) for example, the opaqueness of the IPO markets is addressed

and a solution like Signaling Theory is provided. Other IA problems addressed range from corporate debt financing to dividend policy and corporate takeovers<sup>9</sup>. Under Principal-Agent, or Agency Theory (AT), the presumed conflict of interest between owner-managers and investors is addressed<sup>10</sup> (this is also called “interest asymmetry”) and “optimum” financial contracts are offered to compensate for the assumed conflicts of interest and other additional risks and uncertainties<sup>11</sup>.

However, even with so much work done in the area of financial contracting, a recent study (Bitler, et al, 2009) states, “an extensive theoretical literature examines the principal-agent problem, .... yet, evidence supporting theory’s predictions is mixed and weak.” Besides, Treating entrepreneurs as agents and venture capitalists as principals, as it is the case in AT, is a questionable start; because by definition entrepreneurs are the opposite of agents who are good at taking orders. Entrepreneurs on the other hand are independent individuals, again by definition, because they want to be their “own bosses”! In fact a great majority of entrepreneurs cannot even work within a corporate structure just like a regular employee, an agent.

And this now takes us to the main topic of this writing as discussed in the following section.

### **3. A Behavioral Approach to Decision Making in Entrepreneurial Finance**

The approach that we have taken in this article and especially this section is based on the belief that if we can better understand the types of risks and uncertainties that are involved in and around the entrepreneurial finance problems listed at the beginning of the article, we will have a better chance of understanding the related decision processes. Moreover, we also believe that such an understanding alone would bring more transparency for all the parties in any given transaction, like a financial contract, and consequently, improve their decision processes. However the attempt will not end here as we also try to put together “pieces of the risk puzzle” and see if a meaningful risk framework can emerge for any future use and analysis. With these in mind, we now continue with such a plan and as follows.

#### **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 imbalance, it would be helpful if we refresh our memory about the Prospect Theory and the Affect Heuristic which are discussed in more details in the Appendix.

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<sup>9</sup> For a literature review and a related test of the theory see Cai et al (2007).

<sup>10</sup> For a good discussion and a literature review on Agency Theory and an empirical test of the said theory using data from the VC market, see Kaplan and Stromberg, 2002.

<sup>11</sup> If there is one branch of standard finance that has relevance to the world of entrepreneurs and venture capitalists, it must be the financial contracting branch.

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<sup>12</sup>.

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 possibly conclusion of a deal.

### **Resident Risks and Behavioral Risks: Toward a Behavioral 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

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<sup>12</sup> I am 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, I'd rather to stay on the central issues to prevent any confusion. For detailed discussion of these biases see the Appendix.

standard deviation, beta, or other variations thereof that can be measured and used in financial decision making<sup>13</sup>. 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 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 *creates* and reduces risk”<sup>14</sup>. He further adds that the “concept risk means different things to different people”<sup>15</sup>. Moreover, affect plays one of the most important roles in the perception of risk by individuals. 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.

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”*

### **Resident Risk: Risk as the “Other Side of a Business Opportunity Coin”**

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

I 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

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<sup>13</sup> 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 measure 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.

<sup>14</sup> Paul Slovic, 1987, p 280. Emphasis is mine.

<sup>15</sup> Ibid, p 283

example, success can mean reaching \$10M sales in four years and failure can mean not reaching that sales threshold by the fourth 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.

### **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 exist “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 I refer collectively to these risks as Resident Risks.<sup>16</sup>

### **Behavioral Risks**

The “Behavioral Risk” component is mainly shaped by the editing, evaluating, and affect processes as described earlier in this writing. As shown by the above 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

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<sup>16</sup> 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.

easily be ignored as a behavioral “anomaly”! To a behavioral economist however, the decrease can be attributed to the affect heuristic.

Furthermore, according to the proposed risk framework in above 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.

### **Behavioral Risk Processes**

Although discussion on making the behavioral risk components operational is 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 were briefly described in this writing.

### **Individual Decision Making in Highly Uncertain Entrepreneurial Settings: A Discussion and Two Propositions**

By building upon the Prospect Theory and Affect heuristic, we argued how the editing and evaluation phases, coupled with affect’s capability of producing perceptual judgments, can influence the perception and judgment of the entrepreneurs and VCs regarding the business opportunities that they consider in the course of their businesses. Moreover, by building upon Slovic and Olsen’s notion of risk that all risks are perceptual, and introducing the real-life aspects of risk and risk taking into the discussion, we proposed a two-component risk formula that contained both objective and subjective elements of risk.

Based on what was said in above, and given my own personal experiences as a real-life entrepreneur, investor, and consultant to 100s of entrepreneurs in California, we argue that:

- a. An entrepreneur bases her final decision mainly on the perceived gains and losses of the venture opportunity that she has eventually selected as a result of her search for similar opportunities, and more importantly,
- b. The finalized and selected business opportunity *already* has a level of risk and uncertainty residing in it that the entrepreneur feels comfortable about.

Proposition ‘a’ is based on the Prospect Theory; and proposition ‘b’ is based on the Affect heuristic.

Moreover, proposition ‘b’ is a simple extension of the two-component risk equation just mentioned and discussed in details earlier. Built in proposition ‘b’ is the observation that in the real life, business risks automatically come with business opportunities; just like the coin toss analogy<sup>17</sup>.

#### 4. Summary and Some Suggestions for Future Research

In this article, we discussed three central decisions in entrepreneurial finance and made the case for applying the behavioral finance theories and concepts to better understand such decisions and the underlying processes. We also introduced some new concepts such as ‘Perception Asymmetry’, ‘Resident Risk’, and a preliminary behavioral risk model to further facilitate discussions on related risks and uncertainties. This was done with the belief that if we can better understand the issues, we would have a better chance of improving the decision making processes.

Although the discussions in this writing did not lead to a full model, but we certainly hope the theory- and experience-based concepts and framework provide a starting point for future theoretical and empirical works on the topic. What follows are some suggestions for future research relative to the stated problems in this article.

- a. One immediate and relatively easy-to-implement work is to survey a group of entrepreneurs and see if they behave as hypothesized in this writing. My instinct and first-hand experiences tell me that they do; however I never conducted a formal study.
- b. The same exact experiment in above can be conducted in case of VCs. Again, my view is that VCs also behave as proposed in this article; but this needs to be verified too.
- c. Related to item b in above and as compared with entrepreneurs, I suspect VC’s Total Risk is much influenced by the resident risks than the behavioral risks. In other words, VCs are expected to be less affective when it comes to investment decisions. On the other hand and by definition, entrepreneurs behave the opposite way; i.e., more affectively.
- d. Finally, and this is where the real challenge is, work can be done to make the proposed risk model in this chapter operational so that it could be tested for further analysis and possible use in decision making. Selection and/or development of a suitable methodology that can process both objective and subjective risks and uncertainties is a first major in such direction. A possible starting point on methodology is Lewis’ (1980) ‘The Principal Principle’<sup>18</sup>

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<sup>17</sup> Another fact regarding risk taking in real life goes like this, and every honest venture consultant will tell the same to her/his clients: “The only way to *know the risk* is to *take the risk!*”

<sup>18</sup> Lewis, David, 1980. “A subjectivist’s guide to objective chance”. In: Richard C. JEFFREY, ed. *Studies in Inductive Logic and Probability*. Volume II. Berkeley: University of California Press, Chapter 13, pp. 263-293. I would to thank Martin Sewell for suggesting Lewis’ work.

## Appendix

### A. The Prospect Theory

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.

#### 1.1. The Editing or Framing Phase.

According to Kahneman and Tversky (KT), framing effects in decision situations arise when *different* imagery and descriptions of the *same problem* highlight different aspects of the decision outcomes. Choices often depend on the *manner in which alternatives are framed (described) and presented to us*; something not allowed in the Expected Utility (EU) theory. The role of the initial editing phase is to organize the possible options for the purpose of simplifying the evaluation phase and consequently making it easier to select the final option that has the highest value to the decision maker.

In other words, framing leads to a representation of the acts, outcomes, and contingencies that are associated with a particular choice problem like the choice to pursue a specific venture opportunity by an entrepreneur. Moreover, often time the entrepreneur does not have the basic information about different choices available to her/him; or at least all the available choices are not that clear to him. In such cases she has to actually figure out and possibly *mentally construct* what her options are; a process that is referred to as the *Opportunity Recognition* phase in the traditional entrepreneurship literature and practice<sup>19</sup>.

#### 1.2. Editing Operations

The editing phase also involves the application of a number of operations by the decision maker as briefly outlined in below.

**Coding.** Coding is simply the categorization of the outcomes in terms of gains and losses; and not as final states of wealth which is an underlying assumption used by the EU model. Furthermore, gains and losses are defined relative to the status quo or the reference point. Ruling out any “psychic income” for entrepreneurs and VCs, the reference point for them corresponds to their current assets or their current value of their portfolios. Moreover, by moving the reference point, outcomes may be categorized

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<sup>19</sup> In a working paper on this topic I argue that by mentally constructing different opportunities and in preparation for the next phase of evaluation – where she/he select a specific opportunity for starting a business based on the chosen opportunity – the entrepreneur is effectively, knowingly or knowingly, creating the matching risk that she/he will be comfortable with when and if the envisioned venture is actually launched; pending the needed financing. Otherwise, she/he will not take the next steps of actually starting the venture, including starting his search for a financial backer. Moreover, such constructed and perceived risk – which is unique to the entrepreneur behind the given opportunity – will be discussed along with the *real* uncertainty that certainly exists in the selected opportunity; the risk that is referred to in the literature as “risk out there”. For the lack of a better term, I refer to this “risk out there” as the “resident risk” or the risk that resides in any new opportunity; as there is no such a thing as riskless opportunity. I will also argue that the new term (new as far as I know) is not a tautological argument as it is the next natural step in better understanding how at least entrepreneurs make decisions in the real life and how their financiers would have their own perceived risk which will be different from the one seen by the entrepreneurs and possibly different from the “resident risk” or “native risk”. Finally we hypothesize that the VC’s envisioned/perceived risk is closer to the real risk- the “resident risk” or “native risk” - than that of the entrepreneur.

**Combination.** This refers to the tendency to add together the probabilities of choices that present identical outcomes. For example, the prospect (500, .25; 500, .25) is reduced to (500, .50) to facilitate evaluation.

**Segregation.** This is where the riskless component of a prospect is separated from its risky component.

**Cancellation.** This is the tendency to discard common outcome-probability choices. . For example, and using KT's example, the choices (200, 0.2; 100, 0.5; 20, 0.3) and (200, 0.2; 300, 0.4; -50, 0.4) can be reduced to choices (100, 0.5; 20, 0.3) and (300, 0.4; -50, 0.4).

### 1.3.The Evaluation Phase.

A second phase where acts, related contingencies, and outcomes for each decision choice are evaluated. In this phase, the edited prospects, such as business opportunities, are evaluated and the business opportunity with the highest value is selected. The Value Function as formulated in what follows will be used to assign values to each prospect or opportunity.

To see this, consider a gamble with two outcomes:  $x$  with probability  $p$ , and  $y$  with probability  $1 - p$ ; where  $x \geq 0 \geq y$ . Also assume an initial level of wealth ( $W$ ) is our reference point in this example. According to PT, value of the gamble (or prospect) is

$$V = \pi(p) v(x) + \pi(1 - p) v(y);$$

where  $\pi$  is a probability-weighting function and  $v$  is value of an outcome. KT's value function is shown in Figure 2.1 in below.

*Place figure 1 about here*

The value in PT is defined in terms of expected *gains and losses* and not in terms of expected *level of final* wealth. Furthermore, the probability-weighting function  $\pi(p)$  is not the same thing as original probability  $p$ ; as can be seen from Figure 2.2 that follows. The probability-weighting function transforms original probabilities into subject probabilities that follow a non-linear pattern as shown in Figure 2.2.

*Place figure 2 about here*

## B. The Affect Heuristic

According to Finucane, et al, the affect heuristic refers to the way in which subjective impressions of "goodness" or "badness" can act as a heuristic, capable of producing fast perceptual judgments, and also systematic biases. For example, as Ganzach has demonstrated,

- Stocks perceived as "good" were judged to have *low* risks and *high* return;

- Stocks perceived as "bad" were judged to have *low* return and *high* risks.

That is, for *unfamiliar* stocks, perceived risk and perceived return were *negatively* correlated, as predicted by the affect heuristic. For *familiar* stocks, perceived risk and perceived return were positively correlated; riskier stocks were expected to produce higher returns, as predicted by ordinary economic theory.

### C. Other Heuristics and Biases

When faced with huge amount of data and information and an array of decision problems, people do not do and in fact are not humanly capable of doing the rather complex optimization calculations that are expected of them under standard finance theory. Instead, they rely on a limited number of cognitive strategies or heuristics that will simplify the complex scenarios faced by them in making decisions. We can think of heuristics as information processing shortcuts that mainly result from one's experiences in a field of work. Of course, such simplifying shortcuts are productive; until we consider that heuristics, by nature are imperfect, and, consequently, will result in *biases and errors*.

We furthermore have to add that, in traditional theory, unsystematic biases are expected to average out at the market level and consequently have no effect on asset prices. However, the behavioralists argue that both heuristics and biases are in fact *systematic*, thereby potentially lasting for long periods of time and affecting prices accordingly.

Tversky and Kahneman (TK, 1974), as well as other new researchers, have brought to the attention of the finance professionals a number of such systematic biases as follows.

#### 1. Representativeness (Similarity)

According to TK (TK, 1974), many of the probabilistic questions that people are concerned with can be characterized by, "What is the probability that object A belongs to class B? What is the probability that event A originates from process B? etc." To answer questions like these, people utilize the representative heuristics, in which probabilities are evaluated by the degree to which A resembles B. For example, when A is highly representative of B, the probability that A originates from B is judged to be high.

In such cases the representative heuristic assists in evaluating the *probabilities* dealing with objects or processes A and B. As an example, when A is highly representative of B, the probability that A originates from B is judged to be high; and so forth. The problem is that representativeness (similarity) *should not* affect the judgment of probability. What *should be* considered in the judgment to probability is "prior probability" or "base rate." However, the latter is not the case in practice. (violation of Bayes' rule).

### The Representativeness Heuristic in a Nutshell:

- The "representativeness heuristic" is a built-in feature of the brain for producing rapid probability judgments, rather than a consciously adopted procedure.
- As humans we are not aware of substituting judgment of *representativeness* for judgment of *probability*.

#### 2. Availability

To understand this judgment heuristic, we just need to know that people disproportionately recall the salient events, those that are very recent and/or those that are/were emotionally involved with especially in the recent past. The more salient an event is, the more likely the probability that we can recall that event. The result is that this sort of bias prevents us from considering other potential and related outcomes. For example, one may assess the risk of getting mugged in New York City (NYC) by recalling such incidences among friends and family. Under availability, people search their memories for relevant information.

The problem, however, is that not all memories are equally retrievable/available and this leads to error in judgment. For example, more recent incidences and more salient events (getting mugged in NYC) will weigh more heavily and will lead to prediction biases and distort the judgment or estimate.

The Availability Heuristic in a Nutshell: Biases implicit in the availability heuristic affect estimates of risk.

#### 3. Anchoring, Adjustment, and Contamination

According to TK (1974), when forming estimates and predictions, people usually start with some initial arbitrary value and adjust away from it. Also, people make estimates by starting from an initial value that is adjusted to yield the final answer. The initial value may be suggested by the formulation of the problem or it may be the result of a partial calculation. Regardless, TK argue that "adjustments are typically insufficient", and "*Different starting points yield different estimates which are biased toward the initial value*". This is anchoring. Anchoring happens when the starting point is given to the subject; as well as when the subject bases her estimate on the result of some incomplete computation.

The Anchoring Heuristic in a Nutshell:

- Information that is *visibly* irrelevant still anchors judgments and contaminates guesses. When people start from information known to be irrelevant and adjust until they reach a plausible-sounding answer, they under-adjust.
- People under-adjust more severely in cognitively busy situations and other manipulations that make the problem harder.
- People deny they are anchored or contaminated, even when experiment shows they are.

- These effects are not diminished or are only slightly diminished by financial incentives, explicit instruction to avoid contamination, and real-world situations.

#### Contamination Effects:

It turns out that almost *any* information could work its way into a cognitive judgment. (Chapman and Johnson 2002); and you cannot decrease Anchoring or Contamination effects either (Tversky and Kahneman 1974) and (Wansink et. al. 1998).

#### 4. Overconfidence Heuristics- and Calibration

People typically have great confidence in judgments based upon them. For example, events to which subjects assigned a probability of 2% happened 42.6% of the time!

#### 5. Hindsight Heuristics

Hindsight bias is when subjects, after learning the eventual outcome, give a much higher estimate for the *predictability* of that outcome than subjects who predict the outcome without advance knowledge. Hindsight bias is sometimes called the I-knew-it-all-along effect. Hindsight bias is important in legal cases, where a judge or jury must determine whether a defendant was legally negligent in failing to foresee a hazard (Sancho 2003).

#### 6. Others- Black Swan Phenomenon

As Taleb has coined the term and discussed this phenomenon in much detail, sometimes *most of* the variance in a process comes from exceptionally rare, exceptionally huge events. Consider a financial instrument that earns \$10 with 98% probability, but loses \$1000 with 2% probability; it's a poor net risk, but it looks like a steady winner. As another example, why did Long-Term Capital Management (LTCM) borrow leverage of \$125 billion against \$4.72 billion of equity, almost ensuring that *any* Black Swan would destroy them?

#### Heuristics and Biases: Evidence and Implications- some examples

- Implication for performance-based management contracts: People/managers will prefer performance-based incentives schemes more often than standard theory predicts. This can be attributed to the overconfidence trait. Due to overconfidence, managers prefer riskier projects because they think they can beat the odds. This goes against the standard theory; which predicts that, as output variance increases, principals should offer less output-sensitive contracts to agents because, under standard theory, agents are assumed to dislike risk. According to Camerer and Lovo (1999) there is some evidence in support of this phenomenon.
- Implication for stock selections due to availability bias: People easily recall the information that has recently arrived, especially in the media and corporate releases; and their memory is fresh with their broker's/advisor's recommendations. According to a

study, stocks with very high level of press coverage underperformed in the subsequent two years.

- Implication for asset valuation due to anchoring bias. In a study done in the field of real estate, subjects were asked to give their opinions on the appraisal value, appropriate listing price, and the lowest price they would accept if they were the seller. This was done after they had been given detailed and identical information about the house they had been shown for such a purpose. The only information that was changed in this study was the asking price (the anchoring factor). The result of this study showed individual valuations of houses were directly related to the asking price given to them.

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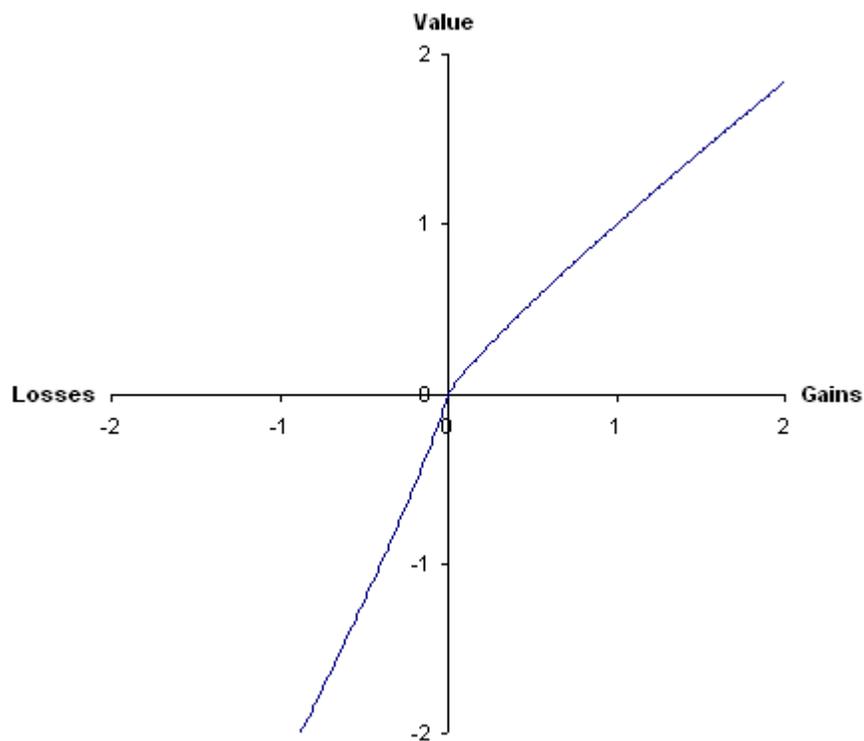
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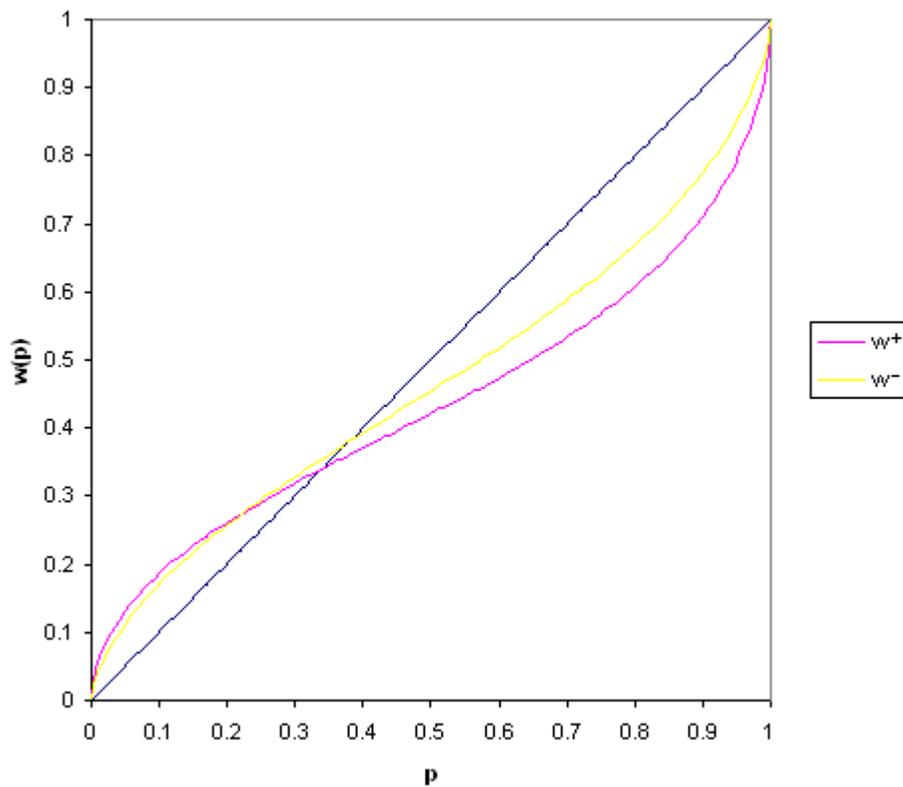
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**Exhibit 1** A Hypothetical Value Function

*Note:* The value function is defined by gains and losses on deviations from a reference point, where the function is concave for gains and convex for losses. This function is steeper for losses than gains (loss aversion). This means a loss causes a greater feeling of pain than a joy caused by the same amount of gain.

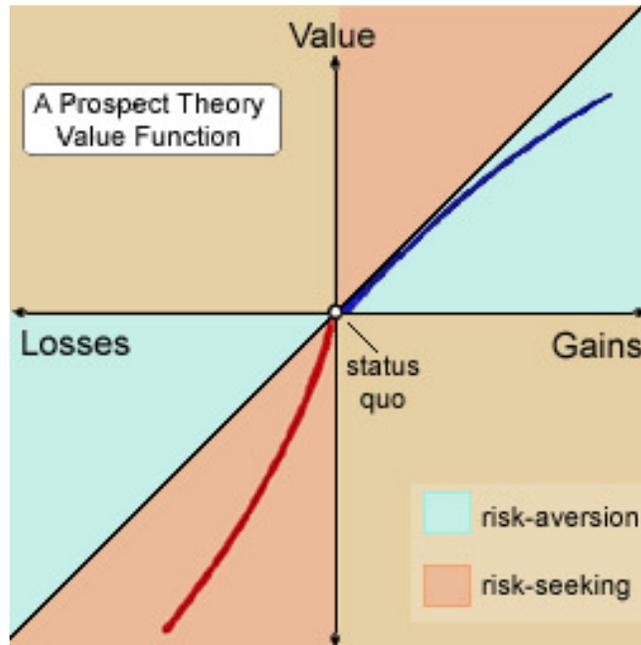
*Source:* This figure is reproduced with permission from Martin Sewell and [behavioralfinance.net](http://behavioralfinance.net).



**Exhibit 2** A Hypothetical Probability Weighting Function for gains ( $w^+$ ) and losses ( $w^-$ )

*Note:* According to prospect theory, a probability  $p$  has a decision weight  $w(p)$ . Probability weighting functions overweight low probabilities and underweight high probabilities.

*Source:* This figure is reproduced with permission from Martin Sewell and [behavioralfinance.net](http://behavioralfinance.net).



**Exhibit 3** Kahneman and Tversky's Value Function

*Note:* This graph illustrates that people are generally risk averse in the gains domain but loss averse in the domain of losses. Furthermore, losses cause greater feelings of pain than joys caused by the same amount of gain. (Courtesy of Professor Ralph Byrns.)