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Entrepreneurial decision-making under risk : prospect theory and dual-process theory.

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ENTREPRENEURIAL DECISION-MAKING UNDER RISK:

PROSPECT THEORY AND DUAL-PROCESS THEORY

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DEDICATION

This dissertation is dedicated to my parents, my wife, and my son.

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I would never have been able to finish my dissertation without the guidance and support of my committee members. I would like to thank my committee chair, Dr. David Dubofsky, for his excellent guidance, caring, and patience for my research. I would like to thank Dr. James Fiet, for his wisdom, knowledge, and financially support of my research. I would also like to thank my other committee members, Dr. Yong Chao and Dr. Jill Adelson, for their comments and assistance over the past four years.

ABSTRACT

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This research addresses the question of why some people become entrepreneurs whereas others do not. The debate has been going on for decades in entrepreneurship. In this dissertation, I address this question by decomposing it into two related questions. The first question is whether entrepreneurs make different decisions compared to non-entrepreneurs when they are facing the same opportunities under risk. The second question is whether these differences in decision-making (if any) are due to the natural proclivity of entrepreneurs themselves. To identify the differences of entrepreneurial decision-making between entrepreneurs and non-entrepreneurs, this study investigates the nexus between entrepreneurs and opportunities from both aspects simultaneously. From an entrepreneur's aspect, based on dual-process theory, I examine how different styles of entrepreneurial thinking influence their decision-making. Considering an opportunity itself, based on prospect theory, I test how different types of opportunity framing influence entrepreneurial decision-making.

The results indicate that entrepreneurs have lower evaluations than non-entrepreneurs do when they are facing the same opportunities under risk. The opportunities in a loss frame have higher evaluations than those in a gain frame. The evaluations are higher in System 2 thinking than in System 1 thinking. The findings suggest that entrepreneurs do make different decisions than non-entrepreneurs and that these differences are more likely due to the natural proclivities of at least some entrepreneurs. These findings provide new insights for the entrepreneurial decision-making literature and enlighten some promising future research.

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CHAPTER I

INTRODUCTION

Chapter Overview

In this chapter, I develop my research questions based on the entrepreneurship literature. First, I describe my research motivation based on the discussion of a well-known paper in entrepreneurship. The unresolved questions left by this paper are my motivation for this dissertation. Broadly, I investigate why some people become entrepreneurs whereas others do not. Then, in order to specify my research questions, I discuss entrepreneurial opportunities, entrepreneurial decision-making, and the differences between entrepreneurs and non-entrepreneurs. Next, I review the nexus between opportunities and entrepreneurs that is the essence of entrepreneurial decision-making. Unlike other scholars who only have examined this nexus from either the perspective of opportunities or the perspective of entrepreneurs, I investigate it from both aspects. On the opportunity side, I am interested in how different types of framing influence entrepreneurial decision-making. On the entrepreneur side, I am interested in how different styles of thinking influence entrepreneurial decision-making. Finally, I specify my research questions.

Motivation

Busenitz and Barney (1997) explored the differences between entrepreneurs and managers in large organizations. They found that entrepreneurs use biases and heuristics

more than managers in large organizations when they are making strategic decisions. They argued that entrepreneurs make many decisions for which there is little or no hard information because the entrepreneurial environment is uncertain and complex. "In this context, simplifying biases and heuristics may have a great deal of utility in enabling entrepreneurs to make decisions that exploit brief windows of opportunity" (Busenitz & Barney, 1997, p. 14). They concluded "that the extent to which decision-makers deviate from a strict econometric approach may not be a constant, that different individuals may utilize biases and heuristics to different degrees" (Busenitz & Barney, 1997, p. 23) and that "biases and heuristics can be an effective and efficient guide to decision-making" (Busenitz & Barney, 1997, p. 9).

Busenitz and Barney's paper (1997) has become one of the most cited papers in entrepreneurship[1]. However, there still are three unresolved questions left. First, Busenitz and Barney (1997) showed that entrepreneurs can make efficient decisions by using biases and heuristics, however they did not address the quality of these decisions. The efficiency and effectiveness of results are both important for decision-making. We cannot examine decision-making only from the perspective of efficiency without regard for the effect of a decision. In other words, there are two kinds of decision-making: one uses more biases and heuristics; whereas, the other uses more analysis and calculation. Entrepreneurs can use the former approach to make efficient decisions. However, we do not know the effectiveness of their decision-making. If entrepreneurs use more biases and heuristics in

[1] Cited by 1474 times according to Google Scholar (scholar.google.com) on 6/15/2014.

decision-making, will they make bad decisions or good decisions compared to using more analysis and calculation?

Second, we do not know whether this cognitive difference of using biases and heuristics exists between entrepreneurs and the general population because Busenitz and Barney (1997) only compared entrepreneurs with managers in large organizations. Both entrepreneurs and managers are special cases from the general population. We cannot make the conclusion that entrepreneurs use more biases and heuristics than the general population only based on the observation that entrepreneurs use more biases and heuristics than managers. There are several possible explanations of this observation. For example, (a) entrepreneurs use more bias and heuristics than the general population; whereas, managers are the same as the general population. (b) Entrepreneurs are the same as the general population; whereas, managers use more analysis and calculation than the general population. (c) Entrepreneurs use more biases and heuristics than the general population; whereas, managers use more analysis and calculation than the general population. Therefore, to examine the differences between entrepreneurs and the general population, we must sample from these two populations.

Third, even if entrepreneurs were different from the general population regarding their greater use of biases and heuristics, there is no evidence that "those who are more susceptible to the use of biases and heuristics in decision-making are the very ones who are most likely to become entrepreneurs" (Busenitz & Barney, 1997, p. 14). In other words, we cannot simply conclude that this difference is due to their *natural proclivity*, which implies that particular attributes exist before people become entrepreneurs, which may partially explain why they become entrepreneurs. However, entrepreneurs could be the

same as the general population when they become entrepreneurs. Nevertheless, due to environmental uncertainty and complexity, they may adapt to use more biases and heuristics. In other words, this difference in decision-making may be an acquired attribute from entrepreneurial practice.

These three unresolved questions connect to my research questions. My first research question is: do entrepreneurs make different decisions from non-entrepreneurs when they face opportunities? I focus on the results of their decisions. In other words, I am interested in the effectiveness of their decisions, which addresses the first unresolved question. In the meantime, I compare entrepreneurs with non-entrepreneurs, which addresses the second unresolved question. Furthermore, if I identify any differences in decision-making between entrepreneurs and non-entrepreneurs, I investigate whether these differences are due to the natural proclivity of entrepreneurs, which drives them to become entrepreneurs or if the differences evolve after a period of time during which they are entrepreneurs. Therefore, my second research question addresses the third unresolved question.

Opportunity

Opportunities are "those situations in which new goods, services, raw materials, and organizing methods can be introduced and sold at greater than their cost of production" (Shane & Venkataraman, 2000, p. 220). According to neoclassical economic theory, because economic actors cannot generate economic wealth under perfect competition, an opportunity will appear when competitive imperfections exist in markets (Barney, 1986; Venkataraman, 1997). These competitive imperfections can exist as "important entry barriers, heterogeneously distributed information or capabilities, significant transaction

costs, the opportunity to produce heterogeneous products, nonprofit maximizing entities in the market, and so forth" (Alvarez, Barney, & Anderson, 2013, p. 302). The opportunities generate economic wealth that is equal to the difference between the value of an economic actor's assets and the cost of those assets (Alvarez et al., 2013).

Although scholars have different perspectives about opportunities based on different assumptions and boundary conditions, in this dissertation, I only examine opportunities that exist exogenously and can be discovered by systematic search. In particular, I consider opportunities that exist ex ante and that have specific risks and payoffs. People can recognize these risks and payoffs.

Entrepreneurship

Entrepreneurship is a process that is intended to identify, evaluate, and exploit opportunities. Its focus has been attributed to be the nexus between entrepreneurs and opportunities (Shane & Venkataraman, 2000; Shane, 2012). This nexus is also the fundamental of entrepreneurial decision-making. Scholars have examined both aspects of this nexus from various perspectives, even though there is still much that we do not understand about. First, one of the reasons that individuals have different beliefs about opportunities may be due to their natural proclivities. When people face the same opportunity, only some of them may think it is feasible. On the other hand, when an individual faces a variety of opportunities, he or she may not think all of them are feasible (Shane & Venkataraman, 2000). Scholars have examined these individual differences from various perspectives, such as age and gender (Long, 1982), prior knowledge (Fiet, 2007; Shane, 2000), human capital (Gimeno, Folta, Cooper, & Woo, 1997; Unger, Rauch, Frese, & Rosenbusch, 2011) , and alertness (McCaffrey, 2013; Tang, Kacmar, & Busenitz, 2012).

Second, opportunity differences also influence opportunity discovery. Compared to individual differences, differences in opportunity have been studied much less. Scholars have examined opportunity differences from various perspectives, even though there is still much that we do not understand about them. For example, scholars have investigated the attractiveness of an opportunity (Holland & Shepherd, 2013), the technology required by an opportunity (Choi & Shepherd, 2004), and the structural alignment of an opportunity (Gregoire, Barr, & Shepherd, 2010). Another aspect could be the *framing* of an opportunity, which refers to an individual's interpretation of an opportunity. Scholars have found that the framing of options will influence individuals' decisions (Kahneman & Tversky, 1979). In my dissertation, I investigate how different types of framing influence entrepreneurial decision-making under risk.

Third, scholars have used different theories to investigate the nexus between entrepreneurs and opportunities, such as, constrained systematic search (Fiet, 2007), resource based theory (Choi & Shepherd, 2004), threshold theory (Holland & Shepherd, 2013), and evolutionary theory (Aldrich & Martinez, 2001). In addition, other theories may also help us to understand the nexus between entrepreneurs and opportunities. For example, prospect theory more accurately explains decision making than expected utility theory (Camerer, 2004). In my dissertation, I use prospect theory to investigate entrepreneurial decision-making under risk.

Many previous studies have investigated decision making under risk (Edwards, 1954). Knight (1921) was the first to use the term *risk* to refer to a situation in which both outcomes and their probabilities of occurrence are known to the decision maker; whereas *uncertainty* refers a situation in which some of outcomes and/or their probabilities of

occurrence are unknown to the decision maker. The difference between a risk and an uncertainty is that a risk is measurable; whereas, an uncertainty is unmeasurable (Knight, 1921).

Differences between Entrepreneurs and Non-Entrepreneurs

To begin to understand why some people become entrepreneurs and others do not, the first step may be to identify the important differences between entrepreneurs and non-entrepreneurs. The second step would be to confirm these differences are due to the natural proclivity of entrepreneurs or acquired attributes from entrepreneurial practice (Alvarez et al., 2013).

Scholars have examined different factors that are likely to distinguish entrepreneurs from non-entrepreneurs. Early research focused on personality and demographic differences, such as age and gender (Long, 1982) and Big-Five personality traits (Wooten, Timmerman, & Folger, 1999). Researchers have also examined different psychological factors, such as locus of control (Shapero, 1975), need for achievement (Begley & Boyd, 1988), and affect (Baron, 2008). However, these approaches have identified very few, even if limited, systematic differences between entrepreneurs and non-entrepreneurs (Busenitz & Barney, 1997). For example, scholars find personality and demographic differences are quite small and rarely systematic (Cooper & Dunkelberg, 1987).

Recently scholars have focused on possible cognitive differences, such as overconfidence and representativeness (Busenitz & Barney, 1997) and intuitiveness (Allinson, Chell, & Hayes, 2000). Although they have found some differences, it is not known whether these differences are due to the natural proclivity of some entrepreneurs that drives them to become entrepreneurs or the acquired attributes that are the result of

entrepreneurial practice (Alvarez & Barney, 2007). This dissertation explores these possible sources of differences.

Entrepreneurial Decision-Making

"Entrepreneurs increasingly operate at the edge of human knowledge in making pioneering decisions that [may] bring fundamentally new products and services into existence" (McVea, 2009, p. 491). These decisions are crucial for entrepreneurs and their firms. For example, scholars have found that the wrong decisions about expected returns are the major reason for the high failure rate among nascent entrepreneurial firms (Hayward, Shepherd, & Griffin, 2006). However, the uncertainty and complexity of the entrepreneurial environment make entrepreneurial decision-making more difficult. As a result, entrepreneurs may use biases and heuristics to make decisions efficiently (Busenitz & Barney, 1997).

There is a growing body of work on entrepreneurial decision-making that has found that entrepreneurs may make decisions based on various heuristics and biases (Busenitz & Barney, 1997; Kickul, Gundry, Barbosa, & Whitcanack, 2009; McVea, 2009; Shepherd, 2011). For example, scholars have examined overconfidence (Busenitz & Barney, 1997; Forbes, 2005; Simon, Houghton, & Aquino, 2000), intuition (Blume & Covin, 2011; Kickul et al., 2009; Mitchell, Friga, & Mitchell, 2005), and affect (Baron, 2008; Foo, Uy, & Baron, 2009). This kind of research "provides an opportunity to gain a deeper understanding of within-individual (i.e., intra-individual) variance" (Shepherd, 2011, p. 417).

This dissertation investigates entrepreneurial decision-making based on the nexus between opportunities and entrepreneurs. Although scholars have examined this nexus for

decades, most studies only focus on one side of the nexus, either opportunities or entrepreneurs. To investigate the nature of this nexus further, this dissertation studies both aspects of it. That is, I investigate both the differences between opportunities and the differences between entrepreneurs and non-entrepreneurs.

Scholars have provided evidence that biases and heuristics are essential in entrepreneurial decision-making. Because my dissertation investigates entrepreneurial decision-making, I must choose the theories that have the power to explain behaviors under biases and heuristics.

The first theory I chose is prospect theory. Prospect theory argues that a reference point, framing, a subjective value function, and a weighting function will influence individuals' decision-making under risk (Kahneman & Tversky, 1979). Therefore, prospect theory can explain how the framing of an opportunity will influence entrepreneurial decision-making.

The second theory I chose is dual-process theory. Dual-process argues that there are two systems interactively involved in individuals' decision-making. Dual-process theory refers to them as System 1 decision-making, which is a rapid, automatic, associative, and intuitive process, and System 2 decision-making, which is a slower, rule-governed, analytic, and deliberate process (Salas, Rosen, & DiazGranados, 2010). If individuals use more System 1 when they make decisions, they will generate intuition. If individuals use more system 2 when they make decisions, they will exhibit analysis. It is very rare for an individual to make a decision only based on one system. System 1 and System 2 are functioning in parallel and interacting when an individual makes decisions. Thus, an individual will make an intuitive decision when using more System 1 thinking. Whereas

regarding a same situation, the individual might make an analytic decision when using more System 2 thinking. Therefore, I argue that the style of thinking (use more System 1 or System 2) will influence entrepreneurial decision-making. Figure 1 shows the theoretical structure of this dissertation.

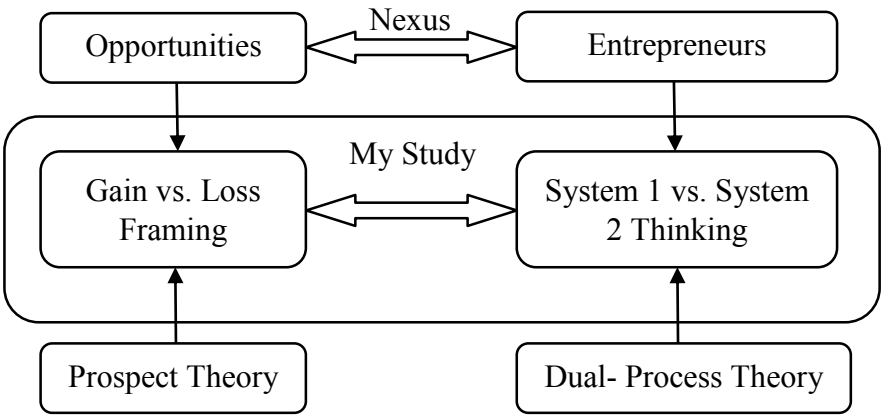

Figure 1. The theoretical structure.

Prospect Theory

Prospect theory has become an influential decision-making perspective, especially under risky conditions (Birnbaum, 2008; Bromiley, 2010; Holmes, Bromiley, Devers, Holcomb, & McGuire, 2011). It offers a descriptive model of decision-making under risk (Kahneman & Tversky, 1979; Tversky & Kahneman, 1991). It argues that people exhibit loss aversion, which means that they are more sensitive to losses than to gains when having to make decisions under risk (Köbberling & Wakker, 2005). Prospect theory argues that loss aversion reflects on a value function that is concave for gains but convex for losses and is deeper for losses than for gains (Abdellaoui, Bleichrodt, & Paraschiv, 2007;

Kahneman & Tversky, 1979; Schmidt, Starmer, & Sugden, 2008; Tversky & Kahneman, 1991).

In order to demonstrate prospect theory, researchers often confront subjects with a pair of economic decisions. An individual chooses the higher overall value option based on a reference point. The reference point is a neutral position used to determine the extent to which outcomes constitute gains or losses (Kahneman & Tversky, 1979). It is a gain when an outcome is above the reference point and it is a loss when an outcome is below the reference point.

For a given question, individuals can make decisions in two different frames: a *gain frame* which refers to anticipating an outcome in excess of one's reference point and a *loss frame* which refers to anticipating an outcome below one's reference point (Tversky & Kahneman, 1981).

The value of an economic decision depends on outcomes and their associated probabilities. For example, suppose there is an economic decision with outcomes *x* and *y* with probabilities *p* and *q*.

$$value\ of\ an\ economic\ decision\ = v(x) * w(p) + v(y) * w(q)$$

Here, *v(.)* is the value function which depicts the subjective value of an outcome and *w(.)* is probability weighting function which depicts the decision weight for a probability.

The value function is subjective as is the utility function, however framing also influences the subjective value. Under some frames, an individual may associate a higher value than the utility, and *vice versa*.

There are four properties of the value function (Kahneman & Tversky, 1979). Individuals evaluate outcomes relative to reference points; the value function is concave above the reference point and convex below; the value function incorporates diminishing sensitivity; and prospect theory assumes that individuals are risk averse, which means they prefer a sure gain to a set of probabilistic gains with the same expected value. Diminishing sensitivity means that the difference between the subjective values of two outcomes is larger, the closer those outcomes are to the reference point (Tversky & Kahneman, 1992). Figure 2 shows the subjective value function.

$$v(x) = x^a, \quad x \geq 0$$

$$v(x) = -\lambda|x|^a, \quad x \leq 0$$

$$Here, 0 < a < 1, \lambda > 0$$

In the formulas above, a determines the shape of the subjective value function, which is concave in the gain frame and convex in the loss frame. The λ is the loss aversion index, which determines the difference between the values of gains and losses. If $\lambda > 1$,

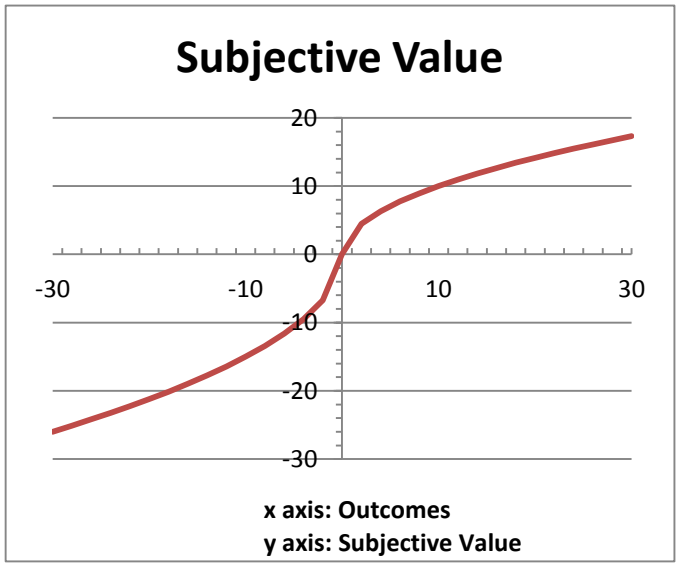

Figure 2. Subjective value.

an individual will exhibit *loss aversion*, which means that "losses loom larger than corresponding gains" (Tversky & Kahneman, 1992, p. 303) as shown in Figure 2. The parameter λ differs across individuals.

The probability weighting function describes an individual's subjective weighting of probabilities. Prospect theory suggests that individuals usually exhibit behavior to overweight probabilities near 0 while underweighting large probabilities. This phenomenon results in an inverse "S" shape curve of weighting function. In the equation below, the k^+ indicates the gain frame and k^- indicates the loss frame. The k^+ is closely identical with k^- for an individual, however they are different across individuals (Tversky & Kahneman, 1992). Figure 3 shows a hypothetical probability weighting function in the gain frame.

$$w^+(p) = \frac{p^{k^+}}{(p^{k^+} + (1-p)^{k^+})^{\frac{1}{k^+}}}$$

$$w^-(p) = \frac{p^{k^-}}{(p^{k^-} + (1-p)^{k^-})^{\frac{1}{k^-}}}$$

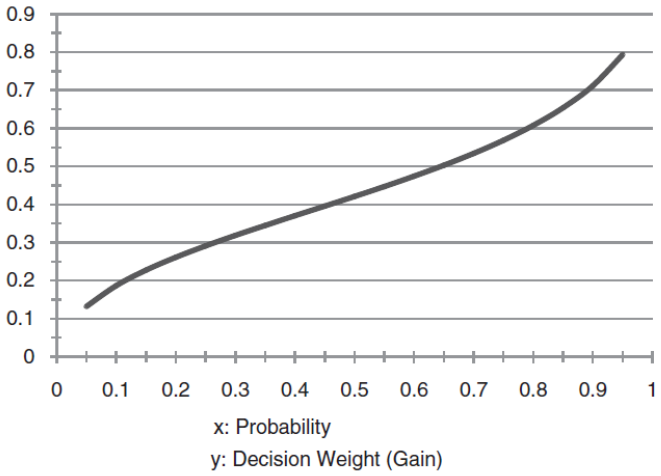

Figure 3. Hypothetical probability weighting functions.

I discuss prospect theory in detail in Chapter II.

Dual-Process Theory

There is growing interest in the role of intuition in entrepreneurial decision-making under risk (Blume & Covin, 2011; Kickul et al., 2009; Mitchell et al., 2005). However most intuition research in entrepreneurship has a limitation that considers intuition and analysis as opposite ends of a continuum. For example, Allinson and Hayes (1996) developed the Cognitive Style Index (CSI) to measure the cognitive style of entrepreneurs, which indicates whether people are more intuitive or more analytical. Based on CSI, Allinson, Chell, and Hayes (2000) examined the cognitive styles of entrepreneurs and managers. They found that entrepreneurs are similar to senior managers in cognitive styles; however, entrepreneurs are more intuitive than the general population and more intuitive than middle and junior managers. Based on cognitive style, Kickul et al. (2009) found intuitive entrepreneurs are more confident in their ability to identify and recognize opportunities whereas analytical entrepreneurs are more confident in their abilities to assess, evaluate, plan, and marshal resources.

However, there is a dispute about the cognitive style of individuals. Dual-process theory argues that there are two distinct systems in human information processing: System 1, which is fast, holistic, and does not require conscious cognitive effort, and System 2, which is slower, analytic, and rule based (Dane & Pratt, 2007; Salas et al., 2010). If individuals use more System 1 when they are making decisions, they will exhibit more intuition. If individuals use more System 2, they are more analytical. These two systems

are not exclusive; individuals can use them simultaneously. For example, experts can generate high usage of both systems (Salas et al., 2010). When individuals make decisions, they often combine the results from both systems. Sometime the results are consistent. Sometimes the results are different or conflict, thus individuals must either choose one or compromise between them (Evans & Frankish, 2009).

Scholars refer to System 1 using different names, such as implicit system, associative system, or intuitive system. Scholars also refer to System 2 using different names, such as explicit system, rule-based system, rational system, or analytic system. Although scholars use different terms to describe features of these two systems (see a summary in Table 1), individuals will exhibit more intuition if they use more System 1 when they are making decisions, and more analysis if they use more System 2.

Table 1
Features Attributed by Various Theorists to the Two Systems of Cognition

System 1	System 2
Evolutionarily old	Evolutionarily recent
Unconscious, preconscious	Conscious
Shared with animals	Uniquely (distinctively) human
Implicit knowledge	Explicit knowledge
Automatic	Controlled
Fast	Slow
Parallel	Sequential
High capacity	Low capacity
Intuitive	Reflective
Contextualized	Abstract
Pragmatic	Logical
Associative	Rule-based
Independent of general intelligence	Linked to general intelligence

(Frankish & Evans, 2009, p. 16)

Between these two types of systems thinking, System 1 thinking draws more attention from entrepreneurship scholars (Blume & Covin, 2011). Sinclair and Ashkanasy (2005, p. 357) define intuition as "a non-sequential information processing mode, which

comprises both cognitive and affective elements and results in direct knowing without any use of conscious reasoning." Plessner and Betsch (2008) provided an alternative definition of intuition:

> *Intuition is a process of thinking. The input to this process is mostly provided by knowledge stored in long-term memory that has been primarily acquired via associative learning. The input is processed automatically and without conscious awareness. The output of the process is a feeling that can serve as a basis for judgments and decisions. (p. 4)*

Although intuition has been defined in many ways, researchers now agree that there are three core components of intuition: the inputs, processes, and outcomes (Blume & Covin, 2011; Salas et al., 2010). My study is consistent with some recent works adopting Dane and Pratt's (2007) definition of intuition (Blume & Covin, 2011; Salas et al., 2010). Dane and Pratt (2007, p. 33) define intuition as "affectively charged judgments that arise through rapid, non-conscious, and holistic associations."

While some scholars have found that intuition is related to creativity and innovation, opportunity recognition, and improved organizational performance (Mitchell et al., 2005), others have found that analysis can improve entrepreneurial performance. For example, Delmar and Shane (2003) have found that business planning can help entrepreneurs' decision-making concerning venture development. Patel and Fiet (2009) have found that systematic search can improve entrepreneurs' decision-making concerning firm founding.

However, intuitive thinking is only part of the process of decision-making. Analytic thinking is also important for decision-making. Recent studies have found that there are significant differences between intuitive thinking and analytic thinking. For example,

analytic decision making has been shown to increase unethical behaviors and reduce altruistic motives (Zhong, 2011), and analytic thinking promotes religious disbelief (Gervais & Norenzayan, 2012). However, the difference between intuitive and analytic decision-making has yet to be fully addressed in entrepreneurship literature, especially when entrepreneurs make decisions under conditions of risk.

Consequently, entrepreneurs use both System 1 and System 2 thinking when they make decisions. They will be more intuitive when they use more System 1 thinking whereas they will be more analytic when they use more System 2 thinking. Therefore I argue that the different *styles of thinking* (use more System 1 or System 2 thinking) may influence entrepreneurial decision-making.

I discuss dual-process theory in detail in Chapter II.

Research Questions

Broadly, my dissertation addresses the question: why do some people become entrepreneurs whereas others do not? I address this question by decomposing it into two related questions. The first question is whether entrepreneurs make different decisions compared to non-entrepreneurs. The second question is whether these differences in decision-making (if any) are due to the natural proclivity of entrepreneurs themselves that drives them to become entrepreneurs.

The nexus between opportunities and entrepreneurs is the essence of entrepreneurial decision-making. To understand this nexus, it is better to study it from both aspects. Prospect theory has become prominent in explaining how different types of framing influence decisions (Barberis, 2013; Holmes et al., 2011). Whereas, dual-process theory has become preeminent in explaining how different styles of thinking influence the

decisions (Evans, 2008; Salas et al., 2010). Because both prospect theory and dual-process theory can help us understand entrepreneurial decision-making under risk and there are many profound studies in each stream, I combine these two theories to investigate entrepreneurial decision-making based on the nexus between opportunities and entrepreneurs.

There is another reason that I chose prospect theory and dual-process theory. Scholars have used these two theories to examine the biases and heuristics in decision-making outside of entrepreneurship for decades and discovered many insightful findings (Barberis, 2013; Evans, 2008). For example, Camerer (2004) has found cumulative prospect theory has better power than expected utility in explaining the phenomena in ten fields (see Appendix B). However, no known study has used them to examine entrepreneurial decision-making. I believe these two theories can significantly improve our understanding of entrepreneurial decision-making.

In particular, entrepreneurs and non-entrepreneurs may make different decisions not only based on the probabilities and payoffs of opportunities but also based on the different framing of opportunities as well as different styles of thinking. Therefore, I specify my first research question as:

RQ1: When confronted with opportunities that are framed differently and usage of different styles of thinking, do entrepreneurs and non-entrepreneurs make different decisions?

If I could successfully identify some differences in decision-making between entrepreneurs and non-entrepreneurs, I would have the further chance to examine whether these cognitive differences were due to the natural proclivity of entrepreneurs or due to

entrepreneurial practice. In other words, if I observe some differences between entrepreneurs and non-entrepreneurs, are these differences the cause or the result? If they were the cause, this would mean that these factors were due to the natural proclivity of some people, which drives them to become entrepreneurs. If they were the result, this would mean that these factors were acquired attributes from entrepreneurial practice.

Therefore, my second research question is:

RQ2: Are these cognitive differences between entrepreneurs and non-entrepreneurs due to the natural proclivity of entrepreneurs, which drives them to become entrepreneurs, or acquired attributes from entrepreneurial practice?

CHAPTER II

THEORIES AND HYPOTHESES

Chapter Overview

In this chapter, I review prospect theory and dual-process theory in detail. Most findings from these two theories are based on the general population. However, these two theories also can explain entrepreneurial decision-making. Based on a literature review, I develop my hypotheses.

Expected Utility Theory

Kahneman and Tversky (1979) argue that decision making under risk is a choice among prospects. They define a prospect $(x_1, p_1; x_2, p_2; \ldots; x_n, p_n)$ as a contract that yields outcome x_i with probability p_i, where $p_1 + p_2 + \cdots + p_n = 1$. For simplification, I omit null outcomes. Therefore, $(x, p) = (x, p; 0, 1 - p)$, which is the prospect that there is a probability p to yield x and a probability $1 - p$ to yield 0. Also if the outcome is certain, the prospect is denoted as (x).

To explain an individual's decision making under risk, scholars developed expected utility theory (Bernoulli, 1954; Edwards, 1954; Von Neumann & Morgenstern, 1944).

Expected utility theory suggests that individuals value a prospect based on its expected utility, which is the probability-weighted utility of the outcomes.

$$Expected\ Utility: U(x_1, p_1; x_2, p_2; \ldots; x_n, p_n) = \sum_{i=1}^{n} u(x_i) * p_i,$$

Where each x_i is a different outcome, $u(x_i)$ is the utility of x_i, and p_i is the probability that x_i will occur. That is, the expected utility of a prospect, U, is the sum of probability-weighted utilities of all outcomes.

Expected utility theory suggests that individuals prefer more utility. Therefore, a prospect is acceptable if and only if the prospect will increase utility. The prospect $(x_1, p_1; x_2, p_2; \dots; x_n, p_n)$ is acceptable iff $U(w + x_1, p_1; w + x_2, p_2; \dots; w + x_n, p_n) > u(w)$. Here w is the initial asset.

Expected utility theory suggests the utility of an outcome depends on an individual's initial wealth. Therefore, the same outcome may have different utility for individuals depending on how much initial wealth they have. For example, a person will value \$100 much more when he or she has zero dollars than when he or she has a million dollars, that is, the \$100 has different marginal utility based on the initial wealth. *Marginal utility* is the amount that utility increases with an increase of one unit of the outcome. Therefore, the marginal utility of an outcome will be influenced by the initial position, that is, the more initial wealth an individual has, the less the marginal utility he or she will gain for an outcome. For example, an individual will prefer \$200 over \$100. The same individual will still prefer \$10,100 over \$10,000, however, the strength of preference will be less. Therefore, the relation between utility and an outcome will be concave because of decreasing marginal utility, that is, u is concave ($u'' < 0$).

Expected utility theory suggests that individuals may exhibit *risk aversion*, preferring the certain prospect (x) to any probabilistic prospect with the same expected value x. For example, there are two options: A, get \$100 for sure; B, 50% chance to get

$200, and 50% chance to get $0. Although two options have same expected values, individuals will prefer option A because of risk aversion.

Prospect Theory

Kahneman & Tversky (1979) critique expected utility theory because it cannot explain the certainty effect, reflection effect, and isolation effect that individuals exhibit in decision making under risk. The *certainty effect* occurs when individuals underweight outcomes that are merely probable in comparison with outcomes that are obtained with certainty (Kahneman & Tversky, 1979). For example, perhaps $U(4{,}000, .8) < U(3{,}000)$. That is, individuals prefer a prospect, which has a certain outcome of 3,000 over a prospect which has .8 probability of 4,000 and .2 probability of 0. Notice that the expected value of the latter is 3,200. The certainty effect is generated by risk aversion, which is a preference for a certain outcome over a probabilistic outcome, which has the same expected value as a certain outcome. Individuals even prefer a certain outcome over some probabilistic outcomes, even though the risky outcomes may have a higher expected value.

The *reflection effect* occurs when the reflection of prospects around 0 reverses the preference order (Kahneman & Tversky, 1979). For example, $U(4{,}000, .8) < U(3{,}000)$ while $U(-4{,}000, .8) > U(-3{,}000)$. That is, individuals prefer a prospect, which has .8 probability of 4,000 loss and .2 probability of 0 loss more than the prospect which has certain loss of 3,000. Therefore, when the prospect is about a loss instead of a gain, the preference order is reversed.

The *isolation effect* occurs when an individual discards components that are shared by all prospects under consideration (Kahneman & Tversky, 1979). For example, an individual would react differently to the following two questions because of the isolation

effect. Both questions have two steps: first, the participant is given a bonus; second, the participant chooses between two options.

Question 1: you have been given 1,000, which one do you prefer?

A: (1,000, .50), and B: (500).

Question 2: you have been given 2,000, which one do you prefer?

C: (-1,000, .50), and D: (-500).

If considering both steps of both questions, the utilities of both questions are equal. That is, the final wealth of A and C are equal, and the final wealth of B and D are equal. If participants integrate the bonus of the first step and the prospects of the second step, they should make similar decisions between question 1 and question 2. However, the results do not support this prediction. The results show that most participants prefer option B for question 1; whereas, most participants prefer option C for question 2, which means that the participants only compared the prospects of the second step and omitted the bonus of the first step. If only considering the second step, this change in preference is consistent with the reflection effect. Participants change their decisions when the outcomes change from gains to losses. Therefore, individuals are more concerned about the change of their wealth, rather than the final wealth. Expected utility theory cannot explain these behaviors.

Because expected utility theory cannot explain the certainty, reflection and isolation effects, Kahneman and Tversky (1979) develop prospect theory. They argue that there are two phases in the process of decision making under risk: the editing phase and the evaluation phase. “The editing phase consists of a preliminary analysis of the offered prospects, which often yields a simpler representation of these prospects. In the second

phase, the edited prospects are evaluated and the prospect of highest value is chosen" (Kahneman & Tversky, 1979, p. 274).

In the editing phase, individuals organize and reformulate the options in order to simplify subsequent evaluation and choice. There are six operations in this phase: coding, combination, segregation, cancellation, simplification, and detection of dominance. *Coding* is the operation in which individuals could perceive outcomes as gains or losses according to their reference point. The formulation of the offered prospects and the expectations of the decision maker influence the reference point. The reference point usually corresponds to the current asset position of the decision maker. Therefore, individuals' coding of gains or losses is consistent with the actual amounts that are received or paid. *Combination* is the operation through which individuals could simplify prospects by combining the probabilities associated with identical outcomes. For example, the prospect (200, .25; 200, .25) will be simplified to (200, .50). *Segregation* is the operation through which individuals could segregate a riskless component from the risky component. For example, the prospect (300, .80; 200, .20) is seen as a sure gain of 200 and the risky prospect (100, .80). *Cancellation* is the operation through which individuals could discard the common constituents or the components that are shared by prospects. The isolation effect is the result of cancellation. *Simplification* is the operation through which individuals could simplify prospects by rounding probabilities or outcomes. *Detection of dominance* is the operation through which individuals could scan the prospects to detect dominant alternatives. For example, (500, .20; 101, .49) will dominate (500, .15; 99, .51) if individuals simplify the second outcome of both prospects to (100, .50) (Kahneman & Tversky, 1979).

The value function

In the evaluation phase, individuals evaluate each of the edited prospects and choose the prospect of highest value (Kahneman & Tversky, 1979). To evaluate the overall value of an edited prospect, V, they introduce two scales, π and v. "π associates with each probability p a decision weight $\pi(p)$, which reflects the impact of p on the over-all value of the prospect" and "v assigns to each outcome x a number $v(x)$, which reflects the subjective value of that outcome" (Kahneman & Tversky, 1979, p. 275). Figure 5 shows a hypothetical value function.

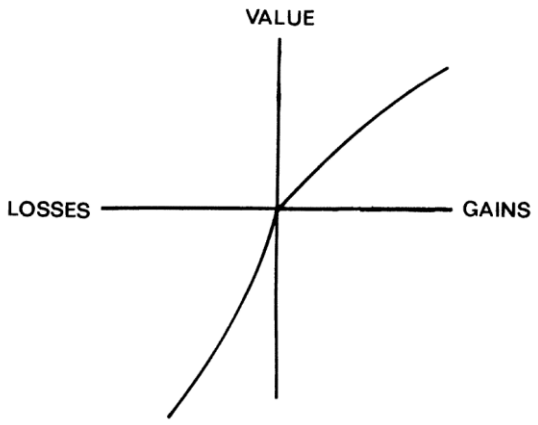

Figure 4. A hypothetical value function.
Adopted from "Prospect theory: An analysis of decision under risk" by Kahneman and Tversky, 1979, *Econometrica: Journal of the Econometric Society*, 47, p. 279.

Kahnman and Tversky (1979, p. 279) propose "that the value function is (i) defined on deviations from the reference point; (ii) generally concave for gains and commonly convex for losses; (iii) steeper for losses than for gains."

There is a simple prospect $(x, p; y, q)$. In such a prospect, an individual receives x with probability p, y with probability q, and nothing with probability $1 - p - q$, where $p + q \leq 1$. If both x and y are positive, the prospect is strictly positive. If *x* and *y* are negative, the prospect is strictly negative. If a prospect is neither strictly positive nor strictly negative, it is regular. Therefore, a regular prospect has at least one non-positive outcome and at least one nonnegative outcome.

If $(x, p; y, q)$ is a regular prospect, (i.e., $p + q < 1, or\ x \leq 0 \leq y\ or\ x \geq 0 \geq y$), then the overall value of the prospect is

$$V(x, p; y, q) = \pi(p)v(x) + \pi(q)v(y) \qquad ①$$

Where $v(0) = 0$, and $\pi(.)$ is weighting function $\pi(0) = 0$, and $\pi(1) = 1$. I discuss the weighing function in detail below.

If $(x, p; y, q)$ is a strictly positive or negative prospect, $p + q = 1, x < y < 0\ or\ x > y > 0$, then the overall value of the prospect is

$$V(x, p; y, q) = v(y) + \pi(p)[v(x) - v(y)] \qquad ②$$

Equation ② shows the segregation operation. That is, the value of a strictly positive prospect equals the value of the smaller outcome plus the probability of the greater outcome times the difference of values between two outcomes. In other words, there is a prospect that has two possible gains, thus, people can achieve the lower gain for sure and get the higher gain for a chance (equal to the higher gain's probability).

Kahneman and Tversky (1979, p. 278) "hypothesize that the value function for changes of wealth is normally concave above the reference point ($v''(x) < 0\ for\ x > 0$) and often convex below it ($v''(x) > 0\ for\ x < 0$). That is, the marginal value of both gains and losses generally decreases with their magnitude."

The weighting function

Prospect theory relaxes the weighting of the values. Instead of probabilities, decision weights multiply the values of each outcome.

> Decision weights are inferred from choices between prospects…However, decision weights are not probabilities: they do not obey the probability axioms and they should not be interpreted as measures of degree or belief" (Kahneman & Tversky, 1979, p. 280).

Kahneman and Tversky (1979) develop a weighting function π, which relates decision weights to stated probabilities. Hence, π is an increasing function of p, with $\pi(0) = 0$ and $\pi(1) = 1$. That is, individuals weight more of the events that have higher probability to occur. Individuals place a weight 0 on the events that would never occur and 1 on the event that would always occur.

Kahneman and Tversky (1979) propose that small probabilities are generally over-weighted and that the weighting function for small probabilities is a sub-additive function. That is $\pi(p) > p$ and $\pi(rp) > r\pi(p)$ for small p. Figure 6 shows a hypothetical weighting function. The solid line shows the subjective weighting and the dotted line shows the 45-degree line. If the solid line is above the dotted line, the subjective weighting is higher than the probability. If the solid line is under the dotted line, the subjective weighting is lower than the probability. Figure 6 shows that individuals tend to overweight small probability and underweight medium and large probability.

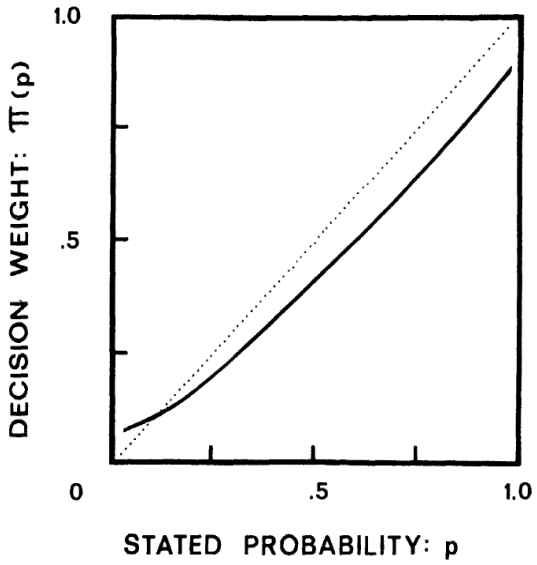

Figure 5. A hypothetical weighting function.
Adopted from "Prospect theory: An analysis of decision under risk" by Kahneman and Tversky, 1979, Econometrica: Journal of the Econometric Society, 47, p. 283.

Kahneman and Tversky (1979) also note the weighting function does not work very well near the end points, where $\pi(0) = 0$ and $\pi(1) = 1$. "Because people are limited in their ability to comprehend and evaluate extreme probabilities, highly unlikely events are either ignored or overweighed, and the difference between high probability and certainty is either neglected or exaggerated" (Kahneman & Tversky, 1979, p. 283). They also provide an interesting example:

> *The following example, due to Zeckhauser, illustrates the hypothesized nonlinearity of π. Suppose you are compelled to play Russian roulette, but are given the opportunity to purchase the removal of one bullet from the loaded gun. Would you pay as much to reduce the number of bullets from four to three as you would to reduce the number of bullets from one to zero? Most people feel that they would be willing to pay much more for a reduction of the probability of death from 1/6 to zero than for a reduction from 4/6 to 3/6. Economic considerations would lead one to pay more in the latter case, where the value of money is presumably reduced by the considerable probability that one will not live to enjoy it. (Kahneman & Tversky, 1979, p. 283)*

Cumulative Prospect Theory

Tversky and Kahneman (1992) developed a new version of prospect theory, cumulative prospect theory, which can apply to more than two prospects under risk and uncertainty. Cumulative prospect theory also differentiates between the value function and weighting for gains and losses.

Cumulative prospect theory introduces two principles, diminishing sensitivity and loss aversion, to explain individuals' behavior when making decisions. *Diminishing sensitivity* refers to the fact that "the impact of a change diminishes with the distance from the reference point" (Tversky & Kahneman, 1992, p. 303). *Loss aversion* refers to "losses loom larger than corresponding gains" (Tversky & Kahneman, 1992, p. 303).

The diminishing sensitivity applies to both value functions and weighting functions. "In evaluation of outcomes, the reference point serves as a boundary that distinguishes gains from losses" (Tversky & Kahneman, 1992, p. 303).

The value function of Cumulative prospect theory is:

$$v(x) = \begin{cases} x^{\alpha}, x \geq 0 \\ -\lambda(-x)^{\alpha}, x < 0 \end{cases}$$

The weighting functions of Cumulative prospect theory are:

$$w^{+}(p) = \frac{p^{\omega^{+}}}{\left(p^{\omega^{+}} + (1-p)^{\omega^{+}}\right)^{\frac{1}{\omega^{+}}}}$$

$$w^{-}(p) = \frac{p^{\omega^{-}}}{(p^{\omega^{-}} + (1-p)^{\omega^{-}})^{\frac{1}{\omega^{-}}}}$$

The experimental results of (Tversky & Kahneman, 1992) show that α is 0.88, λ is 2.25, ω^{+} is 0.61 and ω^{-} is 0.69. The results also show there are four patterns of risk attitudes: risk aversion for gains of high probability; risk seeking for gains of low

probability; risk seeking for losses of high probability; risk aversion for losses of low probability (Tversky & Kahneman, 1992).

Tversky and Kahneman (1992, p. 316) propose cumulative prospect theory as a "descriptive theory in which 1) the objects of choice are prospects framed in terms of gains and losses, 2) the valuation rule is a two-part cumulative functional, and 3) the value function is S-shaped and the weighting functions are inverse S-shaped".

Scholars have found cumulative prospect theory can explain decision making phenomena in many fields better than EU (Barberis, 2013; Camerer, 2004). See the Appendix A for a summary.

Dual-Process Theory

Wason and Evans (1975) first advanced the dual-process theory in 1975. They found there is a dual processing between behavior and conscious thought when individuals are making decisions. They provided two different underlying processes: a performance process and an introspection process. "The processes underlying reasoning performance, e.g., matching bias, are not generally available for introspective report" and "Introspection accounts of performance reflect a tendency for the subject to construct a justification for his own behavior consistent with his knowledge of the situation" (Wason & Evans, 1975, p. 149). After that, researchers developed many labels for each of these systems, see Table 2.

Table 2
Different Labels for System 1 and System 2

System 1	**System 2**	
Automatic	Controlled	(Schneider & Shiffrin, 1977)
Heuristic	Analytic	(Evans, 1984)
Implicit	Explicit	(Reber & Squire, 1994)
Experiential	Rational	(Epstein, 1994)
Intuitive	Analytic	(Hammond, 1996)
Associative	Rule-based	(Sloman, 1996)
System 1	System 2	(Stanovich, 1999)
Holistic	Analytic	(Nisbett, Peng, Choi, & Norenzayan, 2001)
Reflexive	Reflective	(Lieberman, Jarcho, & Satpute, 2004)
Conscious	Unconscious	(Dijksterhuis & Nordgren, 2006)

Evans (2008) provided four clusters of difference between these two systems: consciousness, evolution, functional characteristics and individual differences. First, System 1 is largely unconscious; whereas, System 2 is consciously accessible. Second, System 1 evolved earlier than System 2. Third, System 1 is rapid and automatic whereas System 2 is slow and controlled. Fourth, there is little between-individual variation of System 1 because it is independent of general intelligence and working memory. However, there is more between-individual variation of System 2 because of individuals' capacity and ability. See Table 3.

Table 3
Clusters of Attributes Associated with Dual Systems of Thinking

System 1	System 2
Cluster 1 (Consciousness)	
Unconscious (preconscious)	Conscious
Implicit	Explicit
Automatic	Controlled
Low effort	High effort
Rapid	Slow
High capacity	Low capacity
Default process	Inhibitory
Holistic, perceptual	Analytic, reflective
Cluster 2 (Evolution)	
Evolutionarily old	Evolutionarily recent
Evolutionarily rationality	Individual rationality
Shared with animals	Uniquely human
Nonverbal	Linked to language
Modular cognition	Fluid intelligence
Cluster 3 (Functional characteristics)	
Associative	Rule based
Domain specific	Domain general
Contextualized	Abstract
Pragmatic	Logical
Parallel	Sequential
Stereotypical	Egalitarian
Cluster 4 (Individual differences)	
Universal	Heritable
Independent of general intelligence	Linked to general intelligence
Independent of working memory	Limited by working memory capacity

(Evans, 2008, p. 261)

Early work on dual-process theory focused on the details of the properties of each system, however, recent research has shifted to understand how these systems work together (Salas et al., 2010). It is very rare for an individual to make a decision only based on one system. System 1 and System 2 are functioning in parallel and interacting when an individual makes decisions. System 2 can evaluate the results of System 1. For example, the heuristic judgments associated with System 1 will lead to biases. However, analytic reasoning, which is associated with System 2, may intervene with the heuristic judgment

to improve them and mitigate biases (Kahneman & Frederick, 2002). The interaction between the two systems can generally be framed as "System 1 subservience to System 2" (Salas et al., 2010, p. 946). That is, the results from System 1 serve as inputs of System 2, and then System 2 mitigates biases, adjusts direction or rejects the results of System 1.

There are other different perspectives about the relationship between two systems. For example, Haidt (2001) provides an "emotional dog" model to explain the behaviors of individuals when they are facing ethical questions by using dual-process theory. In this model, System 1 dominates the processing of moral judgments. The job of System 2 is primarily to find the rationalization of the moral decision. The role of the rationalization is to convince the decision makers that they have made right decisions. Moreover, these rationalizations rarely change the initial judgment of System 1.

Hypotheses Development

People may have different subjective values for opportunities. Both the differences among opportunities and the differences among individuals may influence their subjective evaluations of opportunities. Scholars have tested the positive relationship between the elements of opportunity and the subjective value of opportunity in different perspectives. The higher the probability of the opportunity is, the greater the subjective value of the opportunity is. In addition, the higher the outcome of the opportunity is, the greater the subjective value of the opportunity is. In the dissertation, I focus on the moderators of these relationships.

Prospect theory argues individuals have different subjective values for the same outcome based on their reference points (value function, parameter a). A reference point is the distinction between gains and losses. Individuals could change their attitude that they

weigh losses more than gains (loss aversion index, parameter λ). Individuals also have their own weighting function (parameters:k^+, k^-), which over-weights small probabilities and underweights medium and large probabilities. Therefore parameters a, λ, k^+, k^- will determine an individual's subjective evaluation of risky decisions (Tversky & Kahneman, 1992). The parameter a determines the shape of a subjective value curve. The subjective value will be closer to the expected value when a is closer to 1. The subjective value will equal the expected value when a equal to 1. The parameter λ determines the loss aversion. The loss aversion will be less when λ is closer to 1. There will be no loss aversion when λ equals 1, which means an individual has the same subjective value for gains and losses. The parameters k^+, k^- determine the shape of the weighting function curve. The weighting function will be closer to probability when k^+ and k^- are closer to 1. The weighting function will equal to probability when k^+ and k^- are equal to 1. That is, the curve of the weighting function will become a straight line and all subjective weighting of probabilities equal to the actual probabilities.

Hypothesis 1: The framing of opportunity moderates the relationship between the elements of opportunity (outcome and probability) and the subjective value of the opportunity; that is, the subjective value of the opportunity will be higher when the opportunity can be described in a loss frame rather than in a gain frame.

Based on prospect theory, the subjective value of the opportunity equals the product of the subjective value function and the weighting function. I used the natural logarithm to transform the multiplication into a linear relation. Therefore,

$$LnEvaluation = LnSubOutcome + LnSubProbability$$

$$LnSubOutcome(x) = a \ln x$$

$$LnSubProbability(p) = \ln \frac{p^{\omega}}{(p^{\omega} + (1-p)^{\omega})^{\frac{1}{\omega}}}$$

Based on the experimental results of Tversky and Kahneman (1992), here $a = 0.88,\ \omega = 0.66, x = outcome, p = probability$.

Hypothesis 1a: The LnEvaluation will be higher when the opportunity is described in loss frame than in gain frame.

Hypothesis 1b: The framing of opportunity moderates the relationship between the LnSubOutcome and the LnEvaluation; that is, the LnEvaluation will be higher when the opportunity is described in loss frame than in gain frame.

Hypothesis 1c: The framing of opportunity moderates the relationship between the LnSubProbability and the LnEvaluation; that is, the LnEvaluation will be higher when the opportunity is described in loss frame than in gain frame.

Entrepreneurship is the process of identification, evaluation, and exploitation of opportunities and it involves the nexus between entrepreneurs and opportunities (Shane & Venkataraman, 2000; Shane, 2012). Entrepreneurial opportunities are "those situations in which new goods, services, raw materials, and organizing methods can be introduced and sold at greater than their cost of production" (Shane & Venkataraman, 2000, p. 220). However, because of bounded rationality, entrepreneurs may not realize the objective value of opportunities. They may generate different subjective values based on their intuition that originates in System 1. "When there are cues that an intuitive judgment could be wrong, System 2 can impose a different strategy, replacing intuition by careful reasoning" (Kahneman & Klein, 2009, p. 519). The interactions between System 1 and System 2 are complex. However, dual-process theory argues that System 1 is subservient to System 2.

The analytic thinking can evaluate the product of intuitive processing, uncover new information that is acted on by the intuitive system, and generate post hoc rationalizations for moral judgment (Salas et al., 2010). Therefore, an individual's subjective values for an opportunity will be lower when they use more System 1 than System 2.

Hypothesis 2: The style of thinking moderates the relationship between the elements of opportunity (outcome and probability) and the subjective value of the opportunity; that is, the subjective value of the opportunity will be higher when people use more System 2 thinking than System 1 thinking.

To be more specific,

Hypothesis 2a: The LnEvaluation will be higher when people use more System 2 thinking than System 1 thinking.

Hypothesis 2b: The style of thinking moderates the relationship between the LnSubOutcome and the LnEvaluation; that is, the LnEvaluation will be higher when people use more System 2 thinking than System 1 thinking.

Hypothesis 2c: The style of thinking moderates the relationship between the LnSubProbability and the LnEvaluation; that is, the LnEvaluation will be higher when people use more System 2 thinking than System 1 thinking.

Dual process theory argues that the rapid and unconscious processing of System 1 is based on past experience (Salas et al., 2010). From running their businesses, entrepreneurs gain experience about markets, customers, technologies, and organizing. This experience can help them make decisions about opportunities. For example, repeat entrepreneurs discover more valuable opportunities than nascent entrepreneurs (Fiet, Clouse, & Norton, 2004), entrepreneurs can discover different opportunities based on their

experience (Shane, 2000), experience can help entrepreneurs better understand opportunities that they are facing (Shepherd & DeTienne, 2005), and habitual entrepreneurs, especially those who have experienced failure, are less over-optimistic (Ucbasaran, Westhead, Wright, & Flores, 2010). On the other hand, non-entrepreneurs are more likely to be inaccurate when estimating the values of opportunities because they lack experience. Thus non-entrepreneurs' subjective evaluations will deviate more from objective values than those of entrepreneurs. Scholars have found that analysis can improve entrepreneurial performance. For example, Delmar and Shane (2003) have found that business planning can help entrepreneurs' decision making concerning venture development. Patel and Fiet (2009) have found that systematic search can improve an entrepreneur's decision making concerning firm founding. Therefore, entrepreneurs will generate lower subjective values than non-entrepreneurs who do not have prior knowledge regarding opportunities.

Hypothesis 3: The status of entrepreneurs moderates the relationship between the elements of opportunity (outcome and probability) and the subjective value of the opportunity; that is, non-entrepreneurs have higher subjective evaluations of opportunities than entrepreneurs.

To be more specific,

Hypothesis 3a: The LnEvaluation will be higher for non-entrepreneurs than for entrepreneurs.

Hypothesis 3b: The status of entrepreneurs moderates the relationship between the LnSubOutcome and the LnEvaluation; that is, the LnEvalation will be higher for non-entrepreneurs than for entrepreneurs.

Hypothesis 3c: The status of entrepreneurs moderates the relationship between the LnSubProbability and the LnEvaluation; that is, the LnEvaluation will be higher for non-entrepreneurs than for entrepreneurs.

Figure 7 shows the hypothetical model of H1 to H3.

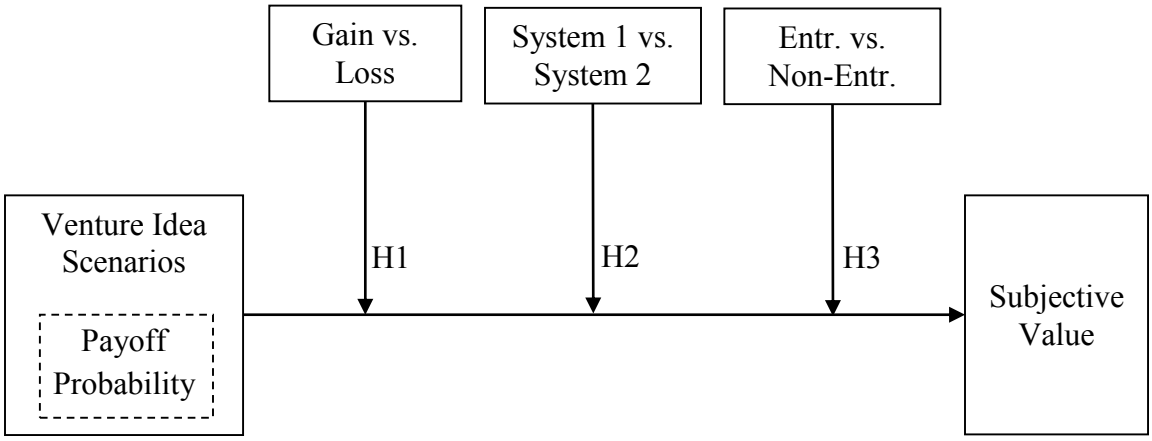

Figure 6. Hypothetical model of H1 to H3.

Why some people become entrepreneurs while others do not is a central question in entrepreneurship. Scholars have looked for the answers for decades (Busenitz & Barney, 1997; Shane, 2012). Recently, they have found systematic cognitive differences in entrepreneurial decision making between entrepreneurs and non-entrepreneurs (Alvarez et al., 2013). However, there is still a question left: are these differences the ones that drive people to become entrepreneurs or the results of entrepreneurial practice? We cannot settle this argument by simply examining the differences between entrepreneurs and non-entrepreneurs because we would observe the differences between them in either situation.

I develop a new method to test this argument. I examine the differences among non-entrepreneurs, nascent entrepreneurs, and experienced entrepreneurs, instead of the

differences just between entrepreneurs and non-entrepreneurs. *Nascent entrepreneurs* are in the process of starting their first businesses. *Experienced entrepreneurs* have started a business more than one year and/or started more than one business. Experienced entrepreneurs have more entrepreneurial experience than nascent entrepreneurs. Specifically, experienced entrepreneurs have more experience starting and running a business and possibly even failure of a business.

Consequently, if these cognitive differences in decision-making are the ones that drive people to become entrepreneurs, we should observe a significant difference in cognitive decision-making between entrepreneurs and non-entrepreneurs. At the same time, we should observe no significant difference between nascent entrepreneurs and experienced entrepreneurs.

> *Hypothesis 4: Entrepreneurs' subjective evaluations of opportunities are different from those of non-entrepreneurs; however, nascent entrepreneurs' subjective evaluations of opportunities would not be different from those of experienced entrepreneurs.*

If these cognitive differences in decision-making result from entrepreneurial practice, we should observe significant differences in cognitive decision-making between nascent entrepreneurs; at same time, we should observe no significant difference between non-entrepreneurs and nascent entrepreneurs.

> *Hypothesis 5: Nascent entrepreneurs' subjective evaluations of opportunities are not different from those of non-entrepreneurs; however, nascent entrepreneurs' subjective evaluations of opportunities would be different from those of experienced entrepreneurs.*

CHAPTER III

RESEARCH DESIGN AND METHODS

Chapter Overview

To test the hypotheses, I have designed a 2x2x2 experimental study. In this chapter, I provide the details of my research design and survey design.

Research Design

The empirical tests of prospect theory usually ask participants their preferences between pairs of gambling choices. However, choosing from a pair of gambling choices cannot fully reflect a participant's subjective evaluation. For example, when comparing choice A and B, Participant M may think that choice A is much better than B. Participant N may think that choice A is a little better than B. The result is that both Participant M and N will choose A. The result cannot reflect the strength of the participants' preferences. Therefore, this kind of design loses the variance of participants' subjective evaluation.

In this study, I asked participants to report their subjective evaluation of different business scenarios. By this design, I can determine the parameters in prospect theory that are different among people. Therefore, I can test decision making between and within different groups of entrepreneurs. Specifically, I can test whether entrepreneurs make different decisions than non-entrepreneurs when they are facing the same opportunity, whether entrepreneurs make different decisions when they rely more on System 1 than

System 2, and whether entrepreneurs make different decisions when they are under a gain-frame than under a loss-frame.

This study is a 2x2x2 experimental study: non-entrepreneurs vs. entrepreneurs, System 1 vs. System 2 thinking, and gain-frame vs. loss-frame. Among entrepreneurs, I also divided them into two subgroups: nascent entrepreneurs and repeat entrepreneurs.

An experimental manipulation can provide two important advantages for a research design. First, the manipulation can present strong evidence of causality. The experimenter can change the independent variables in a systematic way. If the dependent variables change right after the manipulations and are significantly related to the manipulation, we have strong evidence that the independent variables are the cause of dependent variables. Second, the manipulation can mitigate endogeneity. Manipulation allows us to control extraneous variables by varying the variables we are interested in while keeping extraneous variables at similar levels. In this study, I manipulated independent variables, which are the probability and outcome of venture ideas, and moderators, which are participants' styles of thinking and the ways to describe the opportunities.

Independent variable: Probability and outcome of opportunities. In this study, I focus on two elements of opportunities: probability and outcome. I manipulated probability in 5 levels (5%, 25%, 50%, 75% and 95%) and outcome in 4 levels ($100,000, $200,000, $500,000 and $1,000,000). I discuss the design later in this dissertation.

Dependent variable: The subjective value of opportunities. I examined directly the participants' subjective evaluation of venture ideas.

Moderators. Moderators include System 1 vs. System 2 thinking, gain vs. loss frame, and entrepreneurs vs. non-entrepreneurs.

System 1 vs. System 2 thinking manipulation. To manipulate intuitive or analytic thinking, this study followed Zhong's (2011) method. Prior research has shown that calculating math problems can manipulate participants' System 1 thinking whereas examining feelings can manipulate their System 2 thinking (Hsee & Rottenstreich, 2004; Small, Loewenstein, & Slovic, 2007; Zhong, 2011). To manipulate System 1 or System 2 thinking, this study asked participants to answer questions about their feelings or calculate math questions.

Gain vs. loss frame manipulation. This study used the maximum willingness to pay (gain frame) and minimum willingness to accept (loss frame) framework to manipulate gain and loss frames (Abdellaoui et al., 2007; Schmidt et al., 2008). In gain frame, respondents were told there is a venture idea that has p probability of success and it will earn *m* profit if it succeeds. The respondents answered the maximum amount of money they would pay to buy the idea. Whereas in loss frame, respondents were told they have a venture idea that has p probability of success and it will earn *m* profit if it succeeds. The respondents answered the minimum amount of money they would be willing to sell the idea.

Sample size. I used two software programs, Optimal Design (Raudenbush, 2011) and PowerUp! (Dong & Maynard, 2013), to calculate the minimum required sample size. Both of them report the appropriate sample size is 200, when the anticipated effect size is .2 (small) and the expected intra-class correlation (ICC) is .2. Therefore, I collected 100 entrepreneur samples for Experiment 1 and 100 general population samples for Experiment 2. Then I combined two samples to test my hypotheses.

Experiment 1

I used a sample of real entrepreneurs. See chapter 4 for how the sample of real entrepreneurs was assembled.

The participants were randomly assigned to two groups: Group A and Group B. Participants in Group A took System 1 manipulation and then evaluated venture scenarios. Participants in Group B took System 2 manipulation and then evaluated venture scenarios. Each group was randomly divided into two subgroups: Subgroup 1 and Subgroup 2. Participants in Subgroup 1 evaluated scenarios in order 1 and participants in Subgroup 2 evaluated scenarios in order 2. Each subgroup was randomly divided into two subgroups: Subgroup I and Subgroup II. Participants in Subgroup I evaluated scenarios in Gain frame first then evaluated scenarios in Loss frame. Participants in Subgroup II evaluated scenarios in Loss frame first then evaluated scenarios Gain in frame. Finally, all participants answered demographic questions.

An opportunity's value is based on two variables: the probability of success and payoff. To test the subjective value function, I fixed the probability at 25% and varied the payoffs. Because the subjective value function is concave in the gain frame and convex in the loss frame, I need at least 4 observations in each frame. Thus, the payoffs were $100,000, $200,000, $500,000, and $1,000,000. To test the subjective weighting function, I fixed the payoff to $200,000 and varied the probability of success. Because the subjective weighting function is an inverse "S" shape curve, I need at least five observations. Thus, the probabilities were 5%, 25%, 50%, 75%, and 95%. The two parts shared a scenario (25%, $200,000); therefore, there were eight different scenarios. Each scenario was repeated

twice in the Gain frame and the Loss frame. Therefore, each participant evaluated 16 scenarios of venture ideas.

A sample of the Gain frame scenario:

There is a venture idea which has a 25% chance to get a $100,000 payoff and 75% to get a $0 payoff. Please tell us the maximum amount you will pay to buy this idea.

A sample of the Loss frame scenario:

You have a venture idea which has a 5% chance to get a $200,000 payoff and a 95% chance to get a $0 payoff. Please tell us the minimum amount for which you will sell this idea.

At the end of the experiment, I asked questions of control variables and demographic questions.

Figure 8 shows the survey flow.

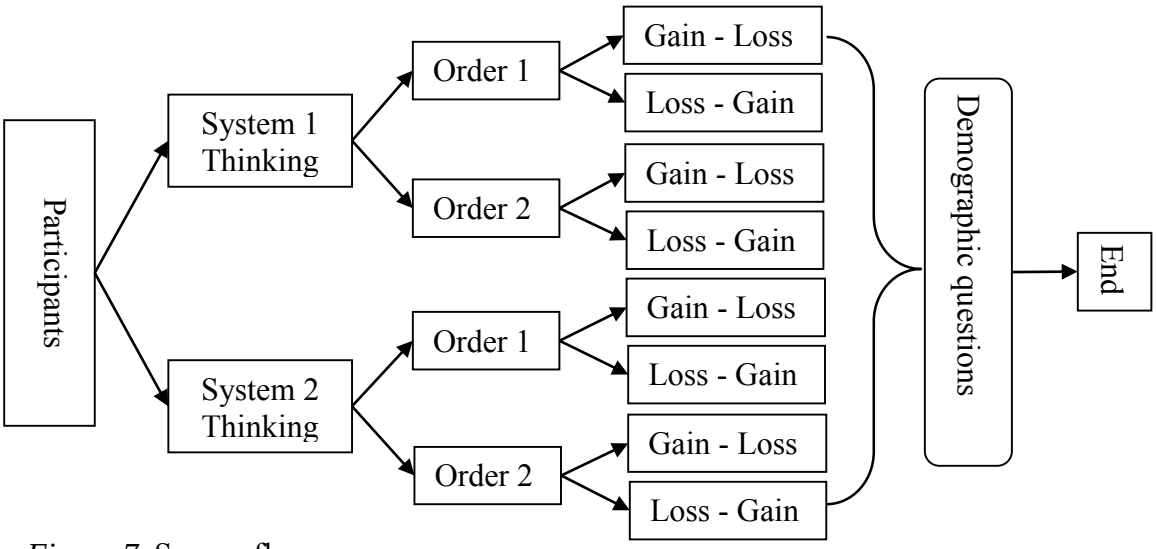

Figure 7. Survey flow.

Experiment 2

I used a general population sample to repeat the Experiment 1 to test whether there are differences between non-entrepreneurs and entrepreneurs.

Survey Design

To manipulate System 1 thinking or System 2 thinking, I asked participants to answer five questions about their feeling or to calculate five questions (Zhong, 2011). I list the manipulation questions below.

Manipulation of System 1 thinking

We are interested in people's impressions of public figures. Please base your answers to the following questions on the feelings you experience.

When you hear the name "George Clooney", what do you feel? Please use one word to describe your predominant feeling: _____.

When you hear the name "George W. Bush", what do you feel? Please use one word to describe your predominant feeling: _____.

When you hear the name "Princess Diana", what do you feel? Please use one word to describe your predominant feeling: _____.

When you hear the words "9/11", what do you feel? Please use one word to describe your predominant feeling: _____.

When you hear the word "baby", what do you feel? Please use one word to describe your predominant feeling: _____.

Manipulation of System 2 thinking

We are interested in the people's calculations of word problems. Please work carefully and deliberately to calculate the answers to the questions posed below.

If an object travels at five feet per minute, then by your calculations how many feet will it travel in 360 seconds? _____ feet

Suppose a student bought a pen and a pencil for a total of $11, and that the pen cost $10 more than the pencil. Then, by your calculations how much did the pencil cost?

_____

If a consumer bought 30 books for $540, then, by your calculations, on average, how much did the consumer pay for each book? $____

If a baker bought nine pounds of flour at $1.50 per pound, then, by your calculations how much did the baker pay in total? $____

If a company bought 15 computers for $1200 each, then, by your calculations, how much did the company pay in total? $____

Scenarios

To examine participants' subjective values of opportunities, I asked participants to evaluate different scenarios of venture ideas. To manipulate gain frame, I asked participants to write down the maximum price to buy the venture ideas. To manipulate loss frame, I asked participants to write down the minimum price to sell the venture ideas. I list the scenarios of venture ideas below.

Gain frame

> **Scenario 1.** *There is a venture idea which has a 5% chance to earn a $200,000 payoff and a 95% chance to get a $0 payoff. Please tell us the maximum amount you will pay to buy this idea.*

Scenario 2. *There is a venture idea which has a 25% chance to earn a $100,000 payoff and a 75% to get a $0 payoff. Please tell us the maximum amount you will pay to buy this idea.*

Scenario 3. *There is a venture idea which has a 25% chance to earn a $200,000 payoff and a 75% to get a $0 payoff. Please tell us the maximum amount you will pay to buy this idea.*

Scenario 4. *There is a venture idea which has a 25% chance to earn a $500,000 payoff and a 75% to get a $0 payoff. Please tell us the maximum amount you will pay to buy this idea.*

Scenario 5. *There is a venture idea which has a 25% chance to earn a $1,000,000 payoff and a 75% to get a $0 payoff. Please tell us the maximum amount you will pay to buy this idea.*

Scenario 6. *There is a venture idea which has a 50% chance to earn a $200,000 payoff and a 5% to get a $0 payoff. Please tell us the maximum amount you will pay to buy this idea.*

Scenario 7. *There is a venture idea which has a 75% chance to earn a $200,000 payoff and a 25% to get a $0 payoff. Please tell us the maximum amount you will pay to buy this idea.*

Scenario 8. *There is a venture idea which has a 95% chance to earn a $200,000 payoff and a 5% to get a $0 payoff. Please tell us the maximum amount you will pay to buy this idea.*

Loss frame

Scenario 1. *You have a venture idea which has a 5% chance to get a $200,000 payoff and a 95% to get a $0 payoff. Please tell us the minimum amount you will sell this idea.*

Scenario 2. *You have a venture idea which has a 25% chance to get a $100,000 payoff and a 75% to get a $0 payoff. Please tell us the minimum amount you will sell this idea.*

Scenario 3. *You have a venture idea which has a 25% chance to get a $200,000 payoff and a 75% to get a $0 payoff. Please tell us the minimum amount you will sell this idea.*

Scenario 4. *You have a venture idea which has a 25% chance to get a $500,000 payoff and a 75% to get a $0 payoff. Please tell us the minimum amount you will sell this idea.*

Scenario 5. *You have a venture idea which has a 25% chance to get a $1,000,000 payoff and a 75% to get a $0 payoff. Please tell us the minimum amount you will sell this idea.*

Scenario 6. *You have a venture idea which has a 50% chance to get a $200,000 payoff and a 50% to get a $0 payoff. Please tell us the minimum amount you will sell this idea.*

Scenario 7. *You have a venture idea which has a 75% chance to get a $200,000 payoff and a 25% to get a $0 payoff. Please tell us the minimum amount you will sell this idea.*

Scenario 8. *You have a venture idea which has a 95% chance to get a $200,000 payoff and a 5% to get a $0 payoff. Please tell us the minimum amount you will sell this idea.*

Manipulation check

I used two 7-point Likert Scale questions to check the manipulation of different styles of thinking. I list them below.

Please indicate that how you evaluate the above venture ideas:

I made my decision fast, intuitively and unconsciously.

I made my decision slowly, analytically and consciously.

Appendix C shows a sample of the survey.

CHAPTER IV

ANALYSIS AND RESULTS

Chapter Overview

I ran three different models to test my hypotheses. First, I ran a model that included all samples to test the moderation effects of entrepreneur, different types of frames, and different styles of thinking. Second, I ran a model that only included non-entrepreneurs and nascent entrepreneurs to test the difference between them. Third, I ran a model that only includes entrepreneurs to test the moderation effect of their entrepreneurial experience.

Data

I sent my survey through Qualtics.com. Qualtrics is a world leading survey technology provider. They sent the survey to entrepreneurs and general population. Entrepreneurs are those who have started at least one business and are currently running a business. General population is American Adult. There were 277 people who participated in the survey. There were 130 entrepreneurs and 147 non-entrepreneurs. I checked whether participants entered valid data based on three rules. First, some participants finished the survey in an unreasonably short time. The average time of completion for this survey was 13 minutes. I treated the participants as invalid if they finished survey within five minutes. Second, some participants consistently entered same numbers for the evaluations. There were four questions of evaluations on each screen when the participant took the survey.

Therefore, I treated the participants as invalid if they entered same numbers for more than four evaluations. Third, some participants entered non-sensible answers. These respondents just did not seem to make sense in their answers to my questions. They included percentage, etc. in response to questions of evaluations. Among all participants, 184 people provided valid data. There were 101 entrepreneurs and 83 non-entrepreneurs.

To further check the validity of participants, I checked the correlations between their evaluations of gain frames and loss frames. The mean of their reliability is .60, the median is .72, and the standard deviation is .40. I used .50 as a threshold of reliability to screen out the participants who have low reliabilities (Holland & Shepherd, 2013). There were 125 participants who had reliabilities greater than .50. There were 66 entrepreneurs and 59 non-entrepreneurs. Table 4 shows the demographic description of the data.

Table 4
Demographic Description

		Full sample		Valid data		Reliable data	
		f	%	*f*	%	*f*	%
Entrepreneur	Yes	130	46.9	101	54.9	66	52.8
	No	147	53.1	83	45.1	59	47.2
Gender	Male	125	45.1	85	46.2	59	47.2
	Female	152	54.9	99	53.8	66	52.8
Race	White/Caucasian	189	68.2	127	69.0	95	76.0
	African American	39	14.1	24	13.0	13	10.4
	Hispanic	24	8.7	20	10.9	11	8.8
	Asian	13	4.7	5	2.7	4	3.2
	Native American	4	1.4	2	1.6	1	0.8
	Other	8	2.9	5	2.7	1	0.8
Education	Less than High School	8	2.9	5	2.7	4	3.2
	High School / GED	54	19.5	37	20.1	24	19.2
	Some College	89	32.1	58	31.5	41	32.8
	2-year College Degree	33	11.9	18	9.8	13	10.4
	4-year College Degree	69	24.9	50	27.2	34	27.2
	Master Degree	17	6.1	12	6.5	7	5.6
	Doctoral Degree	3	1.1	3	1.6	1	0.8
	Professional Degree (JD, MD)	4	1.4	1	0.5	1	0.8

HLM Model 1: Entrepreneurs vs. Non-Entrepreneurs

Because decisions are nested within entrepreneurs, I used HLM 7 (Raudenbush, Bryk, Cheong, Congdon, & du Toit, 2011) to test my hypotheses. HLM has several merits in multi-level analysis. First, I can determine whether OLS regression's independence of responses assumption is violated to see if I need to use a multi-level model. Second, I can examine the effect of controls prior to entering hypothesized variables. Third, I can calculate the percent of variance explained by the controls, direct effects, and moderators (Raudenbush & Bryk, 2002). To linearize the model, I used the natural logarithm function. Therefore,

$$LnEvaluation = LnSubOutcome + LnSubProbability$$

$$LnSubOutcome(x) = a \ln x$$

$$LnSubProbability(p) = \ln \frac{p^{\omega}}{(p^{\omega} + (1-p)^{\omega})^{\frac{1}{\omega}}}$$

Based on the experimental results of Tversky and Kahneman (1992), here $a = 0.88,\ \omega = 0.66, x = outcome, p = probability$.

Table 5 shows the HLM variables. There are two types of methods in HLM based on different types of likelihood of analysis: restricted maximum likelihood (REML) and full maximum likelihood (FIML). In practice, both methods lead to similar results (Kreft, De Leeuw, & Kim, 1990). However, if the number of level-2 groups is small, FIML has a downward bias, which estimates for variance components tend to be smaller than the REML estimates (Raudenbush & Bryk, 2002). Because the number of level-2 groups of my data was bigger than 30, I used FIML to analyze the models. There were 1,914 evaluations nested within 125 individuals. Table 6 shows the descriptive statistics and correlations of HLM Model 1.

First, I ran a null model that only includes the dependent variable and does not include any independent variables. The intra-class correlation (ICC) is 68.0%. That is, 68.0% of variance of subjective values can be explained by the difference among individuals. Therefore, it is appropriate to use a multi-level model to analyze the data. Table 7 shows the HLM results of Model 1.

Table 5
HLM Variables

Variable	Coding	Centering	Variable type
Level-1 variables			
LnEvaluation	Monetary		DV
LnSubOutcome	Monetary	Grand centered	IV
LnSubProbability	Percent	Grand centered	IV
Frame	0: Loss frame 1: Gain frame	Uncentered	M(H1)
*Frame*LnSubOut*		Grand centered	M(H1)
*Frame*LnSubPr*		Grand centered	M(H1)
Level-2 variables			
Age	Years	Grand centered	CV
Gender	0: Female 1: Male	Uncentered	CV
System	0: System 1 1: System 2	Uncentered	M(H2)
Entrepreneur	0: Other 1: Entrepreneur	Uncentered	M(H3)
Nascent entrepreneur	0: Other 1: Nascent entrepreneur	Uncentered	M(H4)
Experience	Years	Grand centered	M(H5)

Note. DV = Dependent variable, IV = Independent variable, CV = Control variable, M = Moderator, and H = Hypothesis.

Table 6

Descriptive Statistics and Correlations of Model 1

	Mean	SD	Correlations								
			1	2	3	4	5	6	7	8	9
1 *LnEvaluation*	9.665	2.636	1								
2 *LnSubOutcome*	10.945	0.581	.150***	1							
3 *LnSubProbability*	-1.052	0.538	.242***	-.113***	1						
4 *Frame*	0.496	0.500	-.054**	.001	.004	1					
5 *Entrepreneur*	0.488	0.500	-.133***	-.003	.009	-.012	1				
6 *System*	0.426	0.495	.077**	-.005	.000	-.010	.043	1			
7 *Age*	37.983	15.408	-.159***	-.002	.012	.005	-.001	-.015	1		
8 *Gender*	0.471	0.500	-.096***	.003	-.007	.006	-.073**	-.073**	.016	1	
9 *Frame*LnSubOut*	0.003	0.409	.105***	.703***	-.081***	.007	-.005	-.002	.000	.003	1
10 *Frame*LnSubPr*	0.005	0.380	.168***	-.081***	.703***	.001	.013	.004	.007	-.004	-.115***

* *p < .05.* ** *p < .01.* *** *p < .001.*

N = 1,914.

Table 7
HLM Results of Model 1

	Null model	Level-1 IV model	Control model	Final model		
Fixed effects			Coefficient (SE)		Cohen's *d*	Effect size
LnEvaluation, β_0						
Intercept, γ_{00}	9.65(0.20)***	9.62(0.20)***	9.63(0.20)***	10.02(0.32)***		
Age, γ_{01}			-0.03(0.01)*	-0.03(0.01)*	.01	Very small
Entrepreneur, γ_{02}				-0.78(0.39)*	.30	Small
System, γ_{03}				0.34(0.39)		
For *LnSubOutcome* slope, β_1						
Intercept, γ_{10}		0.85(0.06)***	0.84(0.06)***	0.78(0.09)***	.29	Very small
Age, γ_{11}			-0.01(0.00)#	-0.01(0.00)*	.00	Very small
Entrepreneur, γ_{12}				-0.05(0.11)		
System, γ_{13}				0.22(0.11)*	.08	Very small
For *LnSubProbability* slope, β_2						
Intercept, γ_{20}		1.42(0.09)***	1.42(0.09)***	1.45(0.15)***	.55	Medium
Entrepreneur, γ_{21}				-0.09(0.19)		
System, γ_{22}				0.13(0.19)		
For *Frame* slope, β_3						
Intercept, γ_{30}				-0.34(0.12)**	.13	Very small
Random effects			Variance component (SD)			
LnEvaluation, u_0	4.74(2.18)***	4.92(2.22)***	4.74(2.18)***	4.94(2.22)***		
LnSubOutcome slope, u_1		0.18(0.42)***	0.16(0.40)***	0.23(0.48)***		
LnSubProbability slope, u_2		0.83(0.91)***	0.83(0.91)***	0.95(0.98)***		
Frame slope, u_3				1.48(1.22)***		
Level-1, *r*	2.24(1.50)	1.19(1.09)	1.09(1.09)	0.71(0.84)		
Deviance	7416.21	6497.52	6569.57	5953.24		
Estimated parameters	3	10	12	23		

** p < .05, ** p < .01, *** p < .001.*
Cohen's d effect size scale: 0.00 to 0.29 = very small; 0.30 to 0.49 = small; 0.50 to 0.79 = medium; and over 0.80 = large (Cohen, 1988).

Second, I added the independent variables (*LnSubOutcome* and *LnSubProbability*) into the model as level-1 variables. I let all level-2 variances be random. The results (see Table 7) indicated that they are all statistically significant; therefore, I keep them random in the model to get the Level-1 IV model.

Third, I built a conditional model by adding control variables (*Age* and *Gender*) to the level-2 intercept and slopes. Then, I eliminated all statistically non-significant level-2 effects ($p > .100$) to get the final control model. As shown in Table 8, only *Age* significantly influences the intercept of DV and the slope of *LnSubOutcome*.

Table 8
Trim Decisions of Control Variables of Model 1

Fixed effect	Coefficient	Standard error	*p*-value	Trim decision
LnEvaluation, β_0				
Intercept, γ_{00}	9.389	0.269	<0.001	
Age, γ_{01}	-0.027	0.012	0.036	Kept
Gender, γ_{02}	0.508	0.391	0.196	Removed
For *LnSubOutcome* slope, β_1				
Intercept, γ_{10}	0.850	0.077	<0.001	
Age, γ_{11}	-0.007	0.004	0.062	Kept
Gender, γ_{12}	-0.013	0.113	0.910	Removed
For *LnSubProbability* slope, β_2				
Intercept, γ_{20}	1.335	0.129	<0.001	
Age, γ_{21}	-0.005	0.006	0.403	Removed
Gender, γ_{22}	0.181	0.189	0.341	Removed

Fourth, I added level-1 moderators (*Frame, Frame*LnSubOut, and Frame*LnSubPr)* into the model as grand centered. I kept statistically significant moderator in the model and removed statistically non-significant moderators. As shown in Table 9, only *Frame* was statistically significant.

Table 9
Trim Decisions of Level-1 Moderators of Model 1

Moderator	Coefficient	Standard error	*p*-value	Trim decision
Frame	-0.343	0.118	.004	Kept
*Frame*LnSubOut*	-0.018	0.064	.776	Removed
*Frame*LnSubPr*	-0.004	0.104	.972	Removed

Fifth, I tested my final model by adding the level-2 moderators (*Entrepreneur* and *System*). I added *Entrepreneur* and *System* as predictors of the intercept and slopes (*LnSubOutcome* and *LnSubProbability*). I calculated effect sizes of the final model by using Cohen's *d* (Cohen, 1988), $d = \frac{\gamma}{\sqrt{\tau_{00}+\sigma^2}}$. The final model is as follows:

Level-1 Model

$$LnEvaluation_{ij} = \beta_{0j} + \beta_{1j}*(LnSubOutcome_{ij}) + \beta_{2j}*(LnSubProbability_{ij}) + \beta_{3j}*(Frame_{ij}) + r_{ij}$$

Level-2 Model

$$\beta_{0j} = \gamma_{00} + \gamma_{01}*(Age_j) + \gamma_{01}*(Entrepreneur_j) + \gamma_{03}*(System_j) + u_{0j}$$

$$\beta_{1j} = \gamma_{10} + \gamma_{11}*(Age_j) + \gamma_{12}*(Entrepreneur_j) + \gamma_{13}*(System_j) + u_{1j}$$

$$\beta_{2j} = \gamma_{20} + \gamma_{21}*(Entrepreneur_j) + \gamma_{22}*(System_j) + u_{2j}$$

$$\beta_{3j} = \gamma_{30} + u_{3j}$$

The HLM results for the final model (see Table 7) indicate that the *Frame* has a moderate effect on the dependent variable. That is, the average natural logarithm of subjective evaluations of gain frame is 0.34 less than that of loss frame. Therefore, H1a is supported, that is the *Frame* moderates the relationship between the opportunity and the subjective value of the opportunity. The Cohen's *d* (1988) of this moderating effect is very small. The *System* has a moderating effect on the slope of *LnSubOutcome*. That is, the slope

of nature logarithm of subjective outcome is 0.22 greater when participants use more System 2 thinking than when participants use more System 1 thinking. Therefore, H2b is supported, that is the type of thinking moderates the relationship between the opportunity and the subjective value of the opportunity. The Cohen's *d* (1988) of this moderating effect is very small. The *Entrepreneur* has a direct effect on the intercept of dependent variable, *LnEvaluation*. That is, the average nature logarithm of subjective evaluations of entrepreneurs is 0.78 smaller than that of non-entrepreneurs when everything else is equal. Therefore, the H3a is supported, that is non-entreprepeurs have higher subjective evaluations of opportunities than entrepreneurs. The Cohen's *d* (1988) of this moderating effect is small. There is no moderation effect on the slope of *LnSubProbability* for entrepreneurs or for differing systems (see Table 7).

The results show that entrepreneurs have lower evaluations than non-entrepreneurs. Figure 8 shows the means of evaluations of each scenario. Most of the evaluations are lower than the expected values. Therefore, the evaluations of entrepreneurs are lower than non-entrepreneurs means that the evaluations of entrepreneurs are more divergent from the expected values.

The results show that the different types of thinking influence the subjective values of outcomes. People's subjective values of outcomes are higher when they use more System 2 thinking than when they use more System 1 thinking. That is, people will evaluate opportunities close to the expected values when they use more System 2 thinking. This result is consistent with dual-process theory.

The results show that people's evaluations of gain frame are lower than those of loss frame. That is, people overweight the losses. This result is consistent with prospect theory.

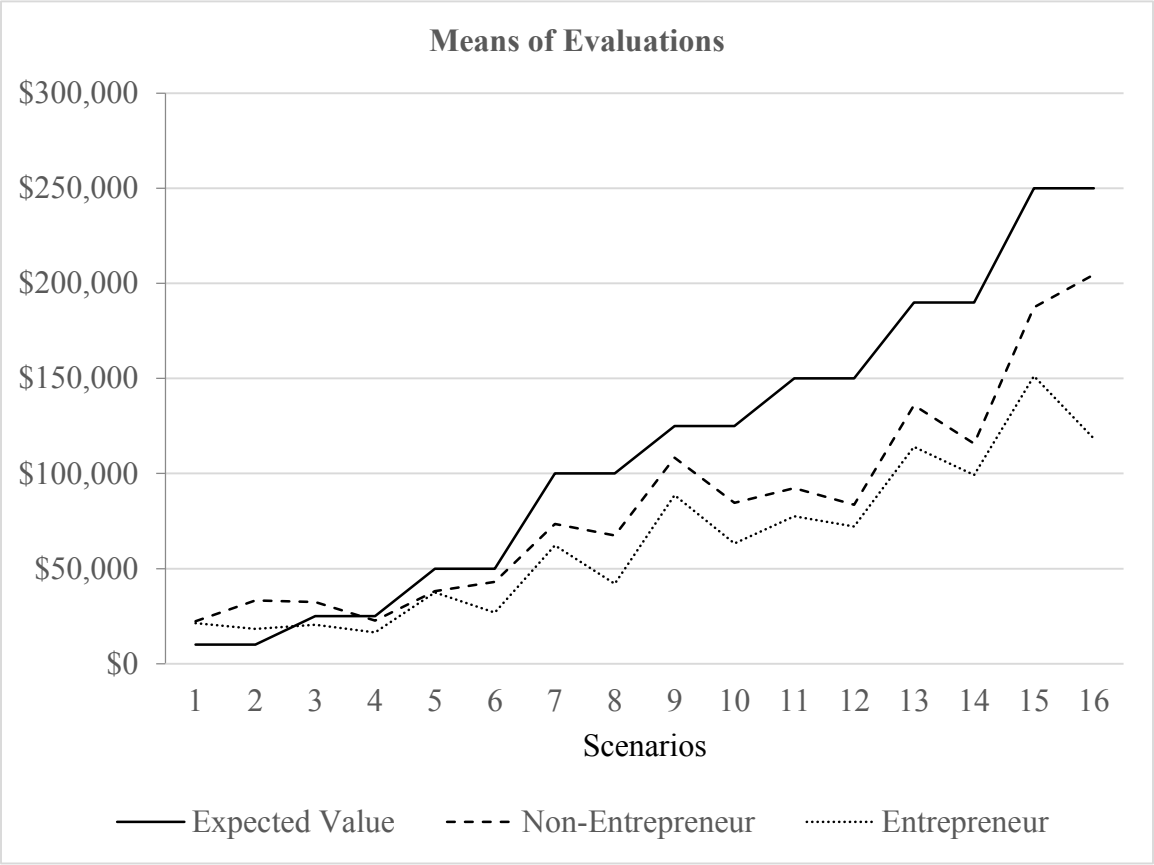

Figure 8
Means of evaluations

HLM Model 2: Nascent Entrepreneurs vs. Non-Entrepreneurs

In model 2, I only included non-entrepreneurs and nascent entrepreneurs. There were 63 non-entrepreneurs who completed 981 evaluations and 14 nascent entrepreneurs who completed 217 evaluations. Totally 217 individuals completed 1198 evaluations. I used the same HLM variables shown in Table 5. Table 10 shows descriptive statistics and correlations.

First, I ran a null model that only includes dependent variable and does not include any independent variables. The ICC is 60.3%. That is, 60.3% of variance of subjective values can be explained by the difference among individuals. Therefore, it is appropriate to use a multi-level model to analyze the data.

Second, I added the independent variables (*LnSubOutcome* and *LnSubProbability*) into the model as level-1 variables. I let all level-2 variances be random. The results (see Table 11) indicated that they are all statistically significant; therefore, I kept them random in the model.

Table 10

Descriptive Statistics and Correlations of Model 2

	Mean	SD	Correlations								
			1	2	3	4	5	6	7	8	9
1 *LnEvaluation*	9.857	2.387	1								
2 *LnSubOutcome*	10.946	0.584	.174***	1							
3 *LnSubProbabilty*	-1.056	0.536	.281***	-.111***	1						
4 *Frame*	0.498	0.500	-.065*	-.003	.000	1					
5 *Nascent*	0.181	0.385	-.135***	-.003	.000	-.014	1				
6 *System*	0.434	0.496	.158***	-.009	-.012	-.007	.122***	1			
7 *Age*	37.258	15.295	-.103***	.000	.009	.009	-.102***	-.010	1		
8 *Gender*	0.455	0.498	-.161***	.000	-.012	.005	-.221***	-.113***	.036	1	
9 *Frame*LnSubOut*	0.004	.413	.115***	.707***	-.079 **	.009	-.004	-.006	-.001	.001	1
10 *Frame*LnSubPr*	-0.003	.379	.199***	-.079**	.707 ***	-.008	.007	-.006	.005	-.006	-.111***

* *p < .05,* ** *p < .01,* *** *p < .001.*

N = 1,198.

Table 11
HLM Results of Model 2

	Null model	Level-1 IV model	Control model	Final model		
Fixed effects			Coefficient (SE)		Cohen's d	Effect size
LnEvaluation, β_0						
Intercept, γ_{00}	9.85(0.22)***	9.84(0.22)***	9.53(0.27)***	9.59(0.33)***		
Gender, γ_{01}			0.69(0.35)	0.52(0.35)		
Nascent, γ_{02}				-0.74(0.55)**	.31	Small
System, γ_{03}				0.75(0.42)		
For *LnSubOutcome* slope, β_1						
Intercept, γ_{10}		0.87(0.07)***	0.85(0.06)***	0.71(0.09)***	.30	Small
Nascent, γ_{11}				0.11(0.16)		
System, γ_{12}				0.34(0.13)*	.14	Very small
For *LnSubProbability* slope, β_2						
Intercept, γ_{20}		1.45(0.12)***	1.43(0.09)***	1.42(0.17)***	.60	Medium
Nascent, γ_{21}				-0.26(0.31)		
System, γ_{22}				0.22(0.25)		
For *Frame* slope, β_3						
Intercept, γ_{30}				-0.35(0.14)**	.15	Very small
Random effects			Variance component (SD)			
LnEvaluation, u_0	3.43(1.85)***	3.57(1.89)***	3.42(1.85)***	3.38(1.84)***		
LnSubOutcome slope, u_1		0.14(0.37)***	0.14(0.37)***	0.16(0.41)***		
LnSubProbability slope, u_2		0.87(0.93)***	0.87(0.93)***	0.98(0.99)***		
Frame slope, u_3				1.21(1.10)***		
Level-1, r	2.26(1.50)	1.16(1.08)	1.16(1.08)	0.76(0.87)		
Deviance	4621.74	3995.74	3991.96	3714.53		
Estimated parameters	3	10	11	22		

* $p < .05$, ** $p < .01$, *** $p < .001$.
Cohen's d effect size scale: 0.00 to 0.29 = very small; 0.30 to 0.49 = small; 0.50 to 0.79 = medium; and over 0.80 = large (Cohen, 1988).

Third, I built a conditional model by adding control variables (*Age* and *Gender*) to the model to predict the intercept and slopes. Then, I eliminated all statistically non-significant level-2 effects ($p > .100$) to get the final control model (see Table 12). The results indicate that only *Gender* significantly influences the intercept of DV (see Table 12).

Table 12
Trim Decisions of Control Variables of Model 2

Fixed effect	Coefficient	Standard error	*p*-value	Trim decision
LnEvaluation, β_0				
Intercept, γ_{00}	9.475	0.285	<0.001	
Age, γ_{01}	-0.019	0.014	0.180	Removed
Gender, γ_{02}	0.805	0.423	0.061	Kept
For *LnSubOutcome* slope, β_1				
Intercept, γ_{10}	0.813	0.092	<0.001	
Age, γ_{11}	-0.005	0.004	0.255	Removed
Gender, γ_{12}	0.125	0.136	0.359	Removed
For *LnSubProbability* slope, β_2				
Intercept, γ_{20}	1.363	0.162	<0.001	
Age, γ_{21}	-0.011	0.008	0.168	Removed
Gender, γ_{22}	0.182	0.241	0.451	Removed

Fourth, I added level-1 moderators (*Frame*, *Frame*LnSubOut*, and *Frame*LnSubPr)* into the model as grand centered. I kept statistically significant moderator in the model and removed statistically non-significant moderators. As shown in Table 13, only *Frame* was statistically significant.

Table 13
Trim Decisions of Level-1 Moderators of Model 2

Moderator	Coefficient	Standard error	*p*-value	Trim decision
Frame	-0.354	0.137	.011	Kept
*Frame*LnSubOut*	-0.080	0.087	.362	Removed
*Frame*LnSubPr*	0.032	0.127	.805	Removed

Fifth, I tested my final model by adding the level-2 moderators (*Nascent* and *System*). I added *Nascent* and *System* as predictors of the intercept and slopes (*LnSubOutcome* and *LnSubProbability*). I calculated effect sizes of the final model by using Cohen's *d* (Cohen, 1988), $d = \frac{\gamma}{\sqrt{\tau_{00}+\sigma^2}}$. The final model is as follows:

Level-1 Model

$$LnEvaluation_{ij} = \beta_{0j} + \beta_{1j}*(LnSubOutcome_{ij}) + \beta_{2j}*(LnSubProbability_{ij}) + \beta_{3j}*(Frame_{ij}) + r_{ij}$$

Level-2 Model

$$\beta_{0j} = \gamma_{00} + \gamma_{01}*(Gender_j) + \gamma_{02}*(Nascent_j) + \gamma_{03}*(System_j) + u_{0j}$$

$$\beta_{1j} = \gamma_{10} + \gamma_{11}*(Nascent_j) + \gamma_{12}*(System_j) + u_{1j}$$

$$\beta_{2j} = \gamma_{20} + \gamma_{21}*(Nascent_j) + \gamma_{22}*(System_j) + u_{2j}$$

$$\beta_{3j} = \gamma_{30} + u_{3j}$$

The HLM results for this final model (see Table 11) indicate that *Nascent* has a statistically significant relationship with the intercept of dependent variable, *LnEvaluation*. That is, the average *LnEvaluation* of nascent entrepreneurs is 0.74 smaller than that of non-entrepreneurs when everything else is equal. The Cohen's *d* (1988) of this moderating effect is small. The *System* has a moderate effect on the slope of *LnSubOutcome*. That is, the slope of *LnSubOutcome* is 0.34 bigger when participants use more System 2 thinking than when participants use more System 1 thinking. The Cohen's *d* (1988) of this moderating effect is very small. There is no moderation effect on the slope of *LnSubProbability*. The *Frame* has a moderate effect on the dependent variable. That is, the

average *LnEvaluation* of gain frame is 0.35 smaller than that of loss frame. The Cohen's *d* (1988) of this moderating effect is very small.

The results of Model 2 show that nascent entrepreneurs have lower evaluations than non-entrepreneurs. Because of most evaluations are lower than the expected values, the evaluations of nascent entrepreneurs are lower than non-entrepreneurs means that the evaluations of nascent entrepreneurs are farther divergent from the expected values.

The results show that the different types of thinking influence the subjective values of outcomes. People's subjective values of outcomes are higher when they use more System 2 thinking than when they use more System 1 thinking. That is, people will have evaluations that are closer to the expected values when they use more System 2 thinking. This result is consistent with dual-process theory.

The results show that people's evaluations of gain frame are lower than those of loss frame. That is, people overweight the losses. This result is consistent with prospect theory.

Consequently, the results of HLM model 2 are similar with the results of HLM model 1, which support that the difference of decision making between entrepreneurs and non-entrepreneurs also exists between nascent entrepreneurs and non-entrepreneurs.

HLM Model 3: Entrepreneurs

In model 3, I only included entrepreneur samples. There were 62 entrepreneurs who completed 933 evaluations. In this model, I tested whether the cognitive differences I found in HLM model 1 due to the acquired attribute of entrepreneurial practice. Therefore, I used

Experience as a moderator and grand-mean centered it. I used the same HLM variables shown in Table 5. Table 14 shows the descriptive statistics and correlations.

First, I ran a null model that only includes dependent variable and does not include any independent variables. The ICC is 73.8%. That is, 73.8% of variance of subjective values can be explained by the difference among individuals. Therefore, it is appropriate to use a multi-level model to analyze the data. Table 15 shows the HLM results.

Table 14

Descriptive Statistics and Correlations of Model 3

	Mean	SD	Correlations								
			1	2	3	4	5	6	7	8	9
1 *LnEvaluation*	9.305	2.994	1								
2 *LnSubOutcome*	10.943	0.578	.130***	1							
3 *LnSubProbabilty*	-1.046	0.542	.202***	-.115***	1						
4 *Frame*	0.490	0.500	-.069*	-.002	.014	1					
5 *Experience*	6.185	4.736	-.142***	-.004	.017	.001	1				
6 *System*	0.448	0.498	.009	.000	.015	-.016	-.100**	1			
7 *Age*	37.971	15.147	-.246***	-.003	.014	.001	.552***	-.088**	1		
8 *Gender*	0.434	0.496	-.049	.006	.000	.011	.149*	-.002	-.012	1	
9 *Frame*LnSubOut*	0.001	0.402	.093**	.695***	-.084 **	.002	-.001	.003	.001	.007	1
10 *Frame*LnSubPr*	0.006	0.380	.142***	-.084*	.701 ***	.015	.011	.015	.007	-.004	-.120***

* *p < .05,* ** *p < .01,* *** *p < .001.*

N = 1,005.

Table 15

HLM Results of Model 3

	Null model	Level-1 IV model	Control model	Final model
Fixed effects		Coefficient (SE)		
LnEvaluation, β_0				
Intercept, γ_{00}	9.30(0.33)***	9.26(0.33)***	9.26(0.32)***	9.57(0.45)***
Age, γ_{01}			-0.04(0.02) *	-0.04(0.03)
Experience, γ_{02}				-0.01(0.08)
System, γ_{03}				-0.23(0.65)
For *LnSubOutcome* slope, β_1				
Intercept, γ_{10}		0.84(0.09)***	0.83(0.08)***	0.77(0.12)***
Age, γ_{11}			-0.01(0.00)	-0.00(0.02)
Experience, γ_{12}				-0.02(0.02)
System, γ_{13}				0.13(0.17)
For *LnSubProbability* slope, β_2				
Intercept, γ_{20}		1.37(0.12)***	1.37(0.12)***	1.34(0.17)***
Experience, γ_{21}				-0.00(0.03)
System, γ_{22}				0.21(0.25)
For *Frame* slope, β_3				
Intercept, γ_{30}				-0.51(0.19)**
Random effects		Variance component (SD)		
LnEvaluation, u_0	6.60(2.57)***	6.76(2.60)***	6.28(2.51)***	7.04(2.65)***
LnSubOutcome slope, u_1		0.18(0.42)***	0.14(0.38)**	0.32(0.57)***
LnSubProbability slope, u_2		0.60(0.77)***	0.60(0.77)***	0.80(0.90)***
Frame slope, u_3				2.16(1.46)***
Level-1, r	2.34(1.63)	1.39(1.18)	1.39(1.18)	0.64(0.80)
Deviance	3672.12	3306.00	3299.82	2881.29
Estimated parameters	3	10	12	23

* $p < .05$, ** $p < .01$, *** $p < .001$.

Second, I added independent variables (*LnSubOutcome* and *LnSubProbability*) into the model as level-1 variables. I let all level-2 variances be random. The results (see Table 15) indicated that they are all statistically significant. Therefore, I kept them random in the model.

Third, I built a conditional model by adding control variables (*Age* and *Gender*) to level-2 intercept and slopes. Then, I eliminated all statistically non-significant level-2 effects ($p > .100$) to get the final control model (see Table 16). The results indicate that *Age* is significantly influences the intercept of *LnEvaluation* and slope of LnSubOutcome (see Table 16).

Table 16
Trim Decisions of Control Variables of Model 3

Fixed effect	Coefficient	Standard error	*p*-value	Trim decision
LnEvaluation, β_0				
Intercept, γ_{00}	9.144	0.427	<0.001	
Age, γ_{01}	-0.045	0.021	0.038	Kept
Gender, γ_{02}	0.265	0.646	0.683	Removed
For *LnSubOutcome* slope, β_1				
Intercept, γ_{10}	0.935	0.110	<0.001	
Age, γ_{11}	-0.010	0.005	0.069	Kept
Gender, γ_{12}	-0.229	0.167	0.175	Removed
For *LnSubProbability* slope, β_2				
Intercept, γ_{20}	1.286	0.163	<0.001	
Age, γ_{21}	0.002	0.008	0.784	Removed
Gender, γ_{22}	0.184	0.248	0.462	Removed

Fourth, I added level-1 moderators (*Frame*, *Frame*LnSubOutcome*, and *Frame*LnSubProbability)* into the model as grand centered. I kept statistically significant moderator in the model and removed statistically non-significant moderators. As shown in Table 17, only *Frame* was statistically significant.

Table 17
Trim Decisions of Level-1 Moderators of Model 3

Moderator	Coefficient	Standard error	*p*-value	Trim decision
Frame	-0.501	0.198	.014	Kept
*Frame*LnSubOut*	0.048	0.111	.659	Removed
*Frame*LnSubPr*	0.062	0.165	.707	Removed

I added *Experience* (grand centered) and *System* (uncentered) to the level 2 intercept and slopes (*LnSubOutcome* and *LnSubProbability*). However, none of them was significant (see Table 15). The final model shows as following:

Level-1 Model

$$LnEvaluation_{ij} = \beta_{0j} + \beta_{1j}*(LnSubOutcome_{ij}) + \beta_{2j}*(LnSubProbability_{ij}) + \beta_{3j}*(Frame_{ij}) + r_{ij}$$

Level-2 Model

$$\beta_{0j} = \gamma_{00} + \gamma_{01}*(Age_j) + \gamma_{02}*(Experience_j) + \gamma_{03}*(System_j) + u_{0j}$$

$$\beta_{1j} = \gamma_{10} + \gamma_{11}*(Age_j) + \gamma_{12}*(Experience_j) + \gamma_{13}*(System_j) + u_{1j}$$

$$\beta_{2j} = \gamma_{20} + \gamma_{21}*(Experience_j) + \gamma_{22}*(System_j) + u_{2j}$$

$$\beta_{3j} = \gamma_{30} + u_{3j}$$

The results indicate that the moderation effects I find in HLM model 1 and HLM model 2 are not statistically significant in HLM model 3 (see Table 7, Table 11, and Table 15). That means there is no statistically significant difference among entrepreneurs.

Entrepreneurial experience has no statistically significant effect on entrepreneurs' evaluations of opportunities. Consequently, H4 is supported, however, H5 is not supported. That is, the cognitive differences in decision-making between entrepreneurs and non-entrepreneurs are more likely due to the natural proclivities of entrepreneurs themselves, based on these findings, rather than being due to attributes acquired from entrepreneurial practice.

CHAPTER V

CONCLUSION AND DISCUSSION

Conclusion

The reasons that people become entrepreneurs are still not clear in entrepreneurship research (Lu & Tao, 2010; Sørensen & Fassiotto, 2011). It is an important question in entrepreneurship. If we knew the reasons that people become entrepreneurs, we could identify them ex ante from the general population, and we can better understand the logic of entrepreneurial decision-making.

This dissertation addresses this question by decomposing it into two related questions. First, do entrepreneurs make different decision compared to non-entrepreneurs when they are facing the same opportunities under risk? Second, are these differences in decision-making due to the natural proclivity of entrepreneurs or due to the attributes acquired from entrepreneurial practice?

Scholars have examined entrepreneurial decision-making from different perspectives. Scholars also argue that the entrepreneurial-decision-making research should focus on the nexus between entrepreneurs and opportunities (Alvarez et al., 2013; Grégoire & Shepherd, 2012; Sarasvathy, Dew, Velamuri, & Venkataraman, 2010; Shane, 2012). However, early research of entrepreneurial decision-making only identified very few limited systematic differences between entrepreneurs and non-entrepreneurs (Busenitz &

Barney, 1997). Recently scholars have achieved some progress in cognitive thinking (Blume & Covin, 2011; Busenitz & Barney, 1997; Kickul et al., 2009). However, there is an issue in existing research. Scholars only study the nexus from one side, either from entrepreneur side or from opportunity side. Therefore, it is important to study the nexus between entrepreneurs and opportunities from both aspects simultaneously.

This dissertation addresses the differences in entrepreneurial decision-making between entrepreneurs and non-entrepreneurs by focusing on the nexus between entrepreneurs and opportunities. Based on dual-process theory, I examined how different styles of thinking of entrepreneurs influence their decision-making. Based on prospect theory, I examined how different types of framing of opportunities influence entrepreneurial decision-making.

This dissertation also addresses whether the differences in decision-making between entrepreneurs and non-entrepreneurs are due to the natural proclivity of some entrepreneurs or due to entrepreneurial practice. If the differences are due to the natural proclivity of some entrepreneurs, we should observe these differences between entrepreneurs and non-entrepreneurs, however, not between nascent entrepreneurs and experienced entrepreneurs. On the other side, if the differences learned or acquired during or from entrepreneurial practice, we should observe these differences between nascent entrepreneurs and experienced entrepreneurs and between non-entrepreneurs and experienced entrepreneurs. We should observe no differences between non-entrepreneurs and nascent entrepreneurs.

The results of HLM model 1 indicate that both entrepreneurs and non-entrepreneurs tend to over-weight the opportunities that have small probabilities and to under-weight the

opportunities that have medium and large probabilities. This finding is consistent with prospect theory.

The results of HLM model 1 indicate that different types of framing of opportunities influence entrepreneurial decision-making. Specifically, the evaluations of opportunities in loss frame are higher than the evaluations of opportunities in gain frame. However, my results provide insufficient evidence that different types of framing of opportunities influence the value function or the weighting function.

The results of HLM model 1 indicate that different styles of thinking of entrepreneurs influence the value function. Specifically, the subjective values of outcomes are higher when people use more System 2 thinking than System 1 thinking. However, my results provide insufficient evidence that different styles of thinking influence the weighting function.

The results of HLM model 1 indicate that entrepreneurs and non-entrepreneurs make different decisions. Specifically, the evaluations of opportunities are lower for entrepreneurs than for non-entrepreneurs. However, my results provide insufficient evidence that entrepreneurs and non-entrepreneurs are different in their value function or weighting function.

The results of HLM model 2 indicate that the same differences also exist between nascent entrepreneurs and non-entrepreneurs. However, my results provide no evidence that these differences exist among entrepreneurs when I used entrepreneurial experience as the moderator in HLM model 3. Therefore, based on my findings, these differences are more likely to predate people becoming entrepreneurs. In other words, these differences are more likely due to the natural proclivity of some entrepreneurs rather than being

acquired or learned from entrepreneurial practice. At minimum, we can say that however these differences were acquired before becoming an entrepreneur.

In summary, the style of thinking and the type of framing both influence entrepreneurial decision-making. If people use more System 1 thinking, they tend to generate higher subjective evaluations of opportunities. If people face opportunities in loss frame, they tend to generate higher subjective evaluations of opportunities. Furthermore, entrepreneurs tend to generate lower subjective evaluations than non-entrepreneurs do, which is more likely due to the natural proclivity of entrepreneurs.

Contributions

This study contributes to the literature theoretically and practically in several ways. First, this research is the first study to investigate the nexus between entrepreneurs and opportunities as it relates to entrepreneurial decision making. Including both aspects is important because entrepreneurial decision-making occurs at and often incorporates or is affected by both entrepreneurs and opportunities (Alvarez & Barney, 2014; Shane, 2012; Venkataraman, Sarasvathy, Dew, & Forster, 2012). The results of this study indicate that both entrepreneurs' thinking style and opportunity framing can influence entrepreneurial decision-making. Second, this study provides evidence in support of the application of prospect theory to research on entrepreneurial decision-making. Prospect theory argues that the framing influences decision-making (Kahneman & Tversky, 1979; Tversky & Kahneman, 1992). In particular, entrepreneurs evaluate opportunities differently when the opportunities are described in different framings. Next, this study also provides evidence in support of the application of dual-process theory to research on entrepreneurship decision-making. Dual-process theory indicates that the style of thinking influences

decision making (Evans, 2008; Salas et al., 2010). In particular, entrepreneurs' evaluations of opportunities are higher when they use more System 2 thinking. Furthermore, this study provides a possible way to investigate the reasons that people become entrepreneurs. Scholars have identified some cognitive differences between entrepreneurs and non-entrepreneurs (Baron, 1998; Haynie, Shepherd, & Patzelt, 2012). However, it is difficult to prove whether these differences were due to the natural proclivity of some entrepreneurs or were acquired from entrepreneurial practice. This study improves our understanding of this question by testing the cognitive differences in two perspectives. One is between non-entrepreneurs and nascent entrepreneurs and the other is between nascent entrepreneurs and experienced entrepreneurs. If the differences are due to the natural proclivity of entrepreneurs, we should observe significant differences between non-entrepreneurs and nascent entrepreneurs. On the other hand, if the differences were acquiring from entrepreneurial practice, we should observe the moderation effect of entrepreneurial experience. The results show that there are significant differences between non-entrepreneurs and nascent entrepreneurs and that there is no moderation effect from entrepreneurial experience. Therefore, these cognitive differences between entrepreneurs and non-entrepreneurs are more likely due to the natural proclivity of entrepreneurs.

Discussion

Regarding the unresolved questions that I mentioned at the beginning of this dissertation, the findings of this dissertation advance our understanding of these questions. The first unresolved question was about the quality of entrepreneurial decision-making: do entrepreneurs make better decisions than non-entrepreneurs? According to the findings of this dissertation, the answer is not always. Entrepreneurs have lower evaluations of

opportunities than non-entrepreneurs (see Figure 8). The evaluations of both entrepreneurs and non-entrepreneurs are higher than the expected values of the opportunities when the probabilities of the opportunities are small. In this circumstance, evaluations of entrepreneurs are closer to the expected value of the opportunities than those of non-entrepreneurs are. That is, entrepreneurs make better decisions. However, the evaluations of both entrepreneurs and non-entrepreneurs are lower than the expected values of the opportunities when the probabilities of the opportunities are medium and large. In this circumstance, evaluations of non-entrepreneurs are closer to the expected value of the opportunities than those of entrepreneurs are. That is, non-entrepreneurs make better decisions.

The second unresolved question was about the difference between decision-making by entrepreneurs and non-entrepreneurs: do entrepreneurs make different decisions than non-entrepreneurs? By comparing the samples from entrepreneurs and general population, I find entrepreneurs make different decisions than non-entrepreneurs. Entrepreneurs have lower evaluations of opportunities than non-entrepreneurs. This finding reveals that entrepreneurs have lower evaluations than non-entrepreneurs when they are facing the same opportunities. If so, then why did non-entrepreneurs not become entrepreneurs since they had higher evaluations of opportunities? One possible reason is that the financial return was not the only factor that influenced an entrepreneur's decision to discover opportunities. For example, scholars have found non-financial benefits and switching costs may influence entrepreneurial opportunity discovery (Holland & Shepherd, 2013). Because this study only investigated the influence of the outcome and probability, and not possible motivating factors, it is a limitation of this research. However, other factors may

also influence entrepreneurial opportunity discovery. Future research can further investigate the influence of these other factors.

The third unresolved question was about whether these differences in decision-making were due to the natural proclivity of some entrepreneurs or were acquired from entrepreneurial practice. The findings of this dissertation suggest one of the reasons that entrepreneurs make different decisions than non-entrepreneurs is more likely due to differences in the natural proclivity of entrepreneurs than due to the acquired attributes from entrepreneurial practice. In other words, it appears that on average entrepreneurs and non-entrepreneurs are different before they become entrepreneurs. Future research can investigate how they are different. There are some possible aspects, such as entrepreneurial passion (Cardon, Foo, Shepherd, & Wiklund, 2012; Cardon, Wincent, Singh, & Drnovsek, 2009), entrepreneurial persistence (Gimeno et al., 1997; Holland & Shepherd, 2013), and entrepreneurial self-efficacy (McGee, Peterson, Mueller, & Sequeira, 2009; Tumasjan & Braun, 2011). Being different also could motivate a very interesting conversation. There are several perspectives that we could use to investigate this idea. For example, since people become entrepreneurs are due to their natural proclivities, how can we identify these natural proclivities ex ante? Can we nurture these natures by education? All these could be very interesting future research.

There are other limitations in this dissertation. First, this study only investigates the opportunities under risk. Entrepreneurs evaluated the opportunities under the situation that they know all the outcomes and the probabilities of opportunities. However, not all opportunities are risks for entrepreneurs. Because the complexity and uncertainty of the environments in which entrepreneurs find themselves, some opportunities are uncertainties

for entrepreneurs. Entrepreneurs either do not know the outcome, or do not know the probability. In other situations, entrepreneurs do not know either the outcomes or the probabilities. Future studies can further investigate how entrepreneurs evaluate opportunities under uncertainty. Second, it is unclear whether the behavior of entrepreneurial decision-making is stable. Therefore, future longitudinal studies are expected to improve our understanding of entrepreneurial decision-making.

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APPENDIX A

Definitions of Key Concepts

Concept	Definition
Decision weight	Depicts the influence of a probability on the value of a gamble (Kahneman & Tversky1979).
Diminishing sensitivity	The difference between the subjective values of two outcomes is larger, the closer those outcomes are to the reference point (Kahneman & Tversky1979).
Expected utility	The probability-weighted average of the utilities of a gamble's outcomes, where utility refers to the pleasure the final wealth positions (i.e., current wealth plus the outcome of the gamble) will provide (von Neumann & Morgenstern, 1944).
Expected value	The probability-weighted average of a gamble's outcomes (Edwards, 1954).
Experienced entrepreneurs	Entrepreneurs who have started a business more than one year and/or started more than one business.
Framing	An individual's interpretation of a decision (Tversky & Kahneman, 1981).
Framing of an opportunity	An individual's interpretation of an opportunity
Gain frame	Anticipating an outcome in excess of one's reference point (Tversky & Kahneman, 1981).
Loss aversion	A tendency to prefer minimizing losses to maximizing equivalent magnitude gains (Kahneman & Tversky1979).
Loss frame	Anticipating an outcome below one's reference point (Tversky & Kahneman, 1981).
Mixed gambles	Gambles that offer both positive and negative outcomes (Kahneman & Tversky1979).
Nascent entrepreneurs	Entrepreneurs who are in the process of starting their first businesses.
Prospect	A contract that yields outcome x_i with probability p_i, where $p_1 + p_2 + \cdots + p_n = 1$ (Kahneman & Tversky1979).

Pure gambles	Gambles that offer strictly positive or strictly negative outcomes (Kahneman & Tversky1979).
Reference point	The neutral position used to determine the extent to which outcomes constitute gains (which are above this position) or losses (which are below this position) (Kahneman & Tversky1979).
Risk	Situations in which both outcomes and their probabilities of occurrence are known to the decision maker (Knight, 1921).
Risk aversion	Preferring sure outcomes to probabilistic outcomes with greater expected value (Kahneman & Tversky1979).
Risk seeking	Preferring probabilistic outcomes to sure outcomes with greater expected value (Kahneman & Tversky1979).
Styles of thinking	Use more System 1 or System 2 thinking.
Subjective value	Depicts the value an individual perceives an outcome to be worth, reflecting the pleasure the outcome will provide (Kahneman & Tversky1979).
Value function	Translates outcomes into subjective values (Kahneman & Tversky1979).

APPENDIX B

Ten Field Phenomena Inconsistent with EU and Consistent with Cumulative Prospect Theory (Camerer, 2004, p. 149)

Domain	*Phenomenon*	*Description*	*Type of Data*	*Isolated Decision*	*Ingredients*	*References*
Stock market	Equity premium	Stock returns are too high relative to bond returns	NYSE stock, bond returns	Single yearly return (not long-run)	Loss-aversion	(Benartzi & Thaler, 1995)
Stock market	Disposition effect	Hold losing stocks too long, sell winners too early	Individual investor trades	Single stock (not portfolio)	Reflection effect	(Odean, 1998)
Labor economics	Downward-sloping labor supply	NYC cabdrivers quit around daily income target	Cabdriver hours, earnings	Single day (not week or month)	Loss-aversion	(Camerer, Babcock, Loewenstein, & Thaler, 1997)
Consumer goods	Asymmetric price elasticities	Purchases more sensitive to price increases than to cuts	Product purchases (scanner data)	Single product (not shopping cart)	Loss-aversion	(Hardie, Johnson, & Fader, 1993)
Macroeconomics	Insensitivity to bad income news	Consumers do not cut consumption after bad income news	Teachers' earnings, savings	Single year	Loss-aversion, reflection effect	(Shea, 1995), (Bowman, Minehart, & Rabin, 1999)
Consumer choice	Status quo bias, Default bias	Consumers do not switch health	Health plan, insurance choices	Single choice	Loss-aversion	(Samuelson & Zeckhauser, 1988), (Johnson,

		plans, choose default insurance				Hershey, Meszaros, & Kunreuther, 1993)
Horse race betting	Favorite-longshot bias	Favorites are underbet, longshots overbet	Track odds	Single race (not day)	Overweight low *p*(loss)	(Jullien & Salanié, 2000)
Horse race betting	End-of-the-day effect	Shift to longshots at the end of the day	Track odds	Single day	Reflection effect	(McGlothlin, 1956)
Insurance	Buying phone wire insurance	Consumers buy overpriced insurance	Phone wire insurance purchases	Single wire risk (not portfolio)	Overweight low *p*(loss)	(Cicchetti & Dubin, 1994)
Lottery betting	Demand for Lotto	More tickets sold as top prize rises	State lottery sales	Single lottery	Overweight low *p*(win)	(Cook & Clotfelter, 1993)

APPENDIX C

A SAMPLE OF SURVEY

Dear Participate: You are being invited to participate in a research study by answering the attached survey about entrepreneurial decision-making. There are no known risks for your participation in this research study. The information collected may not benefit you directly. The information learned in this study may be helpful to others. The information you provide will help us to understand how entrepreneurs make decisions. Your completed survey will be stored at University of Louisville. The survey will take approximately 15 minutes to complete.

Individuals from the Department of Entrepreneurship, the Institutional Review Board (IRB), the Human Subjects Protection Program Office (HSPPO), and other regulatory agencies may inspect these records. In all other respects, however, the data will be held in confidence to the extent permitted by law. Should the data be published, your identity will not be disclosed.

Taking part in this study is voluntary. By completing this survey you agree to take part in this research study. You do not have to answer any questions that make you uncomfortable. You may choose not to take part at all. If you decide to be in this study you may stop taking part at any time. If you decide not to be in this study or if you stop taking part at any time, you will not lose any benefits for which you may qualify.

If you have any questions, concerns, or complaints about the research study, please contact: Dalong Ma, 502 939 9681, dalong.ma@louisville.edu.

If you have any questions about your rights as a research subject, you may call the Human Subjects Protection Program Office at (502) 852-5188. You can discuss any questions about your rights as a research subject, in private, with a member of the Institutional Review Board (IRB). You may also call this number if you have other questions about the research, and you cannot reach the research staff, or want to talk to someone else. The IRB is an independent committee made up of people from the University community, staff of the institutions, as well as people from the community not connected with these institutions. The IRB has reviewed this research study.

If you have concerns or complaints about the research or research staff and you do not wish to give your name, you may call 1-877-852-1167. This is a 24 hour hot line answered by people who do not work at the University of Louisville.

Sincerely,

Dalong Ma

Are you currently running a business?

- ❍ Yes (1)
- ❍ No (2)

Please base your answers to the following questions on the feelings you experience.

When you hear the name "George Clooney", what do you feel? Please use one word to describe your predominant feeling:

When you hear the name "George W. Bush", what do you feel? Please use one word to describe your predominant feeling:

When you hear the name "Princess Diana", what do you feel? Please use one word to describe your predominant feeling:

When you hear the name "9/11", what do you feel? Please use one word to describe your predominant feeling:

When you hear the name "baby", what do you feel? Please use one word to describe your predominant feeling:

Please work carefully and deliberately to calculate the answers to the questions posed below.

If an object travels at five feet per minute, then by your calculations how many feet will it travel in 360 seconds?

Suppose a student bought a pen and a pencil for a total of $11, and that the pen cost $10 more than the pencil. Then, by your calculations how much did the pencil cost?

If a consumer bought 30 books for $540, then, by your calculations, on average, how much did the consumer pay for each book?

If a baker bought nine pounds of flour at $1.50 per pound, then, by your calculations how much did the baker pay in total?

If a company bought 15 computers for $1200 each, then, by your calculations, how much did the company pay in total?

There is a venture idea which has a 75% chance to earn a $200,000 payoff and a 25% chance to get a $0 payoff. Please tell us the maximum amount you will pay to buy this idea.

There is a venture idea which has a 25% chance to earn a $100,000 payoff and a 75% chance to get a $0 payoff. Please tell us the maximum amount you will pay to buy this idea.

There is a venture idea which has a 25% chance to earn a $200,000 payoff and a 75% chance to get a $0 payoff. Please tell us the maximum amount you will pay to buy this idea.

There is a venture idea which has a 5% chance to earn a $200,000 payoff and a 95% chance to get a $0 payoff. Please tell us the maximum amount you will pay to buy this idea.

There is a venture idea which has a 25% chance to earn a $1,000,000 payoff and a 75% chance to get a $0 payoff. Please tell us the maximum amount you will pay to buy this idea.

There is a venture idea which has a 95% chance to earn a $200,000 payoff and a 5% chance to get a $0 payoff. Please tell us the maximum amount you will pay to buy this idea.

There is a venture idea which has a 50% chance to earn a $200,000 payoff and a 5% chance to get a $0 payoff. Please tell us the maximum amount you will pay to buy this idea.

There is a venture idea which has a 25% chance to earn a $500,000 payoff and a 75% chance to get a $0 payoff. Please tell us the maximum amount you will pay to buy this idea.

There is a venture idea which has a 50% chance to earn a $200,000 payoff and a 50% chance to lose money, but the amount of loss is unknown. Please tell us the maximum amount you will pay to buy this idea.

You have a venture idea which has a 75% chance to get a $200,000 payoff and a 25% chance to get a $0 payoff. Please tell us the minimum amount you will accept to sell this idea.

You have a venture idea which has a 25% chance to get a $100,000 payoff and a 75% chance to get a $0 payoff. Please tell us the minimum amount you will accept to sell this idea.

You have a venture idea which has a 25% chance to get a $200,000 payoff and a 75% chance to get a $0 payoff. Please tell us the minimum amount you will accept to sell this idea.

You have a venture idea which has a 5% chance to get a $200,000 payoff and a 95% chance to get a $0 payoff. Please tell us the minimum amount you will accept to sell this idea.

You have a venture idea which has a 25% chance to get a $1,000,000 payoff and a 75% chance to get a $0 payoff. Please tell us the minimum amount you will accept to sell this idea.

You have a venture idea which has a 95% chance to get a $200,000 payoff and a 5% chance to get a $0 payoff. Please tell us the minimum amount you will accept to sell this idea.

You have a venture idea which has a 50% chance to get a $200,000 payoff and a 50% chance to get a $0 payoff. Please tell us the minimum amount you will accept to sell this idea.

You have a venture idea which has a 25% chance to get a $500,000 payoff and a 75% chance to get a $0 payoff. Please tell us the minimum amount you will accept to sell this idea.

You have a venture idea which has a 50% chance to get a $200,000 payoff and a 50% chance to lose money, but the amount of loss is unknown. Please tell us the minimum amount you will accept to sell this idea.

Please indicate that how you evaluated the above venture ideas:

Mcheck1 I made my decisions fast, intuitively and unconsciously.

- ❍ Strongly Disagree (1)
- ❍ Disagree (2)
- ❍ Slightly Disagree (3)
- ❍ Neither Agree nor Disagree (4)
- ❍ Slightly Agree (5)
- ❍ Agree (6)
- ❍ Strongly Agree (7)

I made my decisions slowly, analytically and consciously.

- ❍ Strongly Disagree (1)
- ❍ Disagree (2)
- ❍ Slightly Disagree (3)
- ❍ Neither Agree nor Disagree (4)
- ❍ Slightly Agree (5)
- ❍ Agree (6)
- ❍ Strongly Agree (7)

Please tell us more about yourself:

What is your gender?

- ❍ Male (1)
- ❍ Female (2)

What is your race?

- ❍ White/Caucasian (1)
- ❍ African American (2)
- ❍ Hispanic (3)
- ❍ Asian (4)
- ❍ Native American (5)
- ❍ Pacific Islander (6)
- ❍ Other (7)

What was your age as of January 1, 2014?

- ❍ Under 18 (1)
- ❍ 18 (2)
- ❍ 19 (3)
- ❍ 20 (4)
- ❍ 21 (5)
- ❍ 22 (6)
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- 70 (54)
- 71 (55)
- 72 (56)
- 73 (57)
- 74 (58)
- 75 (59)
- Over 75 (60)

What is the highest level of education you have completed?

- Less than High School (1)
- High School / GED (2)
- Some College (3)
- 2-year College Degree (4)
- 4-year College Degree (5)
- Masters Degree (6)
- Doctoral Degree (7)
- Professional Degree (JD, MD) (8)

What is your annual income range?

- ❍ Below $20,000 (1)
- ❍ $20,000 - $39,999 (2)
- ❍ $40,000 - $59,999 (4)
- ❍ $60,000 - $79,999 (6)
- ❍ $80,000 - $99,999 (7)
- ❍ $100,000 - $119,999 (9)
- ❍ $120,000 - $139,999 (5)
- ❍ $140,000 - $159,999 (3)
- ❍ $160,000 - $179,999 (12)
- ❍ $180,000 - $199,999 (13)
- ❍ $200,000 or more (8)

Do you have the intention to start a business?

- ❍ Yes (1)
- ❍ No (2)

When do you expect to start this business?

- ❍ Less than 1 year (1)
- ❍ 1-2 years (2)
- ❍ 3-5 years (3)
- ❍ 6-10 years (4)
- ❍ more than 10 years (5)

Is your current business family owned?

- ❍ Yes (1)
- ❍ No (2)

Is your current family business a family succession?

- ❍ Yes (1)
- ❍ No (2)

Does your family business have a family succession envisioned in the future?

- ❍ Yes (1)
- ❍ No (2)

What is your business's primary activity?

- ❍ Agriculture, Forestry, Fishing and Hunting (23)
- ❍ Mining, Quarrying, and Oil and Gas Extraction (24)
- ❍ Utilities (25)
- ❍ Construction (26)
- ❍ Manufacturing (27)
- ❍ Wholesale Trade (28)
- ❍ Retail Trade (29)
- ❍ Transportation and Warehousing (30)
- ❍ Information (31)
- ❍ Finance and Insurance (32)
- ❍ Real Estate and Rental and Leasing (33)
- ❍ Professional, Scientific, and Technical Services (34)
- ❍ Management of Companies and Enterprises (35)
- ❍ Administrative and Support and Waste Management and Remediation Services (36)
- ❍ Educational Services (37)
- ❍ Health Care and Social Assistance (38)
- ❍ Arts, Entertainment, and Recreation (39)
- ❍ Accommodation and Food Services (40)
- ❍ Public Administration (42)
- ❍ Other Services (41)

How long have you owned your current business?

- ❍ Less than 1 year (1)
- ❍ 1 year (2)
- ❍ 2 years (3)
- ❍ 3 years (4)
- ❍ 4 years (5)
- ❍ 5 years (6)
- ❍ 6 years (7)
- ❍ 7 years (8)
- ❍ 8 years (9)
- ❍ 9 years (10)
- ❍ 10 years (11)
- ❍ more than 10 years (12)
- ❍ more than 20 years (13)

How many employees currently work in your business? (Not including yourself)

- ❍ 0 (1)
- ❍ 1 (2)
- ❍ 2 (3)
- ❍ 3 (4)
- ❍ 4 (5)
- ❍ 5 (6)
- ❍ 6 (7)
- ❍ 7 (8)
- ❍ 8 (9)
- ❍ 9 (10)
- ❍ 10-19 (11)
- ❍ 20-49 (12)
- ❍ 50-99 (13)
- ❍ 100-249 (14)
- ❍ 250-499 (15)
- ❍ 500-999 (16)
- ❍ 1000 or more (17)

How many companies have you founded in your lifetime?

- ❍ 0 (1)
- ❍ 1 (2)
- ❍ 2 (3)
- ❍ 3 (4)
- ❍ 4 (5)
- ❍ 5 (6)
- ❍ 6 (7)
- ❍ 7 (8)
- ❍ 8 (9)
- ❍ 9 (10)
- ❍ 10 (11)
- ❍ over 10 (12)

How long is it since you founded your first company?

- ❍ Less than 1 year (1)
- ❍ 1 year (2)
- ❍ 2 years (3)
- ❍ 3 years (4)
- ❍ 4 years (5)
- ❍ 5 years (6)
- ❍ 6 years (7)
- ❍ 7 years (8)
- ❍ 8 years (9)
- ❍ 9 years (10)
- ❍ 10 years (11)
- ❍ More than 10 years (12)

CURRICULUM VITA

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