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Opportunity Evaluation under Risky Conditions: The Cognitive Processes of Entrepreneurs

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Even though the entrepreneurship literature places much emphasis on opportunity recognition, little is known about how entrepreneurs actually evaluate opportunities. This study uses a cognitive approach to examine opportunity evaluation, as the perception of opportunity is essentially a cognitive phenomenon. We present a model that consists of four independent variables (overconfidence, belief in the law of small numbers, planning fallacy, and illusion of control), a mediating variable (risk perception), two control variables (demographics and risk propensity), and the dependent variable (opportunity evaluation). We find that illusion of control and belief in the law of small numbers are related to how entrepreneurs evaluate opportunities. Our results also indicate that risk perception mediates opportunity evaluation.

INTRODUCTION

The *entrepreneurial process* involves all the functions, activities, and actions associated with the perception of opportunities and the creation of the organizations to pursue these opportunities (Bygrave & Hofer, 1991). In order to understand what promotes or inhibits entrepreneurial activity, it is important to understand how entrepreneurs construct credible opportunities and the role of perceptions in that process (Krueger, 2000). Some researchers (Kirzner, 1973; Kaish & Gilad, 1991; Douglas & Shepherd, 1999) argue that opportunity recognition is the cornerstone of entrepreneurship. Entrepreneurs often see opportunities where others do not, and envision future possibilities that others fail to recognize (Allinson, Chell, & Hayes, 2000).

An opportunity is defined as a future situation that the decisionmakers deem personally desirable and feasible (i.e., within their control and competence). The state of being "desirable" and "feasible" is subjective to the individual (Krueger, 1993). An opportunity is said to exist when a bundle of resources can be sold at a higher price than the cost to package and deliver this bundle (Shane & Venkataraman, 2000). Most entrepreneurs do not have problems generating ideas, as there are numerous sources of ideas

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of what they can sell, and *evaluation* is the key to differentiate an idea from an opportunity (Hills & Shrader, 1998). As such, it is important to understand how entrepreneurs evaluate the alternatives presented to them. We term this process Opportunity Evaluation (OE).

Deciding whether an idea is an opportunity involves judgments made under conditions of uncertainty and complexity (Das & Teng, 1997; Allinson, Chell, & Hayes, 2000). Closely associated with uncertainty is risk, which is the probability that an entrepreneur is able to successfully turn an idea into an opportunity. An entrepreneur who fails in the business could incur financial losses instead. As such, perceived risk is a significant aspect of how entrepreneurs evaluate available ideas. Entrepreneurs are more likely to evaluate an idea more favorably when they perceive less risk in that idea.

What is less known, however, are the antecedents of risk perception of entrepreneurs. While others have shown that people's cognitive biases affect their decision to start a business venture (e.g., Simon, Houghton, & Aquino, 2000), it is not certain whether entrepreneurs exhibit the same cognitive biases. Kirzner (1973) argues that entrepreneurs are entrepreneurially alert and able to discern opportunities while others are not. Although this assertion has been challenged (e.g., Gaglio, 1997), researchers have found that the cognitive processes of entrepreneurs and nonentrepreneurs are different. For instance, entrepreneurs focus on the future and engage in less counterfactual thinking than nonentrepreneurs (Baron, 1999).

In this article, we study how various cognitive processes affect opportunity evaluation, mediated by risk perception, as opportunity evaluation is essentially a cognitive phenomenon (Palich & Bagby, 1995; Krueger, 2000). Such a cognitive approach can help explain why some people start business ventures while others do not (Venkataraman, 1997; Baron, 1998; Shane & Venkataraman, 2000). While some of the variables we included are similar to Simon, Houghton, and Aquino (2000), the sample of MBA students that they used may not be representative of actions taken by entrepreneurs. Further, the development of scientific knowledge requires testing propositions in different contexts, so that they could either be refuted or be further supported (Popper, 1972, pp. 240–242).

The flow of our study is as follows. First, the theoretical background and research framework are presented. This is followed by the development of testable hypotheses. We then describe the research methodology and conduct the empirical analysis. Finally, the findings, implications, and limitations of the study are discussed.

LITERATURE REVIEW AND RESEARCH FRAMEWORK

Trait and cognition are two major approaches to distinguish entrepreneurs from nonentrepreneurs and to understand how people make decisions (Das & Teng, 1997). The trait approach asserts that entrepreneurs can be recognized by traits such as risk propensity, need for achievement, and locus of control (Palich & Bagby, 1995). The cognitive approach is concerned with the entrepreneur's preferred way of gathering, processing, and evaluating information (Allinson, Chell, & Hayes, 2000). The individual constructs opportunities and risk in his or her mind (Palich & Bagby, 1995). Therefore, perception and other cognitive phenomena are critical to opportunity evaluation and risk perception (Krueger, 2000).

However, research using the trait approach has had limited success in explaining entrepreneurial behaviors and perceptions. For instance, some studies have shown that

risk propensity, the personality trait that determines the tendency and willingness of the individual to take risk, does not explain why entrepreneurs are willing to undertake a business venture (e.g., Low & MacMillan, 1988). Subsequently researchers have turned to the cognitive approach, and recent evidence suggests that this approach better explains entrepreneurial behavior and perception. For example, researchers have shown that entrepreneurs exhibit systematic cognitive biases and overestimate their chances of success. Cooper, Woo, and Dunkelberg (1988) find that 81 percent of entrepreneurs believe that their ventures will have at least a 70 percent chance of succeeding even though 50 percent to 71 percent of all new ventures discontinue after five years.

We are interested in understanding how cognitive factors influence opportunity evaluation mediated by risk perception. The quality of decision making, in the risk-charged environments that entrepreneurs often face, can be improved with a better understanding of risk and its role in opportunity evaluation (Forlani & Mullins, 2000). While it is obvious that individuals are more likely to make risky decisions when they perceive less risk, little is known about the antecedents of risk perception (Sitkin & Weingart, 1995). Although there are many possible cognitive factors, Simon, Houghton, and Aquino (2000) argue that the biases of *overconfidence*, *illusion of control* and *belief in the law of small numbers* directly influence risk perception and the decision to start a business venture. We include these three cognitive biases in an attempt to replicate their findings.

Research Framework (Opportunity Evaluation Model)

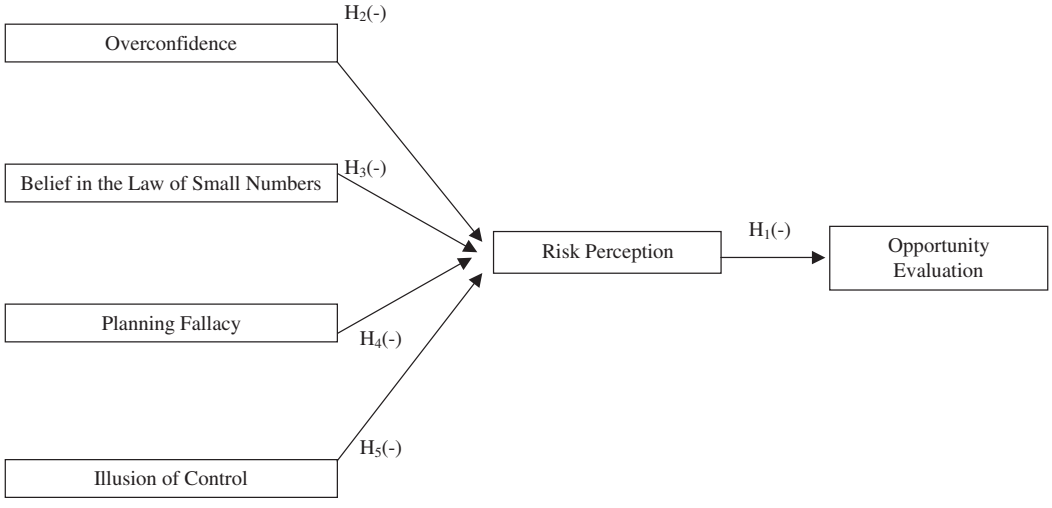
Consistent with previous studies (e.g., Sitkin & Pablo, 1992; Sitkin & Weingart, 1995; Forlani & Mullins, 2000), risk perception is taken to drive entrepreneurial activities. Opportunities, among other outcomes, allow entrepreneurs to receive profits (Shane & Venkataraman, 2000). However, there are risks involved in acting on an idea. Not every idea is an opportunity, as entrepreneurs must cover the costs of gathering and delivering a bundle of goods and services (Shane & Venkataraman, 2000) and business overheads. Entrepreneurs who believe that they are able to predict how well the business will do, and perceive a low probability of failure will view the idea to be an opportunity that is feasible and worth considering. As such,

> **H_1:** Perceiving a lower level of risk is associated with more positive opportunity evaluation.

However, the factors that influence risk perception are less obvious. In this study, we examine how different cognitive processes affect risk perception that in turn affects the evaluation of whether a venture idea is feasible or viable. In particular, we explore how cognitive biases influence decision making under risky conditions (Laibson & Zeckhauser, 1998). Individuals do not have the cognitive capacity to process and remember all information stimuli that arise from complex situations. Entrepreneurs often find themselves in situations that are new and unpredictable. They are less likely to have access to historical trends, past performance, and other information to reduce the level of uncertainty at a relatively low cost (Busenitz & Barney, 1997). In addition, more comprehensive decision making is not possible because entrepreneurs need to act quickly to exploit brief windows of opportunity (Busenitz & Lau, 1996). Therefore, entrepreneurs seek to minimize cognitive effort by using heuristics (mental shortcuts) and simplifying strategies that lead to a number of cognitive biases. These biases in-

Figure 1

Opportunity Evaluation Model



fluence the information that individuals notice and the conclusions they reach (Schwenk, 1984).

Figure 1 represents the model that we study in this article. Four factors are hypothesized to affect risk perception; risk perception in turn affects opportunity evaluation. Three of the biases (i.e., overconfidence, belief in the law of small numbers, and illusion of control) are adapted from Simon, Houghton, and Aquino (2000). Planning fallacy (i.e., individuals do not consider past experiences in similar situations because predictions induce a future orientation) is included as the experience gained by the entrepreneurs is likely to affect their cognitive processes. Repeated successes and failures will reinforce the entrepreneurs' cognitive frameworks regarding risk of ventures (Baron, 1998), which we use as a mediating variable. Table 1 provides a summary of the relevant literature on the four independent factors, the dependent variable (Opportunity Evaluation), and the mediating variable (Risk Perception).

Overconfidence

Overconfidence refers to the failure to know the limits of one's knowledge (Zacharakis & Shepherd, 2001), and this leads to overestimation of one's certainty regarding facts. This bias is especially common in ill-structured decision situations, such as deciding whether to introduce a new product (Simon & Houghton, in press). Overconfidence can occur because individuals base their certainty on the ease with which they can recall reasons for confidence (i.e., availability heuristics). They do not revise their initial estimates after receiving new data due to their initial overconfidence, and have a tendency to seek supporting evidence instead of disconfirming evidence (Russo & Schoemaker, 1992).

Table 1

Variables Used in the Opportunity Evaluation Model

Variable	Description	Works	Findings
Opportunity Evaluation	The evaluation of venture ideas to identify opportunities.	Krueger, 1993	An opportunity is a future situation that is deemed both desirable and feasible.
		Sandberg & Hench, 1999	It is a subjective judgment on the part of the entrepreneurs.
		Krueger & Brazeal, 1994; Krueger, 2000	The cognitive processes of the entrepreneur are important to the study of opportunity evaluation. A cognitive approach was adopted.
Risk Perception	The subjective judgment of the amount of risk inherent in the situation.	Yates & Stone, 1992; Das & Teng, 1997; Allinson, Chell, & Hayes, 2000	Risk is one of the significant aspects of risky entrepreneurial behavior, such as opportunity evaluation.
		Low & MacMillan, 1988	Risk propensity (tendency and willingness to knowingly take risk) does not differentiate the entrepreneur from the nonentrepreneurs.
		Palich & Bagby, 1995; Simon, Houghton, & Aquino, 2000	Entrepreneurs do not knowingly take risks; instead they perceive less risk.
		Sitkin & Pablo, 1992; Simon, Houghton, & Aquino, 2000; Forlani & Mullins, 2000	Risk perception is taken as the intermediate construct that drives risky entrepreneurial decision making. Risk perception mediates the relationship between the independent variables (e.g., overconfidence) and the dependent variable (e.g., opportunity evaluation)
Overconfidence	The failure to know the limits of one's knowledge.	Simon, Houghton, & Aquino, 2000	Entrepreneurs exhibiting overconfidence treat their assumptions as facts and thus see less uncertainty and risk.
		Russo & Schoemaker, 1992	Entrepreneurs may perceive less risk because they are optimistic about their assumptions.
Belief in the Law of Small Numbers	The use of a small sample to draw firm conclusions.	Simon, Houghton, & Aquino, 2000; Golder & Tellis, 1993	Entrepreneurs are more likely to get disproportionately more positive information because failures are less well publicized and less cognitively salient.
		Busenitz & Barney, 1997; Kahneman & Lovallo, 1993	This bias, coupled with mainly positive information, is likely to induce an overly optimistic view of the venture and thus lower perceived risk.
Planning Fallacy	The failure to consider past experiences in similar situations because predictions induce a future orientation.	Kahneman & Lovallo, 1993	Forecasts of future outcomes are often anchored on plans and scenarios of success rather than on past results, and are possibly overly optimistic.
		Zietsma, 1999	Previous entrepreneurial experience makes entrepreneurs more aware of the risks. Therefore, it is likely for them to perceive less risk if they do not use past experience.
Illusion of Control	The overemphasis on one's ability and skills to control events and people.	Kahneman & Lovallo, 1993; Simon, Houghton, & Aquino, 2000	Entrepreneurs exhibiting illusion of control will underestimate risk because they believe their skills can prevent negative occurrences.

Entrepreneurs exhibiting overconfidence tend to treat their assumptions as facts and do not see uncertainty associated with conclusions stemming from those assumptions (Simon, Houghton, & Aquino, 2000). Thus, they perceive less risk. Entrepreneurs may also perceive less risk as they are more optimistic about those assumptions (Russo & Schoemaker, 1992). The optimistic outlook results in less information search (Zacharakis & Shepherd, 2001). Thus, we posit that,

H_2: Entrepreneurs exhibiting higher overconfidence will perceive less risk.

Belief in the Law of Small Numbers

Belief in the law of small numbers refers to individuals using a limited number of informational inputs (a small sample of information, such as attributes and observations) to draw firm conclusions (Tversky & Kahneman, 1971). People ignore sample size in situations when it should play a role because of the representativeness heuristic (Tversky & Kahneman, 1971), which leads people to believe that small samples are highly representative of the populations from which they are drawn. Small, nonrandom samples are not likely to be statistically valid and are not representative of the population as a whole. Entrepreneurs do not use large random samples because they are rarely available. In addition, entrepreneurs do not have the resources to engage in systematic data collection (Busenitz & Barney, 1997).

It is more likely for entrepreneurs to receive disproportionately more positive information because failures are less likely to be well-publicized (Simon, Houghton, and Aquino, 2000). Furthermore, failures exist only for a short time and are therefore less cognitively salient (Golder & Tellis, 1993). A stronger belief in the law of small numbers coupled with mainly positive information is likely to induce an overly optimistic view of the venture (Kahneman & Lovallo, 1993) and thus lower perceived risk. This leads to the following hypothesis:

H_3: Entrepreneurs who have a stronger belief in the law of small numbers will perceive less risk.

Planning Fallacy

Decisionmakers may not consider past experiences in situations with similar circumstances because predictions, by their very nature, induce a future orientation. They tend to treat the current situation or decision as unique, thus isolating it from past experience. This is known as the planning fallacy (Kahneman & Lovallo, 1993). This fallacy tends to operate more strongly in situations that are unique, filled with uncertainties, and where there is a need for a focus on the future (Baron, 1998), such as the evaluation stage of decision making. The planning fallacy is affected by a future time orientation (Mitchell & James, 2001), and is particularly salient in Asian societies, where Confucian dynamism reflects a short-term versus long-term orientation, along with other characteristics (Hofstede & Bond, 1988).

An opportunity in the intertemporal markets does not yet exist except in the mind of the entrepreneur; the entrepreneur must forecast future prices of goods and resources and use intuitive judgment to gauge market potential (Kaish & Gilad, 1991). These forecasts of future outcomes are often anchored on plans and scenarios of success rather than on past results, and may possibly be overly optimistic (Kahneman & Lovallo, 1993). This

indicates that entrepreneurs will perceive less risk if the planning fallacy influences them to a greater extent.

H_4: Entrepreneurs who are influenced by planning fallacy to a greater extent will perceive less risk.

Illusion of Control

Illusion of control is a bias in which an individual overemphasizes the extent to which his or her skills can increase performance in situations where chance plays a large part and skill is not necessarily the deciding factor. For example, people fail to respond differentially to controllable and uncontrollable events (Langer, 1975). There are two reasons for this illusion of control (Langer, 1975). The first reason is that people are motivated to control their environment and the feeling of competence will result from being able to control the uncontrollable. The other reason is that skill and chance factors are closely associated and it is often hard to discriminate between chance and skill elements. This is different from overconfidence as overconfidence relates to an overestimation of one's certainty regarding their metaknowledge (Russo & Schoemaker, 1992), instead of their skills or abilities to cope with and predict future events.

It has often been suggested that entrepreneurs show an unusually strong preference for exerting control over their outcomes because they believe they can exert control over people and events (Shaver & Scott, 1991). Therefore, individuals exhibiting an illusion of control will underestimate risk because they believe their skills can prevent negative occurrences. Thus,

H_5: Entrepreneurs with a stronger illusion of control bias will perceive less risk.

RESEARCH METHODOLOGY AND DESIGN

We first describe the sampling procedure and explain the rationale behind sample selection. Then we operationalize the constructs for empirical testing. These measures are used in the questionnaire sent to the respondents.

Sampling

In this study, owners of small and medium-sized enterprises (SMEs) were identified. Das and Teng (1997) distinguished craftsman entrepreneurs from opportunistic entrepreneurs. Craftsman entrepreneurs are people who seek self-employment through starting a business, e.g., a corner store. These entrepreneurs usually have no desire to grow the business. Opportunistic entrepreneurs, on the other hand, are growth-oriented and continuously pursue opportunities. Since we were interested in entrepreneurs that wanted to exploit potential opportunities, we focused on opportunistic entrepreneurs.

A directory of the top 500 SMEs in Singapore was used as the sample. The Singapore SME 500 was the only independent performance ranking of Singapore's top SMEs, using audited financials and other key financial data. The founders of these companies were likely to be opportunistic, as they had to constantly look for new opportunities for their companies to be among the largest SMEs in Singapore.

A survey was used to collect data from these companies. The questionnaires, administered in English, were mailed to the respondents and confidentiality of the results was

Table 2

Summary Statistics of Entrepreneurs

Sex (N = 77)	
Male	97.0%
Female	3.0%
Total	100.0%
Highest Educational Standard Attained (N = 77)	
Secondary	6.1%
Postsecondary	86.4%
Primary and others	7.5%
Total	100.0%
Age (N = 77)	
Less than 40 years old	22.2%
40 to 60 years old	71.5%
More than 60 years old	6.3%
Total	100.0%
Race (N = 77)	
Chinese	92.4%
Indians	4.5%
Others	3.1%
Total	100.0%
Ownership (N = 77)	
Founded the business	79.0%
Bought over the business	21.0%
Total	100.0%
Size of Business (N = 72)	
Less than S$ 1 m	2.8%
Between S$ 1 m and S$ 25 m	48.6%
Between S$ 25 m and S$ 50 m	44.4%
More than S$ 50 m	4.2%
Total	100.0%

assured. Four hundred eighty-three unique addresses were available from the directory but only 459 addresses were valid. The companies with invalid mailing addresses were contacted by phone and fax to request their participation. A total of 465 companies were contacted through mail, fax, or phone in order to improve the response rate. A search of other business directories did not reveal whether the businesses with invalid contacts had changed premises or had discontinued operations. A final total of 77 completed surveys were returned, giving a 16.6 percent response rate. Table 2 presents some summary statistics of the sample.

Also, given the relatively small sample size, we were concerned about nonresponse error. We applied the strategies explicated by Churchill (1995) to overcome this bias. Firstly, we tried to increase initial response rate by selling respondents on the value of the research and the importance of their participation. We also followed up with phone calls and faxes for the initial nonrespondents. However, we did not attempt to adjust the results, as it was not evident from our sample size that the means of the variables could be meaningfully extended to the rest of the designated sample.

Examining the demographics of the entrepreneurs showed that 97.0 percent of the respondents were male and 86.4 percent had postsecondary education and higher. The profile was consistent with the profile of self-employed persons in Singapore

(Department of Statistics, 1997). We also wanted to know whether there were differences between founders of businesses and those who bought or inherited them. This was conducted using t-tests. Since the variable "belief in small numbers" had nearly half of the observations missing, we only performed t-tests for the following variables: illusion of control, planning fallacy, overconfidence, risk perception, and opportunity evaluation. The results revealed that founders and purchasers did not exhibit significant differences on any of these five cognitive constructs.

Operationalization of Constructs

A questionnaire (see Appendix) was constructed to measure each of the four independent factors (overconfidence, belief in the law of small numbers, planning fallacy, and illusion of control), the dependent variable (opportunity evaluation), mediating variable (risk perception), and control variables (demographics and risk propensity).

Risk Perception and Opportunity Evaluation. A short case study (see Section D of the Appendix) was developed for the respondents to evaluate. Cases can capture the complexities of the evaluation of opportunities and have been used in several studies that evaluated business venture decisions (e.g., Sitkin & Weingart, 1995, and Zacharakis & Shepherd, 2001). The case method allows the context to be specified so that the respondents are exposed to the same set of information (Finch, 1987; Hughes, 1998). To make the situations more concrete, we gave a name to the character, a practice recommended by other researchers[1] (Finch, 1987). Although long cases both contain rich information and are more typical to entrepreneurs, we kept the case to half a page long. This is because entrepreneurs might not be willing to take the time and effort to read and respond to a longer case. Nevertheless, the length is typical of cases as part of a survey (e.g., Hughes, 1998). The case also allows us to study the information that the respondents focus on. Following Sitkin and Weingart (1995), there was no indication in the case of the industry so that the respondents would not be influenced by the characteristics particular to that industry.

Immediately following the case study, four items (Questions 1 to 4 of Section D) were developed to measure perceived risk in the venture ($\alpha = .89$). The four items captured the probability of loss, level of uncertainty in the situation, size of possible loss, and overall risk of the venture. The four questions were summed to measure risk perception and a pretest indicated that the scale was reliable with $\alpha = .79$.

Three items (Questions 5–7 of Section D) were developed to capture whether the entrepreneurs viewed this venture as an opportunity ($\alpha = .90$). Specifically, they were developed to capture the perceived desirability and feasibility of the venture, and overall opportunity. As defined earlier, an opportunity is a future state that is deemed desirable and feasible. The pretest showed that the scale was reliable with $\alpha = .75$.

Belief in the Law of Small Numbers. To capture the respondents' belief in the law of small numbers, they were asked to evaluate the case and describe their reasons for con-

1. A reviewer pointed out that in the questionnaire, we should have an instruction asking the respondent to put him/herself in Mr. Tan's shoes. We agree with this suggestion. However, the case is still valid because respondents often enter into the spirit of the case, and identify themselves with the dilemmas that the character faces (Finch, 1987). Further, the instructions in the case specifically asked how much "you" (i.e., the respondent) agree with different statements. We thank the reviewer for this suggestion.

cluding whether they thought the venture was an opportunity (Question 8 of Section D). They were required to give evidence that influenced their conclusion. The explanations were analyzed and coded independently using the procedures of Simon, Houghton, and Aquino (2000) and Busenitz and Barney (1997). A code of 1 was given for responses that contained no mention of statistical reasoning, but relied on subjective opinions or rules of thumb (e.g., opinions of a few associates or customers). A code of −1 was given for responses that contained some form of statistical reasoning, including references to the importance of market research, variability, or sample size. Other remaining responses were assigned a value of zero. To form a continuous variable, the scores for all explanations were summed to give a single value.

Overconfidence. We adopted the format used by Russo and Schoemaker (1992) and Simon, Houghton, and Aquino (2000), but adapted them to the Singapore context to measure overconfidence. For each of the ten questions (Section C), there was only one correct numerical answer. The subjects were asked to build a confidence interval that they were 90 percent certain would capture the correct answer. If more than 10 percent of the answers fell outside the range, the respondent was overconfident. The quiz measured what Russo and Schoemaker (1992) called metaknowledge (i.e., an appreciation of what an individual knew and what he or she did not know). The respondents were asked about general and not specific knowledge because entrepreneurs draw upon a wide array of information when evaluating new venture ideas (Simon, Houghton, & Aquino, 2000).

Planning Fallacy. Two items (Questions 3–4 of Section B) were developed to capture the use of entrepreneurial experience in assessing the risk of a new venture idea (α = .73). The first item identified whether the respondents believed that entrepreneurial experience would help in assessing the risk of the new venture. The second item measured how likely the respondent would use past experience in businesses of a different nature to evaluate the new venture. The scores for both items were reversed and summed to obtain a measure of planning fallacy. The pretest showed that the scale was moderately reliable with α = .69.

Illusion of Control. This measure was also adapted from Simon, Houghton, and Aquino (2000). We measured the respondents' illusion of control using the three items (α = .80) in Questions 5–7 of Section B). The first two items were used to measure the subjects' perception of their own ability to predict certain uncontrollable outcomes. The third item was used to measure the perception of the subjects' belief that their skills were better than those of others, a belief that might not be related to a person's objective skills (Cooper, Woo, & Dunkelberg, 1988). The items focused on business events, which entrepreneurs often think that they can control or predict (Simon, Houghton, & Aquino, 2000).

Control Variables. Demographic information was collected in the questionnaire (Section E). Due to the low variance in gender, race, and education variables of the sample, only age was included in the analysis. A measure of risk propensity (Section A) was collected and used as a control variable in the analysis. We chose the Risk Style Scale (Forlani & Mullins, 2000) to operationalize risk propensity. This measure dealt with personal propensities toward financial risk taking, as opposed to other kinds of risks, and has shown its efficacy in assessing the construct of interest. Ray (1994) suggests that entrepreneurs do not have generalized risk-taking propensities, hence other research instruments that

focused on risk taking in everyday life situations might not be effective when applied to risk situations actually encountered by entrepreneurs.

ANALYSIS

Three linear regression models were used to test the hypotheses of the opportunity evaluation model. The three models were needed to test the mediation effects of risk perception on opportunity evaluation (Baron & Kenny, 1986), as shown in Figure 1.

Model 1 regressed *risk perception* (mediating variable) on the independent variables (*overconfidence*, *belief in the law of small numbers*, *planning fallacy*, and *illusion of control*). In addition to testing the conditions needed to show mediation, results from Model 1 were also used to test H_2, H_3, H_4, and H_5. Model 2 regressed opportunity evaluation (dependent variable) on the independent variables. Model 3 regressed opportunity evaluation on both the independent variables and risk perception. The three models are represented in mathematical form as follows:

$$\text{Model 1: } y_1 = a_1 + b_{11}x_{11} + \ldots + b_{16}x_{16} + e_1$$

$$\text{Model 2: } y_2 = a_2 + b_{21}x_{21} + \ldots + b_{26}x_{26} + e_2$$

$$\text{Model 3: } y_3 = a_3 + b_{31}x_{31} + \ldots + b_{37}x_{37} + e_3$$

where a_i = intercept of Model i,
e_i = error term of Model i, and
x_{ij} = independent variables in Model i, where $j = 1$ to 4 refers to the independent factors, $j = 5$ to 6 refers to control variables, and $j = 7$ refers to the mediating factor.

To verify the mediation effect of risk perception, four conditions had to be met (Baron & Kenny, 1986):

1) the independent variables had to affect the mediator in Model 1,
2) the independent variables had to affect the dependent variable in Model 2,
3) the mediator had to affect the dependent variable in Model 3, and
4) the effect of the independent variables in Model 3 had to be less than in Model 2.

That is, the inclusion of the mediator into the equation would reduce the effect of the independent variables on opportunity evaluation because part, if not all, of the effect was indirect through the mediator. If the independent variable had no significant effect on the dependent variable in Model 3, full mediation was supported. Full mediation implies that the independent variables affect the dependent variable only via the mediating variable. If the effect of the independent variables remains significant, only partial mediation is supported. Partial mediation implies that the independent variables affect the dependent variable directly, as well as indirectly, through the mediating variable.

Table 3 presents the means, standard deviations, and correlation coefficients among all the variables. These correlations showed that illusion of control was significantly related to both risk perception and opportunity evaluation. This indicated support for H_5. Further examination of Table 3 suggested little collinearity among the independent variables.

Table 4 reports the results of the three regression models to test all the hypotheses. The regression of opportunity evaluation on risk perception showed a highly significant negative relationship, strongly supporting H_1 that the perception of a lower level of risk is associated with more positive opportunity evaluation. Model 1 showed that collec-

Table 3

Means, Standard Deviations and Correlations of Variables

	Mean	SD	1	2	3	4	5	6	7	8
1 Opportunity Evaluation	12.97	4.10	1.00							
2 Risk Perception	19.04	4.92	−.58(**)	1.00						
3 Overconfidence	5.17	2.64	.30(*)	−.19	1.00					
4 Small Numbers	−.08	.99	.32(*)	−.16	.24	1.00				
5 Planning Fallacy	10.41	2.51	.05	.05	.02	−.21	1.00			
6 Illusion of Control	12.94	3.29	.34(**)	−.44(**)	.17	−.07	.16	1.00		
7 Age	46.55	8.61	.01	.12	.12	.16	.07	.09	1.00	
8 Risk Propensity	1.37	1.16	.29(*)	−.13	.13	.36(**)	.00	.09	−.03	1.00

tively, the independent variables explained a statistically significant proportion of the variance in risk perception at the .01 level (R^2 = .30, Adjusted R^2 = .20). Model 1 also showed that illusion of control was significantly related to risk perception ($\beta = -.76$, $p < .01$), supporting H_5. Model 1 did not support H_2, H_3, and H_4.

Model 2 was statistically significant at the .05 level (R^2 = .31, Adj. R^2 = .21). The coefficients for the belief in the law of small numbers variable ($\beta = 1.17$, $p < .06$) and illusion of control variable ($\beta = .40$, $p < .05$) were also statistically significant. Model 3, which included risk perception with the independent and control variables, explained 59 percent of the variance of opportunity evaluation with adjusted R^2 = .52. Risk perception was negatively related to opportunity evaluation ($\beta = -.50$, $p < .001$). This satisfied the third condition of mediation. By comparing the coefficients of illusion of control in Models 2 and 3, a mediation relationship was supported. The coefficients decreased in magnitude after adding risk perception, meeting the fourth condition to support a mediated relationship.

The results also indicated that belief in the law of small numbers had a direct effect on opportunity evaluation. Model 1 showed that belief in the law of small numbers had no significant relationship with risk perception. However, Model 2 showed that belief in the law of small numbers affected opportunity evaluation. Thus, belief in the law of small numbers had a statistically significant effect on opportunity evaluation, but not through the effect on risk perception. Neither of the control variables (i.e., age and risk propensity) was related to either opportunity evaluation or risk perception in all three models.

DISCUSSION AND IMPLICATIONS

This article looks at one part of the opportunity recognition process—the evaluation of opportunities. We use a cognitive approach to explore the extent that cognitive biases affect opportunity evaluation, mediated by risk perception. The strong negative relationship between risk perception and opportunity evaluation (H_1) is consistent with previous studies (e.g., Sitkin & Pablo, 1992; Sitkin & Weingart, 1995; Forlani & Mullins, 2000), in which risk perception has a significant effect on entrepreneurial activities, such as

Table 4

Results of Regression

	H_1 (dependent variable: opportunity evaluation)		Model 1 (y_1) (dependent variable: risk perception)		Model 2 (y_2) (dependent variable: opportunity evaluation)		Model 3 (y_3) (dependent variable: opportunity evaluation)		
	Coefficient	t	Coefficient	t	Coefficient	t	Coefficient	t	
Overconfidence (x_{i1})			−.17	−.64	.33	1.60	.24	1.51	
Small Numbers (x_{i2})			−1.08	−1.39	1.17*	1.91	.63	1.29	*Direct Effect*
Planning Fallacy (x_{i3})			.14	.52	.00	.00	.02	.42	
Illusion of Control (x_{i4})			−.76**	−3.34	.40*	2.23	.02	.13	*Full Mediation*
Risk propensity (x_{i5})			.17	.22	.34	.56	.14	1.26	
Age (x_{i6})			.07	.90	−.02	−.31	.01	.33	
Risk Perception (x_{i7})	−.50***	−5.98					−.50***	−5.17	*Mediator*
F-Statistic	35.72		2.92*		3.18*		8.23***		
R^2	.36		.30		.31		.59		
Adjusted R^2	.35		.20		.21		.52		

*p < .06
**p < .01
***p < .001

opportunity evaluation. For entrepreneurs, deciding whether an idea is an opportunity usually will demand judgments under complex or even uncertain conditions. Thus, perceived risk plays a significant role; when the perceived level of risk is low, the entrepreneur is more likely to give the opportunity a positive evaluation.

The findings show that two cognitive biases (i.e., illusion of control and belief in the law of small numbers) have a significant relationship with opportunity evaluation. While illusion of control is fully mediated by risk perception, belief in the law of small numbers has a direct effect on opportunity evaluation. The findings contrast with Simon, Houghton, and Aquino (2000) who found that risk perception partially mediated the relationship between the law of small numbers and illusion of control on the decision to start a venture. While Simon, Houghton, and Aquino (2000) studied a group of MBA students, this study surveyed entrepreneurs of the top SMEs in Singapore. Baron (1998) asserts that there could be key differences in the way that entrepreneurs and nonentrepreneurs process information.

In our study, the effect of illusion of control on opportunity evaluation is fully mediated by risk perception. The findings suggest entrepreneurs perceive that they are able to influence future outcomes and can take the appropriate actions to hedge the risks. However, they do not believe they can control market conditions. This is probably because they are owners of small businesses with limited influence on the market. On the other hand, the MBA students in Simon, Houghton, and Aquino's (2000) study could have been less realistic and viewed that the viability of the venture resulted from their own actions. Thus, the relationship between illusion of control and opportunity evaluation was only partially mediated by risk perception in that study. Future studies though could improve upon the measures used in this study. For instance, Question B5 of the survey states, "I can accurately forecast the total demand for my business." Since the sample of entrepreneurs is already successful, they are likely to agree to this statement. To increase variance in the answers and to be predictive of a more general illusion of control, the question could refer to "a business" instead of "my business." This rephrasing also applies to question B7.

Belief in the law of small numbers may not affect risk perception because when opportunistic entrepreneurs evaluate business opportunities, potential benefits of the venture may be more salient than risks since they are looking for reasons to accept ventures that help grow their companies (Das & Teng, 1997). As argued by Simon, Houghton, and Aquino (2000), overconfidence does not necessarily lead to lower risk because assumptions held by overconfident respondents may not lead to optimistic conclusions. Another possibility is that overconfidence may not be valid across domains. Future studies could use measures of overconfidence specifically related to the entrepreneurial context.

Planning fallacy also did not affect opportunity evaluation. This could be due to self-serving biases—even if the entrepreneurs considered past entrepreneurial experience in the decision-making process, they tend to attribute negative outcomes to external factors beyond their control and successes to their own efforts (Baron, 1998). Another possibility is that the questions used to assess planning fallacy are too vague. For instance, Questions B3 and B4 tap into general beliefs about whether experience is transferable to new business situations, and beliefs about whether key business issues are similar across different businesses. They might not assess the extent that a business owner relies on past experience to assess the risks or opportunities. In future studies, the questions could respectively be rephrased as "I use past entrepreneurial experiences to assess the riskiness of a new business" and "I use past experiences in dealing with business issues to run different types of businesses."

Future studies should include other considerations in the model. The results indicate that even though risk perception may be one of the more significant aspects in opportunity evaluation, the benefits of the venture have to be examined as well. Finucane and colleagues (2000) show that people tend to view benefits and risks as inversely related so that the judgments made are affectively consistent. Since entrepreneurs are usually enthusiastic and confident about their own venture ideas, they are likely to see their own ideas as beneficial and the risk as low. Other types of risk, besides financial risk, could be considered (Yates & Stone, 1992). How contextual factors (e.g., networking, exposure to role models and government aid) interact with cognitive processes (Forlani & Mullins, 2000) can also be explored in future studies.

While using cognitive processes to understand opportunity evaluation has been shown to be a valid approach, future studies can incorporate other noncognitive factors, such as skills (Herron & Sapienza, 1992), social skills (Baron & Markman, 2000), and knowledge acquisition and learning (Schafer, 1990; Brush, 1992) into the model. Adding these variables could potentially enable us to have a wider appreciation of opportunity evaluation.

Further, most of the entrepreneurs are male Chinese with postsecondary education. While this is the dominant profile of entrepreneurs in the Chinese-based economies like Hong Kong and Taiwan, future studies can examine whether the results generalize to other samples. For example, entrepreneurs with less education may perceive less risk because the opportunity costs of alternative employment are lower. A further limitation is that the results are based on the most successful SMEs in Singapore. Perhaps these entrepreneurs are less susceptible to the effects of cognitive biases—a factor that led them to be more successful in the first place. The alternative hypothesis is that past successes exacerbate these cognitive biases.

A practical implication of the finding is that entrepreneurs' opportunity evaluations are influenced by the belief in small numbers and the illusion of control. In the former, entrepreneurs might consider a few cases or samples to be representative of a larger population even if this is not the case. One way to attenuate this bias is to do systematic research. For example, before embarking on a business venture, entrepreneurs could find statistics of the size of the industry, the range of profits that firms in the industry make, and the failure rate of firms in that industry. Relying on a few cases (e.g., by talking to friends in the industry) might not be sufficient to make a comprehensive evaluation of an opportunity. The illusion of control happens when entrepreneurs are more confident of their ability to predict the outcome of events than they should be. There are several ways to overcome this bias. A suggestion is to do systematic research. Through research, the entrepreneur can be exposed to more information that can help them to make better-informed decisions rather than to merely use their intuition. Another suggestion is to seek the views and advice of others. In this way, they are able to have a wide range of information. Entrepreneurs can also be encouraged to recall past failures. This will force them to recognize that certain events are beyond their control, thus reducing the illusion of control bias.

Shane and Venkataraman (2000) argue that the domain of entrepreneurship research concerns the sources of opportunities and the people who discover, evaluate, and exploit these opportunities. While some people are more entrepreneurially alert than others (Kirzner, 1973), cognitive processes in part determine whether individuals see an opportunity or not. Baron (1999), for instance, showed that entrepreneurs do less counterfactual thinking than nonentrepreneurs. He argued that this is because entrepreneurs are forward looking, focusing on opportunities instead of regretting events that did not happen according to expectations. Our study shows that cognitive biases also determine whether oppor-

tunities are observed. Thus, entrepreneurial alertness may not only refer to an objective realization of an opportunity as envisaged by Kirzner (1973) but also the subjective realization of this opportunity. Studying the heuristics and biases that people use can contribute to the literature of opportunity recognition by showing how individuals process information that in turn affects their decision to start a business venture.

Shane and Venkataraman (2000) focus on the idiosyncratic knowledge and experiences that the individual brings to the opportunity recognition process. Future research can explore how team factors, such as experiences of team members, team processes, and external contacts can affect the opportunity recognition process. For instance, Houghton and colleagues (2000) found that teams are susceptible to the biases of the law of small numbers and illusion of control. These in turn affect the team's perception of the risk of a business idea. They also found that teams are more susceptible than individuals to the law of small numbers bias. Shepherd and Krueger (forthcoming) argue that the team's perceived abilities and collective efficacy influence the team's attitudes toward bringing into existence new products and services. Therefore, future studies can use the team as the unit of analysis. Finally, most studies, including this article, looked at how entrepreneurs evaluated their own business ideas. Future work can use external evaluations of the business idea. External evaluations by individuals experienced in the new venture process are crucial. These individuals, including angel investors, entrepreneurs, venture capitalists, patent lawyers, and accountants, can provide funds and contacts to nascent entrepreneurs.

We are hopeful that this study will spur a program of research that will enrich the conceptual foundations of opportunity recognition and evaluation based on a cognitive approach. The end goal, of course, would be that entrepreneurs have a better-developed body of knowledge from which to draw in order to effectively and efficiently make decisions.

APPENDIX

QUESTIONNAIRE

Section A

Please answer the following five items by circling the alternative ("a" or "b") you would feel most comfortable with.

1. a) An 80% chance of getting $40,000, or
   b) Receiving $32,000 for sure
2. a) Receiving $30,000 for sure
   b) A 20% chance of getting $150,000
3. a) A 90% chance of winning $200,000, or
   b) Receiving $180,000 for sure
4. a) Receiving $16,000 for sure, or
   b) 10% chance of getting $160,000
5. a) A 50% chance of getting $50,000, or
   b) Receiving $25,000 for sure

Section B

Please answer the following items by deciding how much you agree with the statements. ***(Circle the numbers that best reflect your opinions)***							
	Strongly Disagree						Strongly Agree
1. I want to earn more than my current income level in the long run.	1	2	3	4	5	6	7
2. I am looking for businesses or employment with higher income.	1	2	3	4	5	6	7
3. I believe that past entrepreneurial experience helps in assessing riskiness of a new business.	1	2	3	4	5	6	7
4. I believe that the key issues of running different types of businesses are similar.	1	2	3	4	5	6	7
5. I can accurately forecast the total demand for my business.	1	2	3	4	5	6	7
6. I can accurately forecast when larger competitors will enter the market	1	2	3	4	5	6	7
7. I can make my business a success, even though others may fail.	1	2	3	4	5	6	7

Section C

Please answer the following items, by deciding the ranges, which the right answers may be in. You should be 90% certain that the correct answers are in these ranges. If you have absolutely no idea where the answer lies, please fill in the maximum range possible for the question (i.e., 0 to 1,000).			
	Lower Limit	90% confidence that answer will be within this range	Upper Limit
E.g. What is the total population of Singapore in 1999?	3 million		4 million
1. What is the number of tourist arrivals to Singapore in 1999 (excluding Malaysian arrival by land)?	million		million
2. What is the total Gross Domestic Product of Singapore in 1999 (at current market price)?	$ billion		$ billion
3. How many airlines stop over at Singapore Changi Airport?	airlines		airlines
4. What is the number of private cars (per 1,000 people) here in Singapore in 1999?	per 1000		per 1000
5. What is Singapore's unemployment rate in 1999?	%		%
6. What is the daily newspaper circulation (per 1,000 people) here in Singapore in 1999?	per 1000		per 1000
7. What is the total vehicle quota (i.e. COE) for the year from May 2000 to April 2001?	thousand		thousand
8. What is the literacy rate of Singapore citizens aged 15 years and over in 1999?	%		%
9. What percentage of all residential units in Singapore are HDB flats?	%		%
10. What is the prime lending rate (per annum) in Singapore in 1999?	%		%

Section D

Please answer the following questions after reading the case study.

Mr. Tan is a successful manager with four years of experience at a multi-national corporation (MNC). Before that he worked in a medium sized local company for five years. The idea of being his own boss, taking calculated risks, and making a fortune all appeal to him. Hence he is thinking of starting his own business.

He has an idea for a new business and decides to ask around to see if it is a good idea. He has some very positive feedback from some potential customers and some associates who know the industry well. Mr. Tan does not have the resources to do an in-depth market research to find out whether the business is going to work and published data are too general to be useful. However he feels that there is money to be made based on the positive feedback from potential customers and his associates. He is enthusiastic about starting the business even though he has no experience in this industry or starting his own business.

There are a few MNCs in the same industry but they have not targeted the market segment that Mr. Tan is aiming for. He feels that the MNCs are likely to move into the market as long as the new business is successful and he will not be able to fend off this major threat. He is unsure whether the market is still growing or matured. If the market has reached maturity, it is likely for a new business to be squeezed out of the market. If the market is still growing, the new business will be able to survive the entry of MNCs into this market segment. He finds out that there are only a few small businesses that are still surviving in the industry.

Mr. Tan estimates he will need at least S$150,000 to finance the new business. As he has only S$40,000 in savings, he has to borrow from the bank or find partners to get the rest of the investment funds needed.

Please answer the following items by deciding how much you agree with the statements. ***(Circle the numbers that best reflect your opinions)***							
	Strongly Disagree						Strongly Agree
1. The overall risk of the business is high.	1	2	3	4	5	6	7
2. The probability of failure is high.	1	2	3	4	5	6	7
3. The founder stands to lose a lot financially.	1	2	3	4	5	6	7
4. There is a lot uncertainty when predicting how well the business will do.	1	2	3	4	5	6	7
5. I will consider this business an opportunity.	1	2	3	4	5	6	7
6. This business is worth considering.	1	2	3	4	5	6	7
7. This business is feasible given the situation.	1	2	3	4	5	6	7

Please fill in the blanks *(Keep it short and simple)*.

8. State issues that influenced your view on whether Mr. Tan should start the above business or not.
   (Include whatever additional information you may need to make a better decision)
   a)
   b)
   c)

Section E

Please fill in the blanks or circle the appropriate answers

1. Are you one of the owner(s) of this business?
   a) Yes *(If yes, please proceed to item 2)*
   b) No *(If no, please proceed to item 4)*
2. Are you one of the founder(s) of this business?
   a) Yes *(If yes, proceed to item 4)*
   b) No *(If no, proceed to item 3)*
3. How did you become one of the owner(s) of the business?
   a) Inherited the business
   b) Bought the business over from others
   c) Stock options
   d) Others _____
4. What industry is this business currently in *(can choose more than one if the company is involved in one or more industries)*?
   a) Retail
   b) Manufacturing
   c) Wholesale
   d) Construction
   e) Transportation and Communication
   f) Financial
   g) Professional
   h) Others *(please specify)* _____
5. How old is this current business?
   ☐ Years
6. What is the highest education standard attained?
   a) PSLE
   b) "N" levels
   c) "O" levels
   d) "A" levels
   e) Technical institute
   f) Diploma
   g) University degree
   h) Post-graduate degree
   i) Others *(please specify)* _____

7. What is your sex?
   a) Male
   b) Female
8. What is your race?
   a) Chinese
   b) Malay
   c) Indian
   d) Others *(please specify)* _____
9. What is your age?
   ☐ years old
10. Number of employees hired in this business (excluding yourself)?
    ☐ employees
11. Annual revenue of this business?
    a) Less than S$ 1 m
    b) Between S$ 1 m and S$ 25 m
    c) Between S$ 25 m and S$ 50 m
    d) More than S$ 50 m
12. What is the value of the fixed assets of this business?
    a) Less than S$ 1 m
    b) Between S$ 1 m and S$ 15 m
    c) Between S$ 15 m and S$ 30 m
    d) More than S$ 30 m
13. How many hours per week do you spend on this current business?
    ☐ Hours
14. Name of Business: _____
15. Business Address: _____

    _____

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