



COGNITIVE BIASES, RISK PERCEPTION, AND VENTURE FORMATION: HOW INDIVIDUALS DECIDE TO START COMPANIES

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EXECUTIVE SUMMARY

Despite the high risk involved, thousands of individuals decide to start ventures. Past research, however, has found that entrepreneurs do not have a high-risk propensity, that is, a great willingness to knowingly take risks. This study, therefore, explores how individuals cope with the risks inherent in their decisions, and suggests that entrepreneurs may not perceive the riskiness of starting ventures.

The study's findings suggest that risk perceptions may differ because certain types of cognitive biases lead individuals to perceive less risk. Cognitive biases are common types of mental shortcuts used to make judgments. This study examines three cognitive biases that previous research has suggested may lower risk perception. The first, overconfidence, refers to the failure to know the limits of one's knowledge. The second bias tested, the illusion of control, occurs when individuals overemphasize the extent to which

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their skill can increase performance in situations where chance plays a large part and skill is not necessarily the deciding factor. Because the individuals believe that they can control largely uncontrollable events, they also think they can accurately predict the outcome of the events. Finally, the third bias, the belief in the law of small numbers occurs when an individual uses a limited number of informational inputs (a small sample of information) to draw firm conclusions.

This study's sample consisted of 191 students pursuing a Masters of Business Administration. The students' responses to a survey based on a case study regarding a decision to start a venture were examined. The survey included questions about the students' willingness to start the venture, their perception of the venture's riskiness, and the extent to which they exhibited cognitive biases in their decision processes.

The study's findings tentatively suggest that individuals start ventures because they do not perceive the risks involved, and not because they knowingly accept high levels of risks. The belief in the law of small numbers lowered an individual's perceptions of a venture's riskiness, suggesting that some individuals draw firm conclusions from small samples. An illusion of control also decreased risk perception, suggesting that individuals starting ventures might not acknowledge that certain tasks, important to the venture's success, are beyond their control.

Some argue that biases might be associated with venture failure. If this is the case, the very processes that increase the likelihood of starting a venture may actually decrease performance. Entrepreneurs may choose to minimize their biases by soliciting and paying heed to the advice of outsiders, or by using group decision-making techniques, such as devil's advocacy or dialectical inquiry.

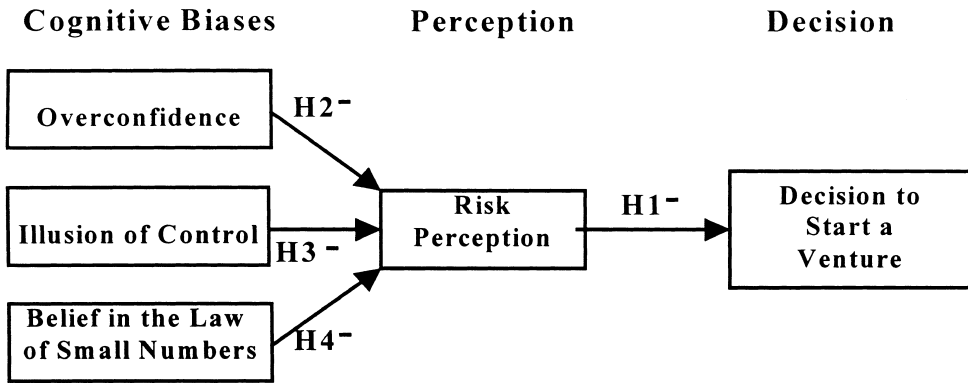
Others, however, suggest that early in the decision process, biases may be beneficial because they lower risk perception, which allows entrepreneurs to generate the commitment needed for success. Even if this is true, entrepreneurs should still institute processes to increase learning so the venture can adjust to unfolding realities and avoid any damage caused by initial misperceptions. Similarly, entrepreneurs need adequate safety nets in case their biases lead them to encounter unforeseen difficulties. The potential positive and negative effects of biases and perceiving low levels of risk suggest the importance of exploring this area further. © 1999 Elsevier Science Inc.

INTRODUCTION

Although entrepreneurs often become dissatisfied with their new venture's poor economic performance (Cooper and Kendall 1995) and over half of all ventures fail within five years (Cooper, Woo, and Dunkelberg 1988), thousands of individuals start ventures. Researchers have, therefore, called for studies explaining why individuals decide to start companies, even though it is very risky (e.g., Boyd and Vozikis 1994; Busenitz and Barney 1997; Krueger, 1993; Krueger and Brazeal 1994). In efforts to answer this question, scholars tested whether the risk propensity of entrepreneurs was greater than that of managers. Risk propensity is the tendency to take actions that one has judged to be risky (Sitkin and Pablo 1992). Surprisingly, research found that this trait did not differentiate entrepreneurs from others (e.g., Brockhaus 1980).

In response, some scholars suggested individuals take risky actions (i.e., actions that have a high possibility of disappointing outcomes) because they perceive less risk than most (Kahneman and Lovallo 1993; MacCrimmon and Wehrung 1990; March and Shapira 1987). Even when individuals evaluate identical situations, some people conclude the situation is very risky, whereas others believe it is not (e.g., Nutt 1986, 1993). Even if they do not have a high-risk propensity, individuals who perceive less risk than others might unknowingly take risky action.

If risk perception influences risk-taking, it becomes important to determine what leads to variations in risk perception. Some scholars have argued that individuals' decision process, particularly a greater susceptibility to cognitive biases, may lower their perception of risk (Busenitz and Barney 1997; McCarthy, Shoorman and Cooper 1993;



The numbers shown on the paths of the model reflect some of the paper's hypotheses. Several hypotheses are not shown because they represent indirect effects (i.e., mediation hypotheses) rather than a specific hypothesized relationship.

FIGURE 1 Model of the decision to start a new venture.

Palich and Bagby 1995; Shaver and Scott 1991). Cognitive biases are subjective or pre-disposed opinions that may emanate from specific heuristics (Bazerman 1990; Busenitz and Lau 1996). Although biases help individuals cope with their cognitive limitations, they may result in less rational, less comprehensive decision-making (Barnes 1984). These biases often arise when making complex and uncertain decisions (Schwenk 1984), and may be especially prevalent among entrepreneurs (Busenitz and Barney 1997).

If, as argued, cognitive biases directly influence risk perception, and risk perception directly influences the decision to start a venture, then cognitive biases indirectly affect the decision through their effect on risk perception. In other words, risk perception mediates the relationship between cognitive biases and the decision to start a venture. Even though entrepreneurship researchers have theorized about associations suggested above (e.g., Busenitz and Barney 1997; Cooper et al. 1988; Palich and Bagby 1995), no research has formally tested these relationships. To fill this gap, we empirically examine two research questions: Are variations in risk perception associated with the decision to start a venture? and, Do cognitive biases lead individuals to perceive different levels of risk in the same decision situation?

To answer these questions, we test the model shown in Figure 1. The following section describes the study's theoretical background, defines the constructs in the model, and presents the hypotheses. The research methods are then detailed and the empirical tests of the hypothesized relationships are reported. Finally, the article discusses the study's findings and implications.

VENTURE FORMATION AND DECISION PROCESSES

Starting a Venture

Scholars have investigated the influence of several factors on venture formation (e.g., Gartner 1985; Gnyawali and Fogel 1994; Reynolds and Miller 1992; Westhead 1990) including culture, demographics, economics and an individual's circumstances (e.g., being laid off). These approaches, however, don't explain the volitional nature of entrepre-

neurship: For instance, why out of hundreds who are laid off will only one person start a venture (Shaver and Scott 1991)? Researchers, therefore, began to examine whether entrepreneurs exhibited certain traits (e.g., locus of control and need for achievement) to a greater extent than others (e.g., McClelland 1961), only to find that, for the most part, they did not (Begley and Boyd 1987). This dead end (Gartner 1985) led researchers to study variations in cognitions and decision processes to explain entrepreneurial activity (Bird 1992; Boyd and Vozikis 1994; Busenitz and Barney 1997; Krueger 1993; Krueger and Brazeal 1994; Shaver and Scott 1991). This approach suggested that an individual's perceptions, rather than objective reality, explain the decision to start a venture (Krueger 1993; Krueger and Brazeal 1994).

The move from traits to cognition was reflected in how researchers examined why, even though new ventures are very risky, individuals decide to start them. Early scholars, who focused on traits, theorized that entrepreneurs had a greater risk propensity than others (e.g., Brockhaus 1980). These researchers argued that the high failure rate of most new ventures suggested that individuals with a greater willingness to knowingly take risky actions would be more likely to start ventures. Surprisingly, however, later empirical testing indicated that risk propensity was not related to venture formation (e.g., Brockhaus 1980; Busenitz and Barney 1997).

This paradoxical finding suggests that it might be valuable to examine the assumptions underlying the risk propensity approach. Proposing that entrepreneurs needed a higher risk propensity to brave the risks inherent in starting a venture implicitly implied that individuals would perceive the risks involved. However, if individuals vary in their perceptions regarding a venture's riskiness, they do not necessarily need a high-risk propensity to start new ventures. They may proceed because they perceive little risk. In other words, risk perception, rather than risk propensity, might explain why individuals start ventures (Palich and Bagby 1995).

This suggestion is consistent with several studies that emphasized the importance of risk perception in explaining risky action. Scholars studying first moving (Lieberman and Montgomery 1988), plant expansion (Nutt 1986; 1993), and innovation (Staw 1991) proposed that managers proceed with an action because they do not perceive the action's riskiness (Kahneman and Lovallo 1993; March and Shapira 1987). Furthermore, Sitkin and Pablo (1992) suggested that entrepreneurship studies' omission of risk perception might have hindered their explanatory power.

Entrepreneurs may be particularly likely to perceive low levels of risk. Cooper and his colleagues (1988) found that 95% of entrepreneurs believe that their ventures will most probably succeed even though over half of all new ventures fail. Similarly, Palich and Bagby (1995) found that entrepreneurs were more likely than managers to perceive strengths and opportunities and less likely to perceive weaknesses and threats. Finally, two thirds of high technology entrepreneurs asserted they were not taking any risk (Corman, Perles and Vancini 1988). Although these studies focused on practicing entrepreneurs, it logically follows that perceiving low levels of risk may influence the individuals' initial decision to start ventures. Hypothesis 1 follows:

H1: Perceiving a lower level of risk is associated with the decision to start a venture.

Cognitive Biases and Risk Perception

If risk perception explains the decision to start a venture, then it is important to determine why risk perception varies among individuals. Understanding the decision-making

process may provide some clues. For decades, the economic assumptions underlying the decision-making literature erroneously implied that individuals would perceive similar levels of risk when viewing identical decision-making scenarios (Nutt 1986, 1993). These assumptions presumed that individuals were fully rational, profit-maximizing, information processors. Closer study of managerial decision-making, however, challenged this view by showing that complex managerial decisions, such as the decision to start a new venture, are a function of behavioral factors and not only economic maximization (e.g., Cyert and March 1963; March and Simon 1958).

Research on behavioral decision-making indicated that individuals neither comprehensively search for, nor accurately interpret, information because their cognitive capacity is limited (Cooper, Folta and Woo 1995; March and Simon 1958). To cope with these limitations, they employ cognitive heuristics and simplifying strategies which may lead to a number of cognitive biases (Schwenk 1986). Entrepreneurs may be particularly prone to biases (Busenitz and Barney 1997; Shaver and Scott 1991) because they unintentionally simplify their information processing to diminish the stress and ambiguity associated with the decision to start ventures (Duhaime and Schwenk 1985; Hansen and Allen 1992).

Because cognitive biases influence the information individuals notice, and the interpretation they reach, biases may affect risk perception (Barnes 1984; Schwenk 1984). Certain cognitive biases may cause individuals to discount the negative outcomes and the uncertainty associated with their decisions (Barnes 1984; Hogarth 1980; Schwenk 1984), thereby leading to the underestimation of risk (Cooper, Woo and Dunkelberg 1988; Shaver and Scott 1991).

Although there are dozens of cognitive biases that may affect risk perception, this study utilized three criteria to identify those biases that are most likely to arise when evaluating the decision to start a venture. A bias was included if previous literature indicated it (1) occurred when facing a novel situation, (2) reduced one's perceptions of risk, and (3) arose during the evaluation stage of decision-making. It is appropriate to focus on the evaluation stage because the purpose of this study is to determine how individuals assess the riskiness of a new venture. Three biases fit the above criteria and play an important role in explaining entrepreneurial activity: overconfidence, the illusion of control, and the belief in the law of small numbers (e.g., Busenitz and Barney 1997; Cooper, Woo and Dunkelberg 1988; McCarthy, Schoorman, and Cooper 1993; Schwenk 1986; Staw 1991).

Oskamp (1965) initially described the first cognitive bias, overconfidence. The bias refers to the failure to know the limits of one's knowledge (Russo and Schoemaker 1992) and tends to be ubiquitous, arising across many different information domains (Barnes 1984; Fischhoff 1982). Overconfidence may occur because individuals do not sufficiently revise their initial estimates after receiving new data (known as the anchoring and adjusting heuristic). They, therefore, do not realize the extent to which their estimates may be incorrect (Tversky and Kahneman 1974). Individuals may also become overconfident because they base their certainty on the ease with which they can recall reasons for confidence (known as the availability heuristic) (Russo and Schoemaker 1992). However, an easily remembered rationale may not increase the accuracy of the person's information (Schwenk 1986).

Because decision-makers exhibiting overconfidence treat their assumptions as facts, they may not see the uncertainty associated with conclusions stemming from those assumptions. They, therefore, may erroneously conclude that a certain action is not risky. This is consistent with the arguments of several theoretical articles that suggest

the overconfidence bias lowers an individual's perception of the riskiness of a strategy (Barnes 1984; Russo and Schoemaker 1992). Specifically, leaders exhibiting the overconfidence bias may steer their firms into unknown territories (Schwenk 1986) and invest in risky ventures (McCarthy, Schoorman, and Cooper 1993).

There is some evidence that overconfidence plays an especially important role when one considers whether to start a venture. For example, Busenitz and Barney (1997) found entrepreneurs display greater overconfidence than managers do. Although their study examined entrepreneurs after they started a venture, a tendency towards overconfidence may have affected these entrepreneurs when they were initially evaluating the ventures' riskiness. The discussion above suggests the following:

H2: Overconfidence decreases one's perception of the level of risk associated with forming a venture.

The second bias tested in this study is the illusion of control. This bias occurs when an individual overemphasizes the extent to which his or her skill can increase performance in situations where chance plays a large part and skill is not necessarily the deciding factor (Langer 1975). To alleviate discomfort with uncertainty, individuals convince themselves that they can control and accurately predict the outcome of uncertain future events (Duhaime and Schwenk 1985). Whereas overconfidence relates to an overestimation of one's certainty regarding current "facts" (i.e., information), the illusion of control refers to an overestimation of one's skills and consequently his or her ability to cope with and predict future events.

Because managers with an illusion of control believe that they can anticipate events (Langer 1975) that affect the venture's outcome (Duhaime and Schwenk 1985), such as market demand or competitive entry (Teece 1986), they may not realize how risky the venture is. Furthermore, individuals exhibiting an illusion of control may underestimate risk because they believe their skills are greater than those of other managers and that these skills can overcome negative occurrences. Managers with an illusion of control bias may generate overly optimistic performance estimates (Barnes 1984; Duhaime and Schwenk 1985; Hogarth 1980; Schwenk 1984). These estimates may lead to risky decisions, such as acquiring poorly performing firms (Duhaime and Schwenk 1985) and developing innovative products (Staw 1991).

There is evidence that the illusion of control may play a role in the decision to start a venture. An individual's belief in his or her ability to control a venture's outcome affects his or her intentions to form a venture (Boyd and Vozikis 1994). This belief, however, is based upon perceptions (Shaver and Scott 1991) and may be inaccurate, or an illusion. For example, Krueger and Brazeal, (1994) argued that entrepreneurs often overlook very real obstacles. Furthermore, even when venture founders have few characteristics associated with venture success, they believe their company will outperform similar ventures (Cooper, Woo and Dunkelberg 1988). Accordingly, we hypothesize the following:

H3: An illusion of control decreases one's perception of the level of risk associated with forming a venture.

The belief in the law of small numbers is evident when an individual uses a limited number of informational inputs (a small sample of information) to draw firm conclusions (Hogarth 1980; Tversky and Kahneman 1974). For example, an entrepreneur may be unduly encouraged by limited feedback from two potential customers who state they

would buy a new venture's proposed product. A small sample, however, may not represent the population as a whole, because it is variable and lacks predictive validity. Thus, individuals exhibiting this bias may often fall prey to base-rate error, that is, they ignore base-rate probabilities of similar endeavors and overlook the 50% failure rate of new ventures (Cooper, Woo and Dunkelberg 1988).

Small samples contain a disproportionate number of successes because failures are less likely to be well publicized. For example, Inc. Magazine articles describe successful new ventures more often than failed attempts. Furthermore, individuals are likely to remember successful firms and forget (or never learn about) the failures because failures may only exist for a short time (Golder and Tellis 1993). Also, individuals who informally discuss business alternatives with a limited number of associates are likely to receive overly positive feedback (Kahneman and Lovallo 1993). Thus, relying on a small sample of data causes one to underestimate risk.

Even if individuals gather feedback through an impartial process, the smaller the sample, the greater the chances of receiving only positive information. If they heard from all potential customers they would have also had at least some (and possibly a preponderance of) negative responses. Therefore, individuals who assume that a small sample of information represents the entire population may not adequately perceive the possibility of losses or the full range of possible outcomes.

Although the link between the belief in the law of small numbers and risk perception in business situations has not been directly tested, previous research suggests a relationship exists (e.g., Schwenk 1984). For example, scholars argue that individuals are likely to utilize limited amounts of positive information to make overly optimistic forecasts (Barnes 1984; Kahneman and Lovallo 1993). Furthermore, Schwenk (1986) argues that managers can induce the belief in the law of small numbers in followers to gain support for risky actions. Similarly, the greater tendency of entrepreneurs to use limited information in decision-making (Busenitz and Barney 1997) suggests that the belief in the law of small numbers may have affected one's perception of risk when deciding to start a venture. Thus, theory and empirical evidence lead to the following hypothesis:

H4: The belief in the law of small numbers bias decreases one's perception of the level of risk associated with forming a venture.

The previous hypotheses argue that cognitive biases directly influence risk perception, and, in turn, risk perception directly influences the decision to start a venture. This suggests that cognitive biases indirectly affect the decision to start a venture through their influence on risk perception. In other words, risk perception mediates the relationship between cognitive biases and the decision to start a venture. A mediated process assumes that a third variable (e.g., risk perception) represents the generative mechanism through which the set of focal independent variable(s) (e.g., cognitive biases) influence the dependent variable (e.g., the decision to start a venture) (Baron and Kenney 1986).

Hypothesizing mediated relationships is consistent with Sitkin and Pablo's (1992) model of risk-taking, which identifies risk perception as an intermediate construct that drives risky behavior. Similarly, our model of venture formation, depicted in Figure 1, proposes a mediated process. Based on this model, and extending the logic of Hypotheses 1–4, we predict the following:

H5: The relationship between overconfidence and the decision to start a venture is fully mediated by risk perception.

H6: The relationship between illusion of control and the decision to start a venture is fully mediated by risk perception.

H7: The relationship between the belief in the law of small numbers and the decision to start a venture is fully mediated by risk perception.

METHODS

Design

Consistent with past research on decision-making processes and perceptions (e.g., Dearborn and Simon 1957; Fredrickson 1984; Fredrickson and Mitchell 1984), this study examines students' responses to surveys based on a teaching case. The surveys captured the students' cognitive biases, risk perception and decision to start a venture. Schwenk (1995) convincingly argues that conducting research in a controlled setting, such as the classroom, is especially promising when researching cognitive biases and competitive strategic decision-making. Other researchers used similar methods to study related topics including risk-taking (Sitkin and Weingart 1995) and willingness to form a venture (Johnson 1990; Krueger and Brazeal 1994).

Data was collected at two different times, approximately a week apart, in efforts to ensure that the measures were independent. The researcher informed the subjects that there was no one correct answer, and that responses were confidential and not for the purpose of evaluation. The researcher also told students not to discuss the case or surveys with others, a message that was repeated in the written instructions accompanying the survey. The students read and completed both parts of the survey at home prior to pre-specified class periods. Debriefing occurred during the class period on the day the last part of the survey was due.

Specifically, the 12-page Harvard Business School Case (Clarke 1988) described a revolutionary new product, contact lenses for chickens. The lens curbed the chickens' natural tendency to fight, a tendency that had economic implications for chicken farmers. In addition to describing the venture's proposed product and market, the case provided encouraging and discouraging information regarding the venture's potential. Although based upon a real situation, we doubled the product costs and made market demand more unpredictable, thereby increasing actual risk. The case's length, ambiguity and complexity allowed subjects to use a variety of approaches to determine whether or not to start the venture.

Using a case ensured all subjects analyzed the same venture. This minimizes several researchers' concern that fundamental relationships may depend upon the type of venture being studied (Johnson 1990; Krueger and Brazeal 1994; Shrader and Simon 1997). The design also ensured each subject faced the same level of actual risk because they were assessing the same venture. A field study would have made it difficult to determine whether variations in risk assessments stemmed from differences in risk perceptions or differences in actual risk. Finally, cases capture much of the complexity of making actual business decisions (Manimala 1992).

Subjects

One hundred and ninety-one out of 232 Masters of Business Administration students at a major state university volunteered to participate in a research project on decision-

making. The subjects came from many different backgrounds, varying in their enrollment status (e.g., part-time versus full time, traditional versus non-traditional), work experience, organizational level, and major. The mean age was 28.4 years ($SD = 4.60$) and the average job tenure was 2.75 years ($SD = 4.42$). Forty-seven percent of the sample were female and 53% were male.

As suggested by several researchers (e.g., Krueger and Brazeal 1994; Shaver and Scott 1991) this study avoided looking backwards through the lens of existing entrepreneurs to explore how individuals decide to start ventures. Instead, the study examined the decision processes of individuals while they were evaluating a venture, rather than after starting the venture. Therefore, the demands of running a new venture did not influence the way in which the individuals generally approached decisions (Busenitz and Barney 1997).

Measures

Data were collected about risk perception, cognitive biases, and starting a venture. Appendix A presents specific measures, and, where appropriate, the relevant inter-item reliability.

Decision to Start a Venture

The researchers computed the mean score of two survey items to measure an individual's decision to start the venture described in the case ($\alpha = 0.84$).

Risk Perception

To assess the individual's perception of the riskiness of the venture, the study asks eight closed-ended questions adapted from previous research (MacCrimmon and Wehrung 1990; Nutt 1986 1993; Thomas and McDaniel 1990). An individual's risk perception score was the mean of the eight items ($\alpha = 0.85$). A factor analysis determined that the measure was unidimensional.

Overconfidence

This study's survey used a well-established format to measure overconfidence, asking the respondents to answer 10 questions (e.g., Russo and Schoemaker 1992). Each question had only one correct numerical answer. For each question, respondents established a range of possible values (i.e., they provided a low and a high estimate) that they were 90% certain would capture the correct answer. If, for all of the questions, more than 10% of the correct answers fell outside of the range, the respondent was overconfident (he or she developed too narrow ranges). Each correct answer that fell outside of the range was scored as a one, rather than a zero. The researchers summed the scores for the 10 questions to measure overconfidence.

Consistent with past research (e.g., Fischhoff, Slovic and Lichtenstein 1977; Russo and Shoemaker 1992), the respondents were asked about general, and not specific, knowledge. Assessing confidence regarding general information was appropriate because entrepreneur's draw upon a very wide array of information when evaluating new venture ideas (Kaish and Gilad 1991).

Illusion of Control

Whereas the overconfidence measure captured the subjects' certainty of their knowledge, the illusion of control measure emphasized the respondents' certainty in their ability to master and predict difficult-to-control, future business events. This research measured the respondents' illusion of control using the mean value for three items ($\alpha = 0.67$). The authors based the general phrasing of two of the three items on the measures in Langer and Roth's (1975) research, which was one of the few illusion of control studies to use survey-based measures. To capture the illusion of control, Langer and Roth (1975) asked respondents about their ability to predict certain uncontrollable outcomes. The third item in our study, *I could succeed at making this venture a success, even though many other managers would fail*, implicitly implies that the respondent believes that his/her skills are greater than those of others, a belief that appears to be unrelated to a person's objective skills (Cooper, Woo and Dunkelberg 1988).

Consistent with past management literature on illusion of control (e.g., Duhaime and Schwenk 1985; Schwenk 1986), this study's survey focused on business events that managers and entrepreneurs often, mistakenly, think they can control or predict. The authors selected events based upon past research findings and the recommendations of industry experts and academic scholars. For example, all three sources indicated that entrepreneurs make inaccurate predictions about the timing of competitive entry. Entrepreneurs often overestimate their ability to fend off competitors, falsely believing that their skills have enabled them to develop a technology that others cannot readily copy (Teece 1986; Zajac and Bazerman 1991).

The Belief in the Law of Small Numbers

The subjects answered questions about the case to capture their belief in the law of small numbers (Busenitz and Barney 1997; Fong, Krantz and Nisbett 1986; Fong and Nisbett 1991). Subjects reported three pieces of evidence from the case that influenced their decision of whether to start the venture. They then explained why each piece of evidence influenced them. The three explanations were content analyzed and independently scored (Busenitz and Barney 1997; Fong, Krantz and Nisbett 1986; Fong and Nisbett 1991).

If a respondent's explanation indicated that he or she relied on a small sample (e.g., feedback from two potential customers) for his or her decision, the explanation received a one to indicate the belief in the law of small numbers. The rater assigned a negative one if the explanation indicated that an individual relied on larger samples or realized that small samples may lack predictive validity. The explanations that remained were assigned a zero. To form a continuous variable, the scores from the three explanations were summed (Busenitz and Barney 1997; Fong, Krantz and Nisbett 1986; Fong and Nisbett 1991), allowing values to range from negative three to positive three. Two raters (one Ph.D. candidate in management and one student with an MS in psychology and completing an MBA) achieved an inter-rater reliability of 0.95 on a subset of the data. Reasons for discrepancies were discussed and areas of disagreement resolved.

Controls

Flexibility, optimism and risk propensity are three factors that affect a decision-maker's tolerance for risk, that is, his or her acceptance of ambiguity (Wally and Baum 1994).

This study controls for these variables because they may affect the decision to start a venture, although past studies suggested that risk propensity may not be important (e.g., Busenitz and Barney 1997) and is difficult to capture (Shaver and Scott 1991). The study measured flexibility using the average score of 10 items ($\alpha = 0.67$) (Wally and Baum 1994). The average of a 3-item scale ($\alpha = 0.68$), adapted from past research (Wally and Baum 1994), captured optimism.

Risk propensity was measured using two standardized scenarios (Brockhaus 1980; MacCrimmon and Wehrung 1990). Each scenario contained a risky and safe alternative. The risky alternative included both a clearly defined positive and negative outcome, whereas, the safe alternative included only one outcome, which was middle of the road. Subjects indicated how high the chances of the positive outcome had to be to induce them to pursue the risky alternative. A relatively low score suggested a high-risk propensity—the respondents would pursue the risky alternative even if the positive outcome was unlikely. The scores for the two scenarios were added to determine the risk propensity across the two business settings.

Analysis

We used two regression analyses to test the direct effects posited in Hypotheses 1–4. The first model tested Hypothesis 1 by regressing the decision to start a venture on risk perception, after including the control variables. The second model examined Hypotheses 2–4 by regressing risk perception on the three cognitive biases.

To verify Hypotheses 5–7, the analysis had to meet the four conditions needed to establish that a mediated relationship exists (Baron and Kenney 1986). Regression model two, which tested Hypotheses 2–4, also tested the first of these mediation conditions, namely, that the independent variables (cognitive biases) affected the mediator (risk perception). We used a third regression model to examine if the independent variables (cognitive biases) affected the dependent variable (the decision to start a venture), which is the second condition needed to establish mediation. A fourth model regressed the dependent variable on the independent variable and the mediator. If the mediator affected the dependent variable, the equation supported the third mediation condition. Finally, the fourth condition was met if the effect of the independent variable on the dependent variable is less in the fourth equation (the one including the mediator) than in the third equation (which excluded the mediator). In other words, the effect of cognitive biases on the decision to start a venture must decrease when risk perception is included in the equation. We entered the three control variables (e.g., flexibility, optimism, risk propensity) prior to testing the effects of the independent variables and the mediator on the decision to start a venture (Baron and Kenney 1986).

The fourth condition supports full mediation if the independent variable (i.e., a cognitive bias) has no significant effect on the dependent variable when the mediator is also in the equation. Full mediation implies the entire effect of the independent variable is indirect through its influence on the mediator variable. In contrast, the fourth condition supports partial mediation if, after adding the mediator, the effect of the independent variable decreases, but remains significant. Partial mediation indicates that the independent variable affects the dependent variable directly, as well as indirectly through the mediator.

TABLE 1 Means, Standard Deviations, and Correlations among Measures of Biases, Risk, and the Decision to Start a Venture

	Mean	SD	1	2	3	4	5	6	7
1. Decision to start a venture	3.38	1.09							
2. Risk perception	3.11	0.68	-0.58**						
3. Overconfidence	6.49	2.85	-0.02	0.03					
4. Ill. of control	3.10	0.74	0.28**	-0.20**	0.10				
5. Small numbers	-0.24	0.94	0.29**	-0.26	-0.10	0.09			
6. Flexibility	2.87	0.50	-0.07	0.70	0.01	-0.80	0.04		
7. Optimism	3.78	0.61	0.08	-0.09	-0.14	0.22**	-0.05	-0.25**	
8. Risk propensity	42.39	20.81	0.07	-0.07	-0.08	0.25**	-0.05	0.02	0.12

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

RESULTS

Table 1 presents the means, standard deviations, and correlations among the study variables.

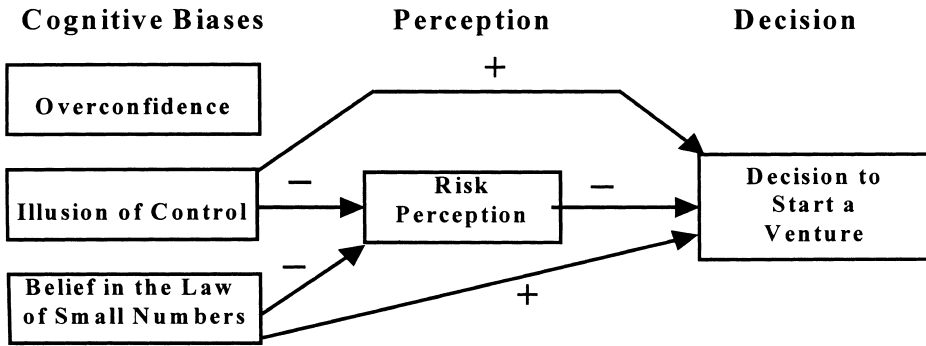
Table 2 contains the results of the four regression models used to test Hypotheses 1–7. The results of model 1 ($R^2 = 0.33$, $p < 0.001$) support Hypothesis 1. There is a significant negative relationship between risk perception and the new venture decision ($\beta = -0.58$, $p < 0.001$), after controlling for optimism, flexibility, and risk propensity. None of the control variables were significant, indicating that tolerance for risk does not affect one's decision to start a venture. Model 2, which tested Hypotheses 2–4, found that collectively the biases explained a significant proportion of the variance in risk perception ($R^2 = 0.10$, $p < 0.001$). Consistent with Hypotheses 3 and 4, the illusion of control ($\beta = -0.19$, $p < 0.01$) and the belief in the law of small numbers ($\beta = -0.24$, $p < 0.001$) lowered risk perception. Hypotheses 2 was not supported, however, as there was no significant relationship between overconfidence and risk perception ($\beta = -0.01$, NS).

Hypotheses 5–7 explored whether risk perception mediated the effects of cognitive biases on the decision to start a venture. In addition to testing Hypotheses 2–4, model 2 also tested the first mediation condition: a significant relationship between the media-

TABLE 2 Results of Regressions: The Relationships among Biases, Risk-taking, and the Decision to Start a Venture

	Model 1 Decision to Start Venture		Model 2 Risk Perception		Model 3 Decision to Start Venture		Model 4 Decision to Start Venture	
Optimism	0.02	(0.20)			0.02	(0.20)	0.02	(0.20)
Flexibility	-0.03	(-0.33)			-0.03	(-0.33)	-0.03	(-0.33)
Risk propensity	0.04	(0.57)			0.04	(0.57)	0.04	(0.57)
Risk perception	-0.58***	(-9.60)					-0.58***	(-9.22)
Overconfidence			-0.01	(-0.13)	0.00	(0.00)	-0.03	(-0.42)
Ill. of control			-0.19**	(-2.63)	0.29***	(3.81)	0.15*	(2.32)
Small numbers			-0.24***	(-3.37)	0.29***	(4.01)	0.16*	(2.51)
F statistic	23.27***		0.63***		4.97***		14.53***	
R ²	0.33		0.10		0.15		0.38	
Adj. R ²	0.32		0.09		0.12		0.35	

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$. All parameter coefficients are standardized estimates. The t -statistics are in parentheses.



Only significant relationships are shown, with the sign of the relationship indicated along each path.

FIGURE 2 Revised model of the decision to start a new venture.

tor (i.e., risk perception) and the independent variables (i.e., cognitive biases). As mentioned, the illusion of control and the belief in the law of small numbers lowered risk perception. In contrast overconfidence did not lower risk perception so it cannot affect the decision to start a venture indirectly through risk perception.

Model 3 reports the results for the second condition, a relationship between the independent variables (i.e., cognitive biases) and the decision to start a venture. The overall equation was significant ($R^2 = 0.15, p < 0.001$), as were the coefficients for the belief in the law of small numbers ($\beta = 0.29, p < 0.001$) and the illusion of control ($\beta = 0.29, p < 0.001$). Overconfidence, however, was not significantly related to the decision to start a venture ($\beta = 0.00, NS$).

Finally, model 4 regressed the decision to start a venture on the independent variables (i.e., cognitive biases) and the mediator (i.e., risk perception). The model explains 38% of the variance in the decision to start a venture ($p < 0.001$). The significant relationship between risk perception and the decision ($\beta = -0.58, p < 0.001$) satisfied the third condition for mediation. To examine the last condition, we compared the coefficients for the cognitive biases in model 3 to their coefficients in model 4. The comparison showed that the coefficients decrease in magnitude after adding risk perception, suggesting a mediated relationship. However, the coefficients for the illusion of control ($\beta = 0.15, p < 0.05$) and the belief in the law of small numbers ($\beta = 0.16, p < 0.05$) were still significant in model 4 supporting partial, rather than full, mediation. Thus, Hypotheses 6 and 7 were only partially supported. The analysis provided no support for Hypothesis 5 because overconfidence was not significant in any of the equations.

DISCUSSION

Every year, thousands of individuals decide to start ventures despite the high risks involved. This study's research questions asked: 1) Are variations in risk perception associated with this decision?, and 2) Do cognitive biases lead individuals to perceive different levels of risk? The results, as summarized in Figure 2, tentatively suggest that the answer to both of these questions is yes.

Specifically, the study found that individuals who perceive lower levels of risks were more likely to decide to form a venture, supporting Hypothesis 1. Although it is not

surprising that perceiving greater risk generates a no-go decision, differences in risk perceptions explained over 33% of the variation in the decision even though individuals evaluated the exact same venture. This result helps unravel the riddle posed by past findings. Entrepreneurs do not need a greater willingness to take risks if they do not perceive the riskiness of their acts.

Consistent with this argument, the study found that the controls (flexibility, optimism, and risk propensity) were not significantly related to the decision to start a venture. This suggests that individuals who start ventures do not knowingly accept higher levels of risks (Brockhaus 1980; Busenitz and Barney 1997). Starting a venture may be so risky that even individuals with a high tolerance for risk will not proceed if they perceive the true risks involved.

However, the lack of a significant relationship between optimism and the decision to start a venture may have occurred because the survey measured optimism in a specific context, namely one's expectations regarding the economy and his or her life. Other studies, however, that used more general measures found optimism can affect both cognition and behavior (e.g., Larwood and Whittaker 1977). Future research, therefore, should explore the questions in this study using other operationalizations of optimism.

The second research question asked whether cognitive biases lead individuals to perceive different levels of risk. The study found that individuals who had an illusion of control (Hypothesis 3) and a belief in the law of small numbers (Hypothesis 4) had a lower perception of a venture's riskiness. In contrast, overconfidence (Hypothesis 2) was not significant.

There are two possible reasons why overconfidence did not lower risk perception. First, while overconfident individuals have a greater belief in the accuracy of their assumptions, those assumptions may not lead to optimistic conclusions. That is, an individual may be certain regarding discouraging assumptions. Second, the lack of significance may have occurred because overconfidence was measured using diverse items that were not directly associated with the case decision. We, however, think the second reason less likely because people are overconfident across domains (Russo and Schoemaker 1992), suggesting the items do not need to reflect the case. Furthermore, entrepreneurs' decisions stem from a wide range of non-business and untraditional information, indicating that it is appropriate to use diverse items (Kaish and Gilad 1991). Future research, however, needs to explore these issues further using other operationalizations of overconfidence.

The study partially supported Hypothesis 6 and 7. The illusion of control and the belief in the law of small numbers do indirectly affect the decision to start a venture through their effect on risk perception. However, these biases also may directly affect the decision, or indirectly affect it via a mediator not tested in this study. For example, they may increase decision-making speed in complex environments, thereby leading individuals to start ventures (Busenitz and Barney 1997).

IMPLICATIONS

The study's findings have helped refine our understanding of risk-taking behavior in two ways. First, they support Sitkin and Pablo's (1992) contention that research needs to distinguish between risk perception and risk propensity. Second, the results suggest

that it may be important to include risk perception as a mediator when analyzing the effects of independent variables on risk-taking (Sitkin and Weingart 1995).

The study also has implications for practitioners. The malleability of cognitions, relative to traits, suggests that after decreasing the actual riskiness of venturing, organizations promoting entrepreneurship should focus on the determinants of risk perception (Sitkin and Pablo 1992). For example, organizations can disseminate credible information about role models and publicize stories about entrepreneurial successes (Krueger and Brazeal 1994). They, however, need to be careful and emphasize only those areas where entrepreneurs are particularly likely to succeed or areas that yield the greatest rewards to society.

This study's findings suggest some interesting avenues for research on new venture performance. Both research and conventional management wisdom suggest that the quality of the decision process may affect a firm's success (Schwenk 1986). For example, less comprehensive decision-making lowers a venture's performance (Smith et al. 1988). The question arises: Are biases associated with venture failure? Individuals exhibiting biases when deciding to start a venture may not be able to cope with the risks after the venture is running. Ironically, the very processes that increase the likelihood of starting a venture may actually decrease performance. Hopefully, further study of biases, risk perception, and venture performance may explain what constitutes a "true opportunity" and why many start-ups fall short of the entrepreneurs' expectations.

If future research suggests that biases lower performance, managers may want to minimize their biases. To counteract the belief in the law of small numbers bias, managers should pay more careful attention to the reliability and predictive validity of information from small samples. They can compare the information they gather to more general base-rates for that class of actions. To minimize the illusion of control, entrepreneurs should recall past failures. Recalling past events increases one's belief that they will reoccur (a process known as the availability heuristic), forcing the entrepreneur to recognize that certain situations are difficult to predict and beyond his or her control. This suggestion is consistent with Larwood and Whittaker's (1977) finding that managers who had unsatisfactory planning experiences were less prone to overestimating their skills.

Despite the suggestions above, it will still be extremely difficult for entrepreneurs to minimize biases in their decision processes. In fact, individuals are often unaware that they exhibit biases (Hogarth 1980). Thus, modifying group decision-making processes may hold the key to coping with individual-level biases (Russo and Schoemaker 1992; Schweiger, Sandberg and Ragan 1986). The safeguards above could be institutionalized through group decision-making techniques such as devil's advocacy or dialectical inquiry (Schweiger, Sandberg and Ragan 1986). Similarly, entrepreneurs may need to solicit and pay heed to the advice of outsiders (McCarthy, Schoorman and Cooper 1993).

Some, however, argue that biases should not be minimized because biases generate the action and the commitment (Schwenk 1986) necessary to starting a venture (Busenitz and Barney 1997). Even if entrepreneurs should not limit their biases, they still need to take steps to minimize any negative ramifications stemming from those biases. For example, they might avoid damage caused by initial misperceptions (Busenitz and Barney 1997) if they institute processes to increase learning, thereby, allowing the venture to adjust to unfolding realities (Cooper 1993). Similarly, even if lowering risk perception

through biases is a prerequisite to starting a venture, the entrepreneur still needs to make sure that adequate safety nets are in place.

LIMITATIONS AND FUTURE RESEARCH

Although this research took a logical first step toward understanding the relationship among cognitive biases, risk perception and venture formation, the reader should be aware of the need to build upon these results. For example, although this study focused on the possibility of economic loss, future researchers need to examine other types of risk, including social risks (Amit, Muller and Cockburn 1995; Birley and Westhead 1994). Future research also needs to explore additional factors that may directly, or indirectly through risk perception, predict the decision to start a venture. These factors include changes in employment status (Amit, Muller and Cockburn 1995), exposure to role models who have started ventures (Dubini 1989), and access to advice about how to start a venture (Chrisman, Hoy, and Robinson 1987). Also, although this study arguably examined the three biases that were most likely to impact risk perception, other biases need to be examined.

Although the study's design provided many advantages, including comparing subjects' risk perceptions of the same venture, it may have resulted in a conservative test of the hypotheses. The class setting might have led students to approach the case more analytically, which suggests they exhibited fewer biases and perceived higher risk. Furthermore, the influence of risk perception on risk-taking may have been minimized because students could not incur actual negative consequences of their choices. Researchers need to explore the extent to which the relationships in this study can be generalized to field settings, different types of ventures, and one's general intention to start a venture.

Although much is left to be done, the present research contributes to the literature by taking a logical first step towards understanding the relationship among biases, risk perception, and deciding to start a venture. The potential positive and negative effects of biases and perceiving low levels of risk suggest the importance of exploring this area further.

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APPENDIX A

Survey Items

Decision to Start a Venture: Respondents had to decide whether the decision-maker in the case, Daniel Garrison, should quit his job to start a venture. The respondents were told that they should put themselves in exactly the same situation as Daniel Garrison and determine what they would do. Responses to each of the two questions ($\alpha=0.84$) below ranged from 1, indicating definitely do not start the venture, to 5, definitely start the venture.

Should ODI go ahead and introduce the contact lens?

Assume that all the principals of ODI had the choice of liquidating the venture for a modest profit; what should ODI do?

Risk Perception

Using the nine items below ($\alpha=0.85$), respondents were asked their perceptions of the level of risk associated with bringing the new product to market and starting ODI. Responses were recorded on a scale ranging from 1 (“strongly disagree”) to 5 (“strongly agree”).

I believe that . . .

The probability of ODI's contact lens introduction doing poorly is very high.

The amount ODI could lose by introducing the lens is substantial.

There is great uncertainty when predicting how well ODI will do with their contact lens introduction.

The overall riskiness of ODI's contact lens introduction is high.

Overall I would label the option of introducing the contact lenses as something negative.

I would label introducing the contact lenses as a potential loss.

Introducing the contact lenses will have negative ramifications for ODI's future.

There is a high probability of ODI losing a great deal by introducing the contact lenses.

Overconfidence

For each of the following questions, respondents provided a low and a high estimate such that they were 90% certain the correct answer fell within these limits. (On average, they expected to get 9 of 10 questions correct).

What percent of new car buyers use some form of financing to buy their car?

How many of Fortune's 1990 "Global 500," the world's biggest industrial corporations (in sales) were Japanese?

What percentage of adults 18 or older, say they have made a purchase they did not need in order to get a prize offered over the phone?

What was the total audited worldwide daily circulation of the Wall Street Journal during the first half of 1990?

What is the average price of a new car?

What was the total U.S. trade balance for all goods and services for the 12-month period ending October 1994? Indicate surplus or deficit and number.

In 1993, how many children under age five needed care because their mothers worked?

How many master's degrees in business and management were conferred in the United States in 1987?

What is the shortest navigable distance (in statute miles) between New York City and Istanbul?

How many German automobiles were sold in Japan in 1989?

Illusion of control: Respondents were asked how well they might perform on different tasks related to the introduction of ODI's contact lenses. Subjects reported their responses to the three questions ($\alpha=0.67$) on a scale ranging from 1 ("strongly disagree") to 5 ("strongly agree").

I could . . .

accurately predict total market demand for the contact lenses.

accurately predict when larger competitors would enter the market.
succeed at making this venture a success, even though many other managers would fail.

Belief in the Law of Small Numbers: Respondents listed three important pieces of information contained in the case that influenced their decision of whether to start the venture. They then explained why the information influenced them. Explanations were content analyzed to determine the presence of the belief in the law of small numbers. Two independent raters obtained an inter-rater reliability of 0.95 on a sub-sample of data.

Flexibility

Flexibility was measured using the 10-item scale below ($\alpha=0.67$). A score of 1 indicated strong agreement and a 5 indicated strong disagreement.

For most questions there is just one right answer once a person is able to get all the facts.

People would be a lot better off if they would just forget about words like probably, approximately, and perhaps.

I don't like things to be uncertain and unpredictable.

I like to have a place for everything and everything in its place.

I set a high standard for myself, and I feel others should do the same.

*I do not always tell the truth.

I think that I am more strict about right and wrong than most other people.

Once I have my mind made up, I seldom change it.

I am in favor of very strict enforcement of all laws.

Most of the arguments I get into are over matters of principle.

*Item with an asterisk are reversed scored.

Optimism

A 3-item scale ($\alpha=0.68$) measured optimism. A score of 1 indicated strong agreement and a 5 indicated strong disagreement.

I feel the economy will expand next year.

I usually expect improvement in my life and the economy.

I feel my performance will improve next year.

*Items with an asterisk are reverse scored.

Risk Propensity

Respondents were directed to read and respond to scenarios. The following was one of the two scenarios utilized in the study.

Assume that you are president of a large multinational corporation, Dominion Integrated. PMG Inc. has threatened to sue your company for patent violation. The case has not yet been filed in court, since PMG are waiting to hear your response to their offer to settle out of court. They have proposed that your company pay them \$300,000 (about 6% of your company's profits). If you do not agree to this proposal, PMG will file their suit, which would, if you lose the case, probably involve a loss of \$1,100,000 in damages. If you win in court, you would only incur a very small sum for legal expenses.

If the chances of winning the court case were 99 out of 100, you would probably recommend taking the case to court. On the other hand, if the chance of winning the court case were 1 out of 100, you would probably recommend accepting the settlement. As the chances were increased, there would be a point at which you would decide to refuse the settlement. What is this switch-over point: that is, what is the lowest chance of winning that would prompt you to take the case to court?

Risk propensity items were reverse scored so that larger numbers indicated a greater risk propensity.