Entrepreneurial Cognition

Three Essays on Entrepreneurial Behavior and Cognition Under Risk and Uncertainty

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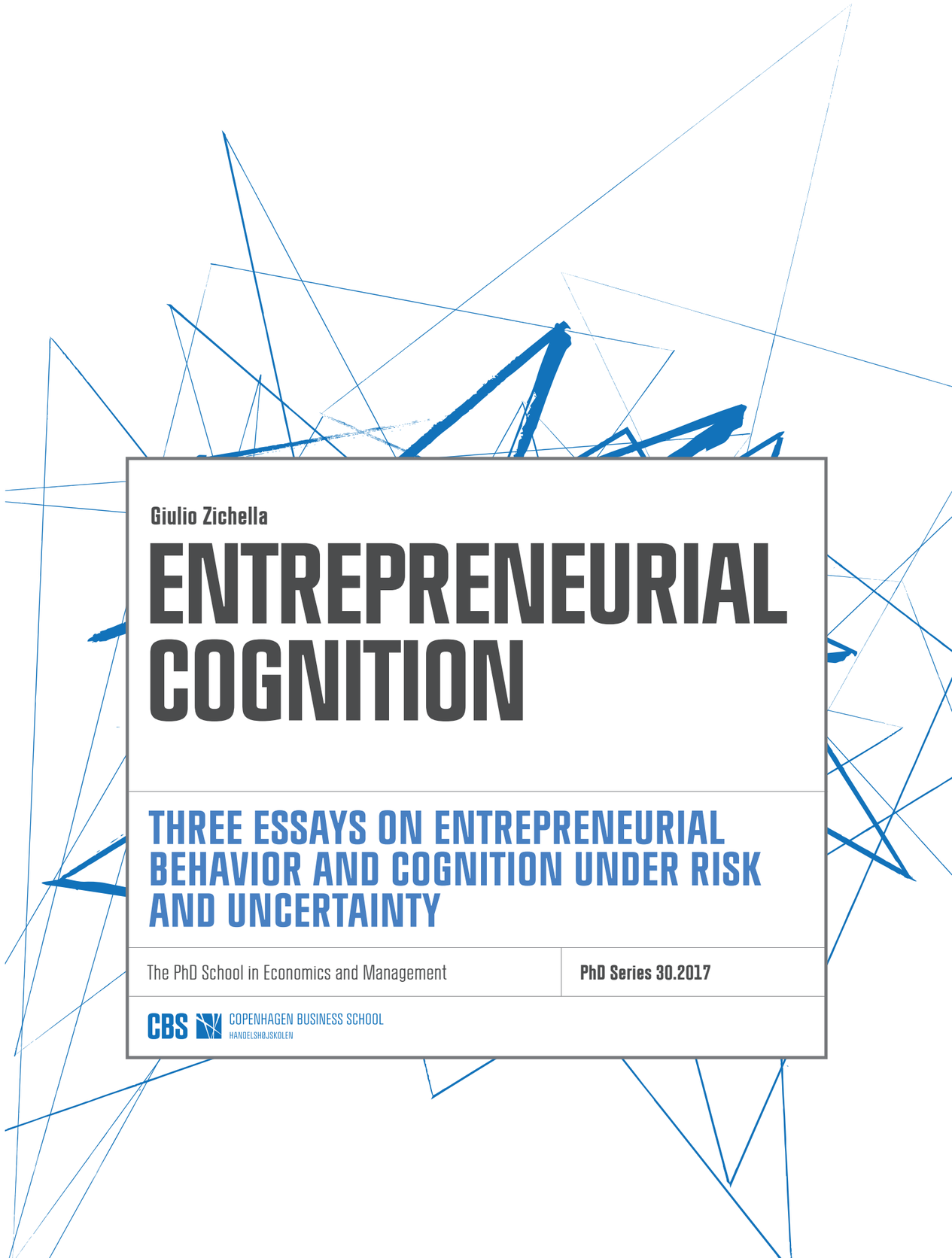

Giulio Zichella

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The PhD School in Economics and Management | **PhD Series 30.2017**

CBS COPENHAGEN BUSINESS SCHOOL
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ENTREPRENEURIAL COGNITION

Three essays on entrepreneurial behavior and cognition under risk and uncertainty

Giulio Zichella

Supervisors: Toke Reichstein, Valentina Tartari

The PhD School of Economics and Management

Copenhagen Business School

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"The PhD School in Economics and Management is an active national and international research environment at CBS for research degree students who deal with economics and management at business, industry and country level in a theoretical and empirical manner".

ENGLISH SUMMARY

Research in decision making and cognition has a long tradition in economics and management and represents a substantial stream of research in entrepreneurship. Risk and uncertainty are two characteristics of the decision environment. It has long been believed that entrepreneurs who need to make business judgments in such environments are less risk- and uncertainty-averse than non-entrepreneurs. However, this theoretical prediction has not been supported by empirical evidence. Instead, entrepreneurs have been found to be more susceptible to cognitive biases and heuristics. These cognitive mechanisms, which represent deviations from rational judgment, help entrepreneurs simplify their decision-making and carry out decisions in a timely manner. As a result, a growing stream of research in entrepreneurship focuses on the cognitive differences between entrepreneurs and non-entrepreneurs when faced with risk and uncertainty.

The purpose of this dissertation is to contribute to this latter stream of research by examining how individuals differ in their cognition and behaviors in situations of risk and uncertainty in a controlled environment. More specifically, the dissertation explores how entrepreneurs and non-entrepreneurs differ in their behavioral susceptibility to prior outcomes, increasing degrees of risk, risk perception, and predictive information. The empirical analyses are based on data from a laboratory experiment that I designed and conducted in October 2014. Individuals participating in the experiment were selected based on their entrepreneurial intentions, with a high degree of comparability and a limited impact of prior entrepreneurial experience. The data include measures of behavior in situations of risk and uncertainty with real monetary incentives, risk perception, and a number of individual characteristics, including personality traits, cognitive biases, and demographics.

In the first essay, I explore how individuals with and without entrepreneurial intentions differ in terms of risk behavior by testing their sensitivity to prior monetary outcomes and an increasing degree of risk. In the second essay, I explore whether individuals with and without entrepreneurial intentions differ in their risk perceptions by examining how they focus their attention on different aspects of risk, specifically either possible monetary outcomes or the probabilities of obtaining these outcomes. In the third and final essay, I test individuals' sensitivity to a lack of predictive information when making choices under uncertainty. In sum, the dissertation contributes to a more nuanced understanding of entrepreneurial cognition in situations of risk and uncertainty by illustrating the direct link between cognition and behavior. Since the dissertation focuses on individuals with limited entrepreneurial experience, it makes important practical contributions with respect to novice entrepreneurs and their cognition in cases of risk and uncertainty. As a result, it provides important insights into how entrepreneurs and non-entrepreneurs differ from a cognitive perspective.

DANSK SAMMENDRAG

Beslutningstagning og kognitiv forskning har en lang tradition i økonomi og ledelse og udgør en væsentlig del af forskningen om iværksætteri. Risiko og usikkerhed er to kendetegn for beslutningsmiljøet. Iværksættere, der tager forretningsbeslutninger i sådan et miljø, har længe menes at være mindre usikkerhed- og risikoavers sammenlignet med ikke-iværksættere. Dog er sådan en teoretisk forudsigelse ikke blevet underbygget af empiriske beviser. I stedet har iværksættere vist sig at være mere modtagelige til at anvende kognitive bias og heuristik end sammenlignelige grupper. Disse kognitive mekanismer, som repræsenterer en afvigelse fra rationalitet i beslutningsprocessen, hjælper iværksættere med at forenkle beslutningsprocessen og træffe beslutninger i tide. Som følge heraf viser en voksende andel af forskningen om iværksætteri, hvordan de observerede forskelle mellem iværksættere og ikke-iværksættere når de står over for risiko og usikkerhed skyldes kognition.

Formålet med denne afhandling er at bidrage til den sidstnævnte forskning. Dette gøres ved at undersøge i et kontrolleret miljø, hvordan individer adskiller sig i kognition og adfærd når de er står over for risiko og usikkerhed. Afhandlingen undersøger mere specifikt, hvordan iværksættere og ikke-iværksættere er forskelligt modtagelige i deres adfærd når det kommer til forudgående resultater, stigende grader af risiko, risikoopfattelse og forudsigende informationer. De empiriske analyser er baseret på data fra et laboratorieeksperiment, som jeg designede og udførte i oktober 2014. Personerne der deltog i forsøget blev udvalgt på baggrund af deres iværksætterintentioner med en høj grad af sammenlignelighed og en begrænset effekt af forudgående iværksættererfaring. Det empiriske data inkluderer mål på adfærd under risiko og usikkerhed med reelle monetære incitamenter, risikoopfattelse og en række individuelle karakteristika herunder personlighedstræk, kognitive bias og demografi.

I det første essay undersøger jeg, hvordan iværksættere og ikke-iværksættere er forskellige i deres risikoadfærd ved at teste deres følsomhed over for tidligere monetære resultater og stigende grad af risiko. I det andet essay undersøger jeg, om iværksættere og ikke-iværksættere er forskellige i deres risikoopfattelse ved at undersøge, hvordan de fokuserer på forskellige aspekter af risiko og særligt hvordan de enten fokusere på de potentielle monetære resultater eller sandsynligheden for at få dem. I det tredje og sidste essay undersøger jeg iværksættere og ikke-iværksætteres følsomhed over for manglende forudsigende information, når de træffer beslutninger i uvished. Kort sagt bidrager afhandlingen til en mere nuanceret forståelse af iværksætteres kognition, når de står over for risiko og usikkerhed ved at vise den direkte forbindelse til adfærd. Dette giver et vigtigt indblik i hvordan iværksættere og ikke-iværksættere adskiller sig fra hinanden ud fra et kognitivt perspektiv.

ACKNOWLEDGEMENTS

This dissertation is a promise kept. A potential has become reality. At the beginning of my journey as a Ph.D. student, I promised myself that I would pursue my aspirations to grow professionally and personally in academia. Staying true to such a promise has proved to be an exciting, yet challenging, journey. What I have experienced has helped me more than I could ever have imagined. Therefore, I am thankful to all who shared this journey with me. During my years working at Copenhagen Business School, I have been fortunate enough to be surrounded by people whose advice and positive criticism helped me shape my research, avoid mistakes, and arguably become a better person, both professionally and personally. Thank you all for such a great, inspiring time together.

I wish to thank my supervisors for navigating with me through the rough waters of experimental research. I am immensely grateful to my first supervisor, Toke Reichstein. Thanks to his support, insightful criticism, and expertise, my research reached a level I certainly would not have been able to achieve alone. Therefore, grazie, Toke. As an intellectually (over)curious person, I will never forget your advice on how to keep focus and think straight. I also would like to express my very great appreciation to my second supervisor, Valentina Tartari. Her honest feedback and guidance, especially in the critical early stages of my Ph.D., proved indispensable in the long run.

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Finally, I want to thank my mother, Anna; Mane; and my wife, Jenny. Thank you for being the best traveling companions anyone could wish for.

This dissertation is dedicated to the loving memory of my father, Giorgio Zichella (1947-2012). A promise kept for you.

Giulio Zichella

Frederiksberg, July 2017

TABLE OF CONTENT

CHAPTER 1: INTRODUCTION

This dissertation consists of three chapters that explore how two groups—individuals with and without entrepreneurial intentions—differ in their cognition and behavior in situations of risk and uncertainty. Chapter 2 finds that contextual factors make individuals with entrepreneurial intentions more willing to choose risk than individuals without entrepreneurial intentions. Chapter 3 shows how the two groups differ in two cognitive respects (focus of attention and risk perception) when choosing between investment opportunities. Chapter 4 shows that individuals with entrepreneurial intentions are less sensitive than individuals without entrepreneurial intentions to a lack of information on the probabilities of monetary outcomes.

This dissertation seeks to contribute to entrepreneurship literature by exploring the cognition and behavior mechanisms that underlie entrepreneurial actions and how these mechanisms differ between individuals with and without entrepreneurial intentions in situations of risk and uncertainty (Mitchell et al., 2002, 2007). Business environments push individuals to make decisions with limited information, and the ways in which they select and make use of such information play an important role in guiding their behavior (Busenitz & Barney, 1997). For this reason, I focus my research efforts on understanding how specific pieces of information increase risk and uncertainty, taking into account how cognitive biases affect individuals with entrepreneurial intentions versus individuals without entrepreneurial intentions. More specifically, I explore: (i) how prior monetary gains increase individuals' bias towards risk-taking under different degrees of risk; (ii) how *risk perception*, defined as the subjective assessment of risk in a given opportunity (Weber et al., 2002), and *focus of attention*, defined as an individual's selection of available information through attention (March & Shapira, 1987, 1992), are unique aspects of entrepreneurs' decision making in situations of risk; and (iii) how

individuals with entrepreneurial intentions are less sensitive to an absence of information about probabilities and, hence, more willing to choose uncertain monetary opportunities.

Risk and Uncertainty in Entrepreneurship: An Overview of the Chapters' Complementarity

Since the work of Frank Knight (1921), risk and uncertainty, defined as measurable and immeasurable risk, respectively, have been treated as two separate concepts in entrepreneurship research. Entrepreneurs operate under both risk and uncertainty, depending on the information available. While it is unrealistic to think about entrepreneurs as individuals operating under a complete lack of predictive information (e.g. on returns of investment opportunities), it is important to understand how entrepreneurs use available information to make decisions. For this reason, in this dissertation, I distinguish both conceptually and empirically between risk and uncertainty in Chapters 2 and 4. In particular, in Chapter 2, I manipulate information on prior winnings and degree of risk, while in Chapter 4, I manipulate predictive information. In Chapter 3, I qualitatively assess individuals' use of available information with a focus on risk perception. Overall, these three chapters present complementary views on how cognition and decision making in situations of risk and uncertainty differ among individuals with different entrepreneurial intentions.

Risk is an important factor in the entrepreneurial environment. An entrepreneur can be defined as someone who runs and bears the risk of a business. In this light, research on entrepreneurs' risk-taking has focused primarily on understanding whether (and how) entrepreneurs differ from non-entrepreneurs in their stable and contextual risk preferences. Based on prior research in economics, entrepreneurs are typically considered (and, to some

degree, still believed to be) less risk averse than non-entrepreneurs (Kihlstrom & Laffont, 1979). Yet, empirical evidence has not confirmed such perceptions (Brockhaus, 1980; Holm et al., 2013; Koudstaal et al., 2015; Stewart & Roth, 2001), hinting instead that there are cognitive differences between entrepreneurs and non-entrepreneurs with respect to risk-taking. To test these differences, in Chapters 2 and 3, I focus only on financial risk. Overall, I argue for and find support for the greater importance of two specific cognitive biases—the prior gain effect and the risk propensity effect—in individuals' increased risk-seeking behavior. Furthermore, I test how individuals with and without entrepreneurial intentions differ in their risk perceptions, which is important for explaining behavior in cases of risk (e.g. opportunity evaluation and choice; Keh et al., 2002; Simon et al., 2000).

Uncertainty is another important element in the entrepreneurial environment. Especially when introducing highly innovative products or services, entrepreneurs often lack predictive information on key variables, such as sales forecasts or returns. Research on entrepreneurs' behavior in cases of uncertainty is relatively more recent than research on risk and often questions how entrepreneurs make use of predictive information (McKelvie et al., 2011). According to effectuation theory, entrepreneurs use heuristics and biases to shape (rather than predict) an uncertain future (Sarasvathy, 2001). In Chapter 4, I operationalize uncertainty as the complete lack of information on monetary opportunities, arguing that individuals with entrepreneurial intentions have a greater propensity to bear uncertainty than individuals without entrepreneurial intentions.

The importance of understanding how entrepreneurs act in situations of risk and uncertainty—and how such behavior can be optimized—is underlined by the emergence of a recent research stream in entrepreneurship that uses experimental evidence to explore the topic (for a review, see Shepherd, 2015; Shepherd et al., 2015). Cognitive research requires a careful

examination of the causal link between behavior and cognition. In such cases, an experimental design (as opposed to the use of questionnaires) is most appropriate. The overall challenge for this dissertation is to observe and measure differences in cognition and behavior in situations of risk and uncertainty between comparable samples of individuals with and without entrepreneurial intentions.

Empirical Setting and Sample Relevance

To answer these research questions, I collected data from a quasi-laboratory experiment that I designed and conducted in October 2014. The subjects comprised 72 individuals with different entrepreneurial intentions. The sample was chosen for several reasons: first, it sought to facilitate an understanding of cognition before entrepreneurial experience. Entrepreneurial intentions[1]—defined here as an individual's active interest in starting a firm—are appropriate for testing whether some of the cognitive mechanisms found in experienced entrepreneurs can also be found in individuals with limited entrepreneurial experience. By using students, I can compare individuals with similar personal and professional backgrounds, but different entrepreneurial intentions. Second, a sample of individuals with entrepreneurial intentions is relevant for research. Several studies have focused on entrepreneurial intentions, arguing for a high predictive power of planned behavior over decisions of self-employment (Krueger et al., 2000, 2007). Third, using individuals with entrepreneurial intentions is relevant for practice. Several public–private institutions (e.g. incubators, accelerators) work with individuals with

[1] The more general definition of entrepreneurial intentions is: "the cognitive state temporally and causally prior to action" (Krueger, 2009, p. 51). In 2016, I surveyed the current status of individuals with entrepreneurial intentions. Approximately 80% of the respondents answered that they had started a firm within two years of the experiment. I cannot rule out the possibility that entrepreneurial intent fully captures differences between entrepreneurs and non-entrepreneurs; yet, I do believe that these results strongly indicate that I have worked with a valuable proxy for entrepreneurship.

limited entrepreneurial experience (e.g. students, novice entrepreneurs). It is important for these institutions to understand how to support these individuals in an effective way (Amezcua et al., 2013). Finally, using the same sample of individuals throughout the dissertation allows me to compare results and provide a complementary picture of differences in cognition and behavior in situations of risk and uncertainty between individuals with different entrepreneurial intentions.

The experiment was programmed in Z-tree (Fischbacher, 2007) and consisted of three parts. In the first part, subjects were presented with a series of real money games involving a total of 24 unique binary choices. Each choice consisted of two monetary opportunities with identical expected values, but different combinations of risk and uncertainty. In the second part, subjects were presented with a series of repeated choices between investments. The design for the simplified investment opportunities was adapted from prior research (Sarasvathy et al., 1998). Finally, the subjects were given a questionnaire capturing demographics, cognitive biases, and personality traits. The models used to analyze the data included regressions (for choices in situations of risk and uncertainty) and verbal content analysis (for focus of attention and risk perception). With particular reference to the latter, three independent coders performed the content analysis and successfully followed the codification protocols.

Contributions to Extant Research

The extant research has yielded mixed evidence regarding entrepreneurs' greater propensity towards risk. My first contribution shows how two specific contextual mechanisms grounded in cognitive psychology and economics—the prior gain effect and the risk propensity effect—play a primary role in observed differences between the behaviors of entrepreneurs and

non-entrepreneurs in situations of risk. In particular, prior monetary gains increase entrepreneurs' risk-taking more than non-entrepreneurs'. By contrast, increasing degrees of risk reduces the differences in observed risk-taking behaviors among groups, indicating similar levels of bias in situations of high risk. This latter finding helps to explain why differences between entrepreneurs and non-entrepreneurs in terms of risk-taking propensities are often not visible (Brockhaus, 1980) without considering the effect of cognitive biases. These findings offer two practical contributions. First, since entrepreneurs often use their experience when pursuing risky opportunities, prior monetary gain from investment decisions may push them to take unnecessary risks in subsequent investment decisions. For this reason, it is important for private stakeholders to consider the potentially detrimental effect of entrepreneurs' successful prior investment decisions. Second, my results indicate that entrepreneurs are not blind risk-takers; rather, they shy away from high predicted monetary outcomes when the risk is too high. For this reason, educational programs aimed at helping entrepreneurs make more thoughtful decisions should focus on the contextual elements (e.g. information, expert opinions, etc.) that drive entrepreneurs to invest in new ventures.

Though risk perception is an important variable in fostering individuals' behavior in situations of risk, very little is known about entrepreneurs' risk perceptions and whether (and how) it differs from those of non-entrepreneurs (Shepherd et al., 2015; Simon et al., 2000). My second contribution shows differences between individuals' risk perceptions are driven by different foci of attention. In particular, I find that individuals focus on different characteristics of investment opportunities, with entrepreneurs focusing more on monetary outcomes and non-entrepreneurs focusing more on probabilities. Such differences in focus translate into differences in perception, with entrepreneurs perceiving more risk when they focus on the size of the monetary outcomes than when they focus on probabilities. These findings offer two practical

contributions. First, it is advisable to inform stakeholders that entrepreneurs use a different logic than non-entrepreneurs and that differences in foci of attention affect investment selection (Sarasvathy et al., 1998, 2001). For this reason, both entrepreneurs and stakeholders (particularly investors) need to align their assessment of risk in new investment decisions by considering their foci on control and attention. Second, I show that risk perception does matter in entrepreneurs' choices as it increases with their focus on investments' desirable elements. This finding contributes to our understanding of whether entrepreneurs perceive the riskiness of their actions, providing an interesting point of departure for future research on entrepreneurs' perceptions of risk.

Entrepreneurs must often make decisions under uncertainty, which can be defined as immeasurable risk (Knight, 1921). Thus, my third contribution is showing how an absence of information regarding probabilities does not impact entrepreneurs' decisions to the same extent that it does for non-entrepreneurs. In particular, entrepreneurs are more likely than non-entrepreneurs to choose consistently between two prospects that have everything in common except for probability information. This result, while confirming the findings of Chapter 3 (i.e. that entrepreneurs do not focus their attention on probabilities) also confirms that entrepreneurs have a greater willingness to bear uncertainty if the stakes at play (in this case, monetary outcomes) are desirable.

In sum, this dissertation advances our understanding of the roles of cognition and information in driving differences between entrepreneurs and non-entrepreneurs, ultimately helping stakeholders (investors and public institutions) in their understanding of the motives behind entrepreneurial action.

Contributions to Entrepreneurship in Practice

The dissertation seeks to contribute to the field of entrepreneurship in practice by informing public–private stakeholders about entrepreneurs' behavior, cognitions, and perceptions in situations of risk and uncertainty. By illustrating the cognitive differences between individuals with and without entrepreneurial intentions, the three chapters present several complementary suggestions for managing relationships between entrepreneurs and their stakeholders. In so doing, this dissertation offers three main contributions: first, stakeholders who work with entrepreneurs, especially those who work with novice or student entrepreneurs (e.g. incubators, accelerators), need to carefully manage entrepreneurs' bias towards prior gains in future risk choices (e.g., by reviewing entrepreneurs' recent past experience and financial results). The results of Chapter 2 suggest that individuals with entrepreneurial intentions are more likely than individuals without such intentions to choose risky monetary opportunities right after having received a monetary gain, even when such a gain is due to a random process. Second, such stakeholders and entrepreneurs need to strategically align their assessment of risk with respect to business opportunities (e.g., by rationally analyzing and comparing all of the elements involved in investment opportunities). The results of Chapter 3 suggest that, in line with the reasoning of Sarasvathy et al. (1998), individuals with entrepreneurial intentions tend to perceive less risk than individuals without such intentions because of their focus of attention. Stakeholders must consider that entrepreneurs do not use predictive information on investment feasibility as a primary factor in investment choices and, as a consequence, should carefully manage entrepreneurs' critical assessment of information. Finally, Chapter 4 bridges the findings of Chapters 2 and 4 by testing individuals' risk behavior and cognition in situations of Knightian (1921) uncertainty, defined as the absence of predictive information on probabilities. In

particular, in situations of uncertainty, individuals with entrepreneurial intentions are less sensitive than individuals without entrepreneurial intentions to the lack of probabilities when choosing between opportunities. The results of Chapter 4 suggest that stakeholders should understand how entrepreneurs evaluate monetary opportunities in terms of possible monetary objectives.

Limitations and Avenues for Future Research

As part of a critical assessment of my work, I acknowledge several limitations that also represent potential avenues for future research and contributions in the field of entrepreneurship. First, the definition of entrepreneurship is here limited to individuals with entrepreneurial intentions. Despite the research and practical importance of intentions in entrepreneurship[2], my results are more relevant for groups of individuals at the beginning of their entrepreneurial careers, particularly novice entrepreneurs. It is worth noting that the definition of entrepreneurial intentions used in this dissertation is further restricted by individuals' types of intentions. Virtually all of the students participating in the experiment intended to start firms based on an innovative idea or service (i.e. they did not intend to be "self-employed" as, for example, journalists). Clearly, this affects the type of novice entrepreneurs to whom the results speak. Future research may compare individuals at different stages in their entrepreneurial careers with relevant comparison groups (e.g. managers). Second, my measurement of the effect of monetary rewards on choice behavior is limited because I do not use a long-term perspective. This was a deliberate choice, given my focus on testing the causal link between cognition and action in situations of risk and uncertainty. However, since monetary rewards are typically delayed in time, my research is particularly relevant for choices made in a limited time frame. Future

[2] Intentions are described as an accurate predictor of entrepreneurial self-selection (Krueger, 2000) and, as a post-experiment sample check, a large share of those who intended to start a firm in the next three years actually started a firm.

research may explore the effect of rewards on entrepreneurial risk-taking when time is manipulated as a critical variable. Monetary rewards delayed in time would require a careful assessment of time preferences (Abdellaoui, Diecidue, & Öncüler, 2011; Andreoni & Sprenger, 2012) and, particularly for entrepreneurs, learning effects for binary choices (Das & Teng, 1997; March & Shapira, 1992; Minniti & Bygrave, 2001; Oskarsson, Van Boven, McClelland, & Hastie, 2009). Third, despite the power of experiments to identify precise causal links between cognition and behavior, experiments always represent a simplification of reality. Individual cognition and stable traits influence risk behavior concurrently. I acknowledge that I cannot identify all of the stable traits that may influence behavior. However, in each chapter, I address strategies to test (and exclude) possible alternative explanations for the results. Fourth, due to experimental constraints in terms of time, I did not measure (and therefore cannot control for) several elements pertaining to the psychology of the entrepreneur that may affects risk behavior, including locus of control (Mueller & Thomas, 2001), self-efficacy (Cassar & Friedman, 2009), and need for achievement (Stewart et al., 2003). Finally, family culture is an important element explaining entrepreneurial decisions in situations of risk (e.g. terminating an investment, Sharma & Manikutty, 2005). Though I control for some family demographics (e.g. parental self-employment, size and industry of parents' firms), culture remains a source of unobserved heterogeneity.

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CHAPTER 2. A RISK WORTH TAKING: RISK AS THE ENTREPRENEUR'S CONDITIONAL CHOICE

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ABSTRACT

It is theorized that entrepreneurs are more likely than non-entrepreneurs to make risky choices. However, the empirical evidence addressing this claim is mixed. This paper offers new insights into entrepreneurs' choices related to risk, investigating the circumstances in which individuals with entrepreneurial intentions are more or less likely to choose risk over certainty. Drawing on prospect theory, we formulate hypotheses about the greater likelihood that individuals with entrepreneurial intentions will choose risk immediately after a positive gain, but shy away from risk as the degree of risk increases. We test the hypotheses using data collected in laboratory-based real money games experiments and find support for the hypotheses, indicating that entrepreneurs' bias towards risk is circumstantial. These results have fundamental implications for our understanding of the factors guiding entrepreneurial choices in situations of risk.

Keywords: risk, entrepreneur, money games, lab experiment, prior gain effect, risk propensity effect

JEL Classifications: L26, D81

INTRODUCTION

How do individuals with and without entrepreneurial intentions differ in their propensity to choose risk? Prior research offers mixed evidence relating to this research question. Some studies suggest that entrepreneurs are more likely to choose risk than non-entrepreneurs (see e.g. Begley & Boyd, 1988; Carland III et al., 1995; Chen et al., 1998; Cramer et al., 2002; Kihlstrom & Laffont, 1979; Mullins & Forlani, 2005; Stewart et al., 1999), while others suggest that there are no differences between these groups (see e.g., Brockhaus, 1980; Holm et al., 2013; Koudstaal et al., 2015; Simon et al., 2000). The absence of a definitive answer to this question represents a conundrum in entrepreneurship research. It is important to resolve this dilemma because both individuals' recognition of entrepreneurial opportunities and their propensity to pursue them are central aspects explaining self-selection into entrepreneurship, which is a relevant phenomenon for public welfare (Baron & Ensley, 2006; Kihlstrom & Laffont, 1979; Shane & Venkataraman, 2000). Further, a better understanding of this issue might help entrepreneurs make more rational and thoughtful decisions and help their stakeholders understand and manage their actions. Finally, by investigating this question, we respond to Shepherd et al.'s (2015) call for a better understanding of the contextual factors that magnify or diminish the effects of individual characteristics on entrepreneurial decision-making (e.g. whether an increasing degree of risk influences entrepreneurs and non-entrepreneurs differently).

The premises of this study are that real decision-makers are influenced by cognitive biases (Busenitz & Barney, 1997; Deligonul, Hult, & Cavusgil, 2008; Kahneman & Tversky, 1979; March, 1994), that entrepreneurs do not choose risk at all costs, and that their choices are circumstantial. We use entrepreneurial intentions as a proxy for entrepreneurship, since intentions are a powerful predictor of entrepreneurship (Krueger, Reilly, & Carsrud, 2000). We

investigate two circumstances that might cause entrepreneurs to respond to risk differently than non-entrepreneurs. First, drawing on the arguments proposed by Thaler and Johnson (1990) and Post et al. (2008), individuals may exhibit increased risk-seeking behavior when they have recently (i.e. immediately before) experienced gains. This has been documented in the presence of gambling both with only positive monetary outcomes ("prior gain effect;" Battalio et al., 1990) and with positive and negative outcomes ("house money effect;" Thaler & Johnson, 1990). Both of these effects represent extensions of the decreasing absolute risk aversion (DARA) prediction that individuals will hold more money in risky assets as their wealth increases (Holt & Laury, 2002). Drawing on prospect theory, we extend our explanation by focusing on the effects of immediate prior gains on subsequent choices, while controlling for accumulated wealth. Since entrepreneurs are characterized by *representativeness*[3] and, hence, make choices based on a few observations (Forbes, 2005; Keh et al., 2002; Simon et al., 2000), we suggest that a gain may generate a more immediate bias towards risk among entrepreneurs than among non-entrepreneurs. That is, entrepreneurs may exhibit a bias towards a potential gain when they have recently experienced a gain from a previous choice. This is consistent with the finding that entrepreneurs often rely on their personal experience when evaluating opportunities (Cassar & Craig, 2009; Fern et al., 2012; Parker, 2006; Stuart & Abetti, 1990).

Second, an increased level of risk has been shown to be key in explaining the differences among individuals' revealed preferences (Rothschild & Stiglitz, 1970; Sarasvathy et al., 1998; Simon et al., 2000). However, it has been argued that individuals tend to exhibit a decreasing tendency to choose options characterized by high levels of risk. Entrepreneurs, however, value small gains/winnings. As a result, their perceived utility from small gains has a greater chance of

[3] The representativeness heuristic is defined as the degree to which an event is similar in essential characteristics to its parent population and reflects the salient features of the process by which it is generated (Kahneman & Tversky, 1972).

exceeding the disutility from choosing low-risk options than among non-entrepreneurs. Consequently, entrepreneurs may be more likely to choose risk in general, but at higher levels of risk, the difference is evened out because the disutility of the increasing risk exceeds the potential gain, even for entrepreneurs.

Entrepreneurship research investigates risk primarily by eliciting entrepreneurs' propensities indirectly through their responses to questionnaires where there is nothing at stake (Brockhaus, 1980; Sarasvathy et al., 1998). However, there is solid body of research in economics that argues for the importance of using real incentives when comparing groups' decision-making, since real incentives increase risk-averse behavior (Holt & Laury, 2002; Kachelmeier & Shehata, 1992; Weber & Milliman, 1997). Furthermore, the presence of real monetary incentives is necessary to account for prior experience (e.g., monetary feedback, Post, Assem, Baltussen, & Thaler, 2008; Thaler & Johnson, 1990) and low-probability events (Schade et al., 2012). A few scholars have tested the risk preferences of entrepreneurs in the presence of real monetary incentives (Holm et al., 2013; Koudstaal et al., 2015). In this paper, we use quasi-laboratory experiments[4] with real monetary incentives. We investigate the behaviors of students enrolled in a general business economics program at a major business school. After the first semester, one group actively selected to enroll in a designated entrepreneurship program, motivated by the desire to pursue careers as entrepreneurs. Thus, our experiment included a sample of "entrepreneurs," defined as individuals demonstrating entrepreneurial intentions (the cognitive state that precedes the decision to launch a new venture) (Krueger et al., 2000). The second sample consisted of general business economics students with no such declared intentions. The choice was made to use students rather than a random sample from the greater population in order to limit variations across subjects in terms of demographics and professional

[4] We use a quasi-laboratory experiment design because the subjects are not randomly selected, but are instead assigned to two groups based on a specific characteristic: their entrepreneurial intentions (Shadish et al. 2002).

experience, thereby isolating the effects of prior gain and risk propensity. Furthermore, the use of students with entrepreneurial intentions limited concerns related to external validity, particularly with respect to novice entrepreneurs (Krueger et al., 2000; Liñan & Chen, 2009).

The experiment required subjects to make choices between certainty and risk in the presence of real monetary incentives. These incentives took the form of one-to-one payoffs from gambling gains. We separately introduced two exogenous manipulations: feedback on monetary outcomes and an increasing variance of risky outcomes. A control for individual risk attitude (Holt & Laury, 2002) was included to separate the effects of these manipulations. The results revealed that, with respect to a certain monetary gain, individuals with entrepreneurial intentions were more likely to favor risky options than individuals from the control sample. However, this finding held only when controlling for prior gains and degree of risk. Furthermore, prior gains had a larger positive impact on the risk choices of individuals with entrepreneurial intentions. In addition, the degree of risk negatively moderates the likelihood that an individual with entrepreneurial intentions will choose risk over certainty, compared to the control sample. Overall, these results confirm the importance of empirical investigations of entrepreneurial decision-making in the presence of real monetary incentives and suggest that the differences in risk preferences between entrepreneurs and non-entrepreneurs are circumstantial.

The remainder of the paper is organized as follows: Section 2 briefly reviews the relevant literature and proposes arguments leading to hypotheses on the prior gain effect and the risk propensity effect. This section seeks specifically to articulate the reasoning justifying testing the different effects comparing entrepreneurs with non-entrepreneurs. Section 3 describes the data and the construction of the sample and provides details concerning the experiment and the methods used to test the proposed hypotheses. Section 4 presents the results. Section 5 concludes and discusses the implications of the findings.

THEORY AND HYPOTHESES

Understanding entrepreneurs' behavior vis-a-vis risk is considered important because entrepreneurship is characterized by risk. It is theorized that entrepreneurs are less risk-averse than non-entrepreneurs. Kihlstrom and Laffont's (1979) model predicts that fewer risk-averse individuals become entrepreneurs and that the least risk-averse entrepreneurs run larger firms. One of the underlying arguments with regard to entrepreneurs is that they are well equipped to cope with environmental uncertainty and complexity because they are characterized by cognitive biases, heuristics, *overconfidence*, *representativeness*, and a belief in the *law of small numbers* (Busenitz & Barney, 1997). These characteristics better equip them to make effective decisions in entrepreneurial settings, which lead them to self-select into entrepreneurship. Cognitive biases and a heuristics-based decision-making approach favor the performance of entrepreneurial activities, since entrepreneurs often face high levels of monetary risk.

These theoretical arguments are at the basis of numerous studies that attempt to determine whether entrepreneurs differ from non-entrepreneurs in terms of making risky choices, where risk is considered to involve situations in which a decision-maker chooses between different alternatives with complete information about the probability of different outcomes (Ellsberg, 1961; Knight, 1921). However, empirical investigations suggest that the association is less straightforward, and there is a growing body of work on risk in entrepreneurship that provides mixed evidence. Numerous studies find empirical support for the proposition that entrepreneurs exhibit higher risk-taking propensities than non-entrepreneurs (see e.g. Begley & Boyd, 1988; Carland III et al., 1995; Stewart et al., 1999). For instance, Moskowitz and Vissing-Jorgensen (2002) found that entrepreneurs do not spread their risk when making portfolio investments, suggesting a lower aversion to risk. Moreover, in a study

investigating school children over a period of 40 years, Cramer et al. (2002) found evidence of a negative association between risk aversion and self-selection into entrepreneurship.

On the other hand, other studies suggest that entrepreneurs are no different from non-entrepreneurs in their propensity to choose risk. Brockhaus (1980) found no empirical evidence to support differences in the risk-taking propensities of entrepreneurs and non-entrepreneurs. Koudstaal et al. (2015) showed that entrepreneurs perceive themselves to be more risk-tolerant than non-entrepreneurs, but also showed that the same subjects, when exposed to incentivized gambles, do not exhibit a higher propensity to choose risk over certainty. We contribute to these findings by showing how circumstantial factors may make entrepreneurs more likely than non-entrepreneurs to choose risk, thereby providing a possible explanation for entrepreneurs' perceptions of their own propensities for risk-taking. Holm et al. (2013) hinted that circumstance-dependent factors may influence the differences in observed risk propensities. Specifically, they find that entrepreneurs are found to differ from non-entrepreneurs in terms of their willingness to accept risk only when choices involve strategic uncertainty, which depends on a decision-maker's beliefs about his or her own performance relative to that of others.

The mixed results regarding risk propensities in entrepreneurship research might suggest that the association is attributable to the contingencies of the decision, as indicated by Holm et al. (2013). We extend this perspective by proposing two contingencies that might provide a more fine-grained understanding of these mixed empirical results for entrepreneurs compared to non-entrepreneurs. First, differences in risk tolerance between entrepreneurs and comparable others might depend on an individual's prior monetary gains/losses. Second, differences between entrepreneurs' and non-entrepreneurs' propensities to choose risk may depend on the level of that risk.

Prior gains and the biased entrepreneur

Prospect theory suggests that individual decisions are affected by gains or losses that alter people's expectations and aspirations. In the words of Kahneman and Tversky (1979), "there are situations in which gains and losses are coded relative to an expectation or aspiration level that differs from the status quo" (p. 286). Decision-makers may, hence, be influenced by and adapt their aspirations based on prior experience when evaluating real monetary opportunities (Oskarsson et al., 2009). Both their satisfaction and their dissatisfaction may be dynamically adapted to feed back into and generate expectations about future outcomes in the short run (Andersen et al., 2014; March, 1994). This cognitive bias may cause individuals to perceive random events as non-random and, ultimately, cause them to adapt their aspirations to their cognitively biased view of opportunities.[5]

Thaler and Johnson (1990) and Post et al. (2008) provided evidence that individuals exhibit a high propensity to choose options characterized by risk after experiencing a monetary gain.[6] The reasoning here is that the individual's reference point changes. Having already won a gamble, individuals reason that they may win again in the subsequent gamble. This behavior, which is based on a biased cognitive assessment of a random sequence of gains, is

[5] Research on individual decision making recognizes that decision makers use multiple reference points when constructing preferences out of choice options (Heath et al., 1999; Köszegi & Rabin, 2006; Stewart et al. 2003). How prior gains affect risk-taking behavior is not part of the original prospect theory, but has attracted substantial attention due to the potential of such gains to change individuals' reference points (Novemsky & Dhar, 2005; Post et al., 2008; Weber & Johnson, 2009). In this paper, the reference point corresponds to a monetary outcome that a subject expects to attain.

[6] Thaler and Johnson's (1990) paper develops the concept of the house money effect, referring to an individual having a sense of "gambling with the house money" rather than his or her own money. This effect is investigated by comparing an individual's behavior when gambling with his or her own money to his or her behavior when gambling with money won from the "house." This phenomenon does not apply in our gambling experiment because individuals do not gamble money won in prior gambles; in other words, they are not putting their winnings at risk. The present experiment is a simplified version of the house money experiment that does not adopt the house money effect terminology.

fundamentally different from a simple adaptation to accumulated wealth[7]. Accordingly, individuals who have achieved prior gains exhibit a lower aversion to risk.

The prior gains effect may be stronger for individuals with entrepreneurial intentions than comparable others for three reasons. First, the effect may be amplified by a self-serving bias, which applies especially to entrepreneurs (Baron, 1998; Parker, 2009). Individuals affected by a self-serving bias attribute positive outcomes to their own skills or talents, while attributing losses to external factors beyond their control. Thus, positive gains may boost their self-confidence in making the right decision, whereas losses may have no such effect. Accordingly, the effect of prior gains may be particularly strong among entrepreneurs because, to a greater extent, they may tend to associate the gains with personal ability, resulting in overconfidence and an increased tendency to choose risk over certainty.

Second, the effect of prior gains may be amplified by the illusion of control, a cognitive bias that persuades an individual that he or she can control or influence a situation even if it is exogenously given or due to a random process (Langer, 1975; Taylor & Brown, 1988). Individuals may be affected by the illusion that they can predict the outcome of a random event. Among such individuals, a gain from a prior gamble may amplify an existing illusion of control. Since entrepreneurs have been shown to suffer from this cognitive bias (De Carolis et al., 2009; Keh et al., 2002; Simon et al., 2000), it is likely that amplification of the effect of prior grains is stronger for entrepreneurs than for comparable others. For this reason, the gains from a prior gamble may have a stronger effect on entrepreneurs than on comparable others.

[7] While prospect theory is well-suited to explain risk-seeking behavior as a result of a biased cognitive assessment of gains, decreasing absolute risk aversion is well-suited to describe increased risk-seeking as a result of an adaptation to accumulated wealth. The cognitive bias approach may, hence, be somewhat more instrumental in disentangling individuals' specific effects, while the DARA seems to be a more global mechanism that holds for all. To separate the two effects, we focus our analysis on the effects of prior gains, distinguishing between the effects on those with entrepreneurial intentions and those without, while controlling for accumulated wealth.

Third, entrepreneurs have been shown to learn and adapt extensively from experience (Shepherd et al., 2015). In risk-taking, individuals respond to prior outcomes by avoiding alternatives that have produced poor past outcomes (Dendrell, 2007). This adaptation influences individuals' risk propensity. Since entrepreneurs are particularly prone to adapt extensively from experience, they are also more likely to be sensitive in their choices and, hence, more likely to make use of adaptive techniques as a response to risk[8] (Patel & Fiet, 2009).

These arguments suggest that individuals with entrepreneurial intentions positively moderate the effect of prior gains on the choice of a risky gamble.

HYPOTHESIS 1: Individuals with entrepreneurial intentions will be more likely to choose risky options after a monetary gain than individuals without entrepreneurial intentions

The "risk propensity" effect

Prospect theory tells us that different presentations of the same monetary opportunity result in different choice behaviors. As one possible psychological explanation, Kahneman and Tversky (1979) introduced the isolation effect, which causes individuals to disregard components that are common to all of the prospects being considered. In a set of gambles with the same expected value and same probabilities for risky outcomes, we posit that individuals may disregard shared components and respond differently to the increasing degree of risk (i.e. the increasing variance in the size of monetary gains). Indeed, variance in risky outcomes is one indicator of monetary risk: an objective assessment of the risk inherent in a situation (Fox et al., 2015; Weber & Milliman, 1997).

[8] Patel and Fiet (2009) investigated adaptive techniques as a response to risk, but did not compare individuals with entrepreneurial intentions and individuals without.

Entrepreneurship research indicates that entrepreneurs, despite not possessing a greater ex ante propensity for risk, react differently than managers (e.g. bankers) when coping with increasing risk. Entrepreneurs tend to accept risk as a given and focus on their personal commitment on achieving success, thus seeing opportunities where others see risk (Sarasvathy et al., 1998). However, Forlani and Mullins (2000) argued that entrepreneurs may be cautious about the increased variability in gains, suggesting that while entrepreneurs believe in their ability to manage lower-variability scenarios, they are less certain of this ability at higher levels of variability. However, this ability-based argument assumes that the individual plays an active role and may not be directly transferable to purely experimental settings, in which the scenarios are given and the subjects play an exogenous role (except in the choice between risk and certainty).

We argue that entrepreneurs generally value and experience utility from gaining when engaging in activities characterized by risk. The experienced utility is comparable to the utility gained from an individual winning (or not) in a game. This is one potential reason entrepreneurs value even the smallest gains and, hence, are willing to exert great efforts to secure gains. The utility entrepreneurs gain from potential gains makes them more likely to choose risk than comparable others. Yet, this effect is only applicable at lower levels of risk. As risk increases, entrepreneurs experience a shift in focus away from the potential utility of gains and instead focus on the risk involved. Accordingly, as risk increases, entrepreneurs portray an increasing likelihood to choose risk to the same degree as comparable others. This suggests that the propensity of entrepreneurs to choose risk may not be significantly different from that of non-entrepreneurs at high degrees of risk.

HYPOTHESIS 2: The propensity of individuals with entrepreneurial intentions to choose risk, compared to individuals without entrepreneurial intentions, is negatively moderated by the degree of risk.

DATA AND METHOD

Sample

To investigate our hypotheses, we identified a sample of individuals who were willing to participate in a lab experiment. Our sample was drawn from students enrolled in a general business economics undergraduate program at a major business school. We chose to use students for several reasons. First, students exhibit representative heterogeneity on many important characteristics (e.g. big five personality traits, family background) that make them suitable for generalizing findings to the greater populations (in our case, entrepreneurs and non-entrepreneurs). Second, we used students in order to minimize the impact of entrepreneurial experience on inter-group differences in risk-taking. This choice at least partially circumvents differences in risk propensities attributable to variations in prior or current entrepreneurial encounters. Third, we specifically used students in general business economics so that we could compare a group with entrepreneurial intentions with a group without such intentions. In particular, subjects were sampled at the beginning of their second year of study and were enrolled in the same study track, making them generally comparable. This high level of comparability allows us to rule out many alternative explanations attributable to unobserved factors.

At the end of their first semester, all general business economics students were offered the chance to select into a specialized program focused on entrepreneurship topics. The students

had to apply to join the program by submitting their motivation for wanting to study entrepreneurship. Of approximately 600 students, 49 applied to the program, and all were accepted, suggesting that selection was based strictly on student preference. Almost all of the applications suggested that the students' motivation for selecting into the program was a desire to establish their own business. Thus, we consider those students who enrolled in the entrepreneurship program to have entrepreneurial intentions and those who did not enroll in the program to not have entrepreneurial intentions (since they actively chose not to specialize in entrepreneurship and to continue instead with their general business economics studies). These two groups define the populations from which we generalize our results: novice entrepreneurs (students with entrepreneurial intentions) and non-entrepreneurs (students without entrepreneurial intentions).

We sent separate e-mails to the two populations to secure subjects for the experiment. The students were able to sign up for the experiment through a website designed to register them and obtain initial details. In total, 18 students from the entrepreneurship population and 27 students from the control population signed up, yielding a total of 45 individuals for the investigation. The sampled students represented approximately 40 percent (i.e. 18 of 45) of the total population of entrepreneurship students and approximately 5 percent (27 out of 550) of the population of non-entrepreneurship students. In order to achieve meaningful comparisons, we checked whether the samples were representative of their respective populations in terms of general characteristics (age and gender) and found that they generally reflected the demographics of their respective populations.

A preliminary analysis of the sampled subjects revealed that 66.7 percent (12) of the students with entrepreneurial intentions intended to start a firm within the next three years, while only 14.8 percent (4) of the group of students without entrepreneurial intentions had similar

ambitions. This provides some support for our sampling method, suggesting that entrepreneurial intentions were greater among the entrepreneurship students than among the general business economics students[9].

The experiment was accompanied by a questionnaire designed to capture individual demographics, psychological profiles, cognitive biases, and economic circumstances. These dimensions were used to ensure that the samples were comparable on dimensions that might otherwise cause spurious correlations and, hence, potential biases in the estimates.

Table 1 provides descriptive statistics for the two groups across categorical variables drawn from the questionnaire data. It also provides test statistics on differences. We found very few differences between the two groups. We used a t-test to check for differences in ages and found that the average age for both groups was 21.5 years old. The t-statistics were insignificant at 0.460. Overall, we believe that these findings suggest that the samples are comparable and justify our categorization of the groups as representing students with and without entrepreneurial intentions.

Insert Table 1 about here

Real money games

Prior studies have used a multitude of research designs to investigate how entrepreneurs differ from non-entrepreneurs in their propensity to make choices characterized by risk. However, two of these research designs are most common in testing what differentiates

[9] As a robustness check, we exclude from the analysis subjects with mixed entrepreneurial intentions and find that the results hold (see Column 3, Table 8).

entrepreneurs with regard to risk and uncertainty: questionnaires (see e.g. Brockhaus, 1980; Busenitz & Barney, 1997) and money games (see e.g. Cramer et al., 2002; Weber & Milliman, 1997). Questionnaire-based research mainly uses sets of scenarios and case-based examples to represent real-life decisions in order to understand respondents' decision-making rationales. By contrast, money games tend to be simple structures (e.g., gambles) that resemble investment opportunities and seek to understand respondents' behaviors in tasks involving stakes. Both incentivized (Koudstaal et al., 2015; Weber & Milliman, 1997) and non-incentivized experiments have been utilized (Forlani & Mullins, 2000; Keh et al., 2002). In this study, we used a real money games experiment. In real money games, subjects are confronted with repeated binary choices between two different gambles. The games involve real money, and at the end of the experiment, the subjects receive an amount of money corresponding to their winnings based on their choices.

Real money games are particularly useful for capturing risk. First, according to *decision affect theory* (Mellers et al., 1997), individuals are expected to choose monetary opportunities with greater subjective emotional value. The presence of real monetary incentives in money games increases the emotional value attached to participants' decisions, sharpening both the research measurements and the comparisons of the decisions related to risk (Mellers et al., 1999; Rottenstreich & Hsee, 2001). Second, greater monetary incentives improve subjects' effort and focus during the experiment (Cramer et al., 2002; Gneezy & Rustichini, 2000). Third, real money games are the best way to measure the "prior gains effect," as indicated by Thaler and Johnson (1990) and Post et al. (2008).

Experiment design

The 45 subjects participated in two separate experiment sessions conducted in a computer laboratory in October 2014 according to group (i.e. those with entrepreneurial intentions [n=18] and those without entrepreneurial intentions [n=27]). Subjects were invited to participate using an online system and were not informed about the purpose of the study with respect to either the group comparisons (with and without entrepreneurial intentions) or the risk-taking behavior. The experiment, which was programmed on Z-Tree (Fischbacher, 2007), followed a between-subjects design that sought to explore the behavioral differences in real money game behaviors between the two groups with different entrepreneurial intentions. Upon arrival, each subject was randomly assigned a computer. No personal belongings, including mobile phones, calculators, and pens, were allowed in the room. Communication was strictly forbidden during the experiment. At the end of the experiment, all subjects were paid a flat cash fee of Danish Kroner (Dkr) 100 (approx. $17.20) for their participation in addition to any winnings from the monetary gains. On average, each session lasted 90 minutes.

The experiment was divided into three parts: an introduction, a money games section, and a questionnaire section. The timeline of the experiment is presented in Table 2.

Insert Table 2 about here

The questionnaire section included questions on investment scenarios, demographics, psychological traits (e.g., Big Five; John et al., 2008) and cognitive bias (e.g., overconfidence;

Fischhoff et al., 1977). At the end of these three parts, participants were paid individually and dismissed.

In the first part, the experimenter briefly explained the structure of the experiment and presented the rules. In particular, the experimenter explained that during the money games, each decision would be rewarded monetarily based on the subjects' choices. The experimenter further stressed that communication was not allowed throughout the entire experiment. In the second part, the subjects were presented with money games. Following well-established prior research on risk propensity measurements in the lab (Fox et al., 2015), two exogenous manipulations were used in a new context to test differences between subjects with and without entrepreneurial intentions. The two manipulations—namely, feedback on the immediate prior monetary gain ("prior gain effect") and an increasing degree of risk ("risk propensity effect")—were adapted here following the definitions of Thaler and Johnson (1990) and Fox et al. (2015), respectively[10]. Each subject was faced with 24 unique binary decisions, which were presented sequentially in the same order for everyone. The experiment used four different gambling combinations: a certain win versus a risky gamble, a certain win versus an uncertain[11] gamble, a risky gamble versus a risky gamble, and a risky gamble versus an uncertain gamble. In this paper, we consider only one combination type (a certain win versus a risky gamble), producing a total of six unique decisions for individuals. Of these six decisions, two are not included in the current analysis. Instead, we used these as manipulation checks, testing the prior gain effect manipulation by giving no feedback on the size of the monetary winning[12]. Thus, a total of 180 observations (four choices each from 45 individuals) were available for the investigation.

[10] A large body of prior literature, particularly in neuroeconomics, has used money games to study individual propensities under different combinations of risk, uncertainty and ambiguity (see e.g. Hsu et al., 2005; Huettel et al., 2006).

[11] In uncertain gambles, we define uncertainty in the Knightian (1921) sense, as the lack of probability of obtaining possible monetary outcomes.

[12] As expected, when no feedback was given on monetary outcomes, the two groups did not significantly differ in their propensities to choose risk.

During the money games, the subjects were presented with a choice between a certain gain and a risky choice, which triggers a 50 percent chance of a greater gain and a 50 percent chance of a smaller gain than the certain option. The four different gambles are presented in Table 3.

Insert Table 3 about here

Throughout the decision rounds, we kept the gamble probabilities and expected values constant (50% and Dkr 14, respectively). As the difference in outcomes for the risk scenario (Option B) increased, the degree of risk for the decision round also increased. This approach follows the standards for capturing risk prescribed by Rothschild and Stiglitz (1970) and, more recently, Fox et al. (2015). An individual subject's payoff was attributable to random draws and did not reflect individual abilities.

The total payoff across all gambles was Dkr 15,036, which was distributed among the 45 participants at the end of the experiment. The total payoffs across the four considered gambles were Dkr3,204, an average of approximately Dkr71 per subject. However, the difference between the two groups evened out across the considered gambles. Individuals with entrepreneurial intentions received an average payoff of approximately Dkr73, which was not significantly different from the corresponding number for individuals without entrepreneurial intentions (approximately Dkr70). The payoffs of individuals with and without entrepreneurial intentions are graphically illustrated in Figures 1a and 1b, respectively.

Insert Figures 1a and 1b about here

Main variables

The main variable of interest was a dummy variable indicating whether, in each gamble, an individual chose risk over certainty. The risky choice applied to 40 percent of the gambles. Individuals with entrepreneurial intentions chose risk in approximately 47 percent (34 out of 72 decisions) of the gambles, while individuals without entrepreneurial intentions chose risk in approximately 35 percent (38 out of 108). These numbers were not significantly different according to a Chi-square test (see Table 4).

Insert Table 4 about here

To test the prior gains effect, we used a dummy variable measuring whether a subject had received a "prior gain" in the previous gamble. In other words, this dummy indicated whether, in the previous gamble, an individual experienced a monetary gain greater than the certain option. Table 3 presents the descriptive statistics for such prior gains. Individuals with entrepreneurial intentions experienced greater gains than expected about 42 percent (33 out of 72) of the time, while the corresponding number for individuals without entrepreneurial intentions was only 10 percent (11 out of 108). Therefore, individuals with entrepreneurial intentions were "luckier" than the other group in their immediately preceding gambles.

Finally, to test hypothesis 2, we created a variable to measure the level of risk the subjects faced in a given choice. We followed the convention prescribed by risk–value models (in this case, mean–variance; see e.g. Jia et al., 1999), taking the difference between the upper and lower potential gain of a given gamble. Accordingly, the risk associated with decision 1 in Table 2 is 12, and the risk associated with decision 4 is 28. These values represent strictly exogenous givens dictated by the gamble design.

Controls

The identified groups were not exogenously given. The subjects self-selected into either an entrepreneurship or a standard business economics study program, which then defined the studied groups. Accordingly, we sought to control for confounding factors that might have caused bias in the results. First, we controlled for personality traits, which have been shown to be associated with entrepreneurship and economic choices (John et al., 1991, 2008; Zhao & Seibert, 2006). Certain personality traits characterize a group's composition and are useful for controlling for the unobserved time-invariant factors that drive choice. In particular, we relied on the so-called big five personality traits, controlling for extraversion, openness to experience, neuroticism, conscientiousness, and agreeableness. To capture these traits, we followed the method used by John et al. (1991, 2008). The results of the factor analysis are presented in Appendix Table A1.

Overconfidence is a cognitive bias believed to be associated with choosing more risky investment opportunities (Barber & Odean 2001; Fischhoff et al., 1978), and it is particularly common among entrepreneurs (Busenitz & Barney, 1997; Koellinger et al., 2007; Koudstaal et

al., 2015)[13]. We controlled for this particular cognitive bias using the method proposed by Fischhoff et al. (1977). In particular, we operationalized overconfidence by comparing individuals' confidence in answering a series of two-choice questions about health statistics (based on 2010 data from the World Health Organization). We expected that individuals scoring highly for overconfidence would have a higher propensity for risk.

The investigation measured subjects' gambling behaviors. However, gambling behaviors can be pathological (see e.g. Stinchfield, 2000; Winters et al., 1998). We controlled for potential pathological gambling bias by including Stinchfield's (2000) pathological gambling index, which measures the degree to which an individual is a gambler, as a control in the analysis. Specifically, we asked five questions about the subjects' frequency of engaging in activities that included gambling (e.g. "gambling in Casinos," "buying lottery tickets," etc.). We expected to find a positive relationship between pathological gambling and a propensity for risk.

Finally, we controlled for a series of demographic variables that have proven to be significant for entrepreneurship or that are associated with specific behaviors related to risk. We controlled for age because aging is associated with changes in personal wealth, attitudes towards independence, and work effort, all of which affect entrepreneurship (Levesque & Minniti, 2006; Levesque et al., 2002) and risk aversion (Holt & Laury, 2002). We also controlled for gender, since we expected women to be more risk averse than men (Croson & Gneezy, 2009) and since gender differences exist in rates of entrepreneurial entry (Langowitz & Minniti, 2007). To measure gender, we included a dummy for whether a subject was female. We also controlled for whether an individual was an international student, defined as being a student with a nationality other than Danish. Finally, we controlled for parental entrepreneurship in at least one of a

[13] We chose not to use incentivized measures of overconfidence, since a recent study found that overconfidence may not differ between entrepreneurs and top managers (Koudstaal et al., 2015).

subject's parents and for the subjects' general income, using a dummy for whether a subject earned more than DKr 50,000 a year (suggesting a non-transitory job).

Method

The experiment was designed to predict the binary choices of the two groups given their subjection to various exogenous stochastic shocks. For this reason, a logistic regression technique was applied to explain the binary choices of the individuals based on the group to which they belonged (i.e. individuals with or without entrepreneurial intentions) and the effects of the exogenously inflicted prior gains and degrees of risk.

We have shown that the two groups were comparable across multiple dimensions. We have also included control variables to make the results more robust and convincing. However, since the two identified groups were self-selected and not randomly assigned, there may be some unobservable factors that could cause bias in the estimates. There may also be some sampling conditions that play a role in generating the results. We consider these potential sources of bias in a supplement to the analysis.

RESULTS

Table 5 presents the descriptive statistics and correlation coefficients for all the considered variables. The subjects received a prior gain in 22 percent of the gambles. Since the subjects chose risk in 40 percent of the gambles, this reflects an approximately 50% chance of winning. None of the correlations in Table 5 are great enough to raise concerns about potential multicollinearity.

Insert Table 5 about here

Table 6 presents the results of the regression analysis. The first column includes only the control variables and the dummy for whether a given subject had entrepreneurial intentions or not. This regression confirms the univariate test, suggesting that subjects with and without entrepreneurial intentions are unlikely to differ in terms of risk aversion. The marginal effect is 0.160 and not statistically significant. The second column reports the results including only the entrepreneurial intentions dummy and the variables used to operationalize the main effects of the prior gains effect and the risk propensity effect (i.e. the degree of risk). Column 3 introduces the interactions between the entrepreneurial intentions dummy and the two explanatory variables. Since these are included sequentially, the entrepreneurial intentions dummy becomes significant, indicating that individuals with entrepreneurial intentions are generally more likely to choose risk over certainty (i.e. they are less risk averse). Yet, this result only appears when coupled with other conditions, which may be one of the reasons prior research on entrepreneurs and their tendency to choose risk have not produced cohesive findings. In other words, entrepreneurs' choices regarding risk seem to be conditional. The results in Column 3 show an insignificant main effect with regard to degree of risk (estimate = 0.009).

The prior gains effect is insignificant when considering the main effect, suggesting that the effect did not hold for the sample of individuals without entrepreneurial intentions. Since the marginal effects of the interaction between entrepreneurial intention and prior gain also prove insignificant, there is no support for hypothesis 1: *Individuals with entrepreneurial intentions will be more likely to choose risky options after a monetary gain than individuals without*

entrepreneurial intentions. These findings are consistent with those in column 4, for which we also included controls.

In terms of the risk propensity effect, the results suggest a general tendency among the subjects to shy away from risk as the risk increases. The estimate for degree of risk is significant at a 1% level in column 4, exhibiting a marginal effect of -0.04. We also find a significant negative marginal effect associated with the interaction between risk and entrepreneurial intention. The marginal effect associated with the interaction between degree of risk and entrepreneurial intention is significant at a 1% level at -0.044, providing support for hypothesis 2: *The propensity of individuals with entrepreneurial intentions to choose risk, compared to the propensity of individuals without entrepreneurial intentions, is negatively moderated by the degree of risk.*

Insert Table 6 about here

We investigated the hypotheses further by considering in more detail the marginal effects of the prior gains and the risk propensity effect based on the results shown in Table 6, column 4. The marginal effects with respect to prior gains are depicted in Figure 2a, and the contrasted marginal effects are shown in Figure 2b. These figures reveal new insights that suggest that the prior gains value (compared to a lack of a prior gains value) has some marginal significance at just below the 5% level. There is, in fact, a difference in the marginal effects when considering prior gains outcomes, though this difference is weak and at the very limit of what can be considered significant.

The corresponding figures for degree of risk are shown in Figures 3a and 3b. Here, it is evident that, at low values of risk, subjects with entrepreneurial intentions exhibit significantly higher propensities for risk than those without. This difference disappears at higher levels of risk. Figure 3a shows that the reason is that subjects with entrepreneurial intent start out with higher propensities for risk, but 'catch up' in terms of risk aversion as the degree of risk increases. This is consistent with the theoretical argumentation and lends further support to Hypothesis 2.

Insert Figures 2a and 2b about here

Insert Figures 3a and 3b about here

In terms of the control variables, the results were mostly consistent with the predicted associations. The women in our sample exhibited lower propensities to choose risk than males, and international students seemed to be more likely to choose risk than native students. In addition, we found that accumulated earnings had a strong effect, suggesting that those who have accumulated wealth during the game are also more likely to choose risky options. The findings concerning the pathological aggregate were odd: In our sample, subjects with gambling habits tended to choose risk less often than those without.

Supplementary analysis

To further investigate the results (or lack thereof), three supplementary studies were conducted. First, we explored the panel structure of the data. Second, we considered the lack of

results on prior pay by considering the amount a subject gained in the prior gamble (rather than a dummy variable). Finally, we limited the sample used to those subjects most likely to fit our theoretical profile of entrepreneurial intent.

Panel data analysis

The results may be biased due to our use of a panel dataset in which the same subjects are considered repeatedly. There may be unobserved elements that could cause bias in the estimates. To investigate this, we ran both fixed effects and random effects models and used a Hausman test to select between the two. The Hausman test is depicted in Table 7. Only the variables that varied within individual subjects were considered, since the fixed effects model could not estimate coefficients for the remaining variables. Fortunately, these variables are also the one considered most prominently in this study. Table 7 clearly shows that the coefficients of the fixed effects and random effects specifications provide similar estimates. Indeed, the test statistics indicate that these coefficients are not statistically significantly different. Accordingly, we choose to consider the random effects model, since this model appears to be both consistent and efficient.

Insert Table 7 about here

The results of the random effects model are shown in column 1 of Table 8. Overall, these results confirm the prior results, although with no significance for the main effect of the degree of risk. The random effects specification allowed us to look at the within-group correlations to assess the nature of the consistency of the choices made by each subject. The rho of the random

effect specification was only 0.12, indicating a relatively low correlation between the subjects' choices after controlling for the observables. Table 9 reports several intra-class statistics for propensity to choose risk over certainty at the 1st, 25th, 50th, 75th, and 99th percentiles. At the median propensity, the marginal probability of choosing risk was 0.348, while the corresponding number for the joint probability of any two given choices was 0.122. These numbers varied greatly across percentiles, with a 0.000 joint probability at the 1st percentile of observed propensity and a 0.912 joint probability at the 99th percentile. At all percentiles, these numbers suggested that an individual was 1.010 times more likely to choose risk if they had chosen risk in the previous round than an individual who had not chosen risk in the previous round.

Insert Table 8 about here

Insert Table 9 about here

Prior pay instead of prior gain

To further explore the weak results of the marginal effects on the prior gain effect, we reconfigured the positive feedback variable to be continuous, measuring the magnitude of the prior gain (prior pay) (rather than a dummy indicating simply whether prior gain was greater

than expected gain). The results are reported in column 2 of Table 8. The marginal effects and contrasted marginal effects are shown in Figures 3a and 3b, respectively.

Insert Figures 3a and Figure 3b about here

The estimate of prior pay did not prove significant in the main effect. There was, however, a weak significance in the interaction term. Figures 3a and 3b provide a more detailed and comprehensive indication of how prior pay correlates with the propensity to choose risk over certainty when comparing individuals with and without entrepreneurial intentions. The marginal effects were significantly higher for individuals with entrepreneurial intentions than for individuals without entrepreneurial intentions when considering the higher values of prior pay. There was no significant difference for the lower values. This might suggest that the amplification effect of the illusion of control and the self-serving bias on the house money effect is particularly strong at higher values of prior gains and insignificant at lower values. Since winnings of DKr 14 and below did not exceed the expected gain, the theory did not predict a significant contrasted marginal effect for these values. However, we also observe insignificant contrasted marginal effects for values of DKr 30 and below. It is worth noting, that Figure 3a suggests that the significance is perhaps more likely to stem from a change in behavior among those without entrepreneurial intentions than among those with entrepreneurial intentions, since it is in these margins that the changes are more pronounced.

Restricted sample

We also considered the sample of individuals included in the analysis. We found that some of the subjects with entrepreneurial intentions did not plan on starting a firm within the next three years, while some without entrepreneurial intentions were planning to do so. We ran the analysis without including these subjects to investigate the sensitivity of the results to this subsample. These results are depicted in column 3 of Table 8. Overall, the results were unchanged, and the estimates were not substantially altered. Due to a upward shift in the estimate, however, the significance of the interaction between prior pay and entrepreneurial intention becomes more significant, suggesting that the weaker results with regard to this hypothesis may be caused by the sampling.

CONCLUSION

In this paper, we addressed the following research question: How do individuals with and without entrepreneurial intentions differ in their propensity to choose risk? Moving beyond the notion that entrepreneurs have higher risk-taking propensities than comparable others, recent empirical studies have considered the circumstantial nature of the differences in risk-taking behaviors between entrepreneurs and non-entrepreneurs. Such studies seek to address the conundrum of entrepreneurs' high level of self-assessed risk-taking propensity and contradictory empirical evidence. Further, these studies challenge the view of the entrepreneur as an individual who is more willing and better able to cope with the risks associated with starting and running a business. To address this issue empirically, it is necessary to understand the circumstances under which entrepreneurs show different propensities for risk. However, endogeneity is a concern in studies exploring behavior because choices are often influenced by

unobservable elements. To overcome this limitation, several recent studies have used data from experimental designs.

We have reported the results of a quasi-laboratory experiment with a number of distinguishing features. First, the results were based on repeated individual decisions with real monetary incentives. This is a special feature of our experiment, since each choice per individual involved real monetary gain. The work of Thaler and Johnson (1990) and Post et al. (2008), among others, suggests that this is the best way to compare individual sensitivity to past experience. Second, we compared individuals with entrepreneurial intentions—a significant predictor of entrepreneurship (Krueger et al., 2000)—with a well-defined group of individuals without entrepreneurial intentions within the same study program. The two groups were very similar in terms of demographics and experience, but clearly differed in terms of their career focus. Third, we collected a variety of additional background characteristics, both psychological and attitudinal, which allowed us to control for a variety of otherwise unobservable characteristics affecting decision-making, such as cognitive biases. Finally, we included both a subjective, survey-based measure of risk attitude and an incentivized, choice-based measure of risk-related preferences. This allowed us to compare subjective perceptions of risk attitude with objective measures based on actual choices with real financial consequences.

In line with previous studies, the individuals with entrepreneurial intentions in our sample were not significantly different from individuals without entrepreneurial intentions in their choices related only to risk (i.e. their level of risk aversion). However, when confronted with two specific exogenous manipulations grounded in cognitive psychology and prospect theory (the prior gains effect and the risk propensity effect, respectively), individuals with entrepreneurial intentions were found to differ significantly from the comparable group of individuals without entrepreneurial intentions. After controlling for a number of alternative

explanations, our results show that these differences arose from the distinctive ways in which the two groups coped with monetary risk. Specifically, the individuals with entrepreneurial intentions were influenced by the prior gains effect, since their propensities to choose risk were higher following the receipt of a monetary gain than the propensities of individuals without entrepreneurial intentions. Moreover, the gap between individuals with and without entrepreneurial intentions in terms of risk aversion closed at higher levels of risk, since the focus of the individuals with entrepreneurial intentions shifted from the potential utility of small gains to the risk involved. This latter result supports the work of both Forlani and Mullins (2000) and Kahneman and Lovallo (1993). Hence, our results provide further specific evidence regarding the circumstantial nature of entrepreneurs' propensities to choose risky monetary opportunities.

Limitations and implications

Our paper has several limitations related to the generalizability of the results and external validity. We chose to restrict the sample to students self-selecting into two distinct programs. While this has advantages in terms of the comparability of the considered groups, it also reduces generalizability. Therefore, the effects explored in this study should be tested across a wider range of subjects and possibly a group already engaged in entrepreneurial activity. Furthermore, while our definition of entrepreneurs follows standard conventions (see e.g. Krueger et al., 2000; Liñan & Chen, 2009; Roach & Sauermann, 2015), we acknowledge its limitations relating to its reliance on entrepreneurial intentions to empirically operationalize entrepreneurship. To limit alternative explanations with respect to sample construction, we used several post-experiment checks and found no reasons for concern. First, we checked whether subjects (both with and without entrepreneurial intentions) were in the same study concentration before entering the

entrepreneurship concentration. Coupling this check with the subjects' stated preferences (i.e. their written applications to the entrepreneurship concentration) suggested that socialization was not a relevant factor. Second, we recruited subjects without specifying the purpose of our study with respect to group comparisons or risk-taking. Third, we checked whether the topic of entrepreneurial risk-taking had been presented in recent classroom work and found no support for such a confounding factor. Finally, we enforced a strict no-communication policy during the laboratory experiment, thereby limiting any possible socialization effect during the experiment. Furthermore, our experiment offers a precise, yet narrowly focused study of the cognitive mechanisms guiding individuals' observed behaviors. This represents a limitation of our study. Real-life entrepreneurial settings involve a number of different dynamic factors that concurrently influence individuals' risk choices. In particular, knowledge and expertise (Heath & Tversky, 1991) may lead individuals to take risks in areas about which they feel confident or passionate (Cardon Wincent, Singh, & Drnovsek, 2009). Future research may test how prior knowledge and passion influence entrepreneurs' risk-taking by reducing (or increasing) the prior gains effect and the risk propensity effect.

This study contributes to our understanding of the mechanisms guiding entrepreneurial decision-making (i.e. the prior gains effect and the risk propensity effect). This has two direct implications for entrepreneurship research. First, entrepreneurs place significant value on monetary gains. However, in real life, entrepreneurs often face an environment that does not provide reliable information or feedback on monetary investments. This might be why entrepreneurs rely on heuristics when making decisions in real-life cases. It might also offer some insights into why successful entrepreneurs abandon entrepreneurial ventures in order to start new businesses. Serial entrepreneurship is not exclusive to necessity entrepreneurs; it also often characterizes some of the most successful entrepreneurs. Prior gains may lead

entrepreneurs to choose more risky career steps and embolden them to embark on new entrepreneurial ventures. This would suggest that this type of serial entrepreneurship is not strictly the result of lower capital barriers, but could also be explained by the individual behavioral traits of entrepreneurs.

Second, entrepreneurs respond to changes in the degree of risk associated with monetary opportunities. This moderating effect is unexpected and tempers the natural tendency of entrepreneurs to choose risky monetary opportunities. In real entrepreneurial ventures, monetary opportunities have the characteristics of investments, and it is often not possible to fully understand the increasing degrees of risk involved. Our laboratory experiment setup allowed us to isolate this effect, illustrating a case in which entrepreneurs and non-entrepreneurs behaved similarly and exhibited similar propensities. This perspective is helpful for resolving the difference between the theory and empirical evidence related to the risk propensities of entrepreneurs and non-entrepreneurs. Our study suggests that entrepreneurs may exhibit consistent behaviors across different degrees of risk, while non-entrepreneurs may change their behaviors at higher levels of risk.

These results have implications for entrepreneurs' stakeholders. Specifically, they offer insights that will help investors, business partners, employees, and other stakeholders better understand and manage the entrepreneurs with whom they do business. For one thing, the results provide evidence that there are certain circumstances in which entrepreneurs are more likely to make risky choices (e.g. immediately after an economic gain). In addition, the results suggest that entrepreneurs may pursue risky choices even when the possibility of an economic gain is low (i.e. cases of low risk). This information may be useful in helping stakeholders manage their entrepreneurial partners.

APPENDIX

Insert Table A1 about here

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TABLES

TABLE 1: Descriptive statistics and test of differences between individuals with and without entrepreneurial intentions (N=45)

	With entrepreneurial intention	Without entrepreneurial intention	χ^2	Sig.
Male	14 (31.1)	21 (46.7)		
Female	4 (8.9)	6 (13.3)	0.000	
Danish	16 (35.6)	26 (57.8)		
International	2 (4.4)	1 (2.2)	0.952	
$50.000 < income < 300.000$	15 (33.3)	24 (53.3)		
$0 < income < 50.000$	3 (6.7)	3 (6.7)	0.313	
Parent entrepreneur	5 (11.1)	7 (15.6)		
No parent entrepreneur	13 (28.9)	(20 (44.4)	0.019	
University degree	3 (6.7)	1 (2.2)		
No University degree	15 (33.3)	26 (57.8)	2.588	
Part-time employed	11 (24.4)	23 (51.1)		
Not part-time employed	7 (15.6)	4 (8.9)	3.389	*
Established firm	3 (6.7)	1 (2.2)		
Not established firm	15 (33.3)	26 (57.8)	2.241	
Establish firm within 3 years	12 (26.7)	4 (8.9)		
Not establish firm within 3 years	6 (13.3)	23 (51.1)	12.672	***

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$, percentages of table total in parentheses

TABLE 2: Timeline of experiment: Tasks and compensation schemes

		Between-Subjects Design	
		With entrepreneurial intentions (N=18)	Without entrepreneurial intentions (N=27)
Tasks	Part 1: Introduction (10 minutes)	Individuals are assigned to a computer and rules are explained. No communication is allowed	
	Part 2: Money Games (15 minutes)	Individuals are presented with 24 unique gamble choices, presented one-by-one in a fixed order. Eight out of twenty-four gambles have no monetary feedback. Four types of gambles are used: certainty-risk, certainty-uncertainty, risk-risk, risk-uncertainty. Each choice has an expected value of Dkr 14.	
	Part 3: Questionnaire (35 minutes)	Individuals answer questions on: demographics, risk attitudes, investment opportunities, cognitive biases (representativeness, overconfidence), psychological traits (Big Five, Gambling attitudes)	

Note: at the end of part 3, subjects were paid according to the rules (fixed show-up fee, and performance during money games) and dismissed.

TABLE 3: Considered four real monetary games between certainty (Option A) and risk (Option B)

	Option A		Option B	
Decision 1	100%	Dkr14	50% 50%	Dkr8 Dkr20
Decision 2	100%	Dkr14	50% 50%	Dkr4 Dkr24
Decision 3	100%	Dkr14	50% 50%	Dkr0 Dkr28
Decision 4	100%	Dkr14	50% 50%	Dkr-2 Dkr30

TABLE 4: Descriptive statistics on key variables (N=180)

	With entrepreneurial intention	Without entrepreneurial intention	Total	χ^2	Sig.
Choose risk (option B)	34 (18.9)	38 (21.1)	72 (40.0)		
Choose certainty (option A)	38 (21.1)	70 (38.9)	108 (60.0)	2.608	
Prior gain greater than expected	33 (18.3)	11 (6.1)	44 (24.4)		
Prior gain not greater than expected	39 (21.7)	97 (53.9)	136 (75.6)	29.724	***
Total	72 (40.0)	108 (60.0)	180 (100.0)		

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$, percentages of table total in parentheses

TABLE 5: Descriptive statistics and Pearson's correlation coefficients

		Mean	S.D.	Min	Max	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]
[1]	With entrepreneurial intention	0.40	0.49	0.00	1.00								
[2]	Prior gain	0.22	0.42	0.00	1.00	0.06							
[3]	Degree of risk	26.67	8.70	12.00	48.00	0.00	0.07						
[4]	Accumulated Winning	198.32	75.51	68.00	388.00	0.07	0.39	0.90					
[5]	Extraversion	0.00	1.00	-3.07	1.46	0.13	0.12	0.00	0.13				
[6]	Openness	0.00	1.00	-2.14	2.52	0.16	0.01	0.00	-0.03	0.00			
[7]	Neuroticism	0.00	1.00	-1.90	1.86	-0.12	0.01	0.00	-0.07	0.00	0.00		
[8]	Conscientiousness	0.00	1.00	-2.87	1.60	0.35	0.06	0.00	-0.08	0.00	0.00	0.00	
[9]	Agreebleness	0.00	1.00	-1.98	1.80	-0.20	-0.14	0.00	-0.13	0.00	0.00	0.00	0.00
[10]	Overconfidence	101.25	21.72	67.00	148.00	-0.25	-0.11	0.00	-0.09	0.03	0.22	0.11	0.11
[11]	Risk neutral	0.27	0.44	0.00	1.00	0.02	-0.02	0.00	0.00	-0.03	0.05	-0.24	-0.06
[12]	Risk prone	0.20	0.40	0.00	1.00	-0.07	0.01	0.00	0.11	0.15	-0.19	-0.05	0.00
[13]	Pathological aggregate	1.52	0.56	1.00	3.20	-0.07	-0.02	0.00	0.00	0.07	-0.22	-0.27	-0.12
[14]	Age	21.51	0.78	20.00	23.00	-0.07	0.09	0.00	0.04	0.02	-0.07	0.06	-0.10
[15]	Female	0.22	0.42	0.00	1.00	0.00	0.04	0.00	0.04	0.35	0.30	0.39	-0.05
[16]	International	0.07	0.25	0.00	1.00	0.15	0.00	0.00	-0.05	0.16	-0.02	0.04	0.18
[17]	Parent entrepreneur	0.27	0.44	0.00	1.00	0.02	-0.02	0.00	-0.03	0.04	-0.01	0.12	0.04
[18]	University degree	0.09	0.28	0.00	1.00	0.22	0.14	0.00	0.05	-0.05	-0.02	0.16	-0.07
[19]	Establish firm within 3 years	0.36	0.48	0.00	1.00	0.53	0.23	-0.00	0.03	-0.01	0.38	-0.18	0.23
[20]	Income above 50.000	0.87	0.34	0.00	1.00	-0.08	-0.04	0.00	-0.04	0.13	-0.19	-0.09	0.03

		[9]	[10]	[11]	[12]	[13]	[14]	[15]	[16]	[17]	[18]	[19]	
[10]	Overconfidence	0.18											
[11]	Risk neutral	-0.15	-0.32										
[12]	Risk prone	-0.20	-0.07	-0.3 0									
[13]	Pathological aggregate	-0.12	0.20	0.25	0.14								
[14]	Age	0.00	0.09	0.06	0.24	0.33							
[15]	Female	0.02	0.10	-0.20	0.00	-0.40	0.06						
[16]	International	-0.16	-0.03	0.24	-0.13	-0.06	-0.29	0.29					
[17]	Parent entrepreneur	-0.04	-0.09	0.09	-0.05	-0.14	-0.27	0.04	0.04				
[18]	University degree	0.00	-0.16	-0.19	-0.16	-0.23	0.00	0.02	-0.08	-0.19			
[19]	Establish firm within 3 years	-0.03	-0.04	0.08	-0.02	-0.09	0.05	-0.06	-0.01	-0.03	0.26		
[20]	Income above 50.000	0.08	0.04	-0.35	0.20	0.17	0.01	-0.26	-0.42	0.09	-0.11	0.02	

Note: Correlation coefficients above 0.06 are significant at a 5% level

TABLE 6: Explaining subjects choice of risk compared to certainty; results of logit regressions

	Standard Logit Models			
	(1)	(2)	(3)	(4)
Explanatory Variables				
Entrepreneurial intention	0.160	0.144	0.680***	0.800***
	[0.123]	[0.097]	[0.156]	[0.133]
Prior Gain		-0.063	-0.044	-0.169
		[0.082]	[0.161]	[0.130]
Degree of risk		0.002	0.009	-0.040***
		[0.005]	[0.007]	[0.014]
Entrepreneurial intention × Prior gain			0.321	0.364
			[0.205]	[0.242]
Entrepreneurial intention × Degree of risk			-0.035***	-0.044**
			[0.012]	[0.017]
Control variables				
Accumulated winning	0.001			0.006***
	[0.001]			[0.002]
Extraversion	0.018			0.027
	[0.035]			[0.037]
Openness	0.071			0.113
	[0.057]			[0.069]
Neuroticism	-0.050			-0.009
	[0.033]			[0.035]
Conscientiousness	-0.061*			-0.042
	[0.035]			[0.038]
Agreebleness	-0.074			-0.046
	[0.049]			[0.048]
Overconfidence	0.005*			0.005*
	[0.003]			[0.003]
Holt & Laury risk attitude				
Risk prone	0.162			0.164
	[0.143]			[0.142]
Risk neutral	0.409**			0.366*
	[0.162]			[0.195]
Risk averse	benchmark			benchmark
Pathological Aggregate	-0.360***			-0.420**
	[0.131]			[0.165]
Age	0.059			0.088
	[0.063]			[0.069]
Female	-0.309***			-0.463***
	[0.118]			[0.153]
International	0.394**			0.699***
	[0.193]			[0.174]
Parent entrepreneur	-0.046			-0.065
	[0.076]			[0.084]
University degree	0.094			0.049
	[0.111]			[0.132]
Establish firm within 3 years	-0.071			-0.096
	[0.138]			[0.148]
Income above 50.000	0.038			0.145
	[0.142]			[0.151]
Number of observations	180	180	180	180
Log-likelihood	-103.144	-119.621	-116.363	-92.856
χ^2	89.430***	2.250	11.599**	164.040***
$Pseudo - R^2$	0.149	0.013	0.040	0.234

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$ at a two sided test, Clustered standard errors in parentheses

TABLE 7: Hausman test for differences between a random and a fixed effects model specification

	Coefficients			
	Fixed Effects	Random Effects	Difference in Coefficients	Standard error
Prior gain	-0.966	-0.786	-0.180	0.462
Entrepreneurial intention × Prior gain	1.641	1.575	0.065	0.790
Degree of risk	-0.251	-0.174	-0.077	0.074
Entrepreneurial intention × Degree of risk	-0.174	-0.191	0.017	0.026
Accumulated Gains	0.035	0.027	0.009	0.009

Hausman test for difference not systematic: $\chi^2(5)=0.020$ (Prob> $\chi^2=1.000$)

TABLE 8: Explaining subjects choice of risk compared to certainty; results when using continuous variable for prior gain (prior pay) and a restricted sample

	Random Effects (1)	Prior Pay (2)	Restricted Sample (3)
Explanatory Variables			
Entrepreneurial intention	4.417**	0.497***	0.706***
	[1.938]	[0.090]	[0.244]
Prior gain/pay	-0.786	-0.008	-0.015
	[0.985]	[0.005]	[0.011]
Degree of risk	-0.174	-0.03***	-0.025
	[0.113]	[0.008]	[0.016]
Entrepreneurial intention × Prior gain/pay	1.575	0.009*	0.021**
	[1.344]	[0.005]	[0.010]
Entrepreneurial intention × Degree of risk	-0.191**	-0.028**	-0.044*
	[0.089]	[0.014]	[0.024]
Control variables			
Accumulated winning	0.027**	0.005***	0.004**
	[0.013]	[0.001]	[0.002]
Extraversion	0.116	0.023	0.075
	[0.368]	[0.028]	[0.054]
Openness	0.486	0.082**	0.145**
	[0.474]	[0.041]	[0.059]
Neuroticism	-0.038	-0.005	0.02
	[0.295]	[0.027]	[0.054]
Conscientiousness	-0.182	-0.031	-0.008
	[0.326]	[0.029]	[0.038]
Agreebleness	-0.199	-0.037	-0.015
	[0.350]	[0.039]	[0.050]
Overconfidence	0.023	0.004	0.004
	[0.021]	[0.002]	[0.003]
Holt & Laury risk attitude			
Risk prone	0.709	0.114	0.255*
	[0.889]	[0.089]	[0.139]
Risk neutral	1.582	0.268**	0.3
	[1.306]	[0.109]	[0.226]
Risk averse	benchmark	benchmark	benchmark
Pathological Aggregate	-1.811	-0.314***	-0.374**
	[1.107]	[0.098]	[0.174]
Age	0.381	0.067	0.052
	[0.512]	[0.051]	[0.075]
Female	-1.999**	-0.343***	-0.433***
	[1.005]	[0.084]	[0.108]
International	3.023	0.505***	0.265
	[2.033]	[0.134]	[0.217]
Parent entrepreneur	-0.28	-0.047	-0.05
	[0.652]	[0.057]	[0.077]
University degree	0.21	0.032	0.09
	[1.750]	[0.092]	[0.118]
Establish firm within 3 years	-0.415	-0.061	
	[1.095]	[0.099]	
Income above 50.000	0.627	0.095	0.032
	[1.455]	[0.104]	[0.143]
Number of observations		180	140
Log-likelihood	-92.855	-92.765	-72.448
χ^2	.	189.250***	1013.810***
$Pseudo - R^2$	.	0.234	0.216
LR test (RE vs. logistic regression)	0.000		

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$ at a two sided test
Clustered standard errors in parentheses

TABLE 9: Measures of intra-class associations in random-effects logit

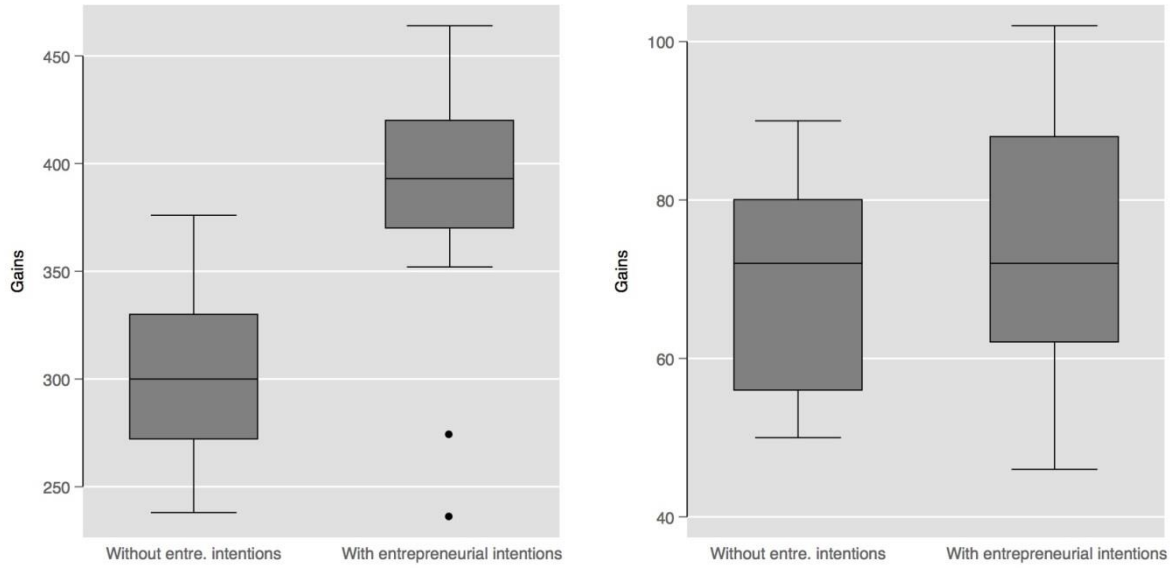
Measure	1st Percentile	25th Percentile	50th Percentile	75th Percentile	99th Percentile
Marginal prob.	0.012	0.180	0.348	0.611	0.955
Joint prob.	0.000	0.033	0.122	0.374	0.912
Odds ratio	1.010	1.010	1.010	1.010	1.010
Pearson's r	0.000	0.001	0.002	0.002	0.000
Yule's Q	0.005	0.005	0.005	0.005	0.005

TABLE A1: Results of factor analysis generating Big 5 Personality Traits

Question	Extraversion	Openness	Neroticism	Conscien–tiousness	Agreeable–ness	As expected
I am someone who ...						
is talkative	0.7915					√
tends to find faults with others					0.4307	√
does a thorough job						
is depressed, blue	-0.5399					
is original, comes up with new ideas	0.4043	0.5208				√
is reserved	0.6932					√
is helpful and unselfish with others					0.5165	√
can be somewhat careless					0.4685	
is relaxed, handles stress well			0.7396			√
is curious about many different things		0.6015				√
is full of energy	0.6498					√
starts quarrels with others					0.4676	√
is a reliable worker						
can be tense			0.6384			√
is ingenious, a deep thinker		0.5641				√
generates a lot of enthusiasm	0.8022					√
has a forgiving nature				-0.5251	0.4328	√
tends to be disorganized				0.7063		√
worries a lot			0.7265			√
has an active imagination		0.4028				√
tends to be quiet	0.8135					√
is generally trusting						
tends to be lazy				0.5232		√
is emotionally stable, not easily upset			0.7654			√
is inventive		0.4512				√
has an assertive personality						
can be cold and aloof					0.5797	√
perseveres until the task is finished				0.6081		√
can be moody			0.5442			√
values artistic, aesthetic experiences		0.4505				√
is sometimes shy, inhibited	0.7268					√
is considerate and kind to almost everyone					0.5876	√
does things efficiently				0.6183		√
remains calm in tense situations			0.6463			√
prefers work that is routine		0.5409				√
is outgoing, sociable	0.7978					√
is sometimes rude to others					0.7959	√
makes plans and follows through with them				0.8054		√
gets nervous easily			0.4898			√
likes to reflect, play with ideas		0.6456				√
has few artistic interests						
likes to cooperate with others	0.4740					
is easily distracted						
is sophisticated in art, music, or literature		0.6223				√

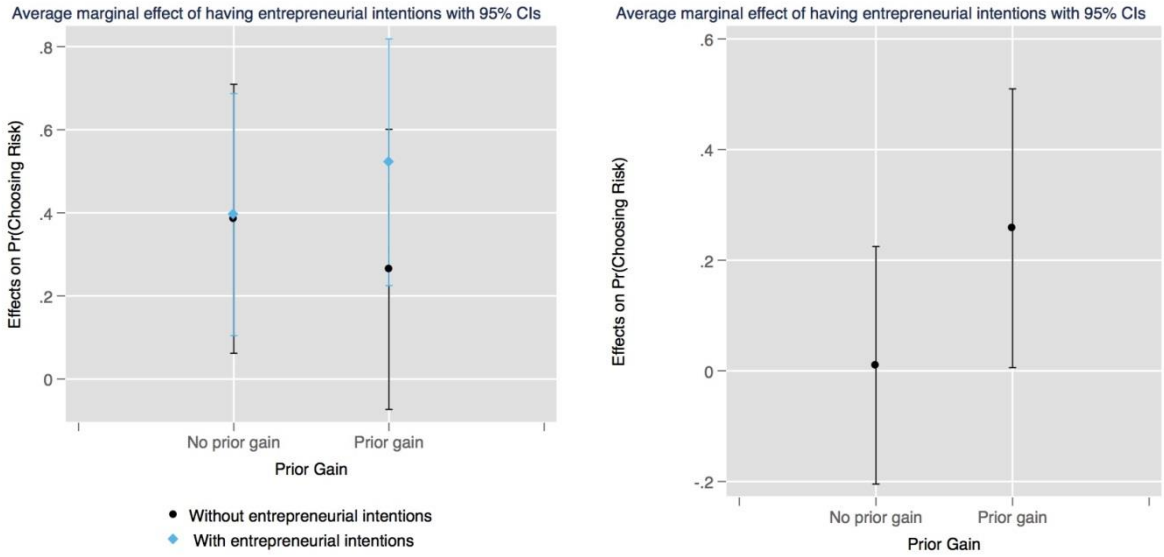
Note: Factor loading above/below 0.4/-0.4 reported – 35 out of 44 load as expected

FIGURES



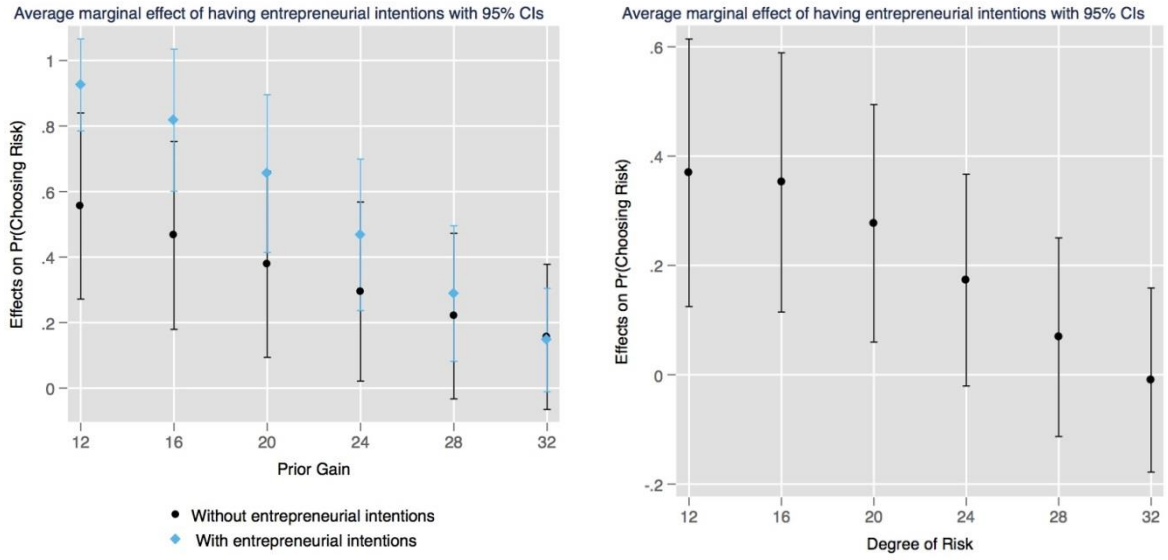
(a) (b)

FIGURE 1: Differences in gains between subjects with entrepreneurial intentions and subjects without entrepreneurial intentions, considering (a) all gains games and (b) all games considered in the analysis



(a) (b)

FIGURE 2: (a) Average marginal effects and (b) contrasting marginal effects of subjects with and without entrepreneurial intentions with respect to prior gains



(a) (b)

FIGURE 3: (a) Average marginal effects and (b) contrasting marginal effects of subjects with and without entrepreneurial intentions with respect to degree of risk

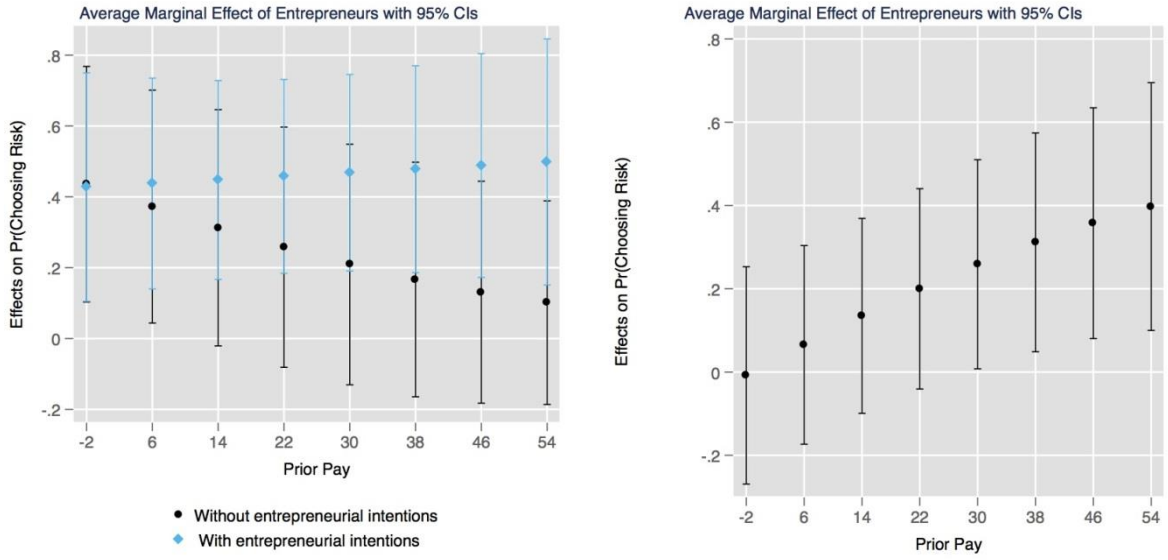


FIGURE 4: (a) Average marginal effects and (b) contrasting marginal effects of subjects with and without entrepreneurial intentions with respect to prior pay

CHAPTER 3. ENTREPRENEURS' FOCUS OF ATTENTION AND PERCEPTION OF FINANCIAL RISK

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Abstract

Content analysis of verbal answers and behavioral data from a laboratory experiment shows that individuals with and without entrepreneurial intentions differ in their perception of financial risk due to their focus of attention. Individuals with entrepreneurial intentions tend to choose risky investment prospects by consistently focusing on the size of possible monetary returns, while individuals without entrepreneurial intentions are inclined to concentrate on the probabilities attached to them. Furthermore, individuals with entrepreneurial intentions who pay more attention to monetary returns exhibit a higher perception of risk compared to individuals in the same group who focus more on probabilities, indicating an overall lower risk perception of individuals with entrepreneurial intentions. My contribution to extant entrepreneurship literature is twofold. First, I show that differences in behavior within and across groups are driven by the tight link between individuals' focus of attention and perception of financial risk. Second, I argue for the ex-ante differences in risk perception between entrepreneurs and non-entrepreneurs by showing how such differences already exist when comparing individuals with different entrepreneurial intentions. The results have practical implications for both entrepreneurs and stakeholders, particularly investors, as they need to align their assessment of financial risk with that of entrepreneurs.

1. Introduction

Defined as the subjective assessment of risk in a given opportunity, risk perception (Weber, Blais, & Betz, 2002) is an important cognitive mechanism that influences choices. Investment opportunities that are perceived as less risky are chosen more often than those that are regarded as more risky (Keh, Foo, & Lim, 2002; Simon, Houghton, & Aquino, 2000). Entrepreneurs are believed to differ from non-entrepreneurs in risk perception; they pursue certain business opportunities involving high risk and uncertainty, while others shy away (Mitchell et al., 2007; Shepherd, Williams, & Patzelt, 2015). However, there is relatively little empirical knowledge of how entrepreneurs and non-entrepreneurs differ in risk perception. From a cognitive perspective, entrepreneurs and non-entrepreneurs vary in the way they think about risky opportunities (e.g., *effectual logic*,[14] see Dew, Read, Sarasvathy, & Wiltbank, 2009; Sarasvathy, 2001) and evaluate these (Wood, McKelvie, & Haynie, 2014; Wood & Williams, 2014). Entrepreneurs accept risk as a given and focus on their personal commitment to cope with it. In contrast, non-entrepreneurs do not accept risk as a given but concentrate on minimizing it (Sarasvathy, Simon, & Lave, 1998). It has been hypothesized that these differences also affect risk perception, as entrepreneurs and non-entrepreneurs focus their attention on controlling different elements of risk (Sarasvathy et al., 1998). In this chapter, these hypotheses are tested, particularly whether entrepreneurs' *focus of attention*—defined as individuals' selection of available information through attention (March & Shapira, 1987)—drives the differences in risk perception between entrepreneurs and non-entrepreneurs.

Accordingly, the following research question is addressed: how do individuals with and without entrepreneurial intentions differ in their perception of financial risk? This question

[14] Effectual logic is defined as the logic of thinking that uniquely serves entrepreneurs when starting businesses (Sarasvathy, 2001).

is important for several reasons. First, perception plays a fundamental role in guiding decision making in environments characterized by high risk and uncertainty, such as entrepreneurship (Slovic, 1987, 2000). Hence, by studying entrepreneurs' perception of financial risk, I help explain the cognitive mechanisms leading individuals to self-select for entrepreneurship. Second, in the few studies that have measured risk perception, it has been treated primarily as a fixed personality trait (Simon et al., 2000; Weber et al., 2002; Weber & Milliman, 1997). In even fewer studies, a difference has been hypothesized between the risk perceptions of entrepreneurs versus non-entrepreneurs (Podoynitsyna, Van der Bij, & Song, 2012; Sarasvathy et al., 1998). Hence, by measuring risk perception as a dynamic aspect of decision making under risk, it is possible to test a more direct link between choice behavior and cognition, a relevant issue in entrepreneurship research (Mitchell et al., 2007). Third, entrepreneurs' focus of attention affects their choices through aspirations (typically two reference points,[15] see March & Shapira, 1987, 1992). However, the question of whether or not these aspirations affect individuals' risk perception remains untested. Finally, by investigating the research question, I answer Shepherd and colleagues' (2015) recent call to test the relationship between individuals' perceptions and decision-making tools in order to understand new venture creation.

In a laboratory setting, I compared the risk choices of two groups of individuals (N = 72) who differed in entrepreneurial intentions—a sample often used in entrepreneurship literature to study the choices of entrepreneurial individuals with limited experience (Krueger, Reilly, & Carsrud, 2000). Each individual was confronted with a total of three choices between two possible investment opportunities—low-risk Option A and high-risk Option B. I

[15] The literature on reference point-dependent choices is fundamental for understanding individuals' risk preferences as these depend on current states (status quo, e.g., owned assets, see Tversky & Kahneman, 1991). Individuals focus their attention on elements that are linked to reference points. Particularly, March and Shapira (1987, 1992) argue that focus of attention is linked to two reference points: a fixed survival point and an aspiration point. An individual's choice is affected by the distance between such a survival and the aspiration point. A test of March and Shapira's model in organizations supports such a view, with organizational risk preferences changing due to financial performance (Miller & Chen, 2004).

exogenously manipulated the risk of Option B. For each individual, I measured (a) his/her choices between the two options, (b) the reasons for such choices, and (c) his/her risk perception.

Several features of my experiment made the approach to the research question unique. First, I used the data from a laboratory experiment. The tasks were designed to identify the causal link between cognition and behavior in a controlled environment (McMullen & Shepherd, 2006). Second, I used a sample of individuals with and without entrepreneurial intentions, who shared similar backgrounds in terms of experience and education but differed in their entrepreneurial intentions. This sample choice had a twofold advantage. It limited the confounding effect of individuals' prior work experience, and it was useful for testing the differences in the focus of attention between individuals with very limited entrepreneurial experience.[16] Third, perception was contextually measured for each choice. This represented an additional feature compared to prior studies (e.g., Sarasvathy et al., 1998; Simon et al., 2000), which allowed for testing the link between focus of attention and risk perception. Fourth, the analysis of risk perception was restricted to financial risk, an important component of the entrepreneurial environment. In essence, financial risk could be decomposed into two elements—the probability distribution of obtaining monetary outcomes and the sizes of such outcomes (Fox, Erner, & Walters, 2016). Finally, focus of attention was measured by codifying the verbal reasoning behind risk choices as suggested by Shepherd and colleagues (2015).

The results provide new insights into the differences within and across groups of entrepreneurs and non-entrepreneurs, both in their perception of financial risk and focus of attention. Across groups, individuals with and without entrepreneurial intentions differ in their

[16] As entrepreneurs have already been found to have a different focus of attention compared to non-entrepreneurs (Sarasvathy et al., 1998), I contribute to extant research by showing how such differences exist before entrepreneurs acquire entrepreneurial experience. Furthermore, I show how such differences in the focus of attention result in different risk perceptions between groups.

focus of attention when faced with risky investment prospects. Particularly, when choosing between investments, the first group makes choices by consistently focusing on the size of possible monetary outcomes. In contrast, the second group concentrates on the probabilities attached to them. Such differences in focus of attention are robust to different manipulations of probabilities and outcomes. Individuals with entrepreneurial intentions also perceive relatively less risk compared to their counterparts without entrepreneurial intentions. Particularly, the first group perceives risk only when paying attention to monetary outcomes, while the second group perceives risk consistently among different foci of attention.

My contribution is twofold. First, the results add to entrepreneurship research by advancing the understanding of cognition under risk before entrepreneurial experience. This is achieved by showing that individuals with and without entrepreneurial intentions differ in their focus of attention when making choices. Second, particularly for individuals with entrepreneurial intentions, the perception of financial risk is tightly linked to their focus on the size of possible outcomes. These findings represent a step ahead in the understanding of entrepreneurs' risk perception and its direct, opportunity-specific importance in making decisions under risk.

The remainder of this chapter is organized as follows. Section 2 reviews the relevant literature and presents my arguments pertaining to risk perception. Section 3 describes the data, the sample construction, the details of the experiment, and the method for testing the proposed arguments. Section 4 presents the results. Section 5 draws the conclusions and discusses the findings' implications and limitations.

2. Theory

2.1. Entrepreneurial cognition

Entrepreneurial cognition is defined as the "knowledge structures that people use to make assessments, judgments, or decisions involving opportunity evaluation, venture creation, and growth" (Mitchell et al., 2002, p. 97). Research on entrepreneurial cognition focuses on understanding how entrepreneurs use mental models to simplify and piece together previously unconnected information. These mental models help entrepreneurs identify opportunities, create new products or services, and assemble the necessary resources to start and grow their businesses (Mitchell et al., 2002, 2007). Cognitive mental models ultimately help entrepreneurs cope with business risks and uncertainties.

Cognitive research on entrepreneurs' risk taking has been especially fruitful. Entrepreneurs use decision heuristics (Busenitz & Barney, 1997; Deligonul, Hult, & Cavusgil, 2008) and cognitive biases (e.g., overconfidence [Simon et al., 2000] or status quo bias [Burmeister & Schade, 2007]) in making decisions under risk. Furthermore, they are over-optimistic both in evaluating opportunities (Cassar, 2010; Parker, 2009) and predicting the likelihood of success (Cooper, Woo, & Dunkelberg, 1988; Dushnitsky, 2010). Cognitive biases and heuristics are fundamental elements behind risk taking. Many entrepreneurial decisions would never be made without the use of biases and heuristics, as they help entrepreneurs make timely decisions and deal with multiple problems connected with successfully starting a new business (Busenitz & Barney, 1997). Even so, there is no direct relationship between cognitive biases and risk taking. Instead, risk perception acts as a mediator between cognitive heuristics and behavior under risk (Keh et al., 2002; Simon et al., 2000). Particularly, heuristics foster risk taking by lowering individuals' risk perception. Despite the importance of risk perception in individuals' behavior under risk, relatively little is known about how risk perception differs among groups of individuals, particularly between entrepreneurs and non-entrepreneurs.

2.2. Entrepreneurs' risk perception

As mentioned, risk perception is defined as the subjective assessment of risk in a given opportunity (Weber et al., 2002). Risk assessment assumes an important role in entrepreneurship because individuals self-select for entrepreneurship by positively assessing opportunities (Choi & Shepherd, 2004; Haynie, Shepherd, & McMullen, 2009). Specifically, the lower the predicted financial risk is in investment opportunities, the more positive entrepreneurs' evaluations of such investments will be (Sarasvathy et al., 1998). Conversely, entrepreneurs' negative assessments of opportunities discourage such new investments and delay decisions to disinvest for existing investments (Shepherd, Wiklund, & Haynie, 2009).

While entrepreneurs are often considered risk takers, empirical evidence shows that their decisions regarding exploiting opportunities are influenced by systematic differences in cognitive processes, not necessarily by a desire to pursue risky ventures (Forlani & Mullins, 2000). Furthermore, individuals' risk perception depends on the risk characteristics of opportunities—for example, the probability of obtaining a certain financial return on investments—and cannot be treated as an individual stable trait, such as risk propensity (Weber et al., 2002). Finally, in managing risky investments, entrepreneurs accept risk as a given, while non-entrepreneurs attempt to control and minimize it (Sarasvathy et al., 1998). My contribution lies in showing that entrepreneurs select and evaluate available information differently from non-entrepreneurs and that such a difference between the two groups exists before entrepreneurial experience. Particularly, they focus their attention to guide the process of information selection. Hence, I argue that differences in financial risk perception between individuals with and without entrepreneurial intentions are driven by investment-specific risk characteristics and that the focus of attention guides such a perception.

2.3. Focus on outcomes versus probabilities

The illusion of control—a bias referring to individuals' overestimation of control in obtaining uncertain outcomes (Simon et al., 2000)—drives individuals to focus their attention on opportunities that are perceived as more manageable or controllable (Sitkin & Pablo, 1992; Weber et al., 2002). This influence is widely recognized in both the fields of cognitive psychology (Kahneman & Tversky, 1982; Lerner & Keltner, 2001; Loewenstein, Weber, Hsee, & Welch, 2001) and entrepreneurship (Baron, 1998; De Carolis & Saparito, 2006; McGrath & MacMillan, 1992). The entrepreneurship literature shows that at the individual level of analysis, the illusion of control positively affects both opportunity evaluations and decisions to start new ventures (Keh et al., 2002; Simon et al., 2000). Risk perception acts as a mediator in the relationship between the evaluation of opportunities and the illusion of control. The overall result is that investment opportunities that are perceived as more manageable or controllable are chosen more often than those that are viewed as less controllable (De Carolis & Saparito, 2006; Keh et al., 2002; Simon et al., 2000).

Under financial risk, entrepreneurs and non-entrepreneurs try to control different elements of risky investments. In contrast to managers—who try to reduce the probabilities of obtaining negative outcomes—entrepreneurs tend to accept such a set of probabilities as a given and focus on personal commitment to reach target outcomes. This argument is consistent with both the effectuation theory[17] (Dew et al., 2009; Sarasvathy, 2001; Sarasvathy et al., 1998) and cognitive psychology, with the bias of the illusion of control over monetary outcomes pushing entrepreneurs to accept high levels of risk in the pursuit of greater outcomes (Forlani & Mullins, 2000). Furthermore, entrepreneurs exhibit a lower risk aversion to the size of possible monetary losses compared to managers (Koudstaal, Sloof, & van Praag, 2015), indicating that they pay

[17] The theoretical reason behind such a finding is effectuation (Sarasvathy, 2001). Instead of focusing on an unpredictable future, entrepreneurs focus on minimizing risk by managing their available monetary resources (e.g., affordable loss).

greater attention to the size of monetary outcomes and that the size matters in their risk choices (Zichella & Reichstein, 2016). Finally, the effectuation logic—defined as the logic of thinking that uniquely serves entrepreneurs in starting businesses (Sarasvathy, 2001)—also helps explain why entrepreneurs differ in their feelings and management of control over risky investments. Effectuation assumes that the future is unpredictable, but entrepreneurs can still control the value-creating part of it through the use of a given set of means available to them. In this sense, entrepreneurs can utilize the means at their disposal to influence their future, without the need to predict it or to consider the expected chance probabilities. Prior research has not tested whether such a difference already exists at the early stage of entrepreneurship (e.g., among novice entrepreneurs or entrepreneurship students), when it is crucial to support efficient decision making in startups (e.g., through incubation, see Amezcua et al., 2013). Based on the preceding discussion, I argue that individuals with and without entrepreneurial intentions perceive financial risk differently due to differences in their focus of attention. Specifically, when comparing risky investment opportunities, I argue that individuals with entrepreneurial intentions choose investments by mainly considering the size of possible outcomes. In contrast, individuals without entrepreneurial intentions primarily consider the probabilities of obtaining possible outcomes. Thus, the following hypotheses are presented.

H1a. *Individuals with entrepreneurial intentions choose investments by mainly focusing their attention on the size of monetary outcomes instead of on the probabilities of obtaining them.*

H1b. *Individuals without entrepreneurial intentions choose investments by mainly focusing their attention on the probabilities of obtaining monetary outcomes instead of on the size of such outcomes.*

2.4. Focus of attention and risk perception

Very little is known about how pieces of information affect entrepreneurs' risk perception. Nonetheless, it is important to understand whether or not entrepreneurs can perceive the riskiness of their own actions or whether they perceive risk differently in such a way that what is considered risky by one person is not viewed as such by another (Shane, Locke, & Collins, 2003).

The link between individuals' focus of attention and risk perception is found in both the logic (or illusion) of control and individuals' aspirations. Individuals subjectively assess (and perceive) the risk of opportunities by selecting pieces of available information. On one hand, the illusion of control bias helps individuals select such pieces of information by focusing their attention on elements that are perceived as more controllable. Entrepreneurs are particularly affected by the illusion of control bias and perceive less risk in opportunities that are assessed as more controllable (De Carolis & Saparito, 2006; Keh et al., 2002; Simon et al., 2000). On the other hand, entrepreneurs' ambitions to reach a target objective (e.g., a greater but riskier monetary outcome) positively affect their risk perception by increasing their awareness of the distance between a safer survival level and their aspiration level (March & Shapira, 1992; Sarasvathy et al., 1998). I argue that the net effect of the illusion of control and individual aspirations may result in conflicting emotions, leading to an overall increase in risk perception for individuals who focus their attention on specific financial risk features. The role of conflicting emotions in increasing risk perception has been shown empirically (Podoynitsyna et al., 2012).

I argue that when individuals face two alternative risky investments, they significantly differ in their financial risk perceptions, depending on whether they focus on the outcomes or on the probabilities attached to the investments. Thus, the following hypotheses are presented.

H2a. *Among individuals with entrepreneurial intentions, risk perception is higher for those who focus their attention on the size of monetary outcomes instead of on the probabilities of obtaining these.*

H2b. *Among individuals without entrepreneurial intentions, risk perception is higher for those who focus their attention on the probabilities of obtaining monetary outcomes instead of on the size of such outcomes.*

3. Data and Method

3.1. Sample

To test the hypotheses, I used data from a computer-based quasi-laboratory experiment designed and conducted in the fall of 2014. A total of 72 students[18] of business economics at a major European business school participated in the experiment. The students in the sample all shared similar backgrounds in terms of experience and education[19] but differed in their entrepreneurial intentions. The purpose of this choice was to test differences between groups of individuals without entrepreneurial experience in both risk perception and focus of attention as possible confounding factors.

Among the programs with an entrepreneurship focus, 11 subjects were sampled from the local student incubator for novice entrepreneurs. The individuals in this group actively applied to enter the local incubator. After handing in their applications with detailed descriptions of the respective business ideas they wished to pursue, they followed a nine-month entrepreneurship program. Another group of 18 subjects was sampled from an entrepreneurship-

[18] To determine my sample size, I have used a goodness-to-fit approach to the contingency table's chi-square tests. Based on the hypothesized large difference in the focus of attention between entrepreneurs and non-entrepreneurs, I use Cohen's *w* effect size coefficient of 0.5, and with 72 individuals, I reach a power of approximately 96% (Critical $\chi^2 = 7.81473$). This sample size is consistent with those of prior studies on entrepreneurship, which have used money games (with and without real incentives, e.g., Forlani & Mullins, 2000 [*N* = 78]; Keh et al., 2002 [*N* = 77]; Weber & Milliman, 1997 [N = 54]).

[19] Admission criteria—particularly with respect to language, mathematical, and logical abilities—are shared among different study programs, making students relatively comparable in terms of abilities.

focused bachelor program. Similar to the students from the local incubator, these entrepreneurship students had to actively apply for the program by submitting individual motivation letters explaining why each of them wanted to study entrepreneurship. This bachelor program had a standard duration of three years. No barriers to entering this program existed, as all the students who applied were accepted.

Among the programs with a focus other than entrepreneurship, 17 subjects were sampled from a two-year business administration program designed for future managers. Individuals in this group did not show a current interest in starting a firm and had not been entrepreneurs previously. Another set of 26 subjects was sampled from a non-entrepreneurship-focused bachelor program. These students were not entrepreneurs prior to starting their program, either, and did not show a current active interest in starting a firm.

I divided these 72 individuals into two groups—entrepreneurial-oriented and non-entrepreneurial oriented individuals[20]. I assigned each person according to three criteria: first, his/her study concentration (entrepreneurship program versus normal business program); second, his/her intention to start a firm over the next three years;[21] and third, his/her current active role as a founder in a student incubator. Active interest in entrepreneurship was valued more heavily than future interest in it. I considered the subjects actively enrolled in either the entrepreneurship program or the incubator to be individuals with entrepreneurial intentions. The students who did not apply for the entrepreneurship program represented the pool of individuals without entrepreneurial intentions since they actively chose not to specialize in entrepreneurship and instead continued in their general business economics studies. I checked that both samples

[20] In my main analysis, to further test the genuine nature of the group dichotomy (individuals with and without entrepreneurial intentions), I checked for differences across study concentrations, finding no statistical significance in both focus of attention and risk perception. See Table 8 in Appendix 1 for the results.

[21] In 2016, I contacted the experiment participants and found that more than 80% of those who intended to start a firm actually did.

were representative of their respective populations in general characteristics (age, gender, and nationality); the samples reflected the demographics of the populations.

After defining the two groups of interest, I sent the participants an email invitation to join the experiment. The purpose of the experiment was not revealed in terms of both group differences and risk perception. A dedicated website was set up for individuals to register and provide their initial demographics (age and sex). All the contacted subjects agreed to participate, providing a total of 72 individuals for the investigation.

The preliminary analysis of the sampled subjects revealed that 75.4% (22) of the entrepreneurship students intended to start a firm over the next three years, while only 16.3% (7) of the control sample had such intentions ($\chi^2 = 25.561$, $p < 0.000$). These findings supported the choice of the group sampling, as it suggested that not only current but also future entrepreneurial intentions were greater among the entrepreneurship students than among the general business economics students. I then checked the match between entrepreneurial traits (Big Five Personality Traits, see John, Donahue, & Kentle, 1991; John, Naumann, & Soto, 2008; Zhao & Seibert, 2006) and group composition. The results confirmed the distinction between the two groups and their compositions.[22]

Insert Table 1 about here

Table 1 compares the descriptive statistics between the two groups. Overall, nuanced differences were found in the demographics. Most notably, differences in part-time jobs ($\chi^2 = 8.815$, $p < 0.000$) and education (possessing a bachelor's degree, $\chi^2 = 3.9355$, $p < 0.05$) were the

[22] The two groups significantly differed in their scores on *openness to experience*, one of the factors correlated with self-selection in entrepreneurship (Zhao & Seibert, 2006). Particularly, individuals with entrepreneurial intentions had positive scores (mean = 0.2321), whereas those without such intentions had negative scores (mean = -0.1565). The difference was statistically significant ($t = -1.63$, $p = 0.05$).

only probable reasons for concern. Regarding the former, only small differences were observed in the overall annual income between the groups, thereby limiting the impact of monetary considerations on choice behavior. Regarding the latter, I controlled for the differences between study concentrations in the key variables of interest, finding no difference (Appendix 1).

Age differences were also tested between the two groups by using a t-test, and no significance was found. Overall, these data findings indicated that the samples were comparable and provided some justification for considering the participants to belong to the two respective groups of individuals with and without entrepreneurial intentions.

3.2. The experimental task

A quasi-experimental design was employed to compare individuals with and without entrepreneurial intentions in their choices of investment opportunities. Programmed on the z-tree (Fischbacher, 2007), the experiment consisted of three unique choices (per individual) between two risky investments.[23] Table 2 presents the full experimental task.

Insert Table 2 about here

The subjects were asked to imagine that they were about to undertake a new investment. After being presented with descriptions of two new potential investments, they were told that both investment prospects were fully comparable in all aspects but two—the sizes of their predicted outcomes (net present values [NPVs]) and the probabilities of such outcomes. The investments were presented one at a time, and no information was given about the number of decisions to be made during the experiment. For every decision, the investments' descriptions

[23] The experiment lasted approximately 40 minutes. Although I could not completely rule out fatigue, I found no reasons for concern when considering the time spent across the different experiment subtasks.

were repeated. The subjects were asked precise questions, requiring them to measure the two key variables of interest—focus of attention and risk perception. The three pairs of investments had equal expected values but differed in their risk characteristics (probabilities and outcome sizes). Particularly, two risk characteristics of Option B were exogenously manipulated one at a time during the experiment to present a higher risk when compared to Option A.

For every decision, three questions were asked. First, the subjects were asked to choose between two alternative investments (Option A or Option B). Second, they were instructed to explain the reasons behind their choice. As the experiment was computer based,[24] the verbal answers were recorded as written explanations limited to 180 characters.[25] Verbal content analysis is a standard procedure used to analyze qualitative data, which has been recently suggested as one of the possible future directions for research exploring entrepreneurial decision making (Shepherd et al., 2015). Each answer was coded independently by three scholars (two PhD students and one assistant professor, whose research focused on entrepreneurship), who were informed about the terminology and the concepts used in this chapter. The intercoder reliability in this experiment was consistently higher than 80% when considering the participants' explanations for their decisions. The focus of attention, codified as the focus on either outcomes or probabilities, recorded the reasons why the subjects decided to choose a particular investment over another. Lastly, the subjects were asked to indicate how risky they perceived their choice to be in comparison to the alternative investment option.

[24] In contrast to the method of Sarasvathy and colleagues (1998), who performed content analysis on the data collected from interviews (think-aloud verbal protocol), my data was collected via a computer-based experiment, and verbal content analysis was performed based on written answers.

[25] The length of the answer was chosen based on the nature of the choice (simplified investment opportunities) and the objective (to identify the main reason behind the choice). The participants in both groups did not express concerns about the limited answering space during or after the experiment.

3.3. Main variables

Focus of attention

The variable used to test the cognition differences *across* groups was the individuals' focus of attention. This variable was codified with a two-step process. The first step involved defining two dummy variables that captured the individuals' focus under financial risk; the investments were chosen mainly due to the focus of attention on NPVs (the sizes of possible monetary outcomes) or on the probability distribution attached to the outcomes. We labeled these dummy variables *FocusOutcome* and *FocusProbabilities*, respectively. The second step entailed performing a verbal content analysis of the qualitative responses by using the two variables. The codification of the variables *FocusOutcome* and *FocusProbabilities* presented several differences compared to that of Sarasvathy and colleagues (1998), who originally codified the focus of attention on entrepreneurship.[26] First, I did not use a think-aloud protocol due to the nature of the experiment (computer based) but a verbal content analysis of the written data. Second, I used three independent coders instead of one. Finally, only the focus on financial risk was tested here. Table 3 presents some quotes from the sample of verbal responses.

Insert Table 3 about here

To give an example of the codification procedure, the variable *FocusOutcome* was codified as 1, with the following explanation: "I choose Option B as it presents higher potential gains compared to Option A." As for the variable *FocusProbabilities*, the following explanation (also codified as 1) was given: "A 20% probability of losing the investment is too much for me." These two variables were mutually exclusive. In limited cases, the coders did not recognize any

[26] Particularly, *FocusOutcome* and *FocusProbability* were codified as the variables *Contret* and *Contrisk*, respectively, in Sarasvathy and colleagues' (1998) study. Both reflected individuals' feeling of control over returns and probabilities, respectively.

main factor between the two and thus codified both as zeros. In Decision 1, both the explanations scoring zeros represented around 5% of the cases (4 out of 72 individuals), while in both Decision 2 and Decision 3, less than 3% of the explanations scored zeros (2 out of 72 individuals). Only in one case did a subject use an ambiguous verbal explanation, citing only a number to explain his/her decision. For the robustness check, these nine observations (the eight explanations scoring zeros, plus the ambiguous one) were removed; at the end, the results held at a 5% level of significance.

Financial risk perception

The variable used to test the differences *within* groups was financial risk perception, specifically, the extent to which an individual perceived his/her investment decision as risky compared to the alternative investment. Risk perception was operationalized as a dummy variable, assuming a *high* or a *low* value according to the score given on a 5-point Likert scale. Specifically, *low* was assigned to values lower than or equal to 3, and *high* was ascribed to values greater than 3.[27] This measurement of risk perception followed that of prior research in the field (Forlani & Mullins, 2000; Podoynitsyna et al., 2012).

Descriptively, investment Option B was consistently perceived as significantly more risky compared to Option A across the participants' decisions (Decision 1, $\chi^2 = 36.9780$, $p < 0.000$; Decision 2, $\chi^2 = 44.8000$, $p < 0.000$; Decision 3, $\chi^2 = 38.3312$, $p < 0.000$). However, the differences in risk perception across groups did not appear stark at first glance. The individuals with entrepreneurial intentions perceived their choices as scoring *high* for risk 34% of the time (30 out of 87 decisions), while the individuals without entrepreneurial intentions regarded their choices as risky about 32% of the time (41 out of 129 decisions). Across decisions, these

[27] The cutoff point of 3 between high and low values followed that of Forlani and Mullins (2000).

numbers indicated a significant difference only in Decision 3, when the entrepreneurs perceived a significantly higher risk compared to the non-entrepreneurs. Table 4 shows the results.

Insert Table 4 about here

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4. Results

Descriptively, the riskier investment Option B was chosen 25% of the time, both by individuals with entrepreneurial intentions, who chose it on average about 25.28% of the time (22 out of 87 decisions), and individuals without entrepreneurial intentions, who chose it on average about 25.58% of the time (33 out of 129 decisions). These differences were not statistically significant, as shown in Table 5.

Insert Table 5 about here

4.1. Focus of attention and financial risk perception across groups

The results fully confirmed both Hypotheses 1a and 1b. The entrepreneurs differed from the non-entrepreneurs in how they focused their attention when choosing between investments. Table 6 provides a test comparing the two groups (with and without entrepreneurial intentions) in their focus on NPVs as opposed to probabilities across decisions.

Insert Table 6 about here

As predicted and in line with the effectuation theory, the individuals with entrepreneurial intentions consistently focused their attention on the sizes of the possible outcomes (NPVs) of the investments. In both Decision 1 and Decision 3, more than 2 out of 3 entrepreneurs (versus 1 out of 4 non-entrepreneurs) in the sample justified their investment choice by specifically mentioning the size of possible outcomes (Decision 1 difference of 38%, $\chi^2 = 9.9923$, $p < 0.001$; Decision 3 difference of 44%, $\chi^2 = 13.8189$, $p < 0.000$). In Decision 2, the difference between the two groups was still significant (difference of 34%, $\chi^2 = 8.3160$, $p < 0.01$).

The individuals without entrepreneurial intentions consistently focused their attention on the probabilities attached to possible outcomes. In both Decision 1 and Decision 3, more than 2 out of 3 non-entrepreneurs (versus approximately 1 out of 4 entrepreneurs) in the sample justified their investment choice by mainly mentioning the risk connected to the probability distribution of possible outcomes (Decision 1 and Decision 3 difference of 46%, $\chi^2 = 14.4351$, $p < 0.000$). In Decision 2, the difference between the two groups was also significant (difference of 38%, $\chi^2 = 9.9923$, $p < 0.001$).[28]

4.2. Focus of attention and financial risk perception within groups

The results confirmed Hypothesis 2a, while Hypothesis 2b was not verified. Only in the group with entrepreneurial intentions did the individuals' focus of attention affect their financial risk perception in a significantly different way. Table 7 provides a test for the dependence between focus of attention and financial risk perception within groups.

[28] Note that the percentages do not total one hundred because in a few cases (<10%), the three coders did not code focus of attention as driven by either outcomes or probabilities but by other factors.

Insert Table 7 about here

In the group of individuals with entrepreneurial intentions, the subjects who focused their attention on the sizes of possible outcomes (NPVs) perceived more financial risks than the individuals who focused on probabilities. However, in the group of non-entrepreneurs, the difference between the subjects focusing on outcomes and on probabilities was not statistically significant. While this evidence should be interpreted cautiously, the results do suggest that individuals with entrepreneurial intentions (who perceive high risk only when focusing on monetary outcomes) perceive on average *less* risk compared to individuals without entrepreneurial intentions (who perceive risk consistently when focusing either on monetary outcomes or probabilities). These findings are in line with those of prior research hypothesizing a lower risk perception for entrepreneurs compared to non-entrepreneurs (Keh et al., 2002; Podoynitsyna et al., 2012; Sarasvathy et al., 1998; Simon et al., 2000).

Given the nature of the experiment, two robustness checks were performed. First, to further validate the results of the grouping dichotomy (with and without entrepreneurial intentions), I checked for differences between the subjects assigned to the two groups. The results (presented in Appendix 1) indicated no reason for concern about the grouping decision with respect to both *focus of attention* and *risk perception*. Second, I checked if the results were influenced by ambiguous responses, defined as the verbal answers that the coders interpreted differently. The choice to remove such observations and results from the analysis did hold. Finally, the findings were robust in comparison to alternative explanations, such as risk propensity and loss aversion, as the individuals belonging to the two groups did not significantly differ in the former, and the hypothesized predictions were verified in the choices where losses were possible (Decision 3).

5. Conclusions

In this chapter, the following research question has been addressed: how do individuals with and without entrepreneurial intentions differ in their perception of financial risk? Several studies have identified risk perception as a primary driver of self-selection in entrepreneurship. The laboratory experiment performed in this study, comparing individuals with and without entrepreneurial intentions in a controlled environment, contributes to the entrepreneurship literature by finding significant differences in financial risk perception. In this chapter, I have tested two specific sets of hypotheses.

First, I have hypothesized that individuals with and without entrepreneurial intentions would differ in their focus of attention when choosing between risky investments. Focus of attention has been considered a factor influencing entrepreneurs' risk perception due to two important characteristics of investments—NPVs and probabilities of success—having different subjective values. The content analysis of the verbal answers reveal that when making decisions between investments, the individuals with entrepreneurial intentions focus on the sizes of possible investment outcomes, while the individuals without entrepreneurial intentions focus on the probabilities of obtaining such outcomes. The results are robust in comparison to several alternative explanations, including individual risk and loss aversion. As I have tested the hypotheses on the sample of individuals with entrepreneurial intentions, the results show that differences in focus of attention and perception exist before the individuals become entrepreneurs, which are particularly relevant for understanding the cognition of individuals with limited entrepreneurial experience (e.g., novice entrepreneurs). Furthermore, the study's results have practical implications for both private and public stakeholders. One such implication is that private investors and entrepreneurs should align their assessments of risky opportunities by comparing their focus on key elements of financial risk. Differences in focus of attention between individuals with and without entrepreneurial intentions reveal different

motives behind their actions under risk that need to be aligned between entrepreneurs and stakeholders because entrepreneurs tend to accept risk as a given and leverage personal commitment to reach target objectives. Another conflicting implication is that focusing on probabilities of obtaining monetary values pushes individuals without entrepreneurial intentions to adopt a more conservative view on investment opportunities. In this regard, the results imply that public institutions investing in entrepreneurship (e.g., universities, public incubators, etc.) have the potential to tailor programs that are better designed to nurture novice entrepreneurs. Such programs should consider the impact of cognitive elements, such as focus of attention, on starting new business ventures, which could ultimately aid in reducing entrepreneurs' underestimation of risk.

Second, I have hypothesized that differences in focus of attention across groups would directly influence individuals' risk perception. While prior literature has identified risk perception as a factor affecting entrepreneurial action, few papers have attempted to measure risk perception. This study has tested the link between risk perception and focus of attention within groups. As individuals focus on different elements when making decisions, I argue that such differences would be reflected among various individuals' and groups' risk perceptions. Specifically, I have hypothesized that individuals with entrepreneurial intentions would perceive a high-level risk when focusing on monetary outcomes, while individuals without entrepreneurial intentions would perceive a high-level risk when focusing on probabilities. The results partly confirm the hypotheses, with the link between focus of attention and risk perception only significant in the group of individuals with entrepreneurial intentions. Although these results are interpreted with caution, some research and practical implications are evident. From the research perspective, the exploratory findings suggest more nuanced differences in risk perception between entrepreneurs and non-entrepreneurs than expected (Sarasvathy et al., 1998). Entrepreneurs appear to be more affected in their risk perception when focusing on outcomes

than non-entrepreneurs when focusing on probabilities. Overall, these differences make entrepreneurs perceive risk *less* than non-entrepreneurs. These findings indicate a different subjective value of available information when evaluating investment opportunities. As information translates into a very different risk perception for individuals with versus without entrepreneurial intentions, further research on entrepreneurship is needed to assess the impacts of information on both behavior and risk perception.

From a private stakeholder's perspective, the results indicate that entrepreneurs are not blind risk takers but perceive risk in a significantly different way as a function of their focus of attention. Particularly for entrepreneurs, predictive information does not drive risk perception as much as monetary information. As the importance of monetary feedback has already been explored (Zichella & Reichstein, 2016), future research on entrepreneurship is required to further understand (a) how focus of attention affects risk perception beyond financial risk[29] and (b) how the limited available predictive information on investment opportunities is used by entrepreneurs versus non-entrepreneurs. While leaving the former challenge to future studies, the latter will be explored in Chapter 4 of this dissertation.

5.1. Limitations and avenues for future research

I acknowledge several limitations in the current study, the most important being the narrow definition of risk, experimental shortcomings, external validity, and possible confounding factors due to unobservable variables (e.g., learning). Financial risk is recognized as only one aspect of evaluating opportunities. However, this study has used a precise and quantifiable definition of risk by narrowing down the scope of the analysis to financial measures. Financial risk is a good indicator of business risk due to its strong connection with the

[29] Particularly, eye tracking and functional magnetic resonance could be appropriate tools for further studies on focus of attention, with the former measuring attention through overt eye orienting and the latter linking attention to brain activity (Duchowski, 2007).

idea that one value, such as profit or the probability of failure, can indicate firms' success and risk, respectively (March & Shapira, 1987).

The laboratory setting limits how much and to how many I can generalize the results. My laboratory setting was designed to study two aspects of individual cognition—focus of attention and risk perception. While cognition is essential in explaining behavior, solely studying cognitive mechanisms is acknowledged as a simplification. Nonetheless, little is known about entrepreneurs' ways of connecting the dots in financial risk assessment (Baron & Ensley, 2006; Mitchell et al., 2007).

Even when using laboratory experiment data, it is recognized that a researcher cannot identify all motivational differences among individuals in their actual risk taking in real-world investment opportunities. Motivational differences indeed influence the entrepreneurial process, and providing real monetary incentives makes it possible to observe the motives behind financial risk taking. With this in mind, it is beyond the scope of this chapter to measure the differences in risk by using its broader definition, but future research in this direction is considered quite promising.

With respect to external validity and the sample used, it is granted that there are advantages and disadvantages of using individuals with and without entrepreneurial intentions. Using a sample of real, experienced entrepreneurs (compared to students) would have required careful management of the endogenous nature of choice by such individuals, with substantial heterogeneity in entrepreneurial experience. In this regard, individuals with entrepreneurial intentions are good proxies for novice entrepreneurs and are easier to access. Although the two groups sampled do not show differences in experience and learning, I acknowledge that I cannot identify possible alternative explanations due to unobservable variables, such as classroom socialization and learning connected to risk. Moreover, due to the low probability of success at the entrepreneurial level, it is reasonable to believe that people who are willing to start a new

venture despite these odds might be more optimistic or have higher self-efficacy than people deterred by such drawbacks. Incorporating this individual-level variation in motivation is considered important to the entrepreneurial process. It is believed that future research will exceed these limitations and further advance our understanding of risk perception in entrepreneurship, for example, by exploring the neurological motives behind risk taking among entrepreneurs (Tom, Fox, Trepel, & Poldrack, 2007).

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6. Tables

Table 1: Descriptive statistics and test of differences between individuals with and without entrepreneurial intentions (N = 72)

	With entrepreneurial intentions (n = 29)	Without entrepreneurial intentions (n = 43)	χ^2	t-test	Significance
Risk averse	13 (44.8)	20 (46.5)	0.0832		
Risk neutral	7 (24.1)	11 (25.6)			
Risk prone	9 (31.1)	12 (27.9)			
Male	22 (75.8)	32 (74.4)	0.0192		
Female	7 (24.2)	11 (25.6)			
Danish	23 (79.3)	41 (95.1)	4.8078		*
Foreign	6 (20.7)	2 (4.9)			
50k DKR < income < 300k DKR	23 (79.3)	40 (93.0)	2.9777		*
0 < income < 50k DKR	6 (20.7)	3 (7.0)			
Parent entrepreneur	7 (24.2)	10 (23.3)	0.0075		
No parent entrepreneur	22 (75.8)	33 (76.7)			
University degree	15 (51.7)	32 (74.4)	3.9355		**
No university degree	14 (48.3)	11 (25.6)			
Employed part time	17 (58.6)	38 (88.4)	8.4997		***
Not employed part time	12 (41.4)	5 (11.6)			
Entrepreneur in 3 years	22 (75.9)	7 (16.3)	25.5610		***
Not entrepreneur in 3 years	7 (24.1)	36 (83.7)			
Overconfidence	70.37 (2.131)	72.06 (1.268)		0.4734	
Age	23.68 (0.726)	24.67 (0.938)		0.4478	

***p < 0.01, **p < 0.05, *p < 0.1; percentages of table total in parentheses

Table 2: Choice tasks (adapted from Sarasvathy et al., 1998): Three decisions between a less risky investment (Option A) and a riskier investment (Option B)

	Option A		Option B	
	Probability (%)	NPV (US$)	Probability (%)	NPV (US$)
Decision 1	30	300,000	30	0
	40	400,000	40	400,000
	30	300,000	30	800,000
Decision 2	30	300,000	20	0
	40	400,000	60	400,000
	30	300,000	20	800,000
Decision 3	30	300,000	20	-10,000
	40	400,000	60	400,000
	30	300,000	20	810,000

Questions for every decision:

1) Which project would you invest in? (Option A or Option B)
2) Why would you invest as such? (Verbal answer, 180-character limit)
3) Compared to the other investment, how risky is your choice? (5-point Likert scale)

Table 3: Sample answers and codification of two main variables (keywords for codification in bold). Groups with and without entrepreneurial intentions

Variable	Group	Verbal explanation
FocusOutcome	With	"Relatively the same NPV, but there is a potential for ***higher gains***"
	Without	"At a minimum, I would rather ***get $300,000*** than $0"
	With	"***Higher payout*** possibility is reasonably leveraged"
FocusProbability	With	"I choose Project 1 because ***30%*** probability of $0 is ***too high*** for me"
	Without	"To make sure that I have the ***highest probability*** for cash flow"
	Without	"There is ***no chance*** to lose all the money"

Table 4: Differences in *high* financial risk perception between entrepreneurs and non-entrepreneurs, across decisions

	With entrepreneurial intentions (*n* = 29)	**Without entrepreneurial intentions (*n* = 43)**	χ^2	**Significance**
Decision 1	17.24%	27.91%	1.0923	
Decision 2	48.28%	51.16%	0.0577	
Decision 3	37.93%	16.23%	4.3304	**

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$; percentages of group total

Table 5: Differences in choices between individuals with and without entrepreneurial intentions, across decisions

	With entrepreneurial intentions (*n* = 29)	Without entrepreneurial intentions (*n* = 43)	χ^2	Significance
Decision 1, Option A	26 (0.90)	34 (0.79)	1.3973	
Decision 1, Option B	3 (0.10)	9 (0.21)		
Decision 2, Option A	17 (0.59)	25 (0.58)	0.0016	
Decision 2, Option B	12 (0.41)	18 (0.42)		
Decision 3, Option A	22 (0.76)	37 (0.86)	1.2142	
Decision 3, Option B	7 (0.23)	6 (0.14)		

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$; percentages of group total in parentheses

Table 6: Individuals' focus across decisions (verbal response analysis)

	With entrepreneurial intentions (*n* = 29)	Without entrepreneurial intentions (*n* = 43)	Difference	χ^2	Significance
Focus on outcomes					
Decision 1	66%	28%	38%	9.9923	***
Decision 2	62%	28%	34%	8.3160	***
Decision 3	72%	28%	44%	13.8189	***
Focus on probabilities					
Decision 1	24%	70%	46%	14.4351	***
Decision 2	34%	72%	38%	9.9923	***
Decision 3	24%	70%	46%	14.4351	***

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$; percentages of group total

Table 7: Differences within groups in their *high* financial risk perception, across decisions

	With entrepreneurial intentions (*n* = 29)		Fisher exact test	Significance
	Focus outcomes	Focus probabilities		
Decision 1	26%	0%	0.098	*
Decision 2	45%	50%	0.558	
Decision 3	50%	11%	0.053	*
	Without entrepreneurial intentions (*n* = 43)			
	Focus outcomes	Focus probabilities		
Decision 1	23%	30%	0.471	
Decision 2	42%	55%	0.332	
Decision 3	15%	17%	0.648	

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$; percentages of group total

7. Appendix 1

Table 8: Shares of individuals who focus on NPVs as opposed to probabilities across decisions (by study concentrations)

			Difference	χ^2	Significance
	Incubator (*n* = 11)	**Entrepreneurship bachelor program (*n* = 18)**			
Decision 1	72%	61%	11%	0.4078	
Decision 2	63%	61%	2%	0.0185	
Decision 3	72%	66%	6%	0.1172	
	Business administration (*n* = 17)	**Non-entrepreneurship bachelor program (*n* = 26)**			
Decision 1	23%	31%	8%	0.2678	
Decision 2	23%	31%	8%	0.2678	
Decision 3	18%	35%	17%	1.4710	

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$; percentages of group total

CHAPTER 4. IT'S ALL OR NOTHING: ENTREPRENEURS' WILLINGNESS TO BEAR UNCERTAINTY

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ABSTRACT

Entrepreneurs are often considered to be more willing to bear and manage uncertainty than non-entrepreneurs. However, the available empirical evidence regarding this topic is limited and mixed. This chapter outlines the performance of a quasi-laboratory experiment that investigated whether a lack of predictive information affects individuals with entrepreneurial intentions in their likelihood to choose uncertainty vis-à-vis certainty. Drawing on prospect theory, it is argued that individuals with entrepreneurial intentions are less sensitive than individuals without entrepreneurial intentions due to a framing effect that occurs when information about probabilities is manipulated. In particular, it is argued that individuals with entrepreneurial intentions are more likely than their comparable counterparts to choose consistently among monetary opportunities that share everything in common but information about probabilities of success. This study finds support for the argument, as individuals with entrepreneurial intentions have preferences pertaining to uncertainty that are more stable compared to those of individuals without such intentions. The results hold after controlling for a number of alternative explanations, including status quo bias, prior gain effect, and risk propensity effect. These results have implications for the understanding of factors that guide entrepreneurial choices under uncertainty and, ultimately, entrepreneurial action.

Keywords: risk, uncertainty, entrepreneur, money games, lab experiment, framing effect, odds of success

INTRODUCTION

Uncertainty—defined as the lack of predictive information (Knight, 1921)—is a fundamental variable that entrepreneurs have to manage. Entrepreneurs are often considered more willing than non-entrepreneurs to bear and manage uncertainty because they self-select in an environment where choices have to be taken despite a lack of critical information (e.g., on expected returns). However, prior research provides mixed evidence on entrepreneurs' willingness to bear uncertainty. Some contributions suggest that entrepreneurs are not more willing to bear uncertainty compared to non-entrepreneurs (e.g., McKelvie et al., 2011; O'Brien et al., 2003), while others suggest that differences between these groups are driven by circumstantial factors such as strategic competition (Holm et al., 2013), monetary losses (Koudstaal et al., 2015), and decision framing (Dew et al., 2009). This latter stream of research aims at understanding whether or not entrepreneurs are unique in their decision making under uncertainty, and new contributions in this direction have been encouraged (for a review, see Shane & Ulrich, 2004; Shepherd et al., 2015). This chapter acts as a follow-up to prior studies that have argued in favor of a different cognitive approach to uncertainty between entrepreneurs and non-entrepreneurs. In particular, it has been argued that entrepreneurs are less likely to predict an unknowable future (Sarasvathy, 2001), and accordingly tend to focus less on predicting information (Zichella, 2017). However, the link between willingness to bear uncertainty and the lack of predictive information has not yet been tested within entrepreneurship research. Individuals with different entrepreneurial intentions provide a relevant group of analysis to test whether differences in willingness to bear uncertainty exist before entrepreneurial experience (Krueger et al., 2000).

The research question follows this call to action: How do individuals with and without entrepreneurial intentions differ in their willingness to bear uncertainty?

Answering this research question is important for several reasons. First, willingness to bear uncertainty is positively associated with self-selection into entrepreneurship, a relevant phenomenon to public welfare (Baron & Ensley, 2006; McMullen & Shepherd, 2006; Shane & Venkataraman, 2000). Understanding under which conditions individuals are more willing to bear uncertainty may help public and private stakeholders to support entrepreneurial action. Second, research on entrepreneurs' behavior under uncertainty is timely, as public and private institutions (e.g., new venture *incubators* and *accelerators*; Amezcua et al., 2013) currently aim at reducing entrepreneurs' chances of failure by focusing on uncertainty management. Furthermore, contributions that compare individuals with different entrepreneurial intentions in their behavior under uncertainty are scarce, particularly those that use an experimental methodology (Shepherd et al., 2015). Third, a better understanding of contextual factors influencing entrepreneurs' willingness to bear uncertainty will help stakeholders to align their objectives with their entrepreneurial partners. Finally, as I specifically explore how information on probabilities of success influences willingness to bear uncertainty, I shed light on a key factor that can help entrepreneurs to assess both the feasibility of an investment and how it affects individuals with different entrepreneurial intentions differently (McMullen & Shepherd, 2006).

In this chapter, I make two assumptions. First, I assume that decision makers suffer from cognitive biases and use heuristics to select among available information under uncertainty (Gigerenzer et al., 1999; Kahneman & Tversky, 1979; March, 1994; Shah & Oppenheimer, 2008). In particular, individuals show inconsistent preferences due to different presentations of the same piece of information (Kahneman & Tversky, 1974; Tversky & Kahneman, 1989). This bias is known as the *framing effect*, a violation of the principle of invariance that underlies the rational theory of choice. Individuals suffer

from the framing effect in a variety of situations, such as when ambiguity or vagueness are involved (Ellsberg, 1961; Tversky & Kahneman, 1981). As an entrepreneur is someone who exercises business judgment in the face of uncertainty, I explore here how a lack of information on probabilities of success affects choices of individuals with and without entrepreneurial intentions differently. I argue that individuals with entrepreneurial intentions are less subject than individuals without entrepreneurial intentions to the framing effect when information about probabilities is manipulated. In particular, individuals with entrepreneurial intentions exhibit a bias toward opting for an uncertain higher monetary gain (vs. a certain lower monetary gain) regardless of the availability of predictive information.[30] This argument resonates well with the finding that entrepreneurs frame decisions while paying less attention to predictive information (Dew et al., 2009).

The second assumption I make is that both the *locus and logic of control*[31] affect entrepreneurs' discovery and exploitation of opportunities (Nordgren et al., 2007; Sarasvathy, 2001). In particular, while non-entrepreneurs focus more on prediction, entrepreneurs make choices by focusing more on opportunities that they subjectively feel in control of. Furthermore, entrepreneurs focus on controlling possible outcomes instead of their odds of success. These findings hold true for individuals with different entrepreneurial experience (serial entrepreneurs, novice entrepreneurs, and individuals with entrepreneurial intentions; see Sarasvathy et al., 1998; Zichella, 2016). Consequently, I argue that individuals with entrepreneurial intentions are more likely

[30] Due to the principle of indifference, individuals can assign the probability 1/2 to the two possible monetary outcomes in the uncertain lottery.

[31] Locus of control refers to the extent to which individuals believe they can control events affecting them (Rotter, 1966). The logic of control refers to the individuals' preference to focus on controllable aspects of an unpredictable future (Sarasvathy, 2001)

than individuals without entrepreneurial intentions to choose consistently between two prospects that share everything in common except for information about probabilities.

I approach the research question methodologically by using real money games in a laboratory quasi-experiment.[32] Scholars have recently started testing entrepreneurs' preferences when faced with real monetary incentives, contributing to our understanding of the role of loss aversion and strategic dynamics under risk and uncertainty (Holm et al., 2014; Koudstaal et al., 2015). I aim at uncovering the role of information pertaining to probabilities of success when real monetary outcomes are at stake. The sample in this study includes students with different entrepreneurial intentions. Some of these individuals exhibit an active entrepreneurial intention as they have selected into a designated entrepreneurship program after their first semester of attending classes. These individuals are motivated by a desire to pursue a career as an entrepreneur, and are similar in many respects (e.g., age, gender, education) to other students except for their entrepreneurial intention. The choice to select a sample of students rather than a random sample from the entire population was motivated by two main reasons. First, using entrepreneurial intentions—defined as the cognitive state that precedes the decision to form a new venture—as a proxy for entrepreneurship is consistent with prior research (Krueger et al., 2000; Lee et al., 2011; Zellweger et al., 2011). Second, by using individuals possessing entrepreneurial intentions, I limit alternative explanations due to heterogeneity in professional experience. It is worth noting that the samples used in Chapter 2 and this chapter are identical. This choice is deliberate, as it makes it possible to compare results under two different conditions—risk and uncertainty, respectively.

[32] Compared with a traditional laboratory experiment, a quasi-laboratory experiment lacks the element of random assignment to treatment group or control group, in this case with or without entrepreneurial intentions.

The experiment consisted of asking participants to choose between two possible combinations—certainty vs. risk and certainty vs. uncertainty—with real monetary incentives. Monetary combinations were presented in a non-random order and in proximity to each other for the purpose of being able to directly compare preferences between the two groups. Monetary rewards were given to each subject at the end of the experiment. The results revealed that instead of pursuing a certain monetary gain, individuals with entrepreneurial intentions consistently chose the lottery option regardless of whether information about probabilities was given (risk) or not (uncertainty). Such an effect is robust to alternative explanations such as status quo bias, prior gain effect, and risk propensity effect.[33] Overall, these results suggest that differences between individuals with and without entrepreneurial intentions under uncertainty are due to a different level of sensitivity to the presence of predictive information.

The remainder of this chapter is organized as follows. Section 2 briefly reviews the relevant literature linking predictive information with uncertainty taking. Section 3 describes data, sample construction, the details of the experiment, and the method for testing the research question. Section 4 presents the results. Section 5 concludes and discusses the implications of the findings.

THEORY AND HYPOTHESES

Uncertainty—defined as immeasurable risk (Knight, 1921)—constitutes a conceptual cornerstone in entrepreneurship literature as entrepreneurs face an unknowable future. Entrepreneurship requires judgments to be made about whether to pursue an opportunity or not and, at the individual level of analysis, an entrepreneur is

[33] By controlling for the two mechanisms tested in Chapter 2—prior gain effect and risk propensity effect—it is possible for me to exclude alternative explanations of results under uncertainty.

someone who exercises business judgment in the face of uncertainty (Hebert & Link, 1988). Therefore, it has been suggested that a higher willingness to bear uncertainty is a distinctive characteristic of entrepreneurs, especially when compared to non-entrepreneurs (McMullen & Shepherd, 2006). However, empirical evidence is mixed. On the one hand, recent available findings do not support an overall greater entrepreneurial willingness to bear uncertainty (McKelvie et al., 2011; O'Brien et al., 2003). On the other hand, it has been recently suggested that there is a need to explore how certain specific factors (e.g., a monetary gain or loss; Koudstaal et al., 2015; Zichella, 2016) can trigger entrepreneurs' willingness to bear uncertainty in a way that exceeds the willingness of non-entrepreneurs (Shepherd et al., 2015). Following this research direction, this chapter explores how availability of information affects individuals' willingness to bear uncertainty. Very little is known on whether this greater willingness to bear uncertainty is a product of a learning process due to experience: To control for such a potential explanation, I compared individuals with and without entrepreneurial intentions.

The concept of uncertainty in entrepreneurship finds its roots in the seminal work of Knight (1921). He posited that profit is the reward for those willing to bear uncertainty because, unlike risk, uncertainty is defined as inestimable and therefore uninsurable. Uncertainty has been under theoretical examination both in economics and psychology. Whereas economic theories of entrepreneurship focus on explaining what must occur (e.g., uncertainty bearing) for the economy to function, psychological theories try to explain why entrepreneurs are more willing than their counterparts to bear uncertainty. A multi-level definition of uncertainty follows from both of these theoretical perspectives.

The first multi-level definition of uncertainty distinguishes between three distinct types: state, effect, and response (Milliken, 1987). *State uncertainty* is defined as the inability to assign probabilities to the likelihood of events; *effect uncertainty* is defined as

the lack of information about cause–effect relationships; and finally, *response uncertainty* is defined as the inability to predict accurately what the outcomes of a decision might be. Milliken's framework implies that these three types of uncertainty influence individuals in the context of action and should be treated separately.

Uncertainty impacts entrepreneurial action in different ways depending on the type of uncertainty faced by the individual. In a recent empirical test, state uncertainty was, surprisingly, found to be a relatively low impactful hindering factor of entrepreneurial action (McKelvie et al., 2011).[34] It is argued here that state uncertainty might not impede entrepreneurial action because entrepreneurs accept it as a given variable in the environment. This also resonates well with the arguments advanced by Sarasvathy et al. (2001) and Dew et al. (2009), as entrepreneurs are seen as individuals who use an effectual logic.

State uncertainty and entrepreneurial action

State uncertainty refers to the "perception by an individual that a particular component of the environment is unpredictable; more specifically, that one does not understand how the components of the environment are changing" (Milliken, 1987, p. 137). As state uncertainty increases, it becomes increasingly difficult to understand and predict the future state of the external environment. This ultimately translates into an aversion toward this type of uncertainty (Ellsberg, 1961) and an impediment to entrepreneurial action (McKelvie et al., 2011). State uncertainty takes the form of doubt, which prevents action by undermining the prospective actor's beliefs. It is detrimental to entrepreneurial action because the individual-level properties that it fuels, such as

[34] McKelvie et al. (2011) specifically use the rate of technological change and the rate of demand change as proxies for environmental (state) uncertainty.

hesitancy, indecisiveness, and procrastination, are thought to lead to missed opportunities (McMullen & Shepherd, 2006).

Cognition helps individuals selecting from among available information, ultimately preventing doubts and encouraging action (Mitchell et al., 2007). These cognitive mechanisms include, in particular, biases and heuristics. While cognitive biases refer to "thought processes that involve erroneous inferences or assumptions" (Forbes, 2005, p. 624), heuristics are "rule-of-thumb" decision-making "toolsets" that are "frugal." An individual using such means is able to select pieces of available information and ignore others (Gigerenzer & Goldstein, 1996).

Entrepreneurs are more biased in their decision making than non-entrepreneurs. Specifically, compared to non-founders, entrepreneurs tend to evaluate equivocal business situations more optimistically (Palich & Bagby, 1995), overestimate their ability to make correct predictions (Cooper et al., 1988), overgeneralize from limited information at hand (Busenitz & Barney, 1997; Forbes, 2005; Simon et al., 2000), focus more on their own competencies while neglecting the competitive environment (Moore et al., 2007), select previously chosen alternatives disproportionally more often (i.e., status quo bias; Burmeister & Schade, 2007), and expand their firms despite negative market feedback (i.e., escalation bias; McCarthy et al., 1993).

Information selection and individuals' willingness to bear uncertainty are tightly linked. In particular, individuals' willingness to bear uncertainty—and, consequently, action-driven behavior—is positively influenced by both individual knowledge and motivation (McMullen & Shepherd, 2006). While motivation pertains to the desirability of obtaining possible outcomes, knowledge pertains to the assessment of the feasibility of obtaining such outcomes. As both motivation and knowledge decrease, willingness to bear uncertainty decreases as well. Even so, the question of whether a lack of knowledge

about probabilities of obtaining outcomes decreases entrepreneurs' willingness to bear uncertainty remains an open one. This is because entrepreneurs often use effectual reasoning and do not attempt to predict an unknowable future, but actually create their own future through their own actions, knowledge, skills, and available means (Sarasvathy, 2001). Uncertainty may not meaningfully impede entrepreneurial action, because such uncertainty is assumed a priori by entrepreneurs.

Entrepreneurs facing state uncertainty: The framing effect

Entrepreneurs combine desires (utilities, personal values, etc.) and beliefs (expectations, knowledge, etc.) to choose a course of action (Hastie, 2001). Individuals do not behave as choice statistical optimizers (for example, finding the best solution), but rather choose the first option that exceeds an aspiration level (March & Shapira, 1992). Given the uncertainty associated with entrepreneurship, founders must make decisions when they frequently lack adequate information. In particular, this is the case for individuals such as novice entrepreneurs or individuals with entrepreneurial intentions.

I argue that when individuals with entrepreneurial intentions lack information about probabilities, they are less likely than individuals without entrepreneurial intentions to change their aspirations and, ultimately, their behavior. To test this argument, I draw on Tversky and Kahneman's (1981) framing effect—a cognitive bias. The authors showed that individuals exhibit inconsistent preferences depending on how the same opportunity is presented; e.g., in a loss scenario vs. a gain scenario. In this chapter, I extend Tversky and Kahneman's definition of the framing effect in the context of uncertainty. This is done assuming that, for the principle of indifference, a decision maker can assume, given $n > 1$ possible events that are mutually exclusive and collectively exhaustive, a probability of $1/n$ to each event. As individuals are uncertainty

averse (Ellsberg, 1961), it is expected that they shy away from a prospect that does not contain information about probabilities (state uncertainty) as compared to a prospect within which probabilities are explicitly stated (Knightian risk). However, as entrepreneurs focus their attention on outcomes over probabilities, they differ in this aspect when compared to non-entrepreneurs (Sarasvathy et al., 1998; Zichella, 2016). The hypothesis is that individuals with entrepreneurial intentions will exhibit a greater willingness to bear state uncertainty compared to individuals without entrepreneurial intentions due to their lower sensitivity to information regarding probabilities of success.

H1: The willingness to bear state uncertainty is higher for individuals with entrepreneurial intentions than individuals without such intentions due to a lower sensitivity to the lack of information about probabilities.

DATA AND METHOD

Sample

The sample size and composition is identical between Chapter 2 and Chapter 4, and consists of students with different entrepreneurial intentions. Besides limiting the impact of entrepreneurial experience in explaining the results, using the same sample makes it possible to compare results between the two chapters, ultimately giving a richer perspective on cognition and behavior under risk (Chapter 2) and uncertainty (Chapter 4). The students were enrolled in a general business economics undergraduate program at a major European business school. Although they were enrolled in the same study line, the students presented different entrepreneurial intentions. All students in the study line of general business were offered, at the end of their first semester, the possibility to enter a specialized program designed to address entrepreneurship topics in detail. Interested students were required to apply by handing in a motivation letter. Forty-nine students

applied for the program and all were accepted. Each of the 49 students had specified within their motivation letters that they had an active interest in starting a firm, and thereby showed entrepreneurial intentions. Students not applying for the entrepreneurship program represented the population of individuals without entrepreneurial intentions. Overall, the sample allowed for comparing individuals who were similar in several demographics and yet different in their entrepreneurial intentions, thus limiting possible alternative explanations due to the factor of prior entrepreneurial experience.

Subjects from the two populations were invited to sign up for a laboratory experiment. The specific purpose of the experiment—namely, to test differences in cognition and behavior under uncertainty between individuals with different entrepreneurial intentions—was not specified in the sign-up call. Individual emails and a specific website were used for this purpose. Eighteen subjects from the population of individuals with entrepreneurial intentions and 27 from the population of individuals without entrepreneurial intentions signed up, making up a sample of 45 individuals in total. I controlled whether both samples were representative of the respective populations in their demographics (age, gender, nationality) and found no overall differences.[35]

Table 1 compares the two sample groups in some of their key demographics, providing evidence of small differences between the groups in all but one dimension: willingness to start a new venture within three years. Among entrepreneurship students,

[35] Among entrepreneurship students: Age (sample mean 21.5; population mean 21), Female student (sample proportion 22%, population proportion 18%), Nationality/International student (sample proportion 11%, population proportion 15%). Among non-entrepreneurship students: Age (sample mean 21.5; population mean 21), Female student (sample proportion 22%, population proportion 31%), Nationality/International student (sample proportion 6%, population proportion 9%). All tests for differences were non-significant at the 5% level.

66.7 percent (12) intended to start a firm within the next three years, while only 14.8 percent (4) of the non-entrepreneurship student sample had such intentions.[36]

Insert Table 1 about here

Overall, the data suggest that the sample groups are both comparable and representative of their respective population.

Experiment

In this study, I made use of an experiment based on a real money games experiment. The experiment's general features (e.g., timeline, laboratory rules, and payment structure) are the same as the ones used in Zichella and Reichstein (2016), described in Chapter 2 of this dissertation. In particular, individuals were assigned to computers randomly, communication among students was strictly forbidden, and individuals were individually paid at the end of the experiment.

The subjects were confronted with binary gamble decisions, for a total of 24 decisions. Subjects were not informed about the number of decisions to be made. Gambles presenting different combinations of certainty, risk, and uncertainty were presented to the individuals. In this chapter, only two types are considered (certainty vs. risk and certainty vs. uncertainty), providing a total of 10 unique decisions for individuals to choose from. This provided a total of 450 observations[37] (10 choices for 45 individuals) available to the investigation. In the "certainty vs. risk" type, the subjects

[36] As a robustness check, we have excluded from the empirical analysis subjects who have mixed entrepreneurial intentions (e.g., not in the entrepreneurial concentration but willing to start a firm in the next three years). The results held overall.

[37] These observations are not independent. Standard errors are therefore clustered in the regression analyses.

were presented with options between a certain gain and a risky choice, with an equal chance (50%) of either a greater gain or a smaller gain. The value of the certain gain and the expected value of the risky gamble were identical and kept constant throughout the experiment (at 14 Danish Krone, or $1.89). The "certainty vs. uncertainty" type was identical to the "certainty vs. risk" type, except that it did not include information about probabilities of obtaining monetary gains, thereby resulting in an uncertain option vis-à-vis a certain one. The combined use of risk and uncertain gambles is a necessary feature for testing the effect of availability of information and makes the findings of Chapter 2 and Chapter 4 complementary.[38] Despite the difference in availability of information about probabilities, choices in the "certainty vs. risk" and "certainty vs. uncertainty" gambles can be compared in the experiment, as in both cases a 50% chance probability distribution could be assumed. The 10 different gambles are specified as depicted in Table 2.

Insert Table 2 about here

Throughout the different decision rounds, I controlled for both the prior gain effect and the risk propensity effect (Zichella & Reichstein, 2017) An individual's payoff is attributable to random draws and does not reflect their abilities.

[38] As specified in the dissertation introduction, the two chapters are complementary with respect to decisions under risk (Chapter 2) and uncertainty (Chapter 4). The reason behind using risk gambles (together with uncertain gambles) in this chapter lies in the very purpose of the answering the research question: to test differences between groups under uncertainty by manipulating the availability of information.

Main variables

The main dependent variable was a dummy indicating whether the individual in each gamble chose uncertainty as opposed to certainty. Descriptively, the uncertain choice was chosen in 26 percent of the gambles. Individuals with entrepreneurial intentions chose uncertainty for about 27 percent (24 out of 90 decisions) of the gambles. Similarly, individuals without entrepreneurial intentions chose it for about 25 percent (35 out of 135 decisions). These numbers were not significantly different, as shown in Table 3.

Insert Table 3 about here

The main independent variable to test the hypothesis was a dummy indicating group belonging (individuals with and without entrepreneurial intentions). As I compared choices with and without predictive information, I added a second dummy indicating whether individuals chose an option where probabilities were specified (risk) before choosing an option where such probabilities were not specified (uncertainty). The two groups did differ in their choice of risk (χ^2 = 4,1446, *p*-value = 0.042), with individuals with entrepreneurial intentions choosing it for about 44 percent of the gambles (40 out of 90 decisions) versus approximately 31 percent (42 out of 135) for individuals without entrepreneurial intentions.

Controls

To test whether observed differences in choice under uncertainty are due to the same mechanisms presented in Chapter 2, I controlled for prior gains effect by adding a

dummy that indicated whether the individual experienced a monetary gain greater than the certain option in the previous gamble. Individuals with entrepreneurial intentions experienced a greater gain than expected about 66 percent (60 out of 90) of the time, while the corresponding number for individuals without entrepreneurial intentions was only 51 percent (69 out of 135). This was significant at a 5% level using a Chi-square test. Individuals with entrepreneurial intentions were "luckier" than individuals without such intentions in their immediate initial risk gambles. Furthermore, I created a variable to control for the degree of risk faced by the subjects in a given choice. As choices were compared in pairs of gambles (certainty vs. risk and certainty vs. uncertainty), and such pairs had different degrees of risk, I controlled for pair number.[39] This was strictly exogenously given by the gamble design.

Several personality and demographic factors were used as controls. First, I controlled for the big-five personality traits (John et al., 1991; John et al., 2008; Zhao & Seibert, 2006), which characterize entrepreneurs and are important in choice behavior (e.g., entrepreneurs' higher degree of "openness to experience"). The results of the factor analysis can be found in Table A1 in the Appendix. Second, I controlled for overconfidence, a cognitive bias that encourages risk taking, particularly in entrepreneurs (Busenitz & Barney, 1997; Koellinger et al., 2007). I followed Fischhoff et al.'s (1977) operationalization of overconfidence by checking individuals' level of confidence in answering a series of two-choice questions about health statistics in Denmark (based on World Health Organization 2010 data). Third, pathological gambling was controlled for, as this might have increased individuals' willingness to choose uncertainty (Stinchfield 2000; Winters et al., 1998). A series of five questions were asked about how frequently

[39] As shown in Table 2, pair number 3 has the lowest degree of risk, while pair number 1 and 4 present a medium degree of risk. Finally, pair number 2 and 5 present the highest degree of risk.

the subjects gambled (e.g., “gambling in casinos” and “buying lottery tickets”). Finally, a series of demographic variables were controlled for (age, gender, nationality, parental entrepreneurship, income, part-time job) that were proven to be significant in explaining entrepreneurship.

Method

The experiment was designed to predict the binary choices of two groups. For this reason, a logistic regression technique was chosen. Clustered standard errors were used to account for repeated choices by the same subject. The main exogenously inflicted manipulation was the presence of information about probabilities—separating risk from uncertainty. Prior risk choice, prior gains, and degree of risk were included as controls for taking into account their main effects on subsequent choices (as shown in Chapter 2). For prior risk choice, I checked also for a possible interaction effect, as I argue that individuals with entrepreneurial intentions are more likely to bear uncertainty due to their lower sensitivity to the lack of predictive information. To account for the potential bias due to unobservable factors and non-random assignment of individuals, a random effect specification of the logistic regression was included.

RESULTS

Table 4 contains descriptive statistics and correlation coefficients between all considered variables. None of the correlations in Table 4 are of a magnitude causing concern in terms of potential multicollinearity.

Insert Table 4 about here

Table 5 illustrates the results of the first regression analysis, where the dependent variable was a dummy indicating the choice between certainty and uncertainty. The first column only includes the control variables and the dummy for group belonging (with and without entrepreneurial intentions). Consistent with prior literature, this regression confirms that individuals with entrepreneurial intentions do not exhibit a lower overall uncertainty aversion compared to individuals without entrepreneurial intentions. The second column reports the results when only including the group dummy and the variable indicating individuals' prior choice in an identical gamble with information about probabilities (prior risk). Column 3 introduces the interaction between the entrepreneurship dummy and prior risk. As this was included, the entrepreneurial intentions dummy became significant at a 10% level, indicating that individuals with entrepreneurial intentions are less likely to choose uncertainty as opposed to certainty in general. Yet Column 3 also reveals that individuals with entrepreneurial intentions are much more likely than individuals without such intentions to choose the uncertain lottery after they have chosen the risk lottery (estimate = 1.675, *p*-value = 0.013). An initial interpretation of this result follows the arguments for the hypothesis; that is, individuals with entrepreneurial intentions do not seem to be affected in their choices by the absence of probability information as much as individuals without such intentions, but rather by monetary outcomes. This result gives early support for the hypothesis: *Entrepreneurs are less sensitive to the lack of information about probabilities compared to non-entrepreneurs*. The results hold in Column 4, which presents a full model with controls. It is noteworthy to mention that while the main negative effect of the "entrepreneurial intentions dummy" was insignificant, the interaction term kept its strength and significance. Furthermore, results were robust after performing a log-likelihood test comparing the interaction model with the full model, as a significant improvement was

found in the full model's predictive power (Chi2 = 20.259, *p*-value < 0.000). In the random effect specification of the logistic regression[40] (Column 5), the interaction coefficient decreased in significance but kept both sign and magnitude.

Insert Table 5 about here

The interaction term reported in Column 4 was investigated further by considering the marginal effect of prior risk on willingness to choose uncertainty. This is depicted in Figure 1. The marginal effect was contrasted between the groups of individuals with and without entrepreneurial intentions. Figure 1 provides further support for the hypothesis, as the marginal effect of prior risk on entrepreneurs' willingness to choose uncertainty was significantly higher for individuals with entrepreneurial intentions than for individuals without such intentions. After expressing a preference toward a risky gamble (vis-à-vis a certain gain), individuals with entrepreneurial intentions remained more consistent than individuals without entrepreneurial intentions in their choice preference when dealing with a lack of information on probabilities.

Insert Figure 1 about here

In terms of the control variables, the results tend to be consistent with the predicted associations. Most notably, the results held even when controlling for the two mechanisms identified in Chapter 2 (degree of risk and prior gain). The increasing degree of risk was significant at a 10% level. International students in our sample seemed to be

[40] We chose to use a random effect specification after controlling for fit with a Hausman test (vs. fixed effects, Chi2 = 6.03, *p*-value = 0.05).

more likely to choose uncertainty than nationals. Also consistent with previous research, it was found that individuals who scored higher on openness to experience and lower on conscientiousness were more prone to choosing uncertainty (Hodson & Sorrentino, 1999). The "pathological gambling" aggregate was negative, which might reflect two possible mechanisms at play. On the one hand, one possibility is that individuals who are habitual gamblers might have an aversion toward gambles where expected values cannot be calculated easily. On the other hand, another possibility is that as habitual gamblers show increased impulsiveness in decision making (Tom et al., 2008), they might reflect a preference for a certain monetary gain.

Overall, the results were confirmed when using a random effects specification, although this was with weakened significances for some of the estimates (Column 5 in Table 5). The random effects specification allowed for a brief look at the inner group correlations in order to assess the nature of the consistency of choices made by the subjects. The rho of the random effect specification was 0.16, indicating a relatively low correlation between the choices of the subjects after controlling for the observables. Table 6 reports some intra-class statistics at the 1^{st}, 25^{th}, 50^{th}, 75^{th}, and 99^{th} percentile of propensity toward choosing uncertainty as opposed to certainty. At the median propensity, the marginal probability of choosing uncertainty was 0.210, while the corresponding number for joint probability of any two given choices was 0.060. These numbers vary greatly across the percentiles, with only a 0.001 joint probability at the 1^{st} percentile of observed propensity, while the corresponding number was 0.631 for observations at the 99^{th} percentile of propensity toward choosing uncertainty. At the median, these numbers suggest that there is a 1.697 times greater chance of someone choosing uncertainty, given that they chose risk previously, than someone who did not choose risk in the previous round.

Insert Table 6 about here

Robustness checks

In the first robustness check, the results presented in Table 5 were expanded by redefining the dependent variable. The new dependent variable takes into account all the possible choice combinations between gamble pairs. In each pair of gamble combinations (certainty vs. risk and certainty vs. uncertainty), individuals can exhibit four distinct patterns of choice (certainty, certainty; certainty, uncertainty; risk, certainty; risk, uncertainty). What is of interest is to see how individuals differ in their choice patterns depending on the group they belong to. In order to investigate this issue, a multinomial logistic regression was used with a dependent variable that proxied individual pair choice pattern with four possible values. I assumed that under risk and uncertainty aversion, individuals would prefer a certain option as compared to a risky or uncertain gamble with the same expected value. Therefore, the baseline outcome was the pattern "certainty, certainty." Before interpreting the results, I checked if the IIA assumption was violated by looking at the Suest-based Hausmann Test: The results confirmed the null hypothesis of independent odds for alternatives in the logistic regression. The results are presented in Table 7.

Insert Table 7 about here

At the start is a comparison of mixed preferences—a combination of a certain option with either a risky or uncertain option—with the baseline. Columns 1 and 2 contain results for the combination "certainty, uncertainty," while Columns 3 and 4

contain results for the combination "risk, certainty." The entrepreneurial intentions dummies' estimates were insignificant in both combinations, leaving the researcher uninformed about the existence of differences between groups in their preferences toward mixed strategies as compared to the baseline, "certainty, certainty." The control variable estimates were in line with the findings presented in Table 5, and their interpretations did not change.

In Columns 5 and 6, I compared the combination of choices "risk, uncertainty" with the baseline "certainty, certainty." The results confirmed the findings in Table 5. In particular, entrepreneurs were found to be more consistent in their choices among a risk gamble (with information about probabilities) and an uncertain gamble (without information about probabilities). These results provide further evidence that *individuals with entrepreneurial intentions are less sensitive to the lack of information about probabilities compared to individuals without entrepreneurial intentions*, as they do not shy away from uncertainty but rather choose it more consistently than individuals without entrepreneurial intentions. Finally, control variables' estimates suggest that when choosing risk and uncertainty, other personal factors become important. In particular, lower conscientiousness and higher agreeableness are positively associated with risk taking and acceptance of uncertainty (but are usually associated with a non-entrepreneurial personality; Zhao & Seibert, 2006), and females are less likely to choose consistently between risk and uncertainty.

A possible alternative explanation—the status quo bias—that could possibly have been driving the results was controlled for. People suffering from this bias select previously chosen alternatives disproportionally more often than others (Burmeister & Schade, 2007). To control for this, the presence of streaks was checked for; namely, a pattern of seven or more repeated identical choices out of a total of 10 possible choices.

The results within and across groups proved insignificant (Fisher Exact Test, *p*-value = 0.395).

CONCLUSION

In this chapter, the following research question has been addressed: How do individuals with entrepreneurial intentions differ from individuals without entrepreneurial intentions in their willingness to bear uncertainty? Despite entrepreneurs perceiving themselves as better able to cope with and take decisions under uncertainty than non-entrepreneurs, empirical evidence has been mixed. Motivated by recent calls for understanding the role of contextual factors in uncertainty taking by entrepreneurs (e.g., McKelvie et al., 2011; Shepherd et al., 2015), I explored the role of information about probabilities of success in driving differences between individuals with and without entrepreneurial intentions under state uncertainty.

Cognitive biases and heuristics are an essential part of entrepreneurial decision making under uncertainty. Entrepreneurs face uncertainty in terms of absence of relevant pieces of information in nearly every stage of their business action. Prior literature has shown that entrepreneurs use biases and heuristics to select relevant pieces of information and discard others. However, it is necessary to study the contextual mechanisms that drive decisions in order to address which pieces of information matter the most to entrepreneurs facing uncertainty, thereby permitting controlling for endogeneity, as choices are often influenced by unobservable elements.

A quasi-laboratory experiment was performed that shed light on this matter. The experiment had a number of unique characteristics. First, the results were based on repeated individual decisions with real monetary incentives. This feature is particularly unique, as each choice per individual had a real monetary gain. Second, the presence of

information about probabilities of success was manipulated, leaving other characteristics constant. Third, I compared individuals with different entrepreneurial intentions, thereby controlling for entrepreneurial experience as a possible explanation of the results. Both groups were enrolled in the same study program but had contrasting entrepreneurial intentions. The two groups were very similar in terms of demographics and experience, but were clearly distinct when considering their career focus. Lastly, information on a variety of additional background characteristics—both psychological and attitudinal—was collected. This made it possible to control for a variety of otherwise unobservable characteristics, such as cognitive biases, that affect decision making.

In line with previous studies, individuals with and without entrepreneurial intentions were not found to be significantly different in their general propensity to bear uncertainty (Holm et al., 2013; Koudstaal et al., 2014). However, individuals with entrepreneurial intentions did exhibit a lower sensitivity to the presence of predictive information in comparison to the group without such intentions. I argue that the *framing effect* does not influence the two groups in the same way, as the propensity to choose uncertainty is higher for individuals with entrepreneurial intentions after having chosen a risky option compared to individuals without entrepreneurial intentions. These results are in tandem with the work by Sarasvathy et al. (2001) and McMullen and Shepherd (2006), which looked at the role of, respectively, information on probabilities and motivation in guiding entrepreneurs' decision making. At the same time, the results of this study contribute to the extant literature by experimentally demonstrating the nature of entrepreneurs' sensitivity to information about probabilities. The results hence provide further specific evidence of the circumstantial nature of entrepreneurs' propensities to choose uncertain monetary opportunities.

Limitations and implications

This chapter presents two important limitations—namely, external validity and a narrow definition of uncertainty. With respect to external validity, I acknowledge that using a sample of individuals with different entrepreneurial intentions provided advantages in terms of comparability of considered groups, but also limited the potential generalizability to entrepreneurs with limited experience (e.g., novice entrepreneurs). With respect to uncertainty and its definition, my study looked only at state uncertainty, one of the three possible types of uncertainty according to Milliken's (1987) categorization. Future research may explore also the role of effect and response uncertainty between entrepreneurs and non-entrepreneurs, giving a comprehensive overview of entrepreneurial behavior under uncertainty.

In this chapter, I tested the impact of information on probabilities on individuals' decision making, ultimately contributing to the understanding of cognitive mechanisms guiding entrepreneurial decision making. This has two direct implications for entrepreneurship research. First, when making decisions, entrepreneurs weigh available information about probabilities less than non-entrepreneurs. In real life, entrepreneurs often face environments and investments that do not provide information regarding their chances of obtaining the monetary objectives they aspire to achieve. The absence of information about their odds of success may lead them to tolerate the uncertainty of starting a new entrepreneurial venture in the pursuit of a monetary return.

The second direct implication of the study's results is related to the stakeholders involved with entrepreneurs. The insights that the findings offer allow investors, business partners, employees, and others to better understand and manage the entrepreneurs with whom they do business. This chapter offers evidence that suggests certain circumstances under which these stakeholders may be alerted to an elevated tendency on the part of the

entrepreneur to make choices under uncertainty (i.e., any time the monetary objective is desirable and within reach). This may indeed prove useful to any stakeholder who looks to manage the relationship with their entrepreneurial partner.

APPENDIX

Insert Table A1 about here

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TABLES

Table 1:Descriptive Statistics and Test of Differences Between Individuals with and without Entrepreneurial Intentions (N = 45)

	With entrepreneurial intention	Without entrepreneurial intention	χ^2	Sig.
Male	14 (31.1)	21 (46.7)		
Female	4 (8.9)	6 (13.3)	0.000	
Danish	16 (35.6)	26 (57.8)		
International	2 (4.4)	1 (2.2)	0.952	
$50.000 < income < 300.000$	15 (33.3)	24 (53.3)		
$0 < income < 50.000$	3 (6.7)	3 (6.7)	0.313	
Parent entrepreneur	5 (11.1)	7 (15.6)		
No parent entrepreneur	13 (28.9)	(20 (44.4)	0.019	
University degree	3 (6.7)	1 (2.2)		
No University degree	15 (33.3)	26 (57.8)	2.588	
Part-time employed	11 (24.4)	23 (51.1)		
Not part-time employed	7 (15.6)	4 (8.9)	3.389	*
Established firm	3 (6.7)	1 (2.2)		
Not established firm	15 (33.3)	26 (57.8)	2.241	
Establish firm within 3 years	12 (26.7)	4 (8.9)		
Not establish firm within 3 years	6 (13.3)	23 (51.1)	12.672	***

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$, percentages of table total in parentheses

Table 2: Considering 10 Real Monetary Games (in Six Pairs) Between Certainty (Option A) and Risk or Uncertainty (Option B). 1Dkr = $0.16, Expected Gain = $2.2 of Decision

		Option A		Option B		Feedback Prior Gain
Pair 1	Decision 1	100%	14 DKr	50% 50%	4 DKr 24 DKr	No
	Decision 2	100%	14 DKr	Unknown chance of getting Unknown chance of getting	4 DKr 24 DKr	No
Pair 2	Decision 3	100%	14 DKr	50% 50%	0 DKr 28 DKr	No
	Decision 4	100%	14 DKr	Unknown chance of getting Unknown chance of getting	0 DKr 28 DKr	No
Pair 3	Decision 5	100%	14 DKr	50% 50%	8 DKr 20 DKr	Yes
	Decision 6	100%	14 DKr	Unknown chance of getting Unknown chance of getting	8 DKr 20 DKr	Yes
Pair 4	Decision 7	100%	14 DKr	50% 50%	4 DKr 24 DKr	Yes
	Decision 8	100%	14 DKr	Unknown chance of getting Unknown chance of getting	4 DKr 24 DKr	Yes
Pair 5	Decision 9	100%	14 DKr	50% 50%	0 DKr 28 DKr	Yes
	Decision 10	100%	14 DKr	Unknown chance of getting Unknown chance of getting	0 DKr 28 DKr	Yes

Table 3: Descriptive Statistics on Key Variables (N = 225)

	With entrepreneurial intentions	Without entrepreneurial intentions	Total	χ^2	Significance
Choose Uncertainty (Option B)	24 (10.7)	35 (15.6)	59 (26.3)		
Choose Certainty (Option A)	66 (29.3)	100 (44.4)	166 (73.7)	0.0153	
Prior gain greater than expected	60 (26.6)	69 (30.6)	129 (57.4)		
Prior gain not greater than expected	30 (13.4)	66 (29.4)	96 (42.6)	5.3416	**
Total	90 (40.0)	135 (60.0)	225 (100.0)		

** p < 0.10, ** p < 0.05, *** p < 0.01, percentages of table total in parentheses*

Table 4: Descriptive Statistics and Pearson's Correlation Coefficients

		Mean	S.D.	Min	Max	[1]	[2]	[3]	[4]	[5]	[6]
[1]	Entrepreneurial Intention	0.40	0.49	0	1						
[2]	Prior gain (monetary)	0.13	0.34	0	1	0.1712					
[3]	Prior gain (presence)	0.66	0.47	0	1	-0.0000	-0.7055				
[4]	Degree of Risk (pair)	1.2	0.75	0	2	0.0000	0.2551	-0.3273			
[5]	Extraversion	0.06	0.92	-3.07	1.46	0.1333	0.0074	0.0000	-0.0000		
[6]	Openness	0.08	0.88	-2.14	2.52	0.1556	0.0137	0.0000	0.0000	-0.0049	
[7]	Neuroticism	-0.03	0.87	-1.90	1.86	-0.1205	-0.0320	0.0000	-0.0000	-0.0754	-0.0334
[8]	Conscientiousness	0.06	0.91	-2.87	1.60	0.3524	0.0032	-0.0000	-0.0000	0.0806	-0.0236
[9]	Agreebleness	0	0.93	-1.98	1.80	0.2007	0.0602	-0.0000	0.0000	0.0291	-0.0315
[10]	Overconfidence	101.25	21.72	67	148	-0.1368	-0.0043	0.0000	-0.0000	0.1037	0.0816
[11]	Pathological Aggregate	1.52	0.56	1	3.20	-0.0715	-0.0208	0.0000	-0.0000	0.0007	-0.2302
[12]	Age	21.51	0.78	20	23	-0.0700	-0.0299	0.0000	-0.0000	-0.0170	0.1560
[13]	Female	0.22	0.42	0	1	-0.0000	0.0038	0.0000	0.0000	0.2078	0.2075
[14]	International	0.07	0.25	0	1	0.1455	-0.0081	0.0000	0.0000	0.0674	0.0236
[15]	Parent Entrepreneur	0.27	0.44	0	1	0.0205	-0.0121	-0.0000	0.0000	0.0499	-0.0411
[16]	Part time employed	0.76	0.42	0	1	-0.2744	-0.0258	0.0000	-0.0000	0.1221	-0.0462
[17]	Income above 50.000	0.87	0.34	0	1	-0.0801	-0.0200	0.0000	0.0000	-0.0015	-0.1855

		[7]	[8]	[9]	[10]	[11]	[12]	[13]	[14]	[15]	[16]
[8]	Conscientiousness	0.0072									
[9]	Agreebleness	0.0568	0.0206								
[10]	Overconfidence	-0.0169	0.0682	0.0570							
[11]	Pathological Aggregate	-0.2210	-0.1521	0.1014	0.2690						
[12]	Age	-0.1316	-0.0403	-0.1299	-0.0314	-0.0140					
[13]	Female	0.2817	0.0120	-0.1989	-0.0294	-0.3749	0.1968				
[14]	International	0.1133	0.2159	0.2743	0.0354	-0.1172	0.0417	0.1917			
[15]	Parent Entrepreneur	0.0916	0.0189	0.0680	-0.0303	-0.0641	-0.1361	-0.0314	-0.0895		
[16]	Part time employed	-0.0551	-0.1901	-0.2687	0.1940	0.1219	-0.0601	0.0314	-0.2217	-0.0798	
[17]	Income above 50.000	-0.0600	-0.0025	-0.1411	0.0856	0.2237	0.0254	-0.2524	-0.4020	0.1080	0.2863

Note: Correlation coefficients above 0.065 are significant at a 5% level

Table 5: Explaining Subjects' Choices Under Uncertainty After Risk, Logit Regressions

	Standard Logit Models				RE Logit
	Baseline Model	Explanatory Model	Interaction Model	Full Model	
Explanatory Variables					
Entrepreneurial intention	0.310	-0.035	-0.815*	-0.454	-0.454
	[0.436]	[0.304]	[0.471]	[0.592]	[0.664]
Risk Prior		0.537**	-0.162	-0.276	-0.0305
		[0.305]	[0.432]	[0.522]	[0.576]
Entrepreneurial intention x Risk Prior			1.675**	1.645**	1.703**
			[0.234]	[0.791]	[0.884]
Control Variables					
Prior Gain (Monetary)	-0.105			-0.447	-0.614
	[0.398]			[0.794]	[0.891]
Prior Gain (Presence)	0.933**			-0.453	-0.568
	[0.464]			[0.424]	[0.459]
Degree of Risk (pair)	0.321			0.400*	0.470*
	[0.220]			[0.238]	[0.262]
Extraversion	-0.086			-0.0371	-0.0201
	[0.221]			[0.229]	[0.270]
Openness	0.414**			0.378**	0.445*
	[0.190]			[0.190]	[0.262]
Neuroticism	-0.134			-0.0901	-0.0816
	[0.158]			[0.160]	[0.278]
Conscentiousness	-0.673***			-0.576***	-0.645**
	[0.192]			[0.189]	[0.264]
Agreebleness	0.195			0.185	0.192
	[0.190]			[0.187]	[0.239]
Overconfidence	0.018			0.0186	0.0199
	[0.023]			[0.0247]	[0.0269]
Pathological Aggregate	-0.893*			-0.873*	-0.939
	[0.463]			[0.467]	[0.574]
Age	0.243			0.193	0.240
	[0.270]			[0.283]	[0.367]
Female	-0.812			-0.825	-0.967
	[0.622]			[0.649]	[0.880]
International	2.245**			1.867**	2.126*
	[0.928]			[0.867]	-1204
Parent Entrepreneur	0.236			0.178	0.112
	[0.383]			[0.380]	[0.537]
Part time employed	0.445			0.472	0.556
	[0.514]			[0.504]	[0.665]
Income above 50.000	0.507			0.427	0.471
	[0.689]			[0.713]	[0.833]
Constant	-8.081	-1.231***	-1.000	-6.374	-7.630
	[5.851]	[0.751]	[0.234]	[6.319]	[8.009]
Number of observations	225	225	225	225	225
Log Likelihood	-115.9824	-127.9790	-124.7084	-109.5551	-108.3070
χ^2	34.91***	3.13	8.91**	37.95***	22.89
LR test (RE vs. Logistic regression)					2.50*

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 6: Measures of Intra-class Associations in Random-effects Logit Regression

Measure	1st Percentile	25th Percentile	50th Percentile	75th Percentile	99th Percentile
Marginal Prob.	.02425	.126013	.210552	.355698	.783894
Joint Prob.	.001046	.02363	.060115	.153578	.63079
Odds ratio	1.85103	1.73944	1.69741	1.66229	1.69539
Pearson's r	.019365	.070378	.094954	.118059	.096222
Yule's Q	.298498	.269925	.258549	.248766	.257991

Table 7: Explaining Individuals' Choice Combinations Across Pairs, Results of Multinomial Logit Regressions

	Multinomial Logit Model (Dep. Var: Choice Pairs. Base Pair: Certainty, Certainty)					
	Pair 1 Certainty, Uncertainty		Pair 2 Risk, Certainty		Pair 3 Risk, Uncertainty	
	Explanatory Model	Full Model	Explanatory Model	Full Model	Explanatory Model	Full Model
Explanatory Variables						
Entrepreneurial intentions	-0.815	-0.689	0.128	0.269	0.989*	1.311**
	[0.579]	[0.751]	[0.490]	[0.557]	[0.543]	[0.636]
Control Variables						
Prior Gain (Monetary)		0.444		0.138		0.0171
		[0.298]		[0.279]		[0.371]
Prior Gain (Presence)		0.0635		0.977		2.184*
		[0.915]		[0.919]		[1.258]
Degree of Risk (pair)		0.433		-0.460*		-0.380
		[0.297]		[0.268]		[0.381]
Extraversion		-0.227		0.107		0.340
		[0.270]		[0.252]		[0.367]
Openness		0.578*		0.173		0.542**
		[0.309]		[0.271]		[0.226]
Neuroticism		-0.150		-0.520**		-0.630**
		[0.296]		[0.262]		[0.274]
Conscentiousness		-0.529**		-0.306		-0.979***
		[0.256]		[0.302]		[0.332]
Agreebleness		-0.126		0.537**		1.082***
		[0.294]		[0.276]		[0.304]
Overconfidence		0.00886		0.0675***		0.0714*
		[0.0346]		[0.0241]		[0.0440]
Pathological Aggregate		-0.542		-1.734***		-2.573**
		[0.581]		[0.612]		-1.178
Age		0.542		0.478		0.254
		[0.363]		[0.313]		[0.325]
Female		-0.622		-1.330		-2.649**
		[0.868]		[0.838]		-1.332
International		0.994		0.381		3.160***
		-1.641		-1.471		[0.834]
Parent Entrepreneur		1.017		0.756		0.311
		[0.656]		[0.512]		[0.455]
Part time employed		0.186		0.492		1.282**
		[0.684]		[0.737]		[0.637]
Income above 50.000		0.415		-0.747		-0.328
		[0.838]		[0.669]		[0.744]
Constant	-1.001***	-15.23**	-0.754***	-12.35*	-1.917***	-9.982
	[0.318]	[-7.621]	[0.286]	[-6.507]	[0.335]	[-7.160]
Number of observations	225	225	225	225	225	225
Loglikelihood	-270.233	-223.410	-270.233	-223.410	-270.233	-223.410
χ^2	7.046*	100.72***	7.046*	100.72***	7.046*	100.72***

Clustered standard errors (unique ID for individuals) in parentheses. *** p<0.01, ** p<0.05, * p<0.1

FIGURES

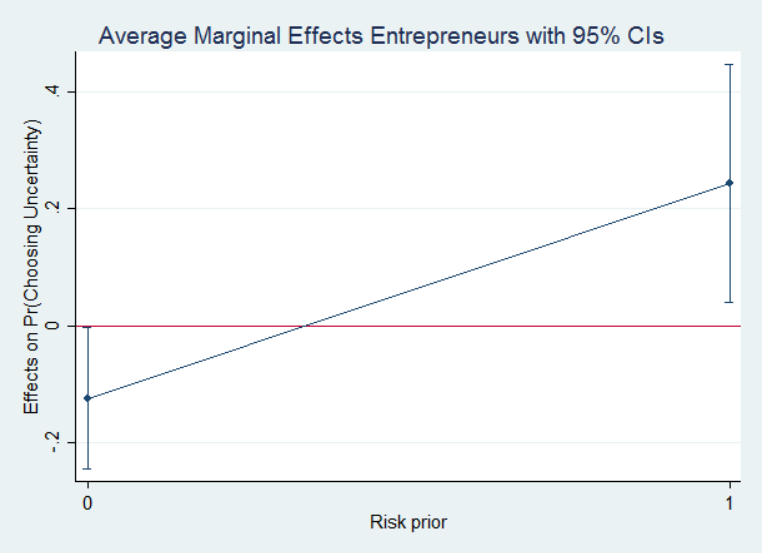

Figure 1: Contrasting the marginal effect of individuals with entrepreneurial intentions (entrepreneurs) against individuals without entrepreneurial intentions (non-entrepreneurs) with respect to uncertainty by prior risk choice.

Table A1

Results of Factor Analysis Generating Big-5 Personality Traits

Question	Extraversion	Openness	Neroticism	Conscien–tiousness	Agreeable–ness	As expected
I am someone who ...						
is talkative	0.7915					√
tends to find faults with others					0.4307	√
does a thorough job						
is depressed, blue	-0.5399					
is original, comes up with new ideas	0.4043	0.5208				√
is reserved	0.6932					√
is helpful and unselfish with others					0.5165	√
can be somewhat careless					0.4685	
is relaxed, handles stress well			0.7396			√
is curious about many different things		0.6015				√
is full of energy	0.6498					√
starts quarrels with others					0.4676	√
is a reliable worker						
can be tense			0.6384			√
is ingenious, a deep thinker		0.5641				√
generates a lot of enthusiasm	0.8022					√
has a forgiving nature				-0.5251	0.4328	√
tends to be disorganized				0.7063		√
worries a lot			0.7265			√
has an active imagination		0.4028				√
tends to be quiet	0.8135					√
is generally trusting						
tends to be lazy				0.5232		√
is emotionally stable, not easily upset			0.7654			√
is inventive		0.4512				√
has an assertive personality						
can be cold and aloof					0.5797	√
perseveres until the task is finished				0.6081		√
can be moody			0.5442			√
values artistic, aesthetic experiences		0.4505				√
is sometimes shy, inhibited	0.7268					√
is considerate and kind to almost everyone					0.5876	√
does things efficiently				0.6183		√
remains calm in tense situations			0.6463			√
prefers work that is routine		0.5409				√
is outgoing, sociable	0.7978					√
is sometimes rude to others					0.7959	√
makes plans and follows through with them				0.8054		√
gets nervous easily			0.4898			√
likes to reflect, play with ideas		0.6456				√
has few artistic interests						
likes to cooperate with others	0.4740					
is easily distracted						
is sophisticated in art, music, or literature		0.6223				√

Note: Factor loading above/below 0.4/-0.4 reported – 35 out of 44 load as expected

CHAPTER 5, CONCLUSIONS

This PhD dissertation addresses the themes of entrepreneurial cognition and behavior in situations of risk and uncertainty using an experimental methodology. This approach advances our understanding of the causal link between cognition and behavior and its implications for individual entrepreneurs and their stakeholders. Despite simplifying reality, an experimental approach exposes individuals to features typical of a business environment. My experiments focused on financial risk by incorporating two essential features that describe an investment opportunity: namely, monetary returns and the probabilities of obtaining them.

This dissertation has explicitly considered that individuals with and without entrepreneurial intentions do not differ in their general preferences towards risk and uncertainty. On the contrary, the dissertation has argued for more nuanced differences between the two groups, looking at both the contextual and the subjective mechanisms that positively affect individuals' willingness to bear risk and uncertainty.

The three essays focus on different mechanisms of risk and uncertainty, giving a complementary overview of entrepreneurial cognition. Chapter 2 explores individuals' sensitivity to two heuristics—the prior gain effect and the risk propensity effect—when choosing between a monetary lottery and a gain. The results of this essay show that individuals with entrepreneurial intentions choose risk more often than individuals without entrepreneurial intentions immediately after a positive gain, thereby illustrating a greater sensitivity to the prior gain effect. Yet, entrepreneurs do not take risk at all costs, since they shy away from high degrees of risk.

Chapter 3 examines how individuals with and without entrepreneurial intentions differ in their perceptions of risk, arguing that the focus of attention plays a prominent role in explaining such differences. The essay compares the two groups' choices, foci, and perceptions of risky

investment opportunities. The results reveal that individuals with entrepreneurial intentions are more likely than comparable others to focus on monetary outcomes rather than probabilities. Furthermore, individuals with entrepreneurial intentions are less likely than comparable others to perceive risk consistently with their focus of attention.

Finally, Chapter 4 explores individuals' choices under uncertainty by investigating how predictive information affects the behaviors groups of individuals with different entrepreneurial intentions differently. Individuals with entrepreneurial intentions are found to choose consistently between two prospects that share everything in common but information about probabilities, thereby exhibiting a lower sensitivity to a lack of predictive information than individuals without entrepreneurial intentions.

This dissertation develops around two growing streams of research in entrepreneurship. On one hand, the research on entrepreneurial decision-making is useful for exploring actual behavior in situations of risk and uncertainty. Our findings, in line with prior research, do not confirm that entrepreneurs have a greater overall propensity for either risk or uncertainty. On the other hand, the research stream on entrepreneurial cognition is useful for exploring the antecedents of entrepreneurs' behaviors. My three essays contribute to the extant literature by providing empirical evidence of the more nuanced differences between entrepreneurs' and non-entrepreneurs' behaviors and cognition in situations of risk and uncertainty.

My results also speak to practice by showing how individuals with different entrepreneurial intentions exhibit unique cognition and behaviors in situations of risk and uncertainty. Stakeholders working with novice or prospective entrepreneurs (e.g. incubators, accelerators) must consider entrepreneurs' greater sensitivity to monetary gains (Chapter 2) and lower sensitivity to the presence of predictive information (Chapter 3 and 4) in order to carefully align their assessments of business opportunities with the entrepreneurs' assessments.

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