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Risk worth taking - Entrepreneurial behaviour when faced with risk and uncertainty: a lab experiment

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Abstract

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Are entrepreneurial-oriented individuals different from others in their propensities to take risk and uncertainty? Entrepreneurial-oriented individuals are defined as individuals that show entrepreneurial intentions ? the cognitive state that precedes the decision to form a new venture. Cognitive theory suggests differences in risk taking due to individual characteristics. However, entrepreneurship theory did not provide empirical support for such differences. Using data from a laboratory experiment with simple money games, we observe how individuals from two different groups (entrepreneurial-oriented, non-entrepreneurial-oriented) react to different degrees of risk and uncertainty when real monetary incentives are involved in each decision. The analysis reveals significant differences between entrepreneurial and non-entrepreneurial-oriented individuals in their decision making. In particular, entrepreneurial-oriented individuals appear to be more sensitive towards a ?house money effect? (increased risk seeking in the presence of a prior gain) and less sensitive towards a ?risk propensity effect? (reduced risk avoidance in the presence of increasing degrees of risk). These results have fundamental implications for the understanding of cognitive factors guiding entrepreneurial decision-making.

“RISK WORTH TAKING” - ENTREPRENEURIAL BEHAVIOR WHEN FACED WITH RISK AND UNCERTAINTY: A LAB EXPERIMENT

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Abstract

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1. Introduction

Are entrepreneurial-oriented individuals different from non-entrepreneurial oriented individuals in their propensities to take risk and uncertainty? This is an important question with no established, definitive answer. It is important because individual recognition of entrepreneurial opportunities and propensity to pursue them are central to explain self-selection into entrepreneurship, a relevant phenomenon for public welfare (Kihlstrom & Laffont, 1979; Shane & Venkataraman, 2000; Baron & Ensley, 2006). Investigation focuses on entrepreneurial-oriented individuals that are defined as individuals that show entrepreneurial intentions – the cognitive state that precedes the decision to form a new venture (Krueger Et Al, 2000).

There is no definitive answer because scholars of entrepreneurship have typically focused on eliciting entrepreneurs’ propensities towards monetary risk indirectly through questionnaires with low or no real stakes involved, ultimately reaching contrasting results (e.g. Brockhaus, 1980; Cramer Et Al, 2002). Furthermore, very little is known about entrepreneurs’ preferences towards uncertain monetary opportunities (Holm Et Al 2014). A solid stream of research in economics have focused on the importance of using real incentives when comparing groups in their decision

making as real incentives increase risk averse behaviour in individuals (Kachelmeier & Shehata, 1992; Holt & Laury, 2002). Only recently some scholars in entrepreneurship started testing risk and uncertainty preferences of entrepreneurs under real monetary incentives (Holm Et Al, 2014). In this paper, we attempt to address our research question empirically by directly eliciting individuals' preferences towards risk and uncertainty through a lab experiment with simple, real-money gambles.

Different mechanisms come into play when trying to assess the effect of a status (being entrepreneurial orientated) on behaviour (risk/uncertainty taking). We begin by assuming that during a lab experiment individual behaviour is influenced by two types of mechanisms: time variant and time invariant. By time variant mechanisms we indicate those factors that influence individuals' risk preferences in a dynamic way during the experiment (e.g. size of monetary winning). On the contrary, time invariant mechanisms stably influence individuals' decision making during the experiment (e.g. individual risk aversion). Our goal is to compare individual propensities towards risk and uncertainty by manipulating exogenously two specific time variant elements, while controlling at the same time for time invariant elements.

The first time-variant mechanism is previous monetary feedback. Following Thaler & Johnson (1990) we call this mechanism "house money effect". The authors found that decision makers are influenced by prior experience when evaluating real monetary opportunities. In particular they are increasingly risk seeking in the presence of a prior monetary gain. It is important to understand whether the house money effect influences entrepreneurs and non-entrepreneurs differently in their choices. We know already that entrepreneurs rely more heavily on heuristics such as representativeness compared to non-entrepreneurs (Barney & Busenitz, 1997) but no final conclusion can be drawn on the effect of monetary experience on choice behaviour.

The second time variant mechanism is the degree of risk – the distance between two risky/uncertain monetary outcomes. In defining increasing risk, Rothschild & Stiglitz (1970) suggested increasing degree of risk as a source of possible differences between individuals' shown preferences. It is important to understand whether an increasing degree of risk influences entrepreneurs and non-entrepreneurs differently in their choices, as entrepreneurs face higher degrees of risk in their investments compared to non-entrepreneurs (Sarasvathy Et Al, 1998).

However, to date very little is known about preferences of entrepreneurs towards monetary opportunities with increasing degrees of risk.

Our empirical analysis reveals significant differences between individuals in their decision making, ultimately confirming differences between entrepreneurial-oriented individuals from non-entrepreneurial oriented risk/uncertainty preferences.

We examine the impact and significance of our identified time-variant mechanisms by investigating choices of seventy-four students at Copenhagen Business School belonging to two groups (entrepreneurship students, non-entrepreneurship students). During the experiment, each student faced twenty-four unique binary decisions with real monetary incentives. At the end of the experiment, each participant got exactly what they won during the experiment. In order to capture sensitivity to risk and uncertainty, alternatives in each monetary decision had the same objective expected value. Two different gambles combinations (certainty versus risk and certainty versus uncertainty) were used. Two exogenous manipulations were separately introduced: feedback on monetary outcomes, and increasing variance of risky outcomes including the possibility of losses.

Our results reveal that vis-à-vis a certain monetary option entrepreneurial-oriented students have a *higher* propensity to take risky monetary options and a *lower* propensity to take uncertain monetary options compared to non-entrepreneurial-oriented students. Both these observed effects can be partly explained due to the nature of monetary gambles. During the experiment, individuals faced only nonstrategic choices – that is not dependent by other individuals (Holm Et Al, 2014). Both these main effects were moderated by our two identified time variant mechanisms. Specifically, entrepreneurial oriented individuals' propensity to take an uncertain monetary option is positively moderated by the house money effect. Furthermore, we find a negative moderation effect of increasing degrees of risk on taking a risky monetary option for entrepreneurial-oriented individuals. The positive and significant aversion towards uncertainty of entrepreneurial-oriented individuals has been surprisingly stable over many robustness checks. Given the uncertain nature of entrepreneurial opportunities, these results reveals an oddity in observed behaviour as it is counterintuitive that entrepreneurs are found to be more uncertainty

averse than non-entrepreneurs. Overall these results confirm the importance of empirical investigation of entrepreneurial decision making under real monetary incentives.

The remainder of this paper is organized as follows: in Section 2 we briefly review the literature on experience and perception influencing decision making, with particular reference to how both of these matters particularly for entrepreneurs. Section 3 describes data, sample construction, and method. Section 4 presents the results. Section 5 concludes and discusses the implications of our findings.

2. Theory and hypotheses

The motivation of this study is twofold. On the one hand, we aim at further understanding individual differences between entrepreneurs and non-entrepreneurs in their decision making by eliciting their preferences in a lab experiment. On the other hand, we aim at filling a research gap. Previous literature adopted two different methodological designs in order to test the link between entrepreneurial traits (including personality, status, intentions etc.) and observed behaviour. Some scholars have used questionnaires (e.g. Brockhaus, 1981; Busenitz & Barney, 1997) and others money games (e.g. Weber & Milliman, 1997). In both cases, a precise definition of risk and uncertainty is used. Risk involves situations in which the decision maker can choose between different alternatives with complete information about the probability of different outcomes (Knight, 1921). As posited by neoclassical utility theory, such decisions are affected by the curvature of the individual's utility function for money. We define uncertainty as situations where economic actors have information about conceivable outcomes, but not about their probabilities (Ellsberg, 1961). As in our framework choices are nonstrategic, that is they do not depend on the decision maker's beliefs about his or her own performance relative to others, we identified two individual cognitive mechanisms as drivers of heterogeneity in individuals choice of monetary gambles: previous monetary feedback (here called "house money effect" in line with Thaler & Johnson, 1990) and degrees of risk (here operationalized as the distance between two possible risky or uncertain outcomes and called "risk propensity effect").

2.1. The house money effect

Due to the non-satiation axiom, a monetary gain is always desirable for individuals compared to the status quo. Individuals tend to exhibit greater risk seeking behavior in the presence of possible risky real monetary gains that are greater than a risk-free monetary option (Kachelmeier & Shehata, 1992). The question of whether or not individuals, and particularly entrepreneurs, exhibit an increasingly risk seeking behavior after having experienced a real monetary gain (called "house money" effect) is yet unsolved. On the one hand we know that individuals adapt their aspirations to their experience. Both their satisfaction and their dissatisfaction are short-lived, that is they dynamically adapt to feedback and generate expectations towards future outcomes in the short run (March, 1994). On the other hand, individuals are cognitively biased in their perception of random events. They adapt their aspirations to their cognitively biased view of opportunities. In a stream of research, individuals are consistently found to believe that a player who scored several times in a row is more likely to score again (so called "hot-hand" fallacy). (Gilovic, Vallone & Tversky, 1985). Kahneman & Tversky's prospect theory also suggests two contrasting ways prior outcomes might be considered by individuals. Firstly individuals might not consider prior outcomes in their subsequent decisions as people generally evaluate only the direct consequences of their act (Tversky and Kahneman 1981). Secondly, Kahneman and Tversky (1979, p. 286) also recognize that "there are situations in which gains and losses are coded relative to an expectation or aspiration level that differs from the status quo." In these situations, "the outcomes of an act affect the balance in an account that was previously set up by a related act" (Tversky and Kahneman 1981, p. 457). For example, "a person who has not made peace with his losses is likely to accept gambles that would be unacceptable to him otherwise" (Kahneman and Tversky 1979, p. 287). To summarize, prospect theory includes an editing phase in which prospects are simplified and encoded. However, within the prospect theory framework, there is some flexibility in how prospects are edited, particularly when a prior outcome might influence the reference point.

2.2. The house money effect in entrepreneurial-oriented individuals

The usage of cognitive biases and heuristics is considered physiological when making decisions, especially in environments characterized by high levels of risk (known probabilities) and uncertainty (unknown probabilities) (Knight, 1921; Kahneman & Tversky, 1974; Kahneman & Lovallo, 1993). Entrepreneurship is one of those environments. In becoming an entrepreneur an

individual risks, among other things, career opportunities, family relations, financial and psychic well-being (Liles, 1974; Bird, 1989). It is well established that under conditions of environmental uncertainty and complexity, entrepreneurs use biases and heuristics as an effective guide to decision making (Busenitz & Barney, 1997). Furthermore when performing an entrepreneurial activity, entrepreneurs have to face and accept high levels of monetary risk and uncertainty. In particular, they face investment payoffs that take place overtime and are highly uncertain. Economic theory predicts entrepreneurs to be different in their risk preferences compared to non-entrepreneurs. In Kihlstrom and Laffont (1979), individuals can choose between entering the labor market with a relatively risk-free wage employment or becoming an entrepreneur facing risky income prospects. At the equilibrium, less risk-averse agents become entrepreneurs, and more risk-averse agents become wage earners. Prospect theory suggests that people use weighting functions instead of probabilities when choosing between different alternatives (Kahneman and Tversky 1979). Decision makers put too little weight on outcomes not obtained with certainty. This phenomenon known as “subcertainty” explains risk aversion in choices involving sure options. Despite these theoretical predictions, the evidence confirming a higher risk tolerance of entrepreneurs compared to non-entrepreneurs when receiving a monetary feedback is largely inconclusive. All these elements suggest a positive moderation effect of previous monetary gain on the choice of risky gambles. Thus we specify the following hypothesis:

HYPOTHESIS 1A: Compared to non-entrepreneurial oriented individuals, entrepreneurial oriented individuals' propensity to choose risk is higher after receiving a monetary gain

With respect to uncertainty preferences, many reasons can be identified as having an impact in entrepreneurs' perception of previous monetary feedback. Firstly, from prospect theory we know that the “hot hand” fallacy is based on the representativeness¹ heuristic. (Kahneman & Twersky, 1974). Entrepreneurial behavior is guided by cognitive biases, in particular representativeness and overconfidence (Busenitz & Barney, 1997). Secondly, compared to managers, entrepreneurs greatly draw from their personal experience when considering opportunities with uncertain outcomes (Stuart & Abetti, 1990). Thirdly, Baron & Ensley (2006) found that entrepreneurs

¹ Kahneman and Tversky (1974) defined representativeness as "the degree to which an event (i) is similar in essential characteristics to its parent population, and (ii) reflects the salient features of the process by which it is generated"

recognize opportunities detecting meaningful patterns (“they connect the dots”) and this ability not only distinguish them from non-entrepreneurs but also help them taking decisions in a rather coherent way at a group level under uncertainty. Finally, entrepreneurs are less likely to engage in counterfactual thinking (i.e., less likely to invest time and effort imaging what "might have been" in a given situation) and less likely to experience regret over missed opportunities (Baron, 2000). All these elements suggest a positive moderation effect of previous monetary gain on the choice of uncertain gambles. Thus we specify the following hypothesis:

HYPOTHESIS 1B: Compared to non-entrepreneurial oriented individuals, entrepreneurial oriented individuals' propensity to choose uncertainty is higher after receiving a monetary gain

2.3. The “risk propensity” effect

When facing a risky monetary opportunity vis a vis a certain monetary opportunity, individuals require a risk premium in order to choose the risky option, that is a compensation for taking risk dependent on (1) the expected value of the risky option and (2) the individual expected utility. When the expected value of the two options is the same, it becomes interesting to compare individuals' choices in their reactions to an exogenous increase in the variability of outcomes², a variation that we will call degree of risk and degree of uncertainty in gambles involving risky or uncertain options respectively. The question of whether or not individuals exhibit an increasingly risk avoiding behavior when facing increasing degree of risks (called “risk propensity” effect) is yet unsolved. On the one hand we know from prospect theory that different presentations of the same monetary opportunity result in a different choice behavior because of an individual bias called “isolation effect” (Kahneman & Tversky, 1979). In this respect, the increasing degree of risk in a set of gambles with the same expected value can be considered part of the “isolation effect”. On the other hand, the variance of risky outcomes is one indicator of monetary risk (Weber & Milliman, 1997). Individuals might react differently to different presentations of the same gamble because as degrees of risk increase, they feel confronted with an increased monetary risk as well.

2.4. The risk propensity effect in entrepreneurial-oriented individuals

² Where a risky option of either 20dkk (p=50%) or 8dkk (p=50%) is less risky than an option offering 28dkk (p=50%) or 0dkk (p=50%). Even though the expected values of the two options are the same, the second presents an increased distance in the possible monetary outcomes and ultimately a higher degree of risk.

Extant research in entrepreneurship provides elements supporting a lower risk and uncertainty propensity for entrepreneurial-oriented individuals compared to non-entrepreneurial-oriented individuals. Compared to bankers, entrepreneurs react differently when coping with risk. They tend to accept it as given and focus on their personal commitment to achieve success (Sarasvathy Et Al, 1998). Authors concluded that entrepreneurs see opportunities where others usually see risks. However, Forlani & Mullins (2000) found that entrepreneurs tend to avoid high degrees of risk in predicted outcomes for a new venture. That is, when confronted with opportunities entrepreneurs tend to avoid the ones that present higher degrees of risk. All these elements suggest a negative moderation effect of increasing degrees of risk on the choice of risky gambles. Thus we specify the following hypothesis:

HYPOTHESIS 2A: Compared with non-entrepreneurial individuals, entrepreneurial oriented individuals' propensity to choose risk is lower for higher degrees of risk

With respect with uncertainty, if it is true that higher degrees of uncertainty reflects higher stakes at play in uncertain gambles, these higher stakes ultimately increase both the desirability of the uncertain option, and individual doubts preventing action (McMullen & Shepherd, 2006). These elements suggest a negative moderation effect of increasing degrees of uncertainty on the choice of uncertain gambles. Thus we specify the following hypothesis:

HYPOTHESIS 2B: Compared with non-entrepreneurial individuals, entrepreneurial oriented individuals' propensity to choose uncertainty is lower for higher degrees of uncertainty

3. Data and Method

Data have been collected through a custom designed lab experiment with both money games and a questionnaire on demographics and individual characteristics.

The suitability of data to test the hypothesis is due to four different characteristics of our study (1) two different groups tested (2) data obtained through lab experiment (both questionnaire and money games) (3) more precise link between treatments and behavior and (4) minimization of unobserved heterogeneity due to individual fixed effects specification.

3.1. Sample construction

Seventy-four business students in two different groups (entrepreneurial-oriented and non-entrepreneurial-oriented) were randomly selected. Students were used to minimize the impact of entrepreneur experience in explaining differences between groups. The distinction between the two groups is possible as they belong to the same study line at Copenhagen Business School. However, some students chose to study in an entrepreneurship study concentration while others did not. Every student in the entrepreneurship focused program expressed desire to start a company. Approximately 10% of the sample of entrepreneurship students has already started a firm at the time of the experiment.

3.2. Experiment Design

The experiment was designed to have two distinct parts: (1) money games with real incentives and (2) questionnaire with demographics, scenario-based games, and individual controls (including personality traits, cognitive biases etc.). In the first part, each student was confronted with twenty-four unique gambles decisions. Eight of these decisions did not have any monetary feedback. The remaining sixteen were with feedback and divided in four different types.

Decision	Certainty vs Risk		Certainty vs Uncertainty	
	Option A (probabilities of payoffs)	Option B (probabilities of payoffs)	Option A (probabilities of payoffs)	Option B (probabilities of payoffs)
1	100% 14dkk	50% of 4 dkk 50% of 24 dkk	100% 14dkk	Unknown chance of 4 dkk Unknown chance of 24dkk
2	100% 14dkk	50% of 2 dkk 50% of 26 dkk	100% 14dkk	Unknown chance of 2 dkk Unknown chance of 26dkk
3	100% 14dkk	50% of 0 dkk 50% of 28 dkk	100% 14dkk	Unknown chance of 0 dkk Unknown chance of 28dkk
4	100% 14dkk	50% of -2 dkk 50% of 30 dkk	100% 14dkk	Unknown chance of -2 dkk Unknown chance of 30dkk

Table 1: Money games Structures (dkk = Danish Kroner)

For this paper, we consider two types only (certainty vs risk; certainty vs uncertainty) and eight

unique decisions for individuals (see table 1). In the different decision rounds, we kept gambles' probabilities and expected value the same, fifty percent and fourteen Danish kroner respectively. For each decision made, students received feedback on their monetary gain. The degree of risk of the uncertain and risky options is increasing during the different decision rounds.

3.3. Variables

Our dependent variable was gamble choice, a dummy indicating whether individuals are choosing a certain option or a risky/uncertain gamble. Our main effect variables are (1) "positive feedback", a dummy indicating whether individuals experienced a monetary gain greater than the certain option (2) degrees of risk, a discrete values variable containing information on the spread between the possible outcomes in risk/uncertain gambles and (3) Entrepreneurial orientation, a dummy indicating whether individuals belonged to the groups of entrepreneur-oriented individuals or not. In our experiment design, individuals are faced with simple repeated choices between a certain (probability = 1) monetary option and either a risky (probability = 0.5) or uncertain (probabilities unknown) monetary option. Both the uncertain and the risky options present a possible greater (and lower) amount of money at stake compared to the certain option. In order to isolate the effect of monetary feedback, the expected value of the two options is the same³. We investigate whether the availability of information regarding the outcome of a gamble decision – namely the size of the winning – influences individuals' subsequent gamble decisions. Furthermore, as in the experiment individuals are faced with repeated choices of two types (certainty vs risk; certainty vs uncertainty) but with an increasing variance between the possible risk/uncertain payoffs, we investigate whether this exogenous manipulation influences individuals' subsequent gamble decisions.

The model includes numerous controls at the individual level of analysis: risk attitude (Holt & Laury, 2002), personality traits (BFI-inventory, John et Al, 2008; John Et Al, 1991), cognitive biases (Fischhoff Et Al, 1978; Busenitz & Barney 1997), pathological gambling (Winters Et Al 1998; Stinchfield, 2000) and general demographics.

³ A typical decision in the experiment is framed as such: 14 dkk (Danish Kroner) with probability 100% (certainty) OR either 20 dkk or 8 dkk both with probability 50%. Note that in both options the expected value is 14 dkk.

4. Results

Given the nature of our dependent variable and the experiment design, we use a logit specification with marginal effects to test our hypotheses.

Y = choice dummy = 0 when certainty is chosen	(1) Certainty vs Risk	(2) Certainty vs Uncertainty
Entrepreneur dummy (ed)	3.285*** (1.155)	-1.511* (0.877)
Positive feedback t-1 (pft1)	-0.257 (0.673)	0.130 (0.499)
Moderation 1 (ed & pft1)	1.509* (0.897)	1.720** (0.711)
Degree of Risk (r)	0.0424 (0.0297)	0.0124 (0.0279)
Moderation 2 (ed & r)	-0.158*** (0.0551)	0.0216 (0.0439)
Constant	2.288 (2.282)	-0.947 (2.455)
Observations	180	180
Demographics	YES	YES
Individual controls	YES	YES

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 2: Logit regression

4.1. Entrepreneurial attitude on “House Money effect”

Results from table 2 suggest a partial support for hypothesis 1A. We find a working positive significance of the moderation1 (effect of monetary feedback on entrepreneurial-oriented individuals’ preferences towards risky gambles) that is confirmed in the analysis of marginal effects. Hypothesis number 1B is verified. Entrepreneurial oriented individuals are less likely to choose uncertainty compared to non-entrepreneurial oriented students. However the propensity to choose uncertainty becomes equal for the two groups after entrepreneurial-oriented individuals experience a monetary gain.

4.2. Entrepreneurial attitude on “Perceived Risk effect”

Hypothesis 2B is not verified as there is no significant effect of higher degrees of uncertainty on individuals' choice. We also find that entrepreneurial oriented individuals in our sample are more likely to choose risk than non-entrepreneurial oriented individuals. However, this propensity to choose risk decreases and disappears for higher degrees of risk. Thus, hypothesis 2A is fully verified.

4.3. Robustness checks (supplementary investigations)

Differences between individuals might be due to some other mechanisms other than the ones identified and controlled for. Robustness checks are then needed. We controlled for two possible sources of alternative explanations.

Firstly, individuals might be belonging to groups due to unobservable reasons other than personal choice. Many controls confirm the non-random nature of the groups' composition. Entrepreneurship students possess entrepreneurial orientation when confronted with Ha-Almen. This is evident in their Psychological variables (Big 5 factors), as entrepreneurship students score higher on Conscientiousness and Openness to Experience and lower on Neuroticism and Agreeableness (Zhao & Seibert, 2006). Furthermore, in case of negative feedback, entrepreneurs show consistency in their preferences (they focus both on downsides and upsides).

A second possible source of concern is over specification due to the numerous control variables at the individual level (fifteen) included in the model. In order to mitigate this issue, we ran a reduced model excluding the dummy variables obtaining similar results. Furthermore, individual fixed effects have to be controlled for when comparing groups of individuals. Results from a random effects specification (see table B in Appendix) confirm the overall general reliability of the results.

5. Conclusion

This study contributes to our understanding of cognitive factors guiding entrepreneurial decision-making. We find significant differences in the way entrepreneurial-oriented individuals respond to different degrees of risk and uncertainty. In particular we find that entrepreneurial-oriented individuals do not exhibit a constant lower risk aversion compared to non-entrepreneurial

oriented individuals. A general preference for risky option is moderated by the negative effect of increasing degree of risk. Furthermore, we find a general aversion towards uncertainty, partially moderated by previous feedback.

6. Limitations

We finally acknowledge that our paper presents limitations. An evident challenge for us is the generalization of these results and external validity. Due to the nature of our sample (Copenhagen Business School students only) we will check for further possible bias due to selection.

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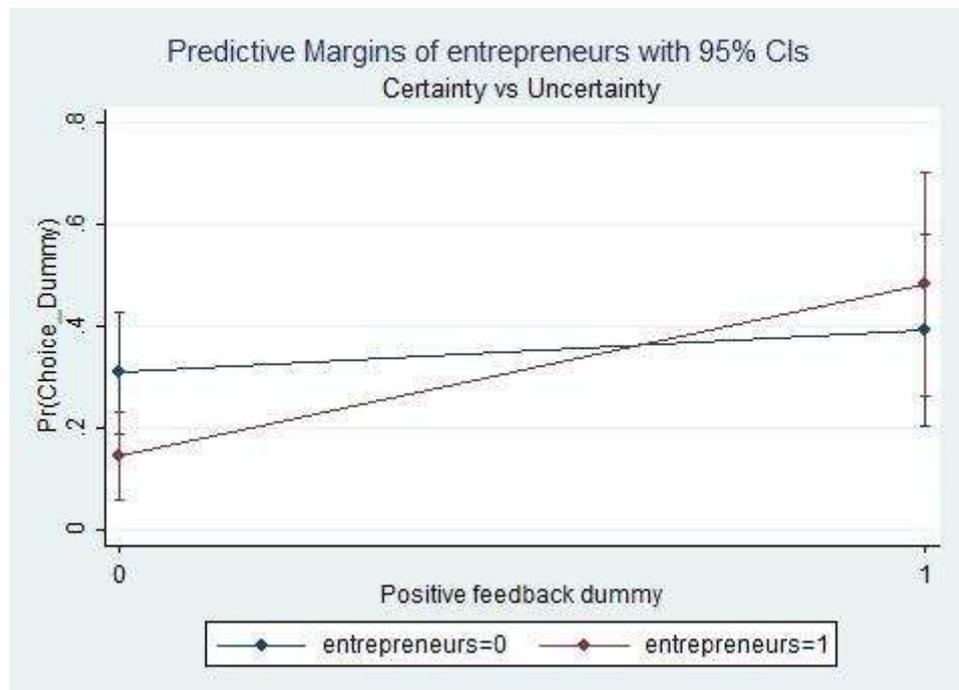
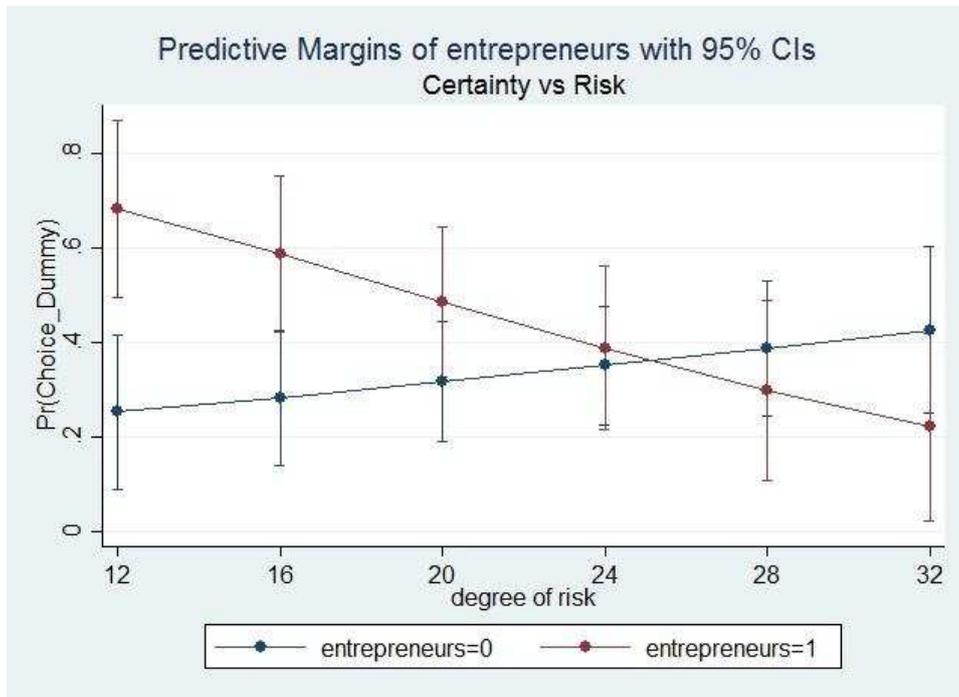
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APPENDIX

A – Marginal effects on logit regression (significant moderations1 and moderation2)



B – Random effects specification (S1 = Certainty vs Risk; S2 = Certainty vs Uncertainty)

VARIABLES	(1) Random Effects S1	(2) Random Effects S2
Entrepreneur dummy (ed)	4.077*** (1.427)	-1.844 (1.354)
Positive feedback t-1 (pft1)	-0.310 (0.851)	0.389 (0.551)
Moderation 1 (ed & pft1)	1.729 (1.266)	1.597* (0.887)
Degree of Risk (r)	0.0475 (0.0309)	0.00695 (0.0315)
Moderation 2 (ed & r)	-0.179*** (0.0686)	0.0312 (0.0504)
Constant	-1.823** (0.821)	-1.071 (0.739)
Observations	180	180
Number of id_unique	45	45

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

NOTE: Y = Choice dummy – 0 when certainty is chosen