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Entrepreneurial Cognition when faced with Risk and Uncertainty:

Methodological Reflections

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Abstract

The purpose of the paper is to review and suggest a categorization of methodologies used to trigger entrepreneurial behavior in a variety of settings involving risk and uncertainty. Even though the link between entrepreneurship and risk is undeniably tight, literature often suffers from low predictive power when explaining such link empirically. We argue that this might be due a lack of consensus over both the definition and operationalization of the constructs of risk and uncertainty in entrepreneurship, with particular reference to risk perception. Three types of methodological designs are identified and presented being money games, scenario-based questionnaires, and hybrids. By looking at their advantages and disadvantages, we aim at contributing to a better understanding of the most suitable game designs to capture risk perception, suggesting their use in specific settings and ultimately helping future research in entrepreneurship.

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"AT YOUR OWN RISK" - ENTREPRENEURIAL BEHAVIOR WHEN FACED WITH RISK AND UNCERTAINTY: METHODOLOGICAL REFLECTIONS

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Abstract

The purpose of the paper is to review and suggest a categorization of methodologies used to trigger entrepreneurial behavior in a variety of settings involving risk and uncertainty. Even though the link between entrepreneurship and risk is undeniably tight, literature often suffers from low predictive power when explaining such link empirically. We argue that this might be due a lack of consensus over both the definition and operationalization of the constructs of risk and uncertainty in entrepreneurship, with particular reference to risk perception. Three types of methodological designs are identified and presented being money games, scenario-based questionnaires, and hybrids. By looking at their advantages and disadvantages, we aim at contributing to a better understanding of the most suitable game designs to capture risk perception, suggesting their use in specific settings and ultimately helping future research in entrepreneurship.

Key words: Entrepreneurial behavior, Risk, Uncertainty, Risk perception, Money Games, Hybrids

1. INTRO

Risk and uncertainty are consistently viewed by scholars as two highly influential variables in entrepreneurship, especially at the individual level (Miller, 1983; Zhao Et Al, 2010). In particular, risk perception has been one of the main investigation candidates in recent years to explain differences in individuals' behavior, for example between entrepreneurs and non-entrepreneurs (Simon Et Al, 2000; Keh Et Al, 2002). Risk perception is defined as the subjective judgment of risk inherent in a situation (Cooper Et al, 1988; Smith, 2003; Keh Et Al, 2002). Measuring the impact of risk perception is still an open problem as a lack of consensus between scholars exists on best measurement practices (Stewart & Roth, 2001). All these elements have fostered the need for filling a research gap in entrepreneurship literature, that is to map games designed to stimulate risk perception (Baron & Ensley, 2006). Our research question then is: "Which games are best suited to capture entrepreneurial risk perception?"

Entrepreneurship provides a unique background to study risk perception due to the high amount of subjectivity in entrepreneurs' decision making (Cooper Et. Al., 1988; Barney & Busenitz, 1997). An entrepreneur is "the organizer of an economic venture, especially the one who organizes, owns, manages and assumes the risk of a business" (Brockhaus, 1980). In becoming an entrepreneur an individual risks, among other things, career opportunities, family relations, financial and psychic well-being (Liles, 1974; Bird, 1989). A better understanding of risk perception role in new venture formation is essential given the significant failure rate among new ventures. Furthermore, it has the potential to improve the quality of decision making in the risk-charged environments which most prospective founders of new firms face (Forlani & Mullins, 2000).

We build our arguments on the idea that individuals' decisions in risky contexts are based on cognitive elements such as perceptions and attitudes towards risk. In general, humans are usually far from being rational due to a variety of factors that deal with cognition; among others, we can identify overconfidence, information overload and counterfactual thinking. These cognitive biases ultimately affect behavior through the mediating effect of risk perception. (Kahneman & Lovallo, 1993; Simon Et Al, 2000; Baron, 2000). The presence of different biases in decision making has strong implications in entrepreneurship. Some scholars believe that without the use of heuristics in decision making, business opportunities discovery and implementation would be much more limited (Busenitz & Barney, 1997). This fact, in turn, creates a challenge: how can we account for these cognitive biases when assessing entrepreneurial risk perception? (Baron & Ward, 2004).

For decades, researchers have used two types of games to measure the impact of cognitive bias: money based and scenario based games. Money based games focus on measuring behavior on tasks (e.g. gambles) including real monetary stakes. Scenario based games focus on measuring complexity in decision making through the use of scenarios. To date there is not a paper that reviews the use of these games in entrepreneurship literature and this is where we aim at contributing. We suggest that the decision to use a particular game to measure risk perception has to be driven by the research objectives. We argue that a hybrid design between money and scenario based games might be the most beneficial for entrepreneurship research.

The paper is structured as follows: in section two we briefly review conceptually the two main variables of risk and uncertainty, underlining the role of risk perception in uncertain situations. In section three we review two different types of game design and present their general features, structures, and advantages versus disadvantages. In section four we present a third category of games, a hybrid type, arguing for its importance in the context of entrepreneurship. Section four concludes.

2. RISK AND UNCERTAINTY: A BRIEF CONCEPTUAL REVIEW

Risky choices and the selection criteria that people seek in order to optimize decision making has been the object of theoretical and empirical investigation for centuries (Machina 1987 ; Glimcher, 2003); this creates the conditions to review some of the most widely recognized definitions and operationalization of risk and uncertainty and how overtime the role of risk perception has become central at the individual level of analysis.

2.1 Definitions

There is a sharp conceptual distinction between decisions under risk and under uncertainty and that depends on the different availability of information possessed by the decision maker (Knight,

1921). Definition wise, risk refers to situations where individuals know with certainty the mathematical probabilities of possible outcomes of choice alternatives. Uncertainty refers to situations where the likelihood of different outcomes cannot be expressed in a mathematical probability form. Two types of uncertainty can be mentioned: aleatory and epistemic uncertainty. Aleatory uncertainty is the objective and irreducible uncertainty about events whereas epistemic uncertainty is the subjective and reducible uncertainty that results from a lack of knowledge related to the events (Weber & Johnson, 2008). A classic economic assumption is that every uncertain situation can be reduced to a risky one by assuming all the possible outcomes as equally likely. However, research showed that people are clearly "ambiguity averse" distinguishing between risky and uncertain options and having a preference for risk (Ellsberg, 1961). In real life decisions, uncertainty and risk are not so clearly distinguishable from each other at the individual level: indeed, knowledge about the probability distribution of possible outcomes of a choice can lie anywhere on a continuum, from complete ignorance to certainty. Scholars refer to "ignorance" when the possible outcomes are unknown whereas they refer to "certainty" when only a single outcome is known to result. In the middle of these two extremes two different degrees of partial ignorance can be found being uncertainty and risk (Weber & Johnson, 2008). Modeling depends strongly on a precise definition of risk and uncertainty in a specific setting: this is why many different conceptual approaches can be mentioned.

2.2 Modeling decision making under risk

It is possible to identify an evolution in modelling decision making under risk at the individual level. Over time, scholars in social sciences (including finance scholars, economists, and psychologists) presented four different models based on a different operationalization of value: Expected Value Theory, Expected Utility Theory, Risk-return models, and Prospect Theory (see table one)

Expected Value Theory dates back to the seventeenth century and assumes as the key decision criterion for individuals the maximization of expected monetary value (EV) of a gamble (X). According to this theory, individuals should face risky situation only by looking at the objective expected outcome probability $p(x)$ and decide accordingly. Mathematician Daniel Bernoulli has been the first to critically address this theory by presenting the paradox of the so-called St. Petersburg lottery (Bernoulli, 1738): in essence, when confronted with a lottery yielding an infinite expected value, individuals show a very low willingness to pay a price for playing it. This is due to the fact that Expected Value Theory does not take into account the subjective benefits an individual receives from the lottery and, as a consequence, the subjective determination of an opportunity's value. Thus, instead of the maximization of expected value, Bernoulli proposed a maximization of expected utility in individual's decision making, with $u(x)$ being the utility funcion.

Table 1
Four models of decision making under risk

Model	Authors	Formula
Expected Value Theory	Huygens (1657)	$EV(X) = \sum_x p(x) * x$
Expected Utility Theory	Bernoulli (1738)	$EU(X) = \sum_x p(x) * u(x)$
Risk-Return Models	Markovitz (1954)	$WTP(X) = V(X) - bR(X)$
Prospect Theory	Kahneman & Twersky (1979)	V(x) = x^{α}

In utility theory, the marginal value of money and wealth connected with an opportunity (including a gamble) is diminishing, ultimately explaining the discrepancy between the objective expected value and observed behavior. The degree of concavity of the relationship between value and utility serves as an index of an individual's degree of risk aversion (Von Neumann & Morgenstern, 1947). In more recent years, expected utility maximization has been empirically tested in its reliability to predict decision making in different context, including risky scenarios: even if results provided mixed evidences, this theory remains a cornerstone in economics (Weber & Johnson, 2008).

Another approach to overcome the limitations of the Expected Value Theory has been proposed in finance by Markovitz (1954) with Risk Return models. In every risky opportunity there is a tradeoff between a given level of risk R(X) and its connected return V(X): both these elements ultimately influence individual's willingness to pay for a risky option (X). The assumption underlining this model is that individuals, for a given level of return, try to minimize their risk. Model parameter *b* is an individual index of risk aversion, describing the nature of the tradeoff between the maximization of return and minimization of risk. In risk-return models, risky options' expected values are proxied by returns V(X) and different utility functions imply different functional forms for risk, *R*(*X*) (Jia and Dyer, 1997).

All the three economic models presented so far lie on a critical assumption: the risk/return of choice options and the utility of decision outcomes are determined entirely by the objective value of possible outcomes and the final wealth generated (Weber & Johnson, 2008). In other words, possible outcomes are assumed to be evaluated independently from a reference outcome. This is a strong assumption: whenever possible, individuals tend to compare their selected option's outcome with the counterfactual outcome, that is what they could have selected (Landman,

1993). According to regret theory, decision makers strongly fear the situation where the counterfactual outcome is better than their selected choice: this pushes them to maximize their expected utility whilst minimizing the possible post-decisional feeling of regret (Loomes & Sudgen, 1982; Bell, 1982). The assumption of independency of reference outcomes (or counterfactual) has been empirically tested: it has been found that even though both Expected Utility Theory and Risk–Return models possess evident prescriptive and normative strengths, in both cases low predictive power has been obtained when trying to explain human behavior in risk choice. These two models are unfortunately far to be descriptive models for decisions under risk and uncertainty (Ellsberg, 1961; McFadden, 1999; Camerer, 2000; Weber & Johnson, 2008).

Conceptually, prospect theory represents a step forward in decision making research. This theory assumes that individuals rely on a variety of relative comparisons when evaluating an outcome (Kahneman & Twersky, 1979; Kahneman, 2003). Consistent with the previous models, Prospect Theory maintains the decreasing marginal sensitivity assumption, where changes in outcomes have a decreasing impact on the decision maker the more is gained or lost.

In prospect Theory's power value function (presented in table 1), parameter α is measuring the decision maker's marginal sensitivity. Indeed a significant part of the systematical deviations from expected behavior by decision makers can be explained by prospect theory through the value function's changes in relative gains and losses. It is noteworthy to review here two empirical properties of the value function V(X). First, the value function is concave only in the domain of gains as individuals become more risk averse as gain increases; on the contrary, the value function is convex only in the domain of losses as individuals become more risk seeking the greater the size of their loss. Second, the value function V(X) presents an asymmetry in steepness: in the gain domain the function is much less steep than in the loss domain, reflecting a greater sensitivity of decision makers for losses than for gains. Scholars defined the ratio between these two different slopes as the loss aversion parameter λ and many studies suggest this parameter to be fundamental in explaining human choice behavior, from the endowment effect (Thaler, 1980) to the status quo bias (Samuelson and Zeckhauser, 1988).

Prospect theory presents at least two important considerations that are useful for the purpose of this paper and will be further developed in the next section. First, it suggests a transformation of objective probabilities into subjective decision weights as individuals are found to be evaluating small probability events more likely that they should be if based on their objective occurrence: this is particularly true for entrepreneurship; second, this theory suggests that decision makers are more likely to use bias and heuristics (including selection of information bias) to simplify their process of decision (Busenitz & Barney, 1997). All these elements are connected with psychological variables that are still not perfectly understood and very hard to be accounted for in an economic model (Smith, 2003). Nonetheless, they help explaining systematical deviations from the expected behavior in many empirical settings.

2.3 Modeling decision making under uncertainty: the central role of perception in individuals

Very often individuals have to make choices under conditions of uncertainty and their primary resource to deal with it is their subjective ability to perceive the odds of different possible outcomes. This is why when modeling decision making under uncertainty, the role of perception becomes fundamental and research in cognitive psychology has been historically the principal driver of investigation compared to economics. Three ways of modeling decision making under uncertainty are presented here: generalized risk return model (Sarin & Weber, 1992), ideal point model (Lopes, 1987; Weber & Kirsner, 1997), and process tracing methods (Weber & Johnson, 2008).

One of the conceptual approaches used to cope with the absence of objective probability has been to adapt the existing model of financial risk-return. In order to measure the influence of subjective perception of risk on determining willingness to pay (WTP) for a risky option X, the three variables of risk, return and the tradeoff parameter *b* had to be transformed into psychological variables (Sarin and Weber, 1992). These transformed variables, unlike in financial risk return models, can differ due to individual or situational characteristics. Consistently with such transformation, empirical evidence shows that the same change in an opportunity's outcome can be perceived in systematically different ways by different individuals and cultures (Brachinger and Weber, 1997). Following these modifications, some scholars in psychology also suggested another review of the risk return models. Instead of assuming decision makers as subjects that strive to minimize risk, they argued instead that people's ideal point for risk or uncertainty could differ, either as a personality difference (Lopes, 1987) or as a situational difference (Weber and Kirsner, 1997).

Ideal point models dig more into this issue: the central assumption of these models is that a decision maker will perceive the riskiness of an alternative as the discrepancy between the alternative's level of uncertainty and the person's ideal point on the uncertainty continuum. In this respect, an individual with a lower ideal point would perceive a higher level of risk in an opportunity with a high objective level of uncertainty than an individual with a higher ideal point. In order to measure empirically differences in such an ideal point for individuals' perception of uncertainty, Zuckerman (1979) introduced the construct of sensation-seeking which has its basis in biology and varies with age and gender (Zuckerman et al., 1988). Empirical research suggest two important evidences: first, the existence of a positive link between sensation-seeking and risk taking behavior in a variety of settings, from ethical risk to thrill seeking (Weber Et Al, 2002) and second, the role of risk perception in influencing such link, creating biases when evaluating opportunities.

Another approach in cognitive psychology that has addressed the problem of modeling decision making under uncertainty is process analysis. The basic idea behind this approach is to complement existing risk models considering more sources of data that could help understand the

subjective dynamics of decision making. Three examples of process-analysis techniques are presented here: first, talk aloud techniques, where individuals explain their thoughts as they make risky choices (Ericsson and Simon, 1980; Bettman and Park, 1980), second, eye fixation/tracking techniques, useful to gather information on visually displayed information while individuals make choices (Russo and Dosher, 1983; Bradley Et Al, 2008); finally, computer-based techniques, recording the mouse clicks that reveal information on the computer screen (Payne Et Al, 1991; Costa-Gomes Et Al, 2001; Gabaix Et Al, 2006).

The empirical testing of these techniques has revealed several interesting patterns in risky decision making. First, compared to simple binary lotteries, complex gambles entail a different kind of decision processing: more specifically, decision-makers try to eliminate options and attend to only a subset of the available information when faced with complex displays or time pressure (Weber & Johnson, 2008). The implication is that scholars should carefully choose between gambles structures when assessing risky choice patterns as individuals' response to stimuli will be different according to the different experimental environments they will face. Second, different choice processes can be observed as a result of different ways of measuring preferences. The behavioral inconsistencies between gamble selection and gamble pricing provides an example to support such statement: it is not unusual to observe that individuals will price the gamble they select lower than the alternative unchosen gamble. This inconsistency, known as reversal (Lichtenstein and Slovic, 1971), occurs because decision makers use different processes and put different weight on probabilities and payoffs when generating a price than when making a choice (Schkade & Johnson, 1989; Mellers Et Al, 1992). Finally, there is significant evidence of shifts in strategies across different kinds of problems especially when variables such as the time available to make a decision or the nature of the choice set changes (Ben Zur & Breznitz, 1981; Payne Et Al, 1988).

3. METHODOLOGICAL REFLECTIONS ON RISK PERCEPTION

The conceptual review of risk and uncertainty provides strong elements to support a further investigation of risk perception role in decision making: risk perception is indeed believed to be the key variable to understand inconsistent behaviors. In this respect, entrepreneurship provides a perfect setting as decision makers have to face high level of risk and uncertainty on a daily basis. Despite empirical research has already provided some support on the importance of risk perception in explaining differences between entrepreneurs and managers (Brockhaus, 1982; Cooper Et Al, 1988), both the conceptualization and, most importantly, operationalization of risk perception in entrepreneurship remains a matter of debate.

The entrepreneurship research dealing with individuals' risk perception clearly points at the urgency of addressing two distinct problems: first the confusion over the role of risk perception in

influencing entrepreneurial behavior, and second the lack of agreement on how to measure such perception.

The definition and role of risk perception vs risk attitude

Many studies in psychology and social science include both the constructs of risk perception and risk attitude in explaining entrepreneurial behavior but systematic analysis of their separate influences on choice making is a relatively recent achievement in management literature. These constructs are conceptually distinct but interlinked at the same time (Sitkin & Pablo, 1992; Sitkin & Weingart, 1995). Therefore, as this linkage often creates confusion, it is important here to consider both their definitions and then provide a review of the research gaps underlying the role of risk perception. Definition-wise, risk perception and risk attitude are different and should not be confused.

Perceived risk is defined instead as the subjective judgment of the amount of risk inherent in a situation (Keh Et Al, 2002). Since the early work of Palich & Bagby (1995), risk perception has been investigated as the key characteristic that differentiates entrepreneurs from managers in their behavior. The two authors found that, ceteris paribus, entrepreneurs tend to perceive some business situations more positively than do non-entrepreneurs. It is this different perception that let them see strengths and opportunities where others see weaknesses and threats, positively influencing venture formation. It follows that cognition plays a big role in the perception of opportunities: but this connection can also be negative, as previous empirical research found that probabilities connected with an economic return that are objectively very small can be perceived as substantially higher due to cognitive biases (Barney & Busenitz, 1997). Later work by Forlani & Mullins (2000) confirmed and built on such results, finding no significant influence of risk attitude on risk perception, and ultimately suggesting a strong direct effect of perception alone in decision making.

Despite their differences, all these studies share a similar approach in underlining the difficulties of finding a generally accepted role of risk perception, particularly when looking at its antecedents (Keh Et Al, 2002). Limited research has explored the influence of cognitive factors on risk perception and mixed empirical evidence has been found to support it. (Simon Et. Al., 1999; Keh Et. AL. 2002). Further research seems to be hindered by the endogenous low predictive power of methodologies based on questionnaires (Stewart & Roth, 2001). Therefore, the role of risk perception remain somehow vague and its definition in entrepreneurship literature, ultimately, incomplete.

Risk is generally recognized to be tightly linked with the objective variability of outcomes, where greater variability in economic returns means greater risk. Following these characteristics, risk attitude has been defined as the stable set of individuals' preferences towards risk and has been used both in the expected utility theory and risk return models to capture differences in choice behavior through a parameter describing the curvature of the utility function (Weber & Johnson, 2008). Scholars disagree on the definition of risk attitude as a personality trait: some authors have

considered risk attitude as a facet of the trait of extraversion, consistent with the Big Five personality theory (Weber & Milliman, 1997; Zhao & Seibert, 2006), but some others have questioned such hypothesis (MacCrimmon & Wehrung, 1990; Hanoch Et Al, 2006).

According to Stewart & Roth (2001), empirical research exploring differences between entrepreneurs' and managers' risk attitude has produced conflicting results because of the same two orders of problems: the lack of a precise definition of risk attitude, and a rigorous measurement technique. The two authors found that differences between entrepreneurs and managers strongly depend on the definition of entrepreneurial risk attitude, and criticize how scholars have often overlooked the distinction between entrepreneurs who primarily focus on growth and profit, and entrepreneurs who focus on producing a family income as small business owners (Carland et al, 1984). As these individuals have different goals and different risk attitudes, it is suggested that empirical results measuring risk attitude have been inconclusive partly due to the different reasons of entrepreneurial self-selection (ibid).

3.1 Risk perception measurement

By reviewing the most recent papers in entrepreneurship research, it is possible to identify two types of methodological designs capturing risk perception: scenario-based questionnaires and money games.

Measuring risk perception through scenario based questionnaires

In scenario based questionnaires individuals are asked to answer questions based on one or more hypothetical scenarios. Many different disciplines in social science (including psychology and entrepreneurship) have used such design extensively to capture the complexity of decision making (Stewart & Roth, 2001). Thanks to its flexibility in design, scenario based questionnaires can have many different structures and measure different cognition related variables including risk perception. When dealing with such design, it is important to control for different types of bias: among others we cite here sample and measurement bias. The presence of sample biases constitutes a well-known problem when making inferences in risk perception. Some studies have used small sample sizes (Sarasvathy Et. Al., 1998) and external validity might be questioned due to possible biases in sampling. Almost no study have included or accounted for the so called "serial entrepreneurs" in the sample of scrutiny (Forlani & Mullins, 2000). This is particularly interesting as some scholars believe that serial entrepreneurs, defined as entrepreneurs that founded more than one firm, can be less affected by the cognitive biases as they might better assess sunk costs, knowing when to persist or to give up their effort (Baron & Markman, 2003). If not accounted for, this evidence might decrease the predictive power of empirical analysis on risk perception. Furthermore, most of the studies do not provide information on the gender characteristics in the

sample. In some cases, the percentage of females in the sample is very low (only 3% of females in sample for Keh Et Al, 2002) and, even though this evidence might be in line with the consideration that female entrepreneurship is less common than male entrepreneurship, this again limits the generalization of results.

Issues related with measurement biases have also exacerbated the discord concerning entrepreneurial risk perception. Due to the very different nature of the variables to measure, there is here a fundamental difference that can be found in the approaches to operationalize risk: whilst scholars exploring risk attitude have often derived empirical measures of absolute/relative risk attitude from utility theory, scholars exploring risk perception have used an approach based on revealed perception in questionnaires. In entrepreneurial risk attitude research it is possible to find a generally accepted measure of absolute risk attitude that is the Arrow-Pratt measure [*ARA u(x)* $=-u''(x)/u'(x)$] defined as the ratio between the (negative) second and the (positive) first derivatives of the person's utility function (Pratt, 1964; Cramer Et Al, 2002). In risk perception, such generally accepted measure does not exist (March & Shapira, 1987; Stewart & Roth, 2001).

Table two list the most used methodologies in extant entrepreneurship research to make inferences on risk perception. Two main instruments are found to be more used in the literature but none of them is considered superior in predictive power than other (Stewart & Roth, 2001). On the one hand, the Kogan-Wallach Choice Dilemmas Questionnaire (CDQ) contains twelve scenarios that describe a person faced with a choice of pursuing risky choice with high return or pursuing a less risky action with a lower return (Kogan & Wallach, 1964). Respondents are also asked in either case to indicate the minimum probability of success that would be sufficient to warrant the choice of the risky alternative, indirectly assessing their perception of the riskiness of the alternative. The main limitation and critique of such instrument is that it relies on projected assessments of risk instead of actual behavior on tasks (Shaver & Scott, 1991; Stewart & Roth, 2001) and that in general CDQ has showed little low reliability in predicting covariance between entrepreneurial behavior and risk.
On the other hand, the Jackson Personality Inventory (JPI) is a 16 personality variables index with a risk taking scale designed to assess the willingness to commit to either successful or unsuccessful decisions knowing the corresponding outcomes. Compared to CDQ, this instrument face individuals with tasks designed to trigger responses under various types of risks including social, physical, ethical, and financial risks.

The other three instruments presented here can be considered as adaptations of the two previous mentioned ones, as they present elements from both CDQ and JPI. Overtime, these other three instruments have focused on a more precise operationalization of risk perception. The Risk Propensity Scale measure the level of risk propensity through a four items 7-point Likert scale ranging from "strongly agree" to "strongly disagree" (Palich & Bagby, 1995). Reliability of the scale is then tested through a Cronbach's alpha and factor analysis to check for its unidimensionality through the various items.

Table 2
Methodologies used to capture risk perception through scenario based questionnaires

Instrument	Authors	Results
CDQ (Choice Dilemmas Questionnaire)	Brockhaus (1980)	Differences between entrepreneurs and managers in their risk propensity are driven by risk perception.
	Sexton & Bowman (1983)	Entrepreneurship major students had higher risk propensity than non-business majors.
JPI (Jackson Personality Inventory)	Begley & Boyd (1987)	Compared to small business managers, founders had higher risk propensity
	Stewart Et Al (1999)	Entrepreneurs had higher risk propensity than managers
RPS (Risk Propensity Scale)	Palich & Bagby (1995)	No difference in risk propensity is found between entrepreneurs and non-entrepreneurs. Risk perception is, however, a differential element between the two
8-items closed-ended questions	Simon Et Al (2000)	Entrepreneurs may not perceive risk because of the influence of cognitive biases
RSS (Risk Style Scale)	Forlani & Mullins (2000); Keh Et. Al. (2002)	Entrepreneurial behavior is influenced by cognitive biases through the mediating effect of risk perception

A questionnaire design that is in between CDQ and JPI is the 8-items closed-ended question scale used by Simon Et Al (2000). Here the authors provide a twelve page school case and then measure risk perception by asking questions on their agreement (disagreement) on statements that deal with risk. A Likert-style scale and factor analysis is used for robustness. Compared with previous studies, the authors specifically aimed at measuring the impact of risk perception directly on entrepreneurial behavior.

Finally, the RSS scale focuses specifically on the perception of monetary risk: the instrument measure both individuals' decision of a risky or sure financial alternative and their correlated perception of risk involved in each case. The focus on risk propensity using monetary values has been indicated as the biggest advantage of this type of scenario based questionnaire (Forlani & Mullins, 2000; Keh Et Al, 2002).

Advantages and disadvantages of scenario based questionnaires

The main advantages of using questionnaires in experimental settings consist in their relative ease to use, limited costs connected with the implementation of the experiments and the flexibility of design they allow for. Questionnaires can include longer or shorter cases depending on the level of complexity that experimenters want to obtain. However all these different forms of questionnaires have in common many issues that are hard to control for and that have limited the applicability of such research designs in entrepreneurship (Stewart & Roth, 2001). The first common problem pertains to the tradeoff between using open or closed questions: in the first case, it is of fundamental importance to know if the respondent understands the questions being asked while in the second case the increased level of precision is obtained at the cost of obtaining minimal, too narrow information (Saccuzzo, 2012). The second common problem pertains to the inability of questionnaires to measure antecedents of risk perception as they record perception after the individual has made a decision; in this sense, questionnaires are "ex post" approaches. Scholars have therefore all suggested to further investigate the decision making process "ex ante", that is by looking specifically at entrepreneurial perception before decisions. Finally, some authors underlines the problem of risk measurement when dealing with irrational agents like entrepreneurs: both risk perception and attitude are influenced by prospects (Kahneman & Tversky, 1979; Cramer Et Al, 2002) and diversity of case studies used in instruments in terms of details provided might lead entrepreneurs to behave in a different way than they would on a real life scenario.

Measuring risk perception through money games

In the case of money games, the experiments include the use of real stakes in order to trigger entrepreneurial behavior in individuals facing risk and uncertainty. The focal point in money games is expressed behavior: researchers focus on individuals' choices (and perception) by reducing the complexity typical of case-based designs. The usual stake involved in such a design is monetary outcomes: individuals participating in money games typically receive a fixed participation sum and a variable sum depending on their performance during the experiment (Weber & Milliman, 1997). Using money should work as an incentive for decision makers to perform in a focused and strategic way as decisions ultimately influence a real monetary outcome. Even though this assumption is often empirically questioned in entrepreneurship (see Weber Et Al, 2002) it is strongly theoretically supported by the widely known axiom of non-satiation, which posit that individuals always prefer a higher monetary outcome whenever possible. Weber & Milliman (1997) adopted money games to explore behavior in a dynamic decision environment represented by different risky investments. The sample of MBA students, after receiving an initial endowment, was asked to choose between six different risky investments in multiple rounds. Information and payouts were widely available to participants during the experiment. Results showed the central

role of risk perception in driving behavior in such a dynamic environment and the stability of risk attitudes. Authors suggest that the differences in risky choices by individuals should not automatically be interpreted as the result of changes in people's preferences for risk, but may also, at least partially, be the result of changes in their perception of the risks due to outcome feedback. A different paper in neuroscience by Huettel Et Al (2006) also used money games to investigate risk perception in individuals. Authors asked subjects to make decisions between two alternatives. The composition of such alternatives was random and contained three different types of gambles: certain, risky and ambiguous.

In this study, parameters for subjects' risk and ambiguity preferences were estimated with their history of choices in both functional magnetic resonance (fMRI) scanning and classic behavioral sessions. Results suggested that the mechanisms that support risk and uncertainty perceptions in humans are separate, as different areas of the brain activated during decision making. If these results would be confirmed with a sample of entrepreneurs, it would be of great importance to test which areas of the brain are activated during decision making and how these activations are different from non-entrepreneurs.

Advantages and disadvantages of money games

Money games possess great advantages when it comes to operationalize variables that deal with risk attitude and risk perception. Risk-return models and expected utility theory need an objective assessment of individuals' willingness to pay and utility respectively and both are based on the assumption that individuals indicate realistic choices in experiments. The presence of real payouts increases the level of reliability of choices that subjects make and help explaining their real behavior as a result of two mechanisms. Focus on tasks is increased due the performance effect on payoffs (De Martino Et Al, 2006) and through a better understanding of the tasks to be performed by individuals. Money games usually have a simple structure with gambles that are easily understandable in order to minimize the effects of complexity on decision making and maximize the role of behavior. The use of neuroscience tools (such as fMRI) can strongly help the internal and external validity of behavioral results obtained from money games. This is due to the additional information on perceived risk coming from brain scanning, providing an "ex ante" explanation of individuals' behavior (Mitchell Et Al, 2007). For example, research in neuroscience has confirmed the hypothesis that risky choices are a result of a dual-processing system in the brain, where risk and uncertainty perception are functions of separate activities in brain areas (Huettel Et Al, 2006)

The advantages of using money games are usually counterbalanced by disadvantages in entrepreneurship and this has strongly limited their use. Possibly the most important disadvantage of using money games is the hard-to-explain theoretical linkage between behavior observed and the subjective payoff levels that scholars use. In practical terms this means that it is hard to support theoretically a strong generalization of results coming from money games. A concrete risk

when dealing with money games is the possibility of choosing a wrong level (usually too low) of payoffs for the sample investigated. This is possible not only when monetary resources are scarce for working on a large enough sample, but also when trying to assess the monetary incentives needed for making entrepreneurs participate and behave naturally in an experimental setting. Entrepreneurs often find themselves evaluating opportunities based on the relative importance of investment needed to fund the venture, the variability in the expected anticipated outcomes, and any potential loss which may entail such investment (Forlani & Mullins, 2000). Even though all these elements are usually impossible to account for when evaluating an opportunity, they all influence risk perception. For these reasons, low levels of stakes involved in money games make the problem of measurement even more relevant as they don't capture the real influence in perception nor the complexity of entrepreneurial behavior (March & Shapira, 1987). For example, in some cases, despite games contained decisions on substantial endowments (e.g. 100k dollars), the real mean payoffs that individuals could obtain due to these decisions were almost irrelevant (17 dollars was the average payoff in Weber & Milliman, 1997). As expected, this is due to the tradeoff between working with a large sample and low payoffs, and working with a relatively small sample with more realistic payoffs (Simon Et. Al., 2000). As a further evidence of the care scholars need to use when generalizing results coming from money games, Weber et al . (2002) found that the decisions adopted for monetary gambling reflected real-world investment decisions far worse than assessed risk-taking for investment decisions, even though both were about monetary returns (Weber & Johnson, 2008).

3.2 Risk perception measurement in Entrepreneurship: hybrids

There is a tension in entrepreneurship research between money games and scenario based questionnaires. Which one of the two is best suited to capture risk perception? Or when should we use one or the other? On the one hand, complexity is always present in entrepreneurial decision making (Busenitz & Barney, 1997). Furthermore, money incentives alone cannot explain entrepreneurial behavior through the moderating effect of risk perception (Simon Et Al, 2000; Weber & Johnson, 2008). Both these reasons have provided support for the use of scenario based questionnaires in entrepreneurship. On the other hand, scenario based questionnaires have been plagued by biases and low predictive power in explaining risk perception (Stewart & Roth, 2001). Behavior on task is more easily captured by money games than scenario based questionnaires.

To solve this tension, scholars in entrepreneurship started using a mixed approach between money games and scenario based questionnaires. We propose here a new categorization of these games, calling them hybrids.

A hybrid design refers to the inclusion of money games in scenario-based questionnaire designs but without the presence of any real monetary payoff for individuals. The focus of studies using such a methodology is to address the tradeoff between an acceptable level of complexity in the

Table *3*

Methodologies used to capture risk perception through money games and hybrids.

Instrument	Authors	Results
Money games (with payouts)	Weber & Milliman (1997)	Choices in a dynamic decision environment that involves repeated decisions and continuous outcome feedback can be attributed to changes in risk perception.
	Huettel Et Al (2006)	The mechanisms that support risk and uncertainty perceptions in humans are separate and due to different areas of the brain activated during decision making.
Hybrids (no payouts)	Cramer Et Al (2002)	Entrepreneurship is discouraged by the individual degree of risk aversion as data suggests that entrepreneurs are less risk averse than non-entrepreneurs.
	De Martino Et Al (2006)	Behavioral results indicate that subjects' decisions are affected by framing manipulation of gambles, with subjects being risk-averse in the gain frame and risk-seeking in the loss frame

scenarios presented during the experiments and a more objective evaluation of behavior when individuals face monetary risky choices. With a hybrid design scholars aim to capture a more realistic behavior of individuals, overcoming the difficulties of the other two methods (e.g. a large sample can be used as individuals do not need to be paid, questions are hardly misunderstood with money games). Table three presents a comparison between money games and hybrids based on payoffs differences. Cramer Et Al (2002) used a hybrid methodology finding a negative impact of risk attitude on individuals' self-selection in entrepreneurship. Methodologically, the authors derived from utility theory an empirical measure of absolute and relative risk aversion by asking individuals their reservation price (WTP in risk return models) when facing a lottery. In neuroscience, De Martino Et Al (2006) provided a further empirical validation of prospect theory: after receiving an initial endowment, participants were asked to choose between a "sure" and a "gamble" option (with equal expected value) presented in the context of two different frames

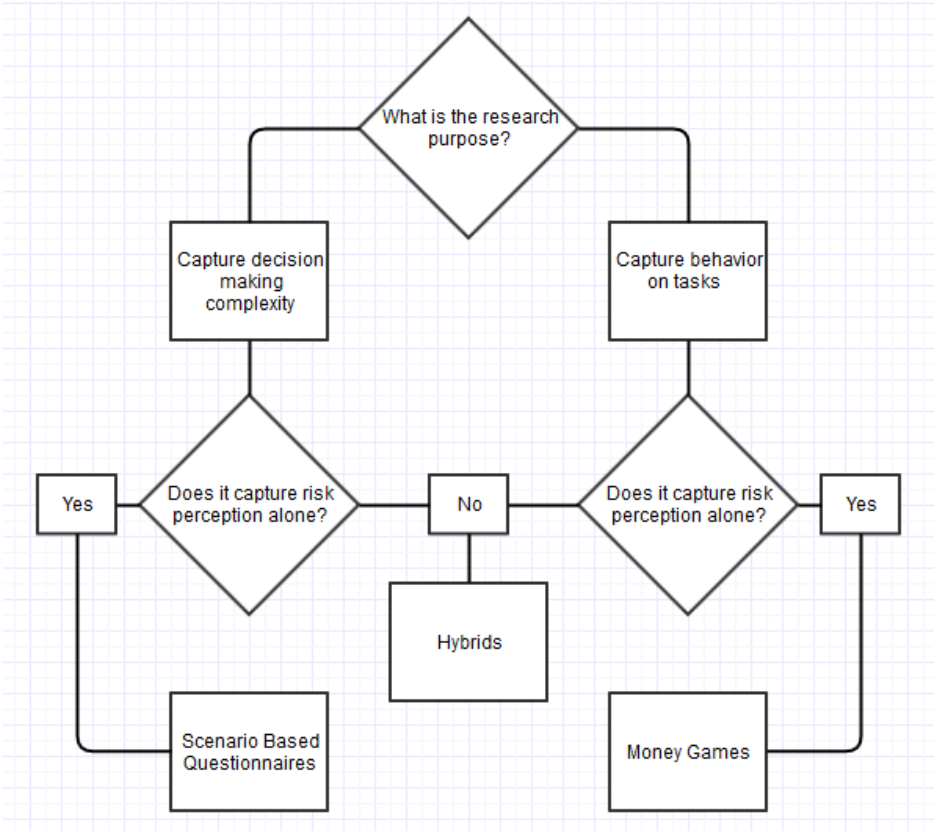
(Gain frame or Loss frame). In this case, the behavior of subjects was the relevant variable to measure and therefore only pie charts for visualization ease were provided instead of a case.

Being somewhere in between two designs, hybrids possess some of the advantages and some of the disadvantages of the two. Therefore, when compared to money games and questionnaires, it cannot be considered as a superior design. In general, what makes a hybrid a very useful (and differential) design is the possibility of addressing two different types of research aim (exploring complexity in decision making and observed behavior in risky gambles) keeping the flexibility and lower costs of a questionnaire. The main disadvantage relies in the difficulties for experimenters to cope with the drawbacks of having a money game structure with no payoffs and a questionnaire structure with complex questions compared to gambles.

4. CONCLUSIONS: HYBRIDS FOR FUTURE ENTREPRENEURSHIP RESEARCH

The first purpose of this paper has been to review methodologies used to trigger entrepreneurial behavior in a variety of settings involving risk and uncertainty. Even though risk can be modelled so that objective criteria describe them, it is indeed individuals' perception the variable that plays a key role in determining behavior in different risky situations.

Figure 1
Entrepreneurial behavior research through risk perception: a design map (read from top to bottom)



In entrepreneurship, individuals have to face risk and uncertainty on a daily basis in their decision making and often rely on bias and heuristics (Busenitz & Barney, 1997): risk models had to be adapted in order to measure behavior in a methodologically accurate way. In this respect we have identified three types of methodological designs: money games, scenario based questionnaires, and hybrids.

The second purpose of this paper has been to suggest the use of games in specific settings. After looking at their advantages and disadvantages, it is suggested that the use of either questionnaires or money games to measure risk perception would be dependent on different aims: behavior on tasks or complexity (see figure one). Hybrids would suit best the context of entrepreneurship as both the research aims co-exist in entrepreneurial decision making. On the contrary, in psychology and economics risk perception can be captured by looking at complexity or behavior on tasks only. We suggest that the use of hybrids has to be carefully managed, especially when designing the games. Sample selection (students or entrepreneurs) and the research question focus (behavior or complexity) have to drive the balance between the scenario length and the money games structure included in the hybrid.

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