

# **Entrepreneurial opportunity decisions under uncertainty: Recognizing the complementing role of personality traits and cognitive skills**

**Emmanuel Kwasi Mensah**

Department of Economics

University of Insubria - Varese, Italy

[ekmensah@uninsubria.it](mailto:ekmensah@uninsubria.it); [emensah@unito.it](mailto:emensah@unito.it)

**Lawrence Adu Asamoah**

Department of Economics

University of Insubria - Varese, Italy

[laduasamoah@uninsubria.it](mailto:laduasamoah@uninsubria.it)

**Vahid Jafari Sadeghi**

Department of Management

Univeristy of Torino, Torino-Italy

[Vahid.JafariSadeghi@unito.it](mailto:Vahid.JafariSadeghi@unito.it)

## **Abstract**

Entrepreneurship research on decision making under uncertainty has focused largely on the effect of uncertainty on the entrepreneurial actions while attempt at the individual level particularly, from the cognitive framework seeks to explain why actions differ. Scholarly efforts have also been made on what informs entrepreneurial actions from the perspective of the entrepreneur's personal attributes. However, no integrated approach is offered in the literature to study how cognitive skills and personality traits complement each other. In this paper, we consider how cognitive skills and personality traits affect an entrepreneur's decision to discover or create opportunities under uncertainty. Specifically, we examine the complementary role of personality traits and cognitive skills towards opportunity decisions. We provide a conceptual basis for a broader perspective on behaviors and cognitions that motivate or hinder entrepreneurial actions while at the same time positioning the entrepreneur's decision at the core of the decision theory. Propositions regarding the application of some selected personality traits and cognitive skills and their complementarity are presented and discussed.

## Introduction

Entrepreneurial decisions on opportunities under uncertainty are at the core of entrepreneurship studies. The decision to discover or create opportunity and taking the corresponding action to exploit them drive market processes and the fulfillment of social and economic needs. In this regard, an entrepreneurial decision under uncertainty defines the boundary and exchange conditions under which individual decision may yield fulfilling outcomes (Short, et al., 2010). The literature conveys different decision styles towards opportunity creation or recognition which most crucially involve the nature of the entrepreneur and his cognition and to a broader spectrum, the biological building block including genetic factors of the entrepreneur Nicolaou & Shane (2010). Mostly, action taking under uncertainty encompasses personality traits or behavioral processes and cognitive skills as well as some heuristics. Cognitive processes that enable “entrepreneurs to use simplifying mental models to unify previously unconnected information that help them to identify and explore opportunities” have been a critical focal point in decision making. Heuristics and cognitive biases, albeit overconfidence and representativeness (Busenitz & Barney, 1997; Kahneman & Frederick, 2002), counterfactual thinking, affect infusion, alertness schema and pattern recognition (Baron 2004; Gaglio & Katz, 2001) and effectuation process (Sarasvathy, 2001) have all been explored as probable strategies used by entrepreneurs to reach acceptable decisions. However, while much of the entrepreneurship literature had previously viewed opportunity as something enacted, thus suggesting personality traits (Short, et al., 2010; Kerr, Kerr, & Xu, 2018) and while a growing number of scholars in recent times view opportunity from the cognitive perspective (Gregoire et al., 2011), there seem to be a conspicuous lack of studies on the complementary role of these two pillars of the literature strands. Indeed, the two should combine, albeit other factors such as information corridors to demystify the understanding on why some people but not others decide to discover and profitably exploit opportunities (Shane & Venkataraman, 2000)

Recent constructs by McMullen and Shepherd (2006) which assessed the link between entrepreneur action and the role of uncertainty, revealed that the entrepreneur’s perception of uncertainty and willingness to bear such uncertainty are the divisive components that separate the entrepreneur’s actions from his inactions on entrepreneurial opportunities Garrett & Holland (2015); McKelvie, Haynie, & Gustavsson (2011); McMullen & Shepherd (2006). In analyzing the role of emotions on investment decision under uncertainty, Brundin & Gustafsson (2013) demonstrated that emotions played a significant role in the entrepreneur’s decisions to continue or discontinue investment under uncertainty. They noted that personal attribute such as self-confidence and hope magnify the entrepreneur’s propensity to invest under high uncertainty whereas frustration and embarrassment decrease the entrepreneur’s predilection to invest in the presence of high uncertainty. In the same vein, Hansen et al., (2016) proposed a model that provided a unified account of different ideologies on opportunity discovery and creation, making

it much easier to identify critical elements that matter for decision making on opportunity outcomes. Hansen et al., (2016) were only able to describe the effect of uncertainties as occurrences that are detrimental to the actions and subsequent decisions of the entrepreneur. As to why and how certain actions are taken on opportunity decisions in an uncertain environment were narrowly discussed to bring a profound generalization of the issue. While their contributions have been profound to entrepreneurial research on attitudes and behavior, the synthesis between personality traits and cognitive skills remain scant for decision making under uncertainty. We address this gap by studying the complementary relationship between personality traits -self-confidence, ambiguity aversion, locus of control and cognitive skills – alertness to schema, tacit knowledge, counterfactual thinking, while addressing distinctively the implication of each on opportunity decisions under uncertainty. To the best of our knowledge, this paper is among the only few if there is, which situate entrepreneurial opportunity recognition or creation in the context of decision making under uncertainty.

To sum it up, the objective of this paper focuses on advancing the entrepreneurial literature by enhancing the understanding of the connections between personal behavior and cognitive skills in decision making under uncertainty. While prior studies focused on the implications of the cognition and individual personality attributes of the entrepreneur, less emphasises have made on the relationships between cognitive skills and personality attributes. We ask: do some entrepreneurs use cognitive skills differently and do those skills lead to opportunity decisions through enhancing the personality traits? More specifically, are the personality traits of the individual differently influenced by how well their cognitive is best put to use in an unexpected environment? For instance, will the ambiguity averse entrepreneur be more alert to opportunity discovery when he has developed his alertness to schema? On the other hand, will a poor cognitive skilled individual be able to decide on opportunities in time if such individual possesses good personal attributes to achieve entrepreneurial success as put forward by McClelland (1987)?. Developing propositions to argue on these questions, we believe that if we can answer them, we will be better positioned to understand further the “why” and “how” questions (Simon, Houghton, & Aquino, 2000; Baron, 2004) on how some individuals are able to recognize or create opportunities in complex environment while others cannot even when high cognitive skills or strong personal attributes for success are considered.

The next portion of this study is used to review themes on decision making under uncertainty. We review the entrepreneurial uncertainty and argue that entrepreneurs are not bound to the strictly normative reasoning of the rational choice theorist or the prescriptive argument of the psychological and behavioural economist; instead they switch on rationalities, using heuristics and biases built on their cognitive skills and personal attributes including available information to make opportunity decisions. This view motivates our contribution on the complementary role of the personal and cognitive skills. The method used for this research is

discussed in the next two sections. We finally engage on a discussion of the views expressed in this paper and make conclusion and suggestions for further research in the future.

## **Literature review**

To position the entrepreneur decision at the center of the decision theory, we focus on the review of distinct streams of the literature on decision making under uncertainty. Specifically, we build on the following strands of the literature; (1) the entrepreneurial uncertainty, (2) rational choice theory, (3) bounded rationality-heuristics and biases, and (4) the role of information in uncertain decisions. Given that the second strand provides the normative understanding of decisions under uncertainty from the economic perspective (Savage, 1954; Scott, 2000) and third strand describes the prescriptive reasoning from the psychological and behavioral economist perspective (Simon, 1957; Kahneman & Tversky, 1979; Gustafsson, 2009), we believe that such review will draw home understanding from not only from the historical antecedent but also how the entrepreneurial decisions differ from some psycho-economic theories of decisions under uncertainty.

### ***The Entrepreneurial uncertainty***

Knight's (1921) work on *risk, uncertainty, and profit* describes risk as a situation or game that can be known with certainty through measurable probability whereas uncertainty as having no measurable probability or likelihood of occurrence. The former depicts some degree of uncertainty that is quantifiable, and which can be avoided or the entrepreneur adjusting by reducing his exposure to it. By Knight's reasoning, only the latter rather than the former is essential to explaining the nature of competition and profit and only through it can it be possible for entrepreneurs to supersede the normal returns associated with equilibrium in competitive markets. Because entrepreneurs cannot prevent uncertainty neither can they insure against it, they are characterized by their aversion or tolerance towards it (Amit et al., 1993). Moreover, the uncertainty type manifested eventually determine the entrepreneur's actions and decision policy (Milliken, 1987; McKelvie et al., 2011). Research shows that entrepreneurs attach different attitude to different uncertainty levels with regards to decision making (Brundin & Gustafsson, 2013) The uncertainty can be perceived as mild, severe or absolute depending on the available information<sup>1</sup>. Mild uncertainties may pose intangible effects on the decisions of the entrepreneur and hence manageable. However, severe uncertainties may create difficult situations for the entrepreneur in discriminating between relevant and irrelevant information in the presence of a foreseeable opportunity.

---

<sup>1</sup>Makridakis, Hogarth, and Gaba (2010) similarly consider these uncertainties as subway, coconut and black swans uncertainties.

As noted in McKelvie et al. (2011) the specific kind of entrepreneurial actions, however, may depend on the nature of uncertainty, mostly influenced by the level of information asymmetry Petrakis & Konstantakopoulou (2015). In regard to the fact that the entrepreneur bears the sole responsibility for unmasking the uncertainty towards making such pertinent opportunity (McMullen & Shepherd, 2006), understanding the nature of uncertainty present ways to delineate them to match one's decision. In this sense, we can argue that the nature of uncertainty plays a significant role in entrepreneurial decisions. It is important to note that, these uncertainties are moderated by the availability of information. Kirzner (1979) suggest that information asymmetry is the revolving factor to market disequilibrium and opportunity recognition, and complete knowledge about the environment balances entrepreneurial decision. Therefore, means of handling certain uncertainties using private information, tacit knowledge and cognitive biases are treated as private resources by entrepreneurs to have a comparative advantage over competitors. In most instances, opportunity seeking entrepreneurs are able to handle uncertainties proficiently, differentiating between risky investments to reach a desired goal/outcome.

### *Rational choice theory*

The normative reasoning implied by the rational choice theorist follow the idea that all human actions are rational in character motivated by want or goals that give optimal satisfaction. Individual decisions must be optimal, decisions ought to follow certain mathematical axioms to be rational, individuals are portrayed as economic agents who are fully 'rational minimizers' of subjective utility Gigerenzer & Selten (2002). The rational choice theory attempts to explain decision behavior according to the assumption of utility maximization based on a selfish or altruistic preference (Neumann & Morgenstern, 1944; Scott, 2000; Moscati & Tubaro, 2011) while its theorist holds the view that people evaluate risky and uncertain prospects by comparing their expected utility values. One of the popularly used yet well criticized for its non-practical axiomatization in human decisions is the Subjective Expected Utility (SEU) popularized by Savage (1954). Savage's SEU describes how individuals make decisions under uncertainty in a fascinating way by reducing the whole decision spectrum into a common set of primitives; probability, utility, and options (Fischhoff, Goitein, & Shapira 1981). Under these primitives, the individual has the option to assign a probability of desirable outcomes (utilities) before making decisions. In other words, individuals are considered as identifying an alternative course of actions, anticipating their outcomes and calculating that which is best for them. Rational individuals select the optimum alternative that gives the best satisfaction (Scott 2000).

However, such rationality is largely incompatible with the kind of information, the computational capabilities of the individual and the environment ( Simon, 1957; Gigerenzer &

Selten, 2002). As contended in literature from the behavioral economists and entrepreneurial point of view, people behavior in the context of complex social phenomena and uncertain environment can be rational or irrational. Behaviors are perceived to be random in nature and diverge from rational choice theory more radically (Moscati & Tubaro 2011). As a result, the rational choice theory may not conform to random behaviors of people in general when presented with uncertain choices. For instance, Ellsberg's famous paradox demonstrates that decision makers and investors faced with uncertainty may not make choices consistent with the SEU but with ambiguity aversion to choices whose likelihood they have confidence in. In the entrepreneurship literature, the view is quite different. The conventional framing of rationality applies perhaps to opportunity discovery since opportunity discovery calls for a rationality that informs the search process, - discovery, evaluation and exploitation, that present an expected outcome on opportunity (Kirzner (1997). Miller (2007) studies show that on the contrary, such rationality may be counterintuitive to opportunity recognition and discovery. This is because, entrepreneurs engage in distinct entrepreneurial process and the concept of rationality if any fails to be characterized with the creative process of the entrepreneur. Recounting further from Knight's experience on rationality, which of course is different from the rational choice theorist view, a rational response to uncertainty may be to reduce it to risk if it is possible to avoid. In this framework, rather than one focusing on only market profit, an effectuation logic must be applied, in this case according to Sarasvathy (2001) by taking decisions based on affordable loss or acceptable risk.

### ***Bounded rationality: heuristics and biases***

Because, there are naturally no such unlimited human resources such as unlimited cognitive capabilities, unlimited information and of time, 'heuristics and biases' instead make up a residual category for deviations from rationality as defined by expected utility theory. According to Simon, individual's cognitive abilities are limited and so decision making becomes a search process that would lead to satisfactory result guided by aspirations (Simon, 1957; Gigerenzer & Selten, 2002). Therefore, by arriving at such satisfying decisions, people are not seen as irrational but rationally bounded by the conditions in which they find themselves. Entrepreneurs particularly do not follow normative theories as their preferences are highly inconsistent even in a situation involving no risk or uncertainty. In making decisions bounded by constraints, entrepreneurs use heuristics and biases based on their adaptation to experiences, skills, psychological plausibility and the structure of the environment. Known as an adaptive toolbox<sup>2</sup>, such tools consist of cognitive

---

<sup>2</sup> The adaptive toolbox offers a bounded rationality decision based on a collection of heuristics, psychological plausibility and adaptation to the structure of the environment. See Gigerenzer and Selten (2002), p. 37 – 41 for more insights.

abilities - set of rules (search, stop, decide) and specific domain heuristics used in achieving proximal goals.

Heuristics and biases study how decision makers, in this case entrepreneurs employ subjective opinions and cognitive mechanisms used in decision making especially in the complex and uncertain environment. For instance, heuristics types such as availability, representativeness and base-rate fallacy, illusion control (Kahneman & Frederick 2002) are commonly used in literature and largely employed by entrepreneurs in decision making. Besides, people who are more prone to use heuristics and biases during decision-making process because of the complexity of the decision environment are more likely to become entrepreneurs (Busenitz & Barney, 1997). The heuristics and biases decision framework takes the SEU model of rationality as the counterfactual for comparison purposes, stretches on the descriptive alternative—but not a normative alternative to decisions under uncertainty (Miller, 2007). While they are very useful to opportunity decisions, they are much dependent on the entrepreneur in question. Entrepreneurs with greater cognitive skills are more probable to construct cogent heuristics towards opportunity decisions than those with lower cognitive skills. In the sections that follow, we demonstrate how some personal behaviors and cognitive skills shape these heuristics and motivate or otherwise prevent the entrepreneur from making opportunity decisions in a complex environment.

### *Role of information in uncertain decisions*

Shane & Venkataraman, (2000) assert that the information necessary to recognize opportunity are not evenly distributed because of its specialization in society. In their celebrated paper, they termed this as 'information corridors' in which human beings possess different stock of information which influence their ability to recognize certain kind of opportunity. The decision environment is thus affected by the availability of information which explains how certain people are able to recognize opportunities that others cannot identify. Available information creates mental schemas, which provide a framework for recognizing new information that triggers an entrepreneurship conjecture (Shane & Venkataraman, 2000; Koellinger et al., 2007). Entrepreneurs tolerance for ambiguity, risk-taking propensity, confidence level, and confirmation bias are all contingent on the weight of evidence-informed by the information at hand. Information asymmetry is important to the success of young entrepreneurs. Recent research on entrepreneurship have suggested that many entrepreneurs would change certain earlier decisions if they had additional relevant information prior to their decision. For instance, for failed new venture owners who took risky action based on very limited information but for overconfidence and illusion control (Zacharakis & Shepherd, 2001; Koellinger, Minniti, & Schade, 2007), additional and relevant information might have saved their short span failed ventures (Simon, Houghton, & Aquino, 2000).

Because, uncertainty is characterized by unknown or limited information, the entrepreneur is unable to anticipate any changes in the environment from which opportunities are generated (McKelvie et al. 2011; Milliken 1987). However, since uncertainty is the main construct under which innovation, profit, market equilibrium and allocation of resources are made information discovery and processing become an important concept in the creation of opportunities (Amit et al. 1993; Kirzner 1979; Knight 1921). As noted by Kirzner (1979), information asymmetry is the revolving factor to market disequilibrium and opportunity recognition. In this sense, information asymmetry forms the synthetic barrier between the rational theorist decisions, which assume full access to information, and the entrepreneurial decisions. While, the former is constructive and formalized on probabilities deduced from given information, the latter is heuristically indeterminate.

## **Research methods**

Our primary purpose is to identify some personality traits also referred as behavioral and cognitive skills entrepreneurs use in their opportunity decisions under uncertainty and further examine the complementary role these two pillars in the entrepreneurship research have on each other. We adapted the framework used by Garrett and Holland (2015), who developed propositions from the conceptual narratives of how environmental uncertainty and complexity differentially affect the motivations and cognition of independent entrepreneurs and corporate entrepreneurs to engage in entrepreneurial action. By examining the personal traits and cognitive skills of entrepreneurs, we construct a theoretical framework via propositions to explain how the creation or discovery of opportunity under uncertainty are affected by traits and skills and why recognizing the complementing role of the two is crucial for the entrepreneur's decisions.

To provide a complete overview of the entrepreneurial decisions under uncertain, we began with the basic concepts of uncertainty in entrepreneurial decisions and its antecedents from the literature, encompassing psycho-economic theories. Decisions under uncertainty following the normative and prescriptive reasoning from the rational theorist and behavioral economist yield optimal decisions and satisfying decisions. However, they are rarely what entrepreneurs rely on to make decisions on opportunity. In this regard, the goal of the literature review was to explain how those psycho-economic theories differ from the former's approach. Moreover, since the main goal of this paper in analyzing the entrepreneurial opportunity decisions under uncertainty is to identify the complementing role of personal traits and cognitive skills distinctively discussed across the literature, a conceptual model which divides into personal traits and cognitive processes is adopted as the framework from which propositions are developed.

Across the literature, different number of elements under these two strands are discussed (see McMullen and Shepherd, 2006; Short, et al., 2010; Shane & Venkataraman, 2000; Hansen et al., 2016). For instance, typical in the cognitive processes category includes elements such overconfidence and representativeness (Busenitz & Barney, 1997; Kahneman & Frederick, 2002), counterfactual thinking, affect infusion, alertness schema and pattern recognition (Baron, 2004; Gaglio & Katz, 2001) and effectuation process (Sarasvathy, 2001) which are all suggested as simple strategies used to reach acceptable decisions. On the other hand, elements in the personality traits category involve person – opportunity nexus (Shane & Venkataraman, 2000) and they include self-confidence, hope and emotions (Brundin and Gustafsson, 2013), self-efficacy and innovativeness, need for achievement (Kerr et al., 2018) and ambiguity seeking (Eichberger et al., 2012) among others. Although there are dozens of these traits and skills of the entrepreneur discussed in the literature, this paper focused on the main cognitive skills and personality traits which are most essential for decisions on opportunity discovery and creation. Figure 1 illustrates the conceptual model used. The model samples three main elements of personality traits: - self-confidence, ambiguity aversion and locus control; and cognitive skills: - alertness to schema, tacit knowledge and counterfactual thinking. It is importance to focus on these few because this study is to determine how these traits and skills complement each other in uncertain environment. The research papers selected for this study therefore focused on the main theme. Papers which drew attention to decision entrepreneurial decisions and the broader decision theory, past and old were used to solicit for vital view that could be used to build argument. Because many of our strong argument needed papers that were published in peer-reviewed journals, we did not include the papers that were not peer-reviewed even though useful.

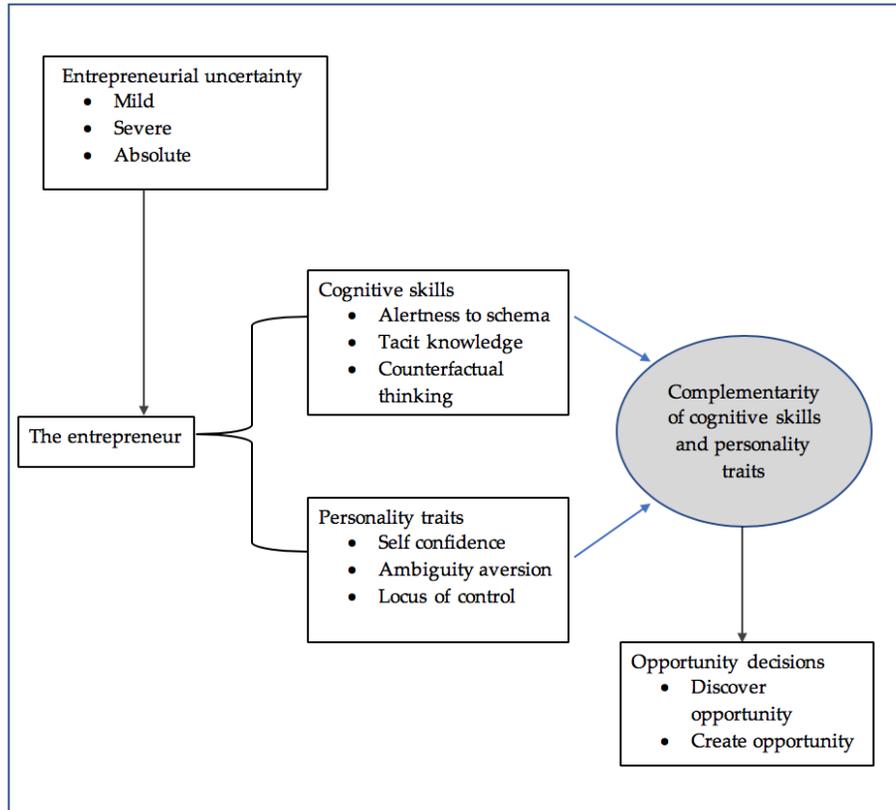


Figure 1. Conceptual model

### **Personality traits and cognitive skills in entrepreneur decisions under uncertainty**

Until recently, prior studies have presented the entrepreneurial personality as the key component of new venture formation and the reason for diverse decisions on opportunities (Shane & Venkataraman, 2000; Mitchell et al., 2002; Jafari Sadeghi & Biancone, 2017). As the unique set of personality traits and differences in psychological and demographic characteristics became difficult to comprehend, studies on decision making shifted focus towards the epistemological difference, informational access and environmental complexities of the entrepreneur. Most of these studies have particularly focused on the cognitive skills of the entrepreneur (Baron, 2004; Busenitz & Barney, 1997; Gaglio & Katz, 2001; Simon et al., 2000). Notwithstanding, who an entrepreneur is, what defines and drive them and how they manage what they do requires an unblemished analysis of the past and recent views of the entrepreneurial opportunity decisions. In this paper, we mostly focus our discussion on both personality traits and cognitive skills that present the entrepreneur with simple mental models towards decision making under uncertainty. We argue in this paper that broad discussion should be focused on the complementing role of

traits and skills towards the decisions on opportunity of the entrepreneur rather than one sided argument or distinct view of the two.

### ***Personality traits towards opportunity decisions under uncertainty***

#### *Self-confidence*

In his article titled "Characteristics of successful entrepreneurs", McClelland (1987) employs a critical realist perspective to understand the personality traits of successful entrepreneurs. His observation demonstrates that self-confidence is among the competences and principal characteristics of successful entrepreneurs. This provided a helpful understanding of the way personality traits such as one's self-confidence contribute to entrepreneurial decision making under uncertainty. The support for this positive relationship is strong both theoretically and empirically. For instance, Schumpeter (1961) postulates show that such motivation drove the will and actions of entrepreneurs to eventually overtake incumbent market leaders (in the sense of creative destruction). This notwithstanding, Bandura's (1997) theory of self-efficacy, which is rooted in social behavioral theory, validates a positive association between self-confidence and entrepreneurial outcome through the thoughts and behavior of the entrepreneur. In a related theory, though not in the entrepreneurial field, Vealey (2001) found a positive relationship between self-confidence and sports performance. Although, majority of prior studies found support for this line of argument, there exist some notable exceptions such as Zacharakis & Shepherd (2001), Hardy, Woodman & Carrington (2004) and Koellinger et al. (2007) who found negative association between self-confidence and performance. One possible explanation for such findings is that high confidence can lead to risk-taking and/or complacency which in turn may impede entrepreneurial decision under uncertainty. However, McMullen and Shepherd (2006) emphasize that if the entrepreneur is pushed by his self-confidence to overcome his doubt beyond a potential cost envisaged, then the entrepreneur's actions will be actualized. Thus, we propose that,

**Proposition 1:** *A higher self-confidence or self-efficacy of the entrepreneur will drive the willingness to bear uncertainty and make uncertain decisions on opportunities.*

Regarding this proposition 1, there is the need to draw a thin line between known self-confidence and over-confidence as a prudent measure to avoid inaccurate decisions. Although entrepreneurial confidence is desirable, overconfidence, on the other hand, create a bias that affects the accuracy of decisions. Busenitz & Barney, 1997; Koellinger et al., 2007; Zacharakis & Shepherd, 2001). Usually, for novice entrepreneurs and new venture founders, overconfidence is pervasive; inaccurate market predictions and perception failures are highly probable. They either

show optimistic overconfidence or overestimation of their own knowledge (Busenitz & Barney, 1997; Zacharakis & Shepherd, 2001) and apparently reduce the need for thorough information required for decisions under uncertainty. Overconfidence is associated with lower metacognitive ability and positive illusions that undermines detailed process in decision making resulting in inaccuracies and poor result.

### *Ambiguity Aversion*

Entrepreneurs are predisposed to uncertainty in which they have to make judgments about a future they do not have control of. Relative to self-confidence and entrepreneur's choices to success, prior studies emphasize that entrepreneurs often are faced with ambiguous future that limits them from exploiting foreseeable opportunities under probabilistic judgments (Eichberger et al., 2012). In this way, ambiguity aversion rather than risk aversion becomes the main inhibitor of entrepreneur opportunity creation (Knight, 1921; Amit et al., 1993). Generally, ambiguity aversion can be an inherent character of the individual which may be invariant with the information required for decision making. For instance, an entrepreneur's willingness to start a business may entail ambiguity judgments in which information about the future is often incomplete. If the entrepreneur is to wait for such additional information to increase the success of the foreseeable opportunity, the opportunity would have passed (Simon and Houghton 2003; Ng 2013). To wit, unwillingness to act, make decisions in the face of uncertainty can discourage the entrepreneur from certain opportunity discovery and creation.

**Proposition 2:** *A high ambiguity aversion towards opportunity in a complex environment will deter entrepreneurial decision on the opportunity.*

A degree of belief informs the entrepreneur perception and psychological aspect of judgment. Subjective judgment formed as a response to an ambiguous future following inadequate information or the environment can worsen the entrepreneur tolerance towards ambiguity. In such instance, An unwillingness to act, make decisions in the face of uncertainty can discourage entrepreneurs from certain opportunity discovery and creation (Bhidé (2000).

Sarasvathy (2001) contend that entrepreneur's often have to undertake economic decision in which the success of the future of their businesses are dependent on leveraging the firm's internal resources with the resources of external stakeholders (Harvey, Ng, and Klein 2015). Notwithstanding, such complexities in the presence of limited resources increases the difficulties of assigning causes of success and failure, and since, the establishment of cause and effect can present difficult situations to the entrepreneur, finding an associated source of performance may be highly ambiguous, in which impreciseness may be eminent in the entrepreneur's decisions

(Ng 2015). An ambiguity seeking entrepreneur may see ambiguity as an opportunity than a threat and such a view of uncertainty, according to Begley and Boyd (1987) may indicate a positive relationship with the financial performance of the venture. For instance, experienced entrepreneurs may draw on existing knowledge to evaluate the ambiguity surrounding future prospects of their businesses. This is because the experienced entrepreneurs exhibit greater knowledge of the causes underlying their subjective probabilities, they may place greater emphasis on their subjective view of the opportunity not only because of its probabilistic success, but because they have their previous experiences bound to the subjective views. Thus, experienced entrepreneurs tend to act on their own personal judgments than consulting on objective probability judgment which they may perceive unreliable (Dew et al. 2009). The implication of this complexity demonstrates that when making judgments to exploit opportunities, causal ambiguities may play a significant role in undermining the belief held in one's probabilistic judgments.

#### *Locus of control*

Locus of control is a very important personality trait in shaping how an individual perceives the environment. It relates to the generalized belief that the outcome of an action is contingent on one's own behaviour or the outcome is a function of external forces or environmental features that cannot be influenced (Rotter, 1990; Kerr et al., 2018). Both internal and external locus of control exist to characterize people on entrepreneurial opportunity decisions under uncertainty. People with internal locus of control believe that event in their lives, both achieving success or avoiding failure on new ventures are due to their own decisions, efforts or action. They, therefore, show capabilities, willingness to learn and pursue courses that will enhance their knowledge to influence the outcome of their environment (Asante & Affum-Osei, 2019). In contrast, people with external locus of control find the success of a new venture to be result of uncontrollable forces (Yan, 2018; Kerr et al., 2018). They perceive event in life as the outcome of luck or chance and hence their ability to discover opportunities may be impeded by their belief in luck rather than effort (Asante & Affum-Osei, 2019). An in-depth examination of the entrepreneurship literature has identified locus of control, internally as one of the most dominant entrepreneurial characteristics and one that is a predictor of entrepreneurial intentions. People with a high level of perceived internal locus of control have been associated with entrepreneurial behavior and a preference for innovative strategies amidst complex environment while people with external or low internal locus of control are perceived with conservative behavior to creation or new business ventures (Wijbenga & van Witteloostuijn, 2007).

Studies have showed that founders of new businesses have more internal locus of control than owners who were not involved in start-up (Begley and Boyd, 1987; Yan, 2018). In their meta-

analysis, Rauch & Frese (2007) concluded that internal locus of control has a significant correlation with opportunity creation and the successful exploitation of the opportunity. An earlier study by Gürol & Atsan (2006) among university students also found that students who are entrepreneurially inclined have internal locus of control and higher need for achievement and innovativeness than students who are not entrepreneurially inclined. Across the literature, internal locus of control is thus observed to have motivational inclinations that make entrepreneurs more proactive and alert to entrepreneurial opportunities. In contrast, low internal locus control tends to be more passive. The support for this claim is given in Wijnbenga & van Witteloostuijn (2007) where it is hypothesized that external locus of control in dynamic environment have low degree of adaptiveness or responsiveness to environmental contingencies. It follows then that this belief makes them prefer low cost-strategies to business innovations. In simple terms, they fail to believe that they may be able to control business outcomes and actively change their environment (Rauch & Frese, 2007; Asante & Affum-Osei, 2019) which implies their failure to recognize opportunity even when it is obvious. The ability to induce decision on new venture and take full control and the responsibility for the business's outcome however requires entrepreneur who have higher internal locus of control and more positive attitude for opportunity creating, thus we summarize with the proposition that:

**Proposition 3:** *A higher internal locus of control will have a strong impact on the entrepreneur perceptions on (new) opportunity discovery or creation.*

### ***Cognitive skills towards uncertain decisions***

#### *Alertness to schema*

A schema is a cognitive structure of an evolving mental model that guides the individual in reasoning and processing of information for a specific task Gaglio & Katz (2001). They could be mental mode construct on market price differentials for which sensitivity and alertness could generate pure arbitrage opportunity. Such schemas can be role defined or event defined, and they demonstrate high performance and opportunity recognition by entrepreneurs who adopt them than those who do not (Baron, 2004; Garrett & Holland, 2015). Entrepreneurial alertness, in line with schema refers to an attitude of receptiveness to overlooked opportunities (Kirzner, 2009). In this regard, entrepreneurial alertness clearly assumes how individuals pay attention to details to mental mode construct. Complex schema structures interlinking each other provides the entrepreneur a projected view of environmental changes and quick corrections to deviation from known patterns. They could be mental mode construct on market price differentials for which sensitivity and alertness could generate pure arbitrage opportunity. On this, we could postulate that sensitivity to schema will lead to higher propensity to opportunity discovery.

**Proposition 4:** *Entrepreneurs who are sensitive to key characteristics of their schema will have a higher propensity to opportunity discovery and quicker ways to decisions under uncertainty than those who do not have.*

Alert entrepreneurs prompted by schema can reassess and react to changes in the environment so easily especially when seemingly unrelated changes in the external environment do not correspond to the current schema. Sensitivity and habitual activation of the schema can lead to the chronic schema Gaglio & Katz (2001), a situation which automates individuals to notice without search opportunities and market disequilibria. McMullen and Shepherd (2006) contend that cognitive and subjective differences between individuals allow some to have a more accurate projected view of changes in reality than others, and as a result, only such personalities can take appropriate entrepreneurial actions to correct deviations from known patterns within that reality. According to Valliere (2013) such entrepreneurial alertness can be said to arise from epistemological differences, where only some individuals know what to do. In this sense, the entrepreneur can make reasonable predictions of the future to plan new business moves at his advantage. For instance, successful product innovations are based on an entrepreneur's ability to recognize and develop new or unique resource combinations. Since alertness favors an intuitive decision processing, an entrepreneur's mental schema enables him to develop a detailed understanding of the unique ways in which the business's resources can be combined to achieve a greater outcome (Ng, 2015). It is roughly the case that entrepreneurs who are more likely to recognize patterns among a system of relationships and schemas are usually those who discover opportunities. This is also mostly the phenomenon with experienced since their experiences and developed schema offer a more nuanced understanding of their decision settings than in the case of novice entrepreneurs (Baron & Ensley, 2006).

#### *Tacit knowledge*

One of the greatest assets of the entrepreneur is his tacit knowledge formed through past experiences and logical understanding of related patterns of events in the past. Tacit knowledge identifies the entrepreneur with a set of epistemic tools under which coherent decisions can be made. Though the concept of tacit knowledge is difficult to visualize or parametrize given its subjective, personal and idiosyncratic nature, it is known to demystify future circumstances and induce information search regarding the decision to create or recognize the opportunity. When the decision environment is varied in different degree of uncertainties and lack of information, tacit knowledge provides an intuitive judgment on what actions must be taken (Ancori, Bureth, & Cohendet 2000; Spulber, 2012). From the cognitive point of view, the entrepreneur knowledge forms the basis for most of the biases made in uncertain decisions. Tacit awareness connects to

the uncertain external environment and induces a construct for schemata, alertness and meaningful patterns for the recognition of opportunities (McMullen and Shepherd, 2006; Kirzner, 2009). Johnson & Bock (2017) demonstrates that the formation of tacit knowledge over time result from accumulated prior knowledge which becomes valuable to the entrepreneur in making sense of the uncertainty in the environment. Prior studies including Kahtri and Ng (2000), Harteis and Gruber (2008) and (Baron & Ensley, 2006) also conclude that entrepreneurs who employ tacit knowledge are “mentally richer” in identifying and further deciding on opportunities whereas novice entrepreneurs may be denied those opportunities under uncertainty. To this end, the following proposition is clear to the concept of tacit knowledge:

**Proposition 5:** *Entrepreneurs who possess tacit knowledge that codify into information will be ‘richer’ in recognizing opportunity and deciding on opportunity creation.*

*Counterfactual thinking.*

Counterfactual thinking is a cognitive skill opportunity seeking entrepreneurs engage in when confronted in surprising or uncertain environment. It involves useful heuristic for developing educated guesses on the contrary to existing facts (Gaglio, 2004) and comparison of actual events to “alternatives that are constructed ad hoc rather than retrieved from past experience” (Kahneman & Miller, 1986, Arora et al., 2013). The imagination of ‘what might have been’ reflecting on alternative outcomes if the individual in question has taken different actions can produce a mixed pattern of both potentially beneficial and harmful effects (Roese, 1997; Baron, 2000). Individuals engaging in counterfactual thinking usually focus on imagined outcomes which are better than those they achieved and therefore produces feeling of regrets. While this may be the case as discussed in the cognition theory elsewhere (Landman, et al., 1995; Roese, 1997), the reserve implication is pervasive in the entrepreneurial literature due to its importance with respect to the process of causal inference—efforts (Baron, 2000; Gaglio, 2004)).

A positive emotional experience (Landman, et al., 1995), resulting from the relevant counterfactual thinking could result in new venture creation and strike a difference between entrepreneurs and non-entrepreneurs (Baron, 2000). Thus, we hypothesize that that relevant counterfactual will lead to opportunity discovery.

**Proposition 6:** *The relevant counterfactual thinking engaged by the entrepreneur will have a causal consequence on opportunity creation than those who do not.*

While we propose that counterfactual thinking will lead to creation of new entrepreneurial opportunities through positive emotional experience, we are most interested in how opportunity finders use counterfactual thinking. To examine this, we turn to use the argument established by Gaglio, (2004) and Baron (2004). Baron (2004) in particular argue that entrepreneurs are less likely

than others, since they may want to reflect on the future-oriented perspective than engage past guilt. This notwithstanding, using a sequence of propositions, Gaglio (2004) proposed that mental simulation and counterfactual thinking of the entrepreneur are mechanism through which entrepreneurs identify and develop innovative opportunities. Because counterfactual thinking is involved in the evaluation of the pursuit of goals, entrepreneurs are able to use it to construct models that correspond to conjecture and into the identification and discovery of opportunities. In a recent study, Karim (2017) found counterfactual thinking to influence the opportunity identification in entrepreneurial career intention. As further propounded in Gaglio, (2004) 'opportunity finders generate forward counterfactuals based on maintaining the unusual or unexpected event's, where as non-finders do not. It follows closely from Kirzners view that, alert individuals, are those who use counterfactuals they construct in order, albeit other mental mode construct to discover opportunities in unknown circumstances.

### ***Recognizing the complementarity of the personality traits and cognitive skills***

Persisting research questions in entrepreneurship encompass how decisions on opportunities are made under a complex and changing environment. Specifically, why some people but not others decide to discover and profitably exploit opportunities? why some people and not others succeed in new venture formation and why some entrepreneurs are more successful than others Baron (2004); Mitchell et al. (2002); Shane & Venkataraman (2000)? These questions underscore the differences among individuals in terms of their personality, biological make-up, and cognitive abilities. The general research on the collective understanding of the thinking process of the entrepreneur has gone beyond the single-insight individual paradigm to embrace access to information and cognitive abilities as the probable factors to discovering opportunities and partially answering the above-raised questions Mitchell et al. (2002); Shane & Venkataraman (2000).

We have earlier on made propositions which reiterate the role personal and cognitive skills play in the uncertain decisions on entrepreneurial opportunities. The importance of cognitive abilities emphasizes the significance of cognition as the divisive component to answering the 'why' and 'how' questions in entrepreneurship decision process (Baron, 2004). It includes all the processes that are cognitive in nature, such as recognizing, problem-solving or creative thinking, all of which take place within a person. The personal nature of the entrepreneur and his environment also represent an important understanding of 'why' certain decisions are made. These two complement each other in answering the 'how' and 'why' questions on opportunities under uncertainty. The significance of these bi-directional complementing effect to the entrepreneurial decisions under uncertainty manifested through the following propositions: (1)

personality traits are enhanced by cognitive abilities and, (2) cognition towards decisions are affected by the personality traits. We argue these propositions below:

**Proposition 7:** *Personality traits are enhanced by cognitive abilities.*

Theorizing from the given propositions, it is easy to recognize that entrepreneurs who have developed their cognitive abilities are adequately prepared mentally in their personal pursuit of profit to make decisions in an uncertain environment. Additionally, their perception and opinions are more influenced towards a positive desire to explore an opportunity when cognition is utilized in the decision process. For instance, entrepreneurs rich in tacit knowledge are enhanced with higher confidence to approach opportunities whereas poor thinking and problem-solving skills contribute to negative outcomes. Previous scholars attribute lower perception of risk and personal decision to start new ventures to cognitive abilities and biases (Busenitz & Barney, 1997; Simon et al., 2000). At the broadest level, these cognitive abilities induce a sense of capabilities – a personal enhancement to pursue opportunities. Cognition plays a central role in self-efficacy, self-confidence, and self-motivation. For example, tacit knowledge and entrepreneur alertness can induce an appreciable level of self-confidence needed to embrace decisions under uncertainty. There have been studies showing a positive correlation between cognitive abilities and personality traits notably of the five-factor model (Tuten et al., 2001; Rammstedt et al., 2016) and between personality and entrepreneurial outcomes (McClelland, 1987; Murnieks et al., 2015) which enhances the argument of role cognitive play in the development of some notable personality traits of the individual.

**Proposition 8:** *Cognition towards decisions are affected by the personality traits.*

Across the breadth of literature on psychology and organizational behavior, personality has been demonstrated to have an influence on several factors germane to prudent decisions Baron (2008); Rammstedt et al. (2016). The existence of the ability to construct schema and be alerted to it, combine task and evaluate decisions on opportunities can be understood to be the consequence of a moral firm and knowledgeable entrepreneur. The study of Rammstedt et al. (2016) established education as the correlation between cognitive abilities and one's openness as well as his emotional stability. It is therefore agreed that personality traits are instrumental in the development of intellectual skills Ackerman (1996) and mental structures. The extent to which one develops an alertness to schema, for instance, depends on his belief and perception of the world. Entrepreneurs who are highly ambiguity intolerant tend to relent on the effort to construct a schema for uncertain decisions. Such a negative view of uncertainty prevents broader cognition and heuristics to creativity and opportunity search. Furthermore, recent findings suggest that emotions, motivation, affect, self-confidence and fear can potentially override and "tip the balance

towards specific decisions” when the environment is uncertain (Baron, 2008; Brundin & Gustafsson, 2013; Dimov, 2007). Therefore, while the personality paradigm, in theory, maybe under-studied in recent works, it’s essential to cognition, the general entrepreneur behavior and decisions in the uncertain environment.

## **Discussion and conclusion**

The central task of entrepreneurship is the willingness to act on economic decisions to which information with or without certainty (Ng 2015). In real-world entrepreneurial decisions, entrepreneurs with balanced personality traits and cognitive skills have been found to invariably exhibit success in their own ventures (McMullen and Shepherd, 2006; Garrett & Holland 2015; Hansen et al., 2016). Yet, few entrepreneurial studies have advanced the literature on the dual complementing role of personal traits and cognitive skills, examining them from the perspective of entrepreneurial behavior, identity and contexts (Jones et al., 2018). The larger framework for decisions under uncertainty rest on the combined personal behavior, sunk outcomes in committed ventures, the entrepreneur’s cognitive skills, and the complexity of the environment. Besides, the contextual and social influences at the given time affect the decisions and the shaping of ideas of the entrepreneur (Dimov, 2007). This characterization of entrepreneurial personality traits and cognitive skills adds to research on decision-making. In this study, we sought to achieve this by connecting the personal traits with cognitive skill in their complementarity using some propositions to buttress our argument. We argue that in the presence of uncertainty, entrepreneurs rely on their personality traits and cognitive skills to make rational choices about foreseeable opportunities.

We conclude by emphasizing that entrepreneurial opportunities are always marked in the understanding of the personality traits and cognitive skills. Therefore, while there is plenty body of entrepreneurial literature on entrepreneurial behavior and cognitive skills, the discussion on the interplay between opportunity decisions must be recognized. Moreover, the framework of entrepreneurial decisions should be expanded to incorporate other symbolisms or identities that have a significant influence on the judgment of individual entrepreneurs to increase our understanding. Future studies can examine the contribution of complexity and its associated biases in different types of entrepreneurial setting. Due to the presence of asymmetries in both aspects of paternal and intergenerational family business, the inclusion of a dimension on complexity may increase our understanding of the biases that may influence the personality traits and cognitive skills of the entrepreneur in decision-making. Finally, while the arguments presented are intuitive, a more empirical research on these propositions would enrich the entrepreneurship literature on decision making.

## References

- Ackerman, P. L. (1996). A theory of adult intellectual development: Process, personality, interests, and knowledge. *Intelligence*, 22(2), 227–257.
- Amit, R., Glosten, L., & Muller, E. (1993). Challenges to theory development in entrepreneurship research. *Journal of Management Studies*, 30(5), 815–834.
- Ancori, B., Bureth, A., & Cohendet, P. (2000). The economics of knowledge: the debate about codification and tacit knowledge. *Industrial and corporate change*, 9(2), 255–287.
- Arora, P., Haynie, J. M., & Laurence, G. A. (2013). Counterfactual thinking and entrepreneurial self-efficacy: The moderating role of self-esteem and dispositional affect. *Entrepreneurship: Theory and Practice*, 37(2), 359–385.
- Asante, A. E., & Affum-Osei, E. (2019). Entrepreneurship as a career choice : The impact of locus of control on aspiring entrepreneurs ' opportunity recognition. *Journal of Business Research*, 98(February), 227–235.
- Bandura, A. (1997). Self-efficacy: The exercise of control (pp. 3-604). New York: wH Freeman.
- Baron, R. A. (2000). Counterfactual thinking and venture formation: The potential effects of thinking about “what might have been.” *Journal of Business Venturing*, 15(1), 79–91.
- Baron, R. A. (2004). The cognitive perspective: a valuable tool for answering entrepreneurship’s basic “why” questions. *Journal of Business Venturing*, 19(2), 221–239.
- Baron, R. A. (2008). The role of affect in the entrepreneurial process. *Academy of Management Review*, 33(2), 328–340.
- Baron, R. A., & Ensley, M. D. (2006). Opportunity recognition as the detection of meaningful patterns: Evidence from comparisons of novice and experienced entrepreneurs. *Management Science*, 52(9), 1331–1344.
- Begley, T. M., & Boyd, D. P. (1987). Psychological characteristics associated with performance in entrepreneurial firms and smaller businesses. *Journal of Business Venturing*, 2(1), 79–93.
- Bhidé, A. V. (2000). *The origin and evolution of new businesses*. Oxford University Press.
- Brandstätter, H. (1997). Becoming an entrepreneur—a question of personality structure? *Journal of Economic Psychology*, 18(2–3), 157–177.
- Brundin, E., & Gustafsson, V. (2013). Entrepreneurs’ decision making under different levels of uncertainty: the role of emotions. *International Journal of Entrepreneurial Behavior & Research*, 19(6), 568–591.
- Busenitz, L. W., & Barney, J. B. (1997). Differences between entrepreneurs and managers in large organizations: Biases and heuristics in strategic decision-making. *Journal of Business Venturing*, 12(1), 9–30.
- Dew, N., Read, S., Sarasvathy, S. D., & Wiltbank, R. (2009). Effectual versus predictive logics in entrepreneurial decision-making: Differences between experts and novices. *Journal of business venturing*, 24(4), 287–309.
- Dimov, D. (2007). Beyond the single-person, single-insight attribution in understanding entrepreneurial opportunities. *Entrepreneurship Theory and Practice*, 31(5), 713–731.
- Eichberger, J., Grant, S., & Kelsey, D. (2012). When is ambiguity--attitude constant? *Journal of Risk and Uncertainty*, 45(3), 239–263.

- Ellsberg, D. (1961). Risk, ambiguity, and the Savage axioms. *The Quarterly Journal of Economics*, 643–669.
- Fischhoff, B., Goitein, B., & Shapira, Z. (1981). Subjective expected utility: A model of decision-making. *Journal of the American Society for Information Science*, 32(5), 391–399.
- Gaglio, C. M. (2004). The Role of Mental Simulations and Counterfactual Thinking in the Opportunity Identification Process. *Entrepreneurship Theory and Practice*, 28(6), 533–552.
- Gaglio, C. M., & Katz, J. A. (2001). The psychological basis of opportunity identification: Entrepreneurial alertness. *Small Business Economics*, 16(2), 95–111.
- Garrett, R. P., & Holland, D. V. (2015). Environmental effects on the cognitions of corporate and independent entrepreneurs. *Small Business Economics*, 45(2), 369–381.
- Grégoire, D. A., Corbett, A. C., & McMullen, J. S. (2011). The cognitive perspective in entrepreneurship: An agenda for future research. *Journal of Management Studies*, 48(6), 1443-1477.
- Gigerenzer, G., & Selten, R. (2002). *Bounded rationality: The adaptive toolbox*. MIT press.
- Gürol, Y., & Atsan, N. (2006). Entrepreneurial characteristics amongst university students. *Education + Training*, 48(1), 25–38.
- Gustafsson, V. (2009). Entrepreneurial decision-making: thinking under uncertainty. In *Understanding the entrepreneurial mind* (pp. 285–304). Springer.
- Hansen, D. J., Monllor, J., & Shrader, R. C. (2016). Identifying the elements of entrepreneurial opportunity constructs: Recognizing what scholars are really examining. *The International Journal of Entrepreneurship and Innovation*, 17(4), 240–255.
- Harteis, C., and H. Gruber. (2008). Intuition and Professional Competence: Intuitive versus Rational Forecasting of the Stock market. *Vocations and Learning* 1: 71–85.
- Harvey, J., D. Ng, and P. Klein. (2015). Complexity, Novelty and Ethical Judgement by Entrepreneurs. *International Journal of Entrepreneurial Venturing* <http://dx.doi.org/10.2139/ssrn.2548773>.
- Hardy, L., Woodman, T., & Carrington, S. (2004). Is self-confidence a bias factor in higher-order catastrophe models? An exploratory analysis. *Journal of Sport and Exercise Psychology*, 26(3), 359-368.
- Jafari Sadeghi, V., & Biancone, P. Pietro. (2017). Exploring the Drivers of Gender Entrepreneurship: Focus on the motivational perspectives in USA, Italy and France. In V. Ratten, V. Ramadani, L.-P. Dana, R. D. Hisrich, & J. Ferreira (Eds.), *Gender and Family Entrepreneurship* (pp. 124–141). Routledge Taylor & Francis Group.
- Johnson, D., & Bock, A. J. (2017). Coping with uncertainty: entrepreneurial sensemaking in regenerative medicine venturing. *The Journal of Technology Transfer*, 42(1), 33-58.
- Kahneman, D., & Frederick, S. (2002). Representativeness revisited: Attribute substitution in intuitive judgment. *Heuristics and Biases: The Psychology of Intuitive Judgment*, 49, 81.
- Kahneman, D., & Miller, D. T. (1986). Norm Theory. Comparing Reality to Its Alternatives. *Psychological Review*, 93(2), 136–153.
- Kahneman, D., & Tversky, A. (1979). Prospect theory: An analysis of decision under risk. In *Handbook of the fundamentals of financial decision making: Part I* (pp. 99–127). World Scientific.
- Kahtri, N., and H. A. Ng. 2000. "The Role of Intuition in Strategic Decision Making." *Human*

Relations 53 (1): 57–86.

- Karim, M. S. (2017). Counterfactual Thinking and Entrepreneurial Career Intention. *Academy of Management Proceedings*, 2017(1), 15900.
- Kerr, S. P., Kerr, W. R., & Xu, T. (2018). Personality Traits of Entrepreneurs: A Review of Recent Literature. *Foundations and Trends® in Entrepreneurship*, 14(3), 279–356.
- Kirzner, I. M. (1979). *Perception, opportunity, and profit*. University.
- Kirzner, I. M. (1985). *Discovery and the capitalist process*. Chicago: University of Chicago Press.
- Kirzner, I. M. (2009). The alert and creative entrepreneur: A clarification. *Small Business Economics*, 32(2), 145–152.
- Knight, F. H. (1921). *Risk, uncertainty and profit*. Courier Corporation.
- Koellinger, P., Minniti, M., & Schade, C. (2007). “I think I can, I think I can”: Overconfidence and entrepreneurial behavior. *Journal of Economic Psychology*, 28(4), 502–527.
- Landman, J., Vandewater, E. A., Stewart, A. J., & Malley, J. E. (1995). Missed opportunities: Psychological ramifications of counterfactual thought in midlife women. *Journal of Adult Development*, 2(2), 87–97.
- Makridakis, S. G., Hogarth, R. M., & Gaba, A. (2010). Why forecasts fail. What to do instead. *MIT Sloan Management Review*, 51(2), 83–90.
- McClelland, D. C. (1987). Characteristics of Successful Entrepreneurs\*. *The Journal of Creative Behavior*, 21(3), 219–233.
- McKelvie, A., Haynie, J. M., & Gustavsson, V. (2011). Unpacking the uncertainty construct: Implications for entrepreneurial action. *Journal of Business Venturing*, 26(3), 273–292.
- McMullen, J. S., & Shepherd, D. A. (2006). Entrepreneurial Action And The Role Of Uncertainty In The Theory Of The Entrepreneur. *Academy of Management Review*, 31(1), 132–152.
- Miller, K. D. (2007). RISK AND RATIONALITY IN ENTREPRENEURIAL PROCESSES KENT. *Strategic Entrepreneurship Journal*, 1, 57–74.
- Milliken, F. J. (1987). Three Types of Perceived Uncertainty About the Environment: State, Effect, and Response Uncertainty. *Academy of Management Review*, 12(1), 133–143.
- Mitchell, R. K., Busenitz, L., Lant, T., McDougall, P. P., Morse, E. A., & Smith, J. B. (2002). Toward a theory of entrepreneurial cognition: Rethinking the people side of entrepreneurship research. *Entrepreneurship Theory and Practice*, 27(2), 93–104.
- Moscato, I., & Tubaro, P. (2011). Becker random behavior and the as-if defense of rational choice theory in demand analysis. *Journal of Economic Methodology*, 18(2), 107–128.
- Murnieks, C. Y., Sudek, R., & Wiltbank, R. (2015). The role of personality in angel investing. *International Journal of Entrepreneurship and Innovation*, 16(1), 19–31.
- Neumann, J. von, & Morgenstern, O. (1944). *Theory of games and economic behavior*. Princeton: Princeton university press.
- Nicolaou, N., & Shane, S. (2010). Entrepreneurship and occupational choice: Genetic and environmental influences. *Journal of Economic Behavior and Organization*, 76(1), 3–14.
- Ng, D. (2013). Seeing Through the Fog of Ambiguity: Entrepreneurial Judgments Under Decision Settings of Complexity. *Human Systems Management* 32 (1): 57–66.
- Ng, D. (2015) Entrepreneurial overconfidence and ambiguity aversion: dealing with the devil you know, than the devil you don't know, *Technology Analysis & Strategic Management*, 27:8, 946-959
- Petrakis, P. E., & Konstantakopoulou, D. P. (2015). Entrepreneurship under Uncertainty. In

- Uncertainty in Entrepreneurial Decision Making* (pp. 59–74).
- Rammstedt, B., Danner, D., & Martin, S. (2016). The association between personality and cognitive ability: Going beyond simple effects. *Journal of Research in Personality*, 62, 39–44.
- Rauch, A., & Frese, M. (2007). Born to Be an Entrepreneur? Revisiting the Personality Approach to Entrepreneurship. In *The psychology of entrepreneurship* Psychology Press (pp. 41–65).
- Roese, N. J. (1997). Counterfactual thinking. *Psychological Bulletin*, 121(1), 133–148.
- Rotter, J. B. (1990). Internal versus external control of reinforcement: A case history of a variable. *American Psychologist*, 45(4), 489–493.
- Sarasvathy, S. D. (2001). Causation and Effectuation: Toward a Theoretical Shift from Economic Inevitability to Entrepreneurial Contingency. *Academy of Management Review*, 26(2), 243–263.
- Savage, L. J. (1954). *The foundations of statistical inference*. Methuen.
- Schumpeter, J. A. (1934). The Theory of Economic Development: An Inquiry into Profits, Capital, Credit, Interest, and the Business Cycle (1912/1934). In *Google Scholar*.
- Scott, J. (2000). Rational choice theory. In *Understanding contemporary society: Theories of the present* (p. 129).
- Shane, S., & Venkataraman, S. (2000). The promise of entrepreneurship as a field of research. *Academy of Management Review*, 25(1), 217–226.
- Short, J. C., Ketchen, D. J., Shook, C. L., & Ireland, R. D. (2010). The Concept of “Opportunity” in Entrepreneurship Research: Past Accomplishments and Future Challenges. *Journal of Management*, 36(1), 40–65.
- Simon, H. A. (1957). *Models of man; social and rational*.
- Simon, M., Houghton, S. M., & Aquino, K. (2000). Cognitive biases, risk perception, and venture formation: How individuals decide to start companies. *Journal of Business Venturing*, 15(2), 113–134.
- Simon, M., & Houghton, S. M. (2003). The relationship between overconfidence and the introduction of risky products: Evidence from a field study. *Academy of Management Journal*, 46(2), 139–149.
- Spulber, D. F. (2012). Tacit knowledge with innovative entrepreneurship. *International Journal of Industrial Organization*, 30(6), 641–653.
- Tuten, Tracy L.; Bosnjak, M. (2001). Understanding differences in web usage: The role of need for cognition and the five factor model of personality. *Social Behavior and Personality: An International Journal*, 29(4), 391–398.
- Wijbenga, F. H., & van Witteloostuijn, A. (2007). Entrepreneurial locus of control and competitive strategies - The moderating effect of environmental dynamism. *Journal of Economic Psychology*, 28(5), 566–589.
- Valliere, D. (2013). Towards a schematic theory of entrepreneurial alertness. *Journal of Business Venturing*, 28(3), 430–442.
- Vealey, R. S. (2001). Understanding and enhancing self-confidence in athletes. In R. N. Singer, H. A. Hausenblas, & C. M. Janelle (Eds.), *Handbook of sport psychology* (pp. 550–565). New York: Wiley.
- Yan, J. (2018). The impact of entrepreneurial personality traits on perception of new venture opportunity. *New England Journal of Entrepreneurship*, 13(2), 21–35.

Zacharakis, A. L., & Shepherd, D. A. (2001). The nature of information and overconfidence on venture capitalists' decision making. *Journal of Business Venturing*, 16(4), 311–332.