

Cucchiarini, Veronica; Scicchitano, Sergio; Viale, Riccardo

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The Entrepreneur's Cognitive and Behavioral Journey: Understanding Heuristics and Bias under Risk and Uncertainty

Veronica Cucchiarini

Department of Economics, Management and Statistics, University of Milano-Bicocca, Milan, Italy

<https://orcid.org/0000-0003-4456-1523>

Sergio Scicchitano

John Cabot University, Rome Italy and Global Labor Organization (GLO), Essen, Germany

<https://orcid.org/0000-0003-1015-7629>

Riccardo Viale

Department of Economics, Management and Statistics, University of Milano-Bicocca, Milan, Italy

<https://orcid.org/0000-0001-6546-6221>

Abstract

The study of the entrepreneurial mindset has provided valuable insights into the cognitive strategies that impact entrepreneurial activities. Researchers have identified several biases and heuristics employed by entrepreneurs, which significantly influence their decision-making processes and actions, but the empirical evidence remains fragmented. To develop a more comprehensive understanding of the cognitive and behavioral mindset of entrepreneurs, it is important to consider the role of the context in which they operate. By analyzing the strengths and weaknesses of heuristics and biases within the context of risk or uncertainty, we can gain a deeper understanding of their influence on entrepreneurial outcomes.

Keywords: Entrepreneurship, biases, heuristics, risk, uncertainty, labour policies

Correspondence concerning this article should be addressed to Veronica Cucchiarini, Piazza dell'Ateneo Nuovo, 1 - 20126, Milan (Italy). E-mail: veronica.cucchiarini@unimib.it

Introduction

Entrepreneurship is one of the main sources of employment and economic growth, fostering innovation, product and service quality, competition, and economic flexibility (Hisrich, Langan-Fox, and Grant 2007). Given the importance of the subject, it is not surprising that research has involved a wide range of experts from various disciplines (including economists, psychologists, and sociologists) in investigating the entrepreneurial mindset. In the cognitive and behavioral perspective, the focus is on how individuals make the decision to start a business and succeed, despite the high risks involved. If we were to consider only bankruptcy rates, very few people would consider becoming entrepreneurs. A recent analysis conducted by Stryber (Dell'Acqua, 2021) shows that 89% of Europe's innovative companies are likely to go bankrupt. Furthermore, while some entrepreneurs earn high incomes, on average, entrepreneurs earn less than they would as employees (Hamilton 2000). However, in Italy alone, there are currently about 14,000 startups, and this number is increasing despite the crisis caused by the pandemic (MISE 2022).

Early research efforts on the topic of entrepreneurship emerged in the second half of the last century, primarily focusing on personality characteristics (for a comprehensive review, see Kerr, Kerr, and Xu 2018). This approach, known as the traits approach, view entrepreneurs as individuals with innate predispositions that set them apart from the general population. However, this perspective does not consider reverse causality (Hisrich, Langan-Fox, and Grant 2007), there is limited empirical evidence to support the notion that these characteristics are learned through the entrepreneurial role itself (Shane 2003)¹, and experimental evidence supporting their impact on entrepreneurial performance is scarce (Kerr et al. 2018). Consequently, research on the entrepreneurial mindset shifted from *who is an entrepreneur* to *how an entrepreneur behaves* (Gartner, 1988) leading to cognitive and behavioral perspectives. These approaches aimed to align the study of entrepreneurs with that of other individuals, dispelling the enigmatic aura surrounding the entrepreneurial figure often referred to as the "imaginary elephant" (Kilby 1971), a concept that eluded comprehension despite the attempts made by researchers from various disciplines. Like other human beings, entrepreneurs do not

¹ This representation of entrepreneurship persists in the collective imagination, even among the younger generation. A survey conducted in Italy by Testa and Frasccheri (2015) explored the beliefs of young students aged between 16 and 19. The survey revealed that approximately 60% of the participants believed that only individuals who are "born entrepreneurs" have the ability to pursue entrepreneurship. Interestingly, this belief was shared by both students who had not received any entrepreneurship education and those who had undergone such courses.

adhere to a purely rational decision-making model (Baron 1998) and rely on cognitive shortcuts known as heuristics.

Heuristics enable individuals to make judgments and choices in the face of cognitive limitations without considering all available information. In other words, using heuristics involves simplification, although this notion can be interpreted in different ways. The study of entrepreneurial decision-making follows the dichotomy of cognitive biases (Tversky and Kahneman, 1974) and adaptive heuristics (Gigerenzer and Todd 1999; Goldstein and Gigerenzer 2002; Gigerenzer and Brighton 2009). Although both approaches rooted in Simon's concept of limited rationality (1955), the concept of simplification has essentially followed two different binaries. According to Simon (1957), rationality can be compared to a two-bladed scissor that operates in tandem, so that satisficing decisions are made when individuals simplify tasks based on the characteristics of the environment in which they find themselves. In this perspective, heuristics are strategies used to identify crucial and salient information within the decision-making context, aiming to achieve a result without expending excessive time and energy on utility maximization as prescribed by normative theory. Tversky and Kahneman's view focuses on the cognitive limitations of human beings, leading to errors when judged by the model of formal rationality. On the other hand, Gigerenzer and colleagues' perspective places greater emphasis on the ecological aspect. In their view, the alignment with environmental characteristics determines the effectiveness of cognitive shortcuts. The same dichotomy can be found in the study of the entrepreneur's cognitive and behavioral mindset, creating some confusion between what cognitive shortcuts are advantageous or disadvantageous for entrepreneurs. Therefore, the aim of this work is to integrate the main contributions that have shed light on decision-making strategies employed by entrepreneurs, which have initially been fragmented, taking up the fundamental point from which the visions themselves originated, that is the importance of the relationship between the human mind characteristics and the context characteristics. Collectively, the experimental evidence related to the study of heuristics and biases in the business field provides a comprehensive understanding of what can be referred to as the entrepreneur's cognitive behavioral mindset.

Risk, uncertainty, and rationality in entrepreneurship

In the business environment, uncertainty stands out as a key characteristic, alongside risk. As early as 1921, Frank Knight established the foundation for the entrepreneurial role by emphasizing the agent's compensation for taking on uncertainty through profits. However, he did not elaborate on how entrepreneurs deal with uncertainty, and much of the research on entrepreneurial cognition has conflated risk and uncertainty, treating the latter as if it were a situation that can be managed mathematically. Nevertheless, Knightian uncertainty is fundamentally unknowable.

Traditionally, uncertainty is viewed as undesirable in decision-making since it does not allow for the application of optimizing strategies, unlike situations involving risk. This may explain why biases, despite their negative connotation from a theoretical standpoint, can actually benefit entrepreneurs in certain stages. Viale (2021) argues that distinguishing between calculable risk and uncertainty enables a more accurate assessment of the role of cognitive shortcuts and biases in business judgment and decision-making. In situations of calculable risk, where there are few alternatives and it is possible to assign probabilities and utilities to their outcomes, standard decision models can be applied, rendering limited rationality as non-adaptive (NALR). Biases in these situations, such as those occurring after a business has entered the market and the entrepreneur has access to all available environmental data, can have highly negative consequences.

In contrast, in complex and uncertain situations where predicting alternatives and outcomes is impossible, formal rationality rules do not apply. In such cases, the only prescriptive criterion is achieving cognitive success in problem-solving and adapting to the situation (adaptive limited rationality, ALR). Applying standard decision templates in these situations leads to incorrect and non-adaptive choices. The early stages of business start-up, characterized by uncertainty regarding alternatives and their outcomes, can be defined as ALR situations. For example, an entrepreneur may lack the resources to conduct a comprehensive market analysis that can convert uncertainty into calculable risk, or they may be unsure how the market will respond to the introduction of a new product (McMullen and Shepherd 2006). Similarly, entering a new market without access to prior data can add to the uncertainty (Busenitz and Barney 1997). In these uncertain conditions, biases can also be considered adaptive choices, as the prescriptive criterion is cognitive success in problem-solving and adapting to the situation.

To test this perspective, we propose a narrative review of the main cognitive biases and ecological heuristics addressed by research perspectives on entrepreneurship, focusing on the influence of these in the early stage of entrepreneurship or in the performance in later stages. Although experimental evidence is imbalanced, it is clear that the characteristics of the decision-making context play a crucial role in determining the success or failure of these cognitive shortcuts.

Cognitive biases' influence in early stage and performance

Overconfidence

First described by Oskamp (1965), overconfidence can be understood as the gap between an individual's subjective certainty and their objective accuracy (Busenitz 1999; Gudmundsson and Lechner 2013). The bias can be attributed to the use of the anchor and adjustment heuristic (Tversky and Kahneman 1974). Overconfidence is most pronounced in uncertain environments or when individuals are faced with challenging tasks (Lichtenstein and Fischhoff 1977). Moreover, when individuals possess greater confidence in their abilities and operate in uncertain environments, they tend to perceive a reduced need for additional information and consider fewer variables in their decision-making process (Buehler et al. 1994). Entrepreneurs are more prone to overestimating their actual performance compared to non-founder managers (Forbes, 2005; Busenitz and Barney, 1997). This trait can be influenced by age and experience (Ilieva, Bruderermann, and Drakulevski, 2018; Koellinger, Minniti, and Schade, 2007).

Excessive confidence is relevant to early business activities and can explain some business creation decisions despite high bankruptcy rates (Busenitz, 1999; Hayward et al., 2006; Lowe and Ziedonis, 2006). Entrepreneurs exhibiting greater overconfidence are more dedicated during the vital early phases of their businesses, potentially overlooking risks (Lichtenstein and Brush, 2001; Stevenson and Gumpert, 1985). In later stages, entrepreneurs with higher overconfidence tend to engage in behaviors considered risky for the company's survival (Camerer and Lovallo, 1999). They appear to be more willing to bring products with lower success rates and higher risk to the market (Simon et al., 2000) and rely less on external networks to develop their relational networks (Hayward et al., 2006). The danger of overconfidence on survival is a phenomenon that

transcends cultural differences. Using data from the Global Entrepreneurship Monitor survey conducted in 18 countries, Koellinger and colleagues (2007) found that countries with a high entrepreneurial confidence rate have higher startup activity, but also a lower average chance of survival in the market for more than three and a half years. On the other hand, overconfidence can generate entrepreneurial resilience and reduce the emotional costs of failure (Hayward et al., 2010; Ucbasaran et al., 2013).

Overconfidence, as discussed by Moore and Healy (2008), isn't uniform. It is seen in three distinct forms affecting entrepreneurial behavior: a) overestimation, people may overrate their performance, a trend seen more in company founders than in non-founding managers (Forbes, 2005; Busenitz and Barney, 1997); b) overplacement, that results in a superior performance perception than others. It is seen in entrepreneurs unduly optimistic about their chances of success, even when statistics suggest otherwise, for example many investing heavily in time and finance due to this belief (Cooper et al., 1988); c) overprecision, an excessive confidence in one's belief accuracy. While some studies suggest overprecision does not influence risk perception or entrepreneurial intention (Simon, Houghton, and Aquino, 2000), others have found a relationship between overconfidence, risk perception, and entrepreneurial intention (Robinson and Marino, 2015; Zaiane and Moussa, 2018; Kannadhasan et al., 2014). However, Bernoster et al. (2018) noted differences in its influence among students and small business owners.

Optimism bias

Optimists are generally defined as individuals who tend to maintain positive expectations for their future (Scheier et al., 1994). However, when individuals overestimate the likelihood of positive future events and underestimate the likelihood of negative future events, they are exhibiting optimism bias (Sharot, 2011).

In the context of entrepreneurship, research suggests that entrepreneurs exhibit high levels of optimism bias (Dosi and Lovallo, 1995; Fraser and Greene, 2006; Lovallo and Kahneman, 2003), yet there are differing opinions on this matter. For example, Lowe and Ziedonis (2006) found that entrepreneurs do not necessarily display higher levels of optimism compared to non-entrepreneurs. Individuals with an optimistic mindset tend to bounce back quickly from setbacks, viewing challenges as opportunities for growth (Ucbasaran et al., 2013;

Seligman, 2006). They are more likely to perceive adversity as a challenge rather than a threat, maintaining their confidence throughout the process of failure (Ucbasaran et al. 2013).

The bias of optimism is often conflated with overconfidence, but they differ in their focus. Optimism bias tends to be more externally focused, while excessive confidence is internally focused (Robinson and Marino 2015). Fraser and Greene (2006) found that optimism, in contrast to overconfidence, decreases with increasing experience using a dataset from England spanning from 1984 to 1999. This differs from findings on overconfidence (e.g., Koellinger et al., 2007; Ilieva et al., 2018), where it tends to increase with experience.

Regarding entrepreneurship's early stages, Simon et al. (2000) did not find significant results on the relationship between students' entrepreneurial intention and optimism. The authors suggest that this lack of association may be attributed to measuring optimism in a general sense rather than in the specific context of business. Indeed, some studies have examined financial-specific optimism and its impact on entrepreneurial behavior. Dawson et al. (2014) found that employees who eventually become entrepreneurs tend to overestimate their short-term financial well-being more than those who do not become entrepreneurs. Additionally, employees aspiring to start their own businesses exhibit above-average levels of optimism. Similarly, Arabsheibani et al. (2000) analyzed data from the British Household Panel Study and discovered that self-employed individuals expect better financial outcomes compared to employees, despite evidence suggesting otherwise.

However, research also demonstrates the positive influence of optimism bias in samples from diverse cultural backgrounds. Using a sample of Indian students, Kannadhasan et al. (2014) found that optimism bias influences risk perception, although it does not directly affect entrepreneurial intention. Bernoster and colleagues (2018) showed that optimism was associated with both entrepreneurial intention and entrepreneurial orientation.

Notably, excessive optimism can hinder firm performance (Brown and Marshall, 2001; Hmieleski and Baron, 2009) and negatively impact a company's survival (Gudmundsson and Lechner, 2013), potentially leading to resource wastage (Lowe and Ziedonis, 2006). In particular, research indicates a curvilinear relationship between optimism and firm performance (Brown and Marshall, 2001). A certain degree of optimism can be beneficial, but excessive optimism bias becomes detrimental to a firm's performance. Hmieleski and Baron

(2009) suggested that most entrepreneurs fall into the portion of the performance-optimism function beyond the inflection point, where excessive optimism starts to hinder performance.

Illusion of control

The illusion of control refers to the tendency to overestimate one's ability to control events, believing that one has more power to prevent or manage future outcomes than is actually the case (Langer, 1975). This cognitive bias arises from two causes. Firstly, individuals are motivated to maintain a sense of control over their environment, and their sense of competence is tied to the belief that they can control even uncontrollable factors. Secondly, it can be challenging to distinguish between random chance and one's actual abilities. Situational factors also influence the illusion of control (Keil et al., 2007). Despite its significance, the illusion of control has received relatively less attention compared to other cognitive biases.

his bias, stemming from an individual's need for control and challenges in distinguishing skill from chance, can influence the early stages of entrepreneurship. Simon et al. (2000) noted its role in reducing perceived risk and boosting entrepreneurial intent, a view supported by Kannadhasan et al. (2014). In contrast, Keh, Der Foo and Lim (2002) argued that its influence on opportunity assessment is channelled solely via risk perception, while Zaiane and Moussa (2018) found no impact on entrepreneurial intention. De Carolis, Litzky, and Eddleston (2009) linked the illusion of control to new business creation and risk perception, highlighting its increase with shared capital.

In terms of performance, Carr and Blettner (2010) investigated how the illusion of control affects decision-making quality among small business founders, drawing on Janis and Mann's decision conflict model (1977) as a theoretical framework. They found that higher levels of the illusion of control negatively correlated with decision quality based on seven criteria reflecting rationality.

Belief in the law of small numbers

This bias refers to the flawed belief that a small sample of observations can accurately represent the larger population from which it is drawn (Tversky and Kahneman, 1974). Small samples may lack predictive validity and not be representative of the entire population. This belief is influenced by the representativeness heuristic, as described by Tversky and Kahneman (1971). For entrepreneurs, this bias can lead to an overestimation of demand based on limited feedback (Simon and Houghton, 2002). The tendency to prioritize vivid personal feedback over general data may exacerbate this issue (Schwenk, 1986; Nisbett & Ross, 1980; Hogarth, 1980). However, established firms may have certain factors that limit this personal information bias (Hannan and Freeman, 1977). Busenitz and Barney (1997) emphasized that entrepreneurs, often working with sparse data, may be more prone to this bias than managers in established companies.

Simon et al. (2000) noted that belief in the law of small numbers can reduce risk perception and increase entrepreneurial intent. On the other hand, Keh et al. (2002) found that its impact is more pronounced on opportunity assessment than on risk perception. In a study involving 253 Chinese entrepreneurs, Zhang, Van der Bij, and Song (2020) found that deviations from the normative profile resulting from the heuristic of representativeness were beneficial for both business start-ups, including serial entrepreneurship, and performance in terms of net gain. This finding could be attributed to the fact that entrepreneurs often rely on small, non-random samples, as large random samples are rarely available. In contrast, managers in established companies typically have better access to historical data for analysis (Busenitz and Barney, 1997; Busenitz, 1999). Entrepreneurs may be able to use this bias in an ecologically rational manner, discriminating between relevant and irrelevant information in an environment that never fully satisfies their information needs.

Affect heuristic

The affect heuristic, as identified by Finucane et al. (2000), highlights the significant role of emotions in shaping risk-benefit judgments. People's feelings profoundly influence their perception of risks and benefits: positive emotions tend to be associated with lower perceived risks and higher perceived benefits, whereas negative emotions generally lead to the opposite. The weight of emotions in decision-making becomes particularly evident during conflicts between emotional reactions and cognitive risk evaluations. The influence of the affect heuristic can vary depending on context and individual experience, with experts typically

demonstrating more robust capabilities in regulating their emotions compared to novices (Hsu and Price, 1993; Lopes et al., 2005).

In the early stages of entrepreneurship, positive emotional states can enhance the recognition of new opportunities (Hayton and Cholakova, 2012), whereas negative emotions are often negatively correlated with opportunity evaluation and exploitation (Grichnik et al., 2010). Fear of failure and other negative affective states can increase risk aversion and decrease motivation to seek investment resources (Martina, 2020). However, it is important to note that these negative emotional states do not necessarily impede the initiation phase of a business (Cacciotti and Hayton, 2015).

When considering the impact on performance, Fodor and Pintea (2017) found through a meta-analysis that negative affective states do not significantly impact the achievement of entrepreneurial goals such as profitability, growth, and innovation. On the other hand, positive moods have been linked to entrepreneurial success.

Furthermore, Fodor, Curşeu, and Fleştea (2016) discovered that emotions indirectly influence decision-making, particularly in relation to the use of social heuristics. Entrepreneurs experiencing negative emotions tend to conform to the majority, while those in positive emotional states are more likely to emulate successful individuals.

Sunk cost bias

The sunk cost bias, as introduced by Thaler (1980) and rooted in Kahneman and Tversky's prospect theory, describes the tendency to continue investing resources due to past irrecoverable costs. Entrepreneurs, with their significant commitments, are particularly susceptible to this bias as they seek to justify their initial decisions. Although research on this topic is limited, existing studies provide valuable insights.

Entrepreneurs, and particularly those who are new to the field, exhibit a strong sunk cost bias, often persisting in their ventures despite negative feedback or expert advice to the contrary. Lowe and Ziedonis (2006) noted that nascent entrepreneurs tend to persist with their ventures for extended periods compared to more established companies, indicating a pronounced sunk cost bias among this demographic. McCarthy, Schoorman and

Cooper (1993) found that the sunk cost bias becomes particularly apparent in entrepreneurs who receive negative financial feedback in their venture's initial year.

In a study conducted by Åstebro, Jeffrey and Adomdza (2007), 29% of potential entrepreneurs who received advice from the Canadian Innovation Centre to discontinue their projects continued to invest funds, while 51% continued to invest time. This study also revealed a correlation between the amount of time and money initially invested by entrepreneurs and their likelihood to continue investing after being advised to stop. Furthermore, those with optimistic tendencies were found to invest significantly more (by 166%) than their more pessimistic counterparts.

Yang et al. (2015) highlighted that this bias is particularly prevalent among technology entrepreneurs and those driven by intrinsic motivation who do not have a predetermined budget.

Ecological rationality in early stage and performance

While the research primarily focused on heuristic-based intuitive decisions made by managers and top managers of large companies, yielding promising results (see, for example: Gigerenzer, 2015; Artinger et al., 2015; Luan, Reb, and Gigerenzer 2019), recent years have witnessed efforts to apply ecological rationality to entrepreneurship research. An important specification is that research under this perspective focuses on real behavior rather than intention evaluation, for example in early stage of the venture. This is another important difference between studies on bias and ecological heuristics in entrepreneurship.

Furthermore, there have been real business model proposals that incorporate the principles of ecological rationality to enhance adaptive controls in the process of creating and strengthening startups, such as the Lean Methodology (Ries, 2011). Ghezzi (2020) considered three digital startups that adopted Lean Startup approaches in the early stages of their development process. By analyzing interviews with startup managers, they found that entrepreneurs use fast, frugal heuristics to filter and target the guidelines of the Lean Startup approach. While the business model gives rise to a set of first-order heuristics (more abstract and generalized), these, in turn, are utilized to generate second-order heuristics (more concrete and specific). Entrepreneurs

effectively leverage relevant information from both inside and outside the organization, and these heuristics facilitate cognitive efficiency in translating and specifying generic information, enabling informed decision-making and action.

Satisficing heuristic

The term "satisficing" was coined by Simon in 1956. According to the author, applying this heuristic involves relying on experience to form an expectation and stopping the research process as soon as a certain threshold of satisfaction is reached. Instead of striving for optimization, one settles for a solution that meets expectations, thereby reducing computational costs (Simon, 1990). The author argues that choosing the first satisfactory alternative solves the problem of decision-making when: there are a large number of alternatives, possibly even infinite ones, and the problem's structure is so poorly understood that examining all alternatives to determine the optimal one is necessary. While there is no standardized formalization of this heuristic (Bendor, Kumar, and Siegel, 2009), some studies in entrepreneurship have identified its use in specific decision-making situations within entrepreneurial start-ups. For what concerning entrepreneurship's early stages, some authors focused on the decision about the locations of new companies. For instance, Berg (2014) interviewed 49 entrepreneurs and senior managers with personal capital at risk who were responsible for deciding the locations of new companies in different districts of the city. According to the author, the choice of location provided an opportunity to compare optimization models' forecasts with the actual decision-making processes employed. The results revealed that, especially among the most successful companies, the set of considered attributes was surprisingly small. None of the respondents described a decision-making process that adhered to the standard optimal stopping condition, which involves continuing the search until the marginal benefit of exploring another location exceeds its marginal cost. Instead, entrepreneurs' reasoning was characterized by decision-making procedures expressed in terms of simple thresholds or satisfactory cut-off rules. This was not because entrepreneurs were unable to calculate marginal benefits and costs, but because they took into account the rapid rate of change in their real-world environments, which, in their opinion, rendered the collection of historical data irrelevant for estimating the parameters necessary to apply optimal stopping rules. In short, entrepreneurs who spend too much time gathering different types of information achieve below-average results. Martyniuk and Gierusz (2016) confirmed similar findings, observing that most family businesses in

Poland aim for satisficing rather than optimization when selecting business locations. However, non-family businesses appeared to give more weight to marginal costs.

Although research in this area is somewhat limited, these findings hold importance for policymakers seeking to stimulate investment in specific locations. Berg (2014) notes that tax incentives, designed to encourage entrepreneurs to consider certain leases, are not particularly effective among those without prior experience in the area. The incentives are based on an optimization model that entrepreneurs do not frequently utilize when making ranking choices. As identified by Berg, a starting point could be to implement policies that facilitate greater interaction between residents and the opportunity to spend personal time in the areas being promoted, thus increasing knowledge and familiarity with the place. In the future, it will be crucial to examine mechanisms for effective decision-making that can include the promoted location in the limited pool of alternatives considered by decision-makers.

Imitation heuristic

Social imitation refers to a set of decision-making strategies that involve imitating behaviors observed in socially influential individuals, such as the majority or successful individuals. Although seeking imitation in activities traditionally associated with innovation may seem contradictory (Schumpeter, 1934), imitation can be a successful strategy in uncertain settings like business start-ups.

Imitation heuristics can be advantageous for small investment projects as they reduce research costs and utilize decisions and information readily available from others (Berg, 2014). Among immigrant entrepreneurs, the use of imitation heuristics becomes particularly significant, especially in new environments with information and resource constraints. Glinka and Hensel (2020) found that immigrants often imitate co-ethnic groups, especially when establishing businesses in foreign countries where language barriers might exist. The shift to local entrepreneur imitation happens when the ethnic community is small. Factors influencing this behavior include generational membership, knowledge of the host country, perceived entrepreneurial skills, and the strength of ethnic identity.

While imitation might be beneficial for deciding the location and initial stages of business, there's a negative correlation between imitation and performance in larger projects, indicating a preference for innovative behaviors (Berg, 2014). Glinka and Hensel (2020) also emphasized that while imitation offers an easy approach, it can pigeonhole immigrant entrepreneurs into unsatisfactory economic sectors, leading to detrimental effects on community development.

Tallying (1/N)

Another decision-making strategy, known as tallying, involves simply counting the number of signals favoring one alternative over another, without considering the relative importance of each signal. In simpler terms, it can be likened to weighing the pros and cons between the characteristics of two alternatives: one searches for signals, tallies the number of positive signals, subtracts the number of negative signals, and stops when there are no more signals to consider; the alternative with the higher tally is chosen, and if there is a tie, a random selection is made. Czerlinski, Gigerenzer, and Goldstein (1999) compared tallying with multiple linear regression and found that tallying had greater predictive accuracy. Additionally, Hogarth and Karelaia (2007) formally demonstrated that tallying works better than other strategies in compensatory environments. Åstebro and Elhedhli (2006) examined the use of this heuristic in predicting the commercial success of early-stage companies. The decision-making scenario they studied involved a large number of attributes to consider (a total of 37), and the expected outcomes were highly uncertain. When comparing the heuristic with a log-linear regression model, they found that both correctly classified the same number of outcomes. However, the heuristic was more successful in identifying successful firms, which were 10 times less frequent than failures and therefore more challenging to identify. Similarly, Albar and Jetter (2013) demonstrated that disregarding weights could be an effective strategy when evaluating new product ideas. Through a simulation study, they compared the effectiveness of heuristics in identifying profitable ideas with more advanced computational models. The authors concluded that tallying achieved an 80% accuracy rate in correct classifications, equivalent to that of a regression model.

Take-the-best heuristic

The take-the-best heuristic, proposed by Gigerenzer and Goldstein (1996), leads decision-makers to base their choices on a single criterion while disregarding others.

Empirical research conducted by Guercini (2012) over a span of more than ten years in the Italian fashion sector revealed that textile entrepreneurs commonly apply heuristics to predict the most sought-after fabrics in upcoming seasons. They relied solely on one signal, namely the price of natural fibers. Similar heuristics are also employed by entrepreneurs when deciding the location of their companies. Dahl and Soreson (2012) discovered that Danish entrepreneurs tend to establish their businesses in regions where they have strong roots or connections, remaining within the boundaries of their residential regions. Startup founders who base their decisions on this single criterion tend to experience better corporate survival rates and profits.

Discussion

The framework that constitutes the cognitive and behavioral mindset of entrepreneurs is rich, still evolving but only seemingly fragmented. While research perspectives on the role of the environment characteristics in shaping biases and heuristics have been somewhat imbalanced, the experimental evidence collected so far clearly indicates that the stages in which biases and heuristics were adopted play a crucial role in determining the success or failure of these cognitive shortcuts. Even biases, therefore, which are formally systematic errors of reasoning, can positively influence decisions if implemented in contexts where uncertainty reigns, and therefore in which classical economic models cannot serve as a criterion for evaluating judgments and decision-making. Returning to talk about models of rationality in the business environment is not just a theoretical whim but seems to be particularly relevant in the context of public policies. Any policy that aims to promote a certain behavior must implicitly or explicitly adopt a model that closely reflects human rationality. However, if rationality is not as firm and formal as commonly believed, policies should consider the interplay between cognitive limitations and contextual factors. This also necessitates reducing the emphasis on economic incentives. The concept of using monetary incentives or disincentives to motivate individuals to make specific choices originates from a model of the human mind resembling Skinner's pigeon, which repeats rewarded

behavior and suspends it when punished. As we have seen, the human mind is much more complex, and economic incentives only work if they align with the relevant attributes considered in decision-making.

This issue holds significant implications for policymakers. Establishing an efficient labor market is a challenging task, as it depends on the behaviors and biases of numerous stakeholders. Governments have historically relied on two approaches to enhance employment outcomes from a macroeconomic perspective rooted in micro-foundations: (I) providing incentives such as jobseeker transfers, wage benefits, and employer benefits; and (II) imposing sanctions, such as the removal of unemployment benefits for non-compliant jobseekers. As employment constitutes one of the longstanding areas of focus for behavioral insights teams, it has been demonstrated that applying behavioral insights can enhance existing approaches and offer alternative solutions that prioritize individuals and their decision-making within the system. A key lesson learned recently is that for effective employment policies to be designed, governments must enhance their understanding of how entrepreneurs, as well as workers, make decisions and interact within the labor market, including through intermediary labor services channels (Briscese and Tan 2018).

By distinguishing between NALR and ALR policymakers can revitalize the tools available for fostering entrepreneurship. In NALR situations, heuristics and biases are limitations that need to be addressed. For example, entrepreneurs can be provided with debiasing techniques (Fischhoff, 1982) that raise awareness of the underlying mechanisms causing biases, offer decision-making enhancement strategies, or intervene directly in the decision-making process (Thaler and Sunstein, 2008). On the other hand, in ALR situations, policies could assist entrepreneurs in employing appropriate heuristics in specific choice contexts and leverage heuristics to communicate content that is relevant to the set of attributes entrepreneurs consider.

A significant part of promoting a cognitive behavioral mindset lies in entrepreneurial education. Sarasvathy (2001) highlights that the entrepreneurial decision model predominantly taught in courses and universities focuses on goal-oriented deliberate decision-making (causality model), which relies on making predictions about the future. However, in conditions of uncertainty, such as during startup phases, forecasting is not useful (Dew, Read, Sarasvathy and Wiltbank, 2009). This may explain why some research has yielded less promising results regarding the connection between entrepreneurship education and entrepreneurial intentions and skills (e.g., Åstebro and Thompson 2011; Osterbeek et al., 2010; Van Der Sluis et al., 2008). Therefore,

distinguishing between NALR and ALR situations is crucial for introducing different decision models in entrepreneurial education pathways.

Another key point is determining when to introduce entrepreneurship education courses that focus on this approach. While broad European attention has been given to entrepreneurship in primary school in recent decades, entrepreneurship education is particularly overlooked at this level, despite childhood and adolescence being recognized as ideal stages for instilling entrepreneurial skills and abilities (Filion, 1994). Moreover, there is limited literature on this aspect (European Commission et al., 2016) and a lack of empirical evidence on how to effectively incorporate entrepreneurship education at an early age. Some efforts have been made in Italy (e.g., Floris and Pillitu, 2019), but interventions mostly concentrate on developing creative skills and raising awareness of future job opportunities. In a broader perspective, Hertwig and Engel (2016) argue that the ability to select relevant information and intentionally ignore others should become a fundamental cultural competence taught in schools alongside reading and writing.

Conclusion

The existing literature does not provide a single definition of the entrepreneurial mindset. However, it is generally understood as a collection of cognitive skills and abilities that enable individuals to create value by recognizing and seizing opportunities, making decisions with limited information, and adapting to uncertain and complex conditions (Daspit, Fox, and Findley, 2021; Naumann 2017). This concept aligns with Simon's famous metaphor (1955) of human rationality, which likens it to a pair of scissors representing the limited computational capacity of the human mind and the structure of the decision-making environment. Nevertheless, there are different perspectives on the limited rationality of human beings (Viale 2020) that stem from distinct evaluative criteria: regulatory theory and adaptability to the environment. When research on entrepreneurial mindset delved into cognitive characteristics, it inevitably drew influence from underlying theoretical frameworks. Consequently, our understanding of entrepreneurs' cognitive strategies has become an uneven accumulation of knowledge. However, a point of convergence can be found by revisiting Simon's original notion that the scissor blades must be coordinated for optimal functioning. This refocuses attention on uncertainty, a concept of fundamental importance in business but often overshadowed, as emphasized by

Knight (1921). Making decisions in the face of uncertainty is the essence of entrepreneurship, particularly in its early stages. The effectiveness of cognitive strategies varies, irrespective of the theoretical framework, based on the risk or uncertainty conditions faced by entrepreneurs, i.e., whether or not future events can be predicted. Heuristics and biases, in this regard, could precisely embody what Keynes (1936) referred to as *animal spirits*—a spontaneous impulse to action, a belief in success even in the absence of sufficient information to gauge the viability of an idea.

This perspective has important policy implications. It confirms that behavioral insights and robust evaluation can enhance employment policies and contribute to evidence-based policy design. The policies should take into account the decision-making processes of all key actors, including entrepreneurs, workers, intermediaries, and employment services, which traditionally have had limited relevance in our country. A better understanding of the behavior of these actors and their interactions will assist governments in designing more effective policies that can complement or, at times, replace more drastic labor reforms (Briscese and Tan, 2018). Specifically, there are three areas that need to be addressed to improve labor policies and create more efficient labor markets in Italy. First, there should be an increased use of experimental methods in policy making. Second, data should be leveraged to inform policy decisions, facilitating evidence-based policy formulation and empowering labor market participants. Third, policymakers should proactively work on enhancing the skills and resilience of workers and jobseekers (Briscese and Tan 2018).

The fact that the entrepreneurial mindset is shaped by decision-making strategies that evolve over time and are influenced by the environment provides an opportunity for policymakers to intervene and stimulate the establishment and success of new businesses. Different tools are relevant for different stages of a business. When facing risks, public policies could implement debiasing techniques, while in the face of uncertainty, strengthening heuristic decision-making becomes crucial. Keynes himself believed that the government, through various mechanisms, could stimulate animal spirits to foster the creation of new businesses and innovative processes.

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