

New Venture Decisions - A Literature Review of the Entrepreneurial Heuristics and Biases

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ABSTRACT

New Ventures Decisions are critically important for our society and have been increasingly studied in the management literature. A number of biases can affect the ways in which entrepreneurs and venture capitalists take decisions in the evaluation of new venture opportunities. These biases are not peculiar to the entrepreneurship domain, but, nonetheless, they are susceptible to manifest in entrepreneurs and venture capitalists in their decision-making more than in general population. Entrepreneurial evaluation and decision-making have been studied extensively and some studies have made the links to heuristics and biases. We systematically review those studies on the heuristics and biases of entrepreneurs and venture capitalists, based on the common evaluation criteria of new ventures established along dynamic capability view. Our findings suggest that heuristics and bias are useful to explain the evaluation and decision-making in new ventures, however, the scattered extant results are not systematic, occasionally inconsistent, and lack of in-depth discussions. A lot of gaps and future research opportunities were identified.

INTRODUCTION

New venture decisions are important and usually made under great uncertainty. The decision-making environment of entrepreneurs has shown that they are biased towards action and creation on one hand, and on the other hand they need to sit down to evaluate the opportunities created in the setting of new ventures and decide which ones to pursue. The evaluation is prone to shortcuts and errors, and the systematic studies of such reproducible shortcuts and errors as well as the underlying mental processes are known as the heuristics and biases from cognitive psychology. Heuristics and biases have made discoveries highly relevant to entrepreneurial decision-making [5,6,24,53].

Heuristics and biases study how decision makers, in this case entrepreneurs and venture capitalists (VCs), are able to process information in an imperfect manner [5,25,53] and how various errors are produced [32,59].

Entrepreneurs tend to display greater bias than general population because the entrepreneurs' decision-making environment is especially uncertain and complex [5,49] and in such environment people who think in certain ways tend to be attracted to entrepreneurship [24,30]. Specifically, people who are more susceptible to use of biases and heuristics during their decision-making process will be more likely to become entrepreneurs [8].

Evaluating new venture opportunities is also the essential task of VCs. VCs evaluate hundreds of different information aspects in a high-speed environment during venture screening, which can lead to information overload [58]. Moreover, much of the surrounding information is ambiguous and uncertain in nature, making VCs highly susceptible to biases [59].

There are a number of studies of heuristics and biases in the entrepreneurial decision-making literature. The studies are scattered in their focus and unsystematic in their relation with heuristics and biases. Scholars have analyzed the impact of overconfidence, how biases affect the risk perception, etc [24,33,47]. There has not been a meticulous review on the topic, to our best knowledge. Specifically, no studies before have thus far reviewed the heuristics and biases of entrepreneurs and VCs in their evaluation and decision making of new venture opportunities and pointed out the research gap and future directions, as we do in this paper. The closest prior works include, the criteria VCs employ when assessing venture proposals [26,36], VC decision-making in general [44], the cognitive orientation of entrepreneurs [50]. We systematically review the heuristics and bias in entrepreneurial opportunity evaluation and decision-making and organize literature by dynamic capability view.

The paper serves a pausing point for researchers to reflect what has been done in this stream of research in the last decades and ponder what could be done in the future. Based on the analysis of the different biases and the

context where they apply, researches would have a clear starting point to pursue the study of the impact of these biases in entrepreneurial decision making, having a stronger and systematic theoretical background as a support.

METHODS

We used two methods to look for articles related to heuristics and biases in entrepreneurial decision-making and evaluation: 1) a thorough search of the entrepreneurship and management journals in the *Financial Times journal list* plus *Strategic Entrepreneurship Journal*, and 2) using key words to search in databases of *Scopus* and *Web of Science*.

We scanned exhaustively all relevant empirical and qualitative studies published from year 2000-2012 in the related journals of *Financial Times* list as the following:

- *Academy of Management Journal*,
- *Academy of Management Review*,
- *Academy of Management Perspectives*,
- *Journal of Business Venturing*,
- *Entrepreneurship: Theory and Practice*,
- *Journal of Business Research*,
- *Journal of International Business Studies*
- *Journal of Management Studies*,
- *Management Science*,
- *Organization Studies*,
- *Organizational Behaviour and Human Decision Processes*,
- *Strategic Entrepreneurship Journal (added by the authors)*

In addition to those articles in the most prestigious journals, we also performed a search in *Scopus* and *Web of Science*, using various combinations of key words such as cognition, heuristics, biases, venture capital, decision, entrepreneurship, evaluation. From the database, we find articles published in other journals, for example: *Journal of Management*, *Venture Capital: An International Journal of Entrepreneurial Finance*, *Journal of Financial Economics*, *Management Decision and Strategic Change*.

The selected papers were then interrogated using the following questions:

- 1) Which kind of heuristics and biases were studied?
- 2) Which decision makers were studied?
- 3) What was the research method?

Following a grounded theory approach, as the conceptual framework and research questions were obtained as we collected and analyzed the selected articles, we organized and grouped the literature collected based on similar

concepts. We found that empirical studies so far examined the heuristics and bias in four major attributes of startups: organizational resources, context, the entrepreneur (his dynamic capability), and expected return under risk. This is consistent with both the evaluation and decision-making by both entrepreneurs and venture capitalists, and with the work proposed in literature [30].

In entrepreneurs' studies, it has been established the importance of the entrepreneurial human capital (knowledge, skills, affect and abilities of the entrepreneurs), evaluation of actual and future resources, dynamic context and environments, and the perception of return under risk in the decision to pursue a venture [27,29,33,34,37,47].

In venture capital studies, four similar attributes, the entrepreneurs, the product or service, the market, and the expected financial returns, are well established as common criteria for the evaluation and decision of VCs [26,42,58].

With the categorization consolidated after using the grounded theory approach, we, rather than attempted to form any new theories from the categorization, first compared the patterns emerged from the categorization to existing theories [37]. The patterns emerged are fairly along the line of resource-based view, and especially its recent twist – dynamic capability view. Using an existing and known framework was considered to be the best way to analyze the role of the biases and heuristics in different contexts for entrepreneurs and VCs, as well as to understand in a comprehensive approach the impact that they have in decision-making.

The resource-based view argues that the performance of firms stems from the resources they possess, specifically those resources that are valuable, rare, inimitable and nonsubstitutable [16,56].

A key shortcoming of the resource-based view of the firm is that it ignores factors surrounding resources, instead assuming that they simply “exist”. Considerations such as, how resources are developed, how they are integrated within the firm and how they are released, led to the development of dynamic capabilities. Dynamic capabilities concern the integration of firm resources and the changing business environment.

Dynamic capability, and its precedent, the resource-based view, has been an influential theoretical framework to evaluate the competitive advantages and the performance of firms in its market context [2,21,56].

In entrepreneurship, resource based view and dynamic capability are used extensively. The entrepreneurial activity is centered on the entrepreneur's capabilities (talent, skill, experience, ingenuity, leadership, and etc.) to combine tangible and intangible assets in new ways and to deploy them to meet customer needs in a manner that could not easily be imitated [1]. Using specifically resource-based view, [29] evaluate entrepreneurial opportunity,

which has been complemented by a study of the relative importance that entrepreneurs give to the different attributes of a resource, specifically value, rarity, imitability and nonsubstantibility [34].

The dynamic capabilities focus on the integration and reconfiguration of resources especially in high-velocity markets, and the tasks of integration and reconfiguration are usually performed by entrepreneurs in startups [21]. The capability and characteristics of the entrepreneurs are central to VCs' assessment of new ventures [26] and are particularly prone to bias [8].

Finally, the expected return of investment, along with the risks associated with it, while not strictly belonging to the dynamic capability view, is also well studied in the empirical literature, due to its terminal importance in the evaluation of startups. Accordingly, we put the expected return under risk as a separate category.

The literature of the decision-making on new ventures is generally separated based on the decision makers: entrepreneurs, venture capitalists, corporate entrepreneurship executives, business angle investors, and etc [59]. Studies have found that different types of decision makers all consistently apply heuristics to simplify their decision-making process, resulting in the common use and exhibition of non-rational biases [10,32]. Because our intention is to focus on the entrepreneurial decision-making, this article focuses on two types of decision makers: entrepreneurs and VCs, which are highly important in new venture decision and have been the focus of recent literature.

However, heuristics and biases may not act in the same fashion for different types of every decision makers; entrepreneurs have characteristic cognitive processes [9]. Entrepreneurs use heuristics and biases as a response to certain conditions they must face as entrepreneurs, such as high uncertainty and high time pressure while they develop and evaluate venture opportunities [5]. While, entrepreneurs may face the challenge to evaluate a few different opportunities, but dealing with a huge uncertainty and pressure [19], venture capitalist, due to their different roles, must evaluate hundreds of proposals, which severely overload them information about the team, market, product and financial data of various startups, and therefore they are highly susceptible to cognitive bias [58,59].

Consequently it is of crucial relevance to compare and contrast the decision-making (the use of different heuristics and bias) of entrepreneurs and VCs regarding different attributes of new ventures. This would let us to understand how the decision-making differs for each actor and would give insights to improve the decision and negotiation process in the funding of new ventures.

To get findings and future research proposal, we construct a table tabulating the empirical studies in literature for different biases, using the four evaluation attributes consolidated.

FINDINGS

There have been multiple studies related to biases in entrepreneurial decision-making. For entrepreneurs the focus has been in evaluation of opportunities of new ventures and the effect of biases to characterize the entrepreneurs. Also it has been studied the impact on the entrepreneurs' and venture capitalists' evaluation process of opportunities and decision criteria for assessing new ventures [5,25,48,59].

The study of bias started in the decade of the 70's by Tversky & Kahneman (e.g 1973). Since the first studies, a huge number of heuristics and biases have been identified in the psychology field with possible implications in management and decision-making, such as: availability, anchoring and adjustment, representativeness, planning fallacy, hindsight bias, omission bias, confirmation bias, illusion of control, overconfidence, etc.

The main heuristics and biases used in psychology with managerial implications are:

Overconfidence. We will first use an example to explain overconfidence bias in a simple way. *"Suppose I ask you for your best guess as to an uncertain quantity, such as the number of "Physicians and Surgeons" listed in the Yellow Pages of the Boston phone directory, or total U.S. egg production in millions. You will generate some value, which surely will not be exactly correct; the true value will be more or less than your guess. Next I ask you to name a lower bound such that you are 99% confident that the true value lies above this bound, and an upper bound such that you are 99% confident the true value lies beneath this bound. These two bounds form your 98% confidence interval. If you are well calibrated, then on a test with one hundred such questions, around 2 questions will have answers that fall outside your 98% confidence interval"* [57].

The more relevant information a person has, the more overconfident he/she becomes [22]. Overconfidence has been studied as bias in the literature because is common, pervasive and of great practical importance [35].

Representativeness. Representativeness is a cognitive shortcut, using which decision makers decide through comparison with similar known situation [55]. The following example gives a clear view about this heuristic:

"A cab was involved in a hit and run accident at night. Two cab companies, the Green and the Blue, operate in the city. 85% of the cabs in the city are Green and 15% are Blue. A witness identified the cab as Blue. The court tested the reliability of the witness under the same circumstances that existed on the night of the accident and concluded that the witness correctly identified each one of the two colors 80% of the time and failed 20% of the time. What is the probability that the cab involved in the accident was Blue rather than Green knowing that this witness identified it as Blue?"

Most subjects gave probabilities over 50%, and some gave answers over 80%. The correct answer, found using Bayes' theorem, is lower than these estimates: There is a 12% chance (15% times 80%) of the witness correctly identifying a blue cab. There is a 17% chance (85% times 20%) of the witness incorrectly identifying a green cab as blue. There is therefore a 29% chance (12% plus 17%) the witness will identify the cab as blue. This results in a 41% chance (12% divided by 29%) that the cab identified as blue is actually blue [32].

Hindsight bias, justified by representativeness, explains why individuals tend to see past events as being more predictable, or to believe after an event, that their prediction of the outcome was more accurate than it actually was [15].

An example will help to understand better this kind of bias. Fischhoff & Beyth presented students with historical accounts of unfamiliar incidents, such as a conflict between the Gurkhas and the British in 1814 [23]. Given the account as background knowledge, five groups of students were asked what they would have predicted as the probability for each of four outcomes: British victory, Gurkha victory, stalemate with a peace settlement, or stalemate with no peace settlement. Four experimental groups were respectively told that these four outcomes were the historical outcome. The fifth, control group was not told any historical outcome. In every case, a group told an outcome assigned substantially higher probability to that outcome, than did any other group or the control group.

Similarity Bias. Byrne & Griffitt proposed that individuals rate other people in a better way the more similar they are to themselves, in other words similarity describes the extent to which there is resemblance and similitude between two persons or concepts [11].

It has been studied that similarity is not only limited to external characteristics, also to thinking processes. For instance, two individuals may arrive to a similar conclusion or judgment regarding some actionable decision (e.g. to travel somewhere), but they could have done it by engaging in substantially different reasoning processes [41].

Availability. Availability is how easily an example can be called to mind is related to perceptions about how often this event occurs. Thus, people tend to use a readily accessible attribute to base their beliefs about a relatively distant concept [32].

An example of psychology put this bias in a clear context. "Suppose you randomly sample a word of three or more letters from an English text. Is it more likely that the word starts with an R ("rope"), or that R is its third letter ("park")?"

A general principle underlying the heuristics and biases program is that human beings use methods of thought

heuristics, which quickly return good approximate answers in many cases; but which also give rise to systematic errors called biases. An example of a heuristic is to judge the frequency or probability of an event by its availability, the ease with which examples of the event come to mind. R appears in the third-letter position of more English words than in the first-letter position, yet it is much easier to recall words that begin with R than words whose third letter is R. Thus, a majority of respondents guess that words beginning with R are more frequent, when the reverse is the case [53].

Illusion of Control. Illusion of control refers to the fact that an individual overemphasizes how much his skill may improve performance in situations where chance is the most responsible for the outcome [39].

A common example we can see it in gambling. When rolling dice in a craps game people tend to throw harder when they need high numbers and softer for low numbers [31].

Belief in Law of Small Numbers. The belief in law of small numbers is defined as an individual uses a limited amount of information in order to propose and assume conclusions for a larger population. The problem is that small samples are variable and unpredictable [28]. This bias is used by people who follow the representativeness heuristic [55].

Lets see the following example to understand this bias. *“The mean IQ of the population of eighth graders in a city is known to be 100. You have selected a random sample of 50 children for a study of educational achievements. The first child tested has an IQ of 150. What do you expect the mean IQ to be for the whole sample? The correct answer is 101. A surprisingly large number of people believe that the expected IQ for the sample is still 100. This expectation can be justified only by the belief that a random process is self-correcting”* [52].

Wadeson (2006) proposes two different categories to understand and divide the biases. The first one is heuristics, focusing in the three major and best-know heuristics in literature: availability, representativeness and anchoring and adjustment heuristic [54]. In this category we find biases such as: overconfidence, belief in law of small numbers, availability bias and hindsight bias. The second one is based on over-optimism, referred to a tendency to believe that things are going to turn out to well [55]. In this category we find the optimistic and overconfidence bias, illusion of control, planning fallacy and self-justification.

J. Baron in his book *Thinking and Deciding*, propose a classification based on three major areas [3]. The first one deals with attending to one attribute when other attributes are relevant, this includes biases in which the attribute in question captures our attention because it is the result of recent or immanent events (availability, anchoring and

under adjustment, planning fallacy), or one attribute is used because it is usually a good indicator for another attribute (hindsight bias, information bias, omission bias) and finally cases in which people put more attention or isolate one attribute even though it is not particularly salient or useful as an indicator (illusion of control, conjunction effect, failure to integrate).

The second area involves biases that result from effects of goals or desires on beliefs. In this section we have biases such as: inappropriate extreme confidence, biased assimilation, illusory correlation. The third area refers to psychophysics, the study of the relation between quantitative attributes and our perception of these attributes. A standard result of psychophysics is that our sensitivity usually diminishes as intensity increases. The biases listed in this category are: overweighting low probabilities, framing effect for gains and losses, dynamic inconsistency.

The amount of studies and results in entrepreneurial decision-making is diverse, which clarifies the importance and necessity of a review that based on a solid theoretical framework, organize, classify and present the key biases in the entrepreneurs' evaluation process and venture capitalists' investment decision.

In order to have a clear overall picture of the research that has been done regarding heuristics and bias on the decision-making involving the key evaluation attributes, we present a summary in tables 1 and table 2. A ✓□ represents that studies have been done, a ✗□ implies that no studies have been done and the ? represents that the heuristic or bias has not been studied directly or is unclear.

Heuristic/Bias	Entrepreneur	Organizational Resources	Context	Expected results under risk
Overconfidence	✓□	✓	✓	?
Similarity	✓	✗	✗	✗
Availability	✓	✓	?	✗
Illusion of Control	✓	✗	✓	?
Representativeness	✓	✗	✓	?

Table 1: Summary of Extant Research of Biases in Entrepreneurs

Heuristic/Bias	Entrepreneur	Organizational Resources	Context	Expected results under risk
Overconfidence	✓□	✓□	✓	?
Similarity	✓	?	✓	✗
Availability	?	✗	?	✗
Illusion of Control	?	✗	✗	✗
Representativeness	✗	✗	✗	✗

Table 2: Summary of Extant Research of Biases in Venture Capitalists

From table 1 and 2 show that the heuristic and bias of entrepreneurs in their evaluation of their own capabilities have been relatively well covered. For venture capitalists, similarity is the most studied based on the evaluation attributes.

Next, we will present in detail the heuristics and bias entrepreneurs and VCs use based on the four attributes identified previously from the theoretical framework: Entrepreneurs' Capability, Organizational Resources, Context and Expected return under risk.

Entrepreneurs' Capabilities

Entrepreneurs' capabilities, when properly engaged in tasks related to their knowledge and skills, are simple, highly experiential and fragile processes [21], which are important for the performance of the new ventures [27]. Based on a resource-based view, entrepreneurs who consider their capabilities to combine resources in opportunities make better evaluation than those who do not consider them, and therefore they enjoy a competitive advantage [29].

Overconfidence. A bias highly related with the entrepreneurs' capability is overconfidence [49,59]. This bias explains the tendency of decision makers to be overly optimistic in their estimation abilities on receiving initial information [10]. High levels of overconfidence lead entrepreneurs to undertake and persist with challenging tasks [30].

Forbes studies the different degrees of overconfidence bias by different entrepreneurs [24]. The study examines in a two-stage survey 115 lead managers of new ventures in New York. The results of this study show that individual age, firm decision comprehensiveness and external equity funding affect how much overconfident entrepreneurs tend to be. Founder-managers were found to be more overconfident than new-venture managers who did not found their

firms. Overconfidence cannot be explained based only from the individual level, but also from organizational and contextual levels at the same time. However this study did not correlate overconfidence with new venture decisions.

The entrepreneurs exhibit overconfidence bias and cognitive errors in decision-making when they have an inflated sense of strategic capacity [7]. An inflated sense of strategic capacity rises from emphasis in the use of strategic fit between the opportunity and the vision of the new venture. The heuristic fit and its associated biases are proposed to be more common among entrepreneurs with stronger promotion focus and self-efficacy. Bryant was a conceptual study without empirical or experimental evidences [7].

Entrepreneurs underestimate their own absolute abilities to lead new firms to enter market, and they underestimate the abilities of their competition in such entrance even more [40]. Skill based tasks do not always elicit overconfidence; instead, confidence and entry rates depend in part on how difficult potential entrants see the task.

Similarity. In entrepreneurial decisions, Franke et al. were the first to analyze similarity bias between VCs and start-up teams using a sample of 51 interviews in 26 VC firms in Europe [25]. VCs give favorable evaluation to start-up teams that are more similar to them. They further examine the similarity from five dimensions: age, educational background, field of training, prior professional experience (large firm or start-up), and leadership experience. Similarity in two out of the five dimensions, type of education and previous working experience, are found to bias VCs evaluation.

Murnieks et al. check whether similarity in decision-making between VCs and entrepreneurs lead to favorable evaluation outcome [41]. Using a sample of 60 VCs in the States, they find that VCs evaluate more favorably opportunities from entrepreneurs who think in ways similar to their own. This similarity positively moderates the positive relationship between founder quality and the probability of investment.

Cable & Shane propose that the probability of cooperative relationships between entrepreneurs and venture capitalists increases as (a) demographic similarity, (b) work values congruence, and (c) perceived power equality between entrepreneurs and venture capitalists increase [12].

Organizational Resources

The resource-based view and its extension, the dynamic capabilities view, posit that firms' idiosyncratic and difficulty to imitate resources determine their competitive advantage [51]. The competitive advantage is bigger when the resources have value, rarity, inimitability, and nonsubstitutability [29]. Such resources enable strategies that are not easily duplicable by competitors [2,21,29].

Availability. Haynie et al. develop a model of entrepreneurial opportunity evaluation constructed on the resource-based view [29]. Opportunity evaluation decisions are framed as an assessment of the attractiveness of future resources and resource combinations conferred to the venture from exploitation. They used a sample of 73 entrepreneurs and find that entrepreneurs evaluate opportunities as more attractive when those opportunities are related to the entrepreneurs' skills, knowledge and abilities. At the same time, three conditions enable to analyze and be attracted to other kind of opportunities that are inconsistent with the entrepreneurs' human capital: rarity of the opportunity, limits on competition and age of the firm.

Kemmerer et al. examine whether entrepreneurs use value, rareness, inimitability and nonsubstitutability - the four identified characteristics of valuable resources [34]. They used a sample of 181 entrepreneurs and find that entrepreneurs only use three of the four characteristics: value, rareness and inimitability. The underuse of nonsubstitutability can be attributed to availability bias, because entrepreneurs have to search for possible substitution candidates and therefore are subjected to available bias. Rareness has a negative correlation with resource importance, which could be explained also by the use of availability, as rarity is an attribute hard to imagine and to relate to previous events, is not consider as important when entrepreneurs are assessing a resource.

The authors explain the importance of value as it is related to affection and emotions; inimitability based on availability bias, because of the availability of competitors in the area or the lack of available protection mechanisms.

Overconfidence. Hayward et al. propose that more overconfident entrepreneurs start their ventures with smaller resource endowments and commit greater resources to their main opportunity [30]. More overconfident entrepreneurs underestimate the need for and overestimate their ability to secure and defend intellectual property and key resources from competitors, as well as they could engage in price-based competition, which would create a perception for the necessity of smaller initial resource endowments. The insufficient resource endowments will excessively deplete the resources that they have at their disposal, depriving their ventures of resourcefulness and increasing the chances that their ventures will fail [30].

VCs studies have heavily investigated on the importance of resources, especially, product and service, in evaluation of new ventures, but the important role of heuristic and biases has not been studied in deep [44,45]. Zacharakis & Shepherd studied the role of information in order to analyze if VCs were overconfident or not. They found that the level of overconfidence depended upon the amount of information. As more information becomes available, people tend to believe they will make better decisions, however this amount of information makes the

decision more complex. The study showed that more information increased the level of confidence, but at the same time decreased the accuracy of the VC.

Context

Dynamic capabilities view proposes the role of strategic management is essentially the adaption, integration, and reconfiguration of resources to match changing environments [51]. A firm's evaluation cannot be done without consideration of its environments. Environmental context have empirically been pointed out as important moderating variables in entrepreneurship studies -for example, Baron & Tang found that environmental dynamism moderates positively the relationship between creativity and innovation performance [4].

Overconfidence. Hayward et al. studied the impact of overconfidence to explain why ventures are created despite high failure rates [30]. They propose that greater environmental complexity and dynamism, the greater the founder overconfidence. Regarding to complexity, the authors explain that entrepreneurs will tend to underestimate the difficulty to solve complex problems, therefore they become more overconfident in their abilities to solve them. Related to environmental dynamism, it is proposed that entrepreneurs tend to generalize the confidence in their capabilities to potential ventures even as the utility of such abilities diminishes.

Zacharakis & Shepherd studied whether VCs are overconfident, as well as factors involved in the decision-making context that could lead them to overconfidence [59]. The results of the analysis of 51 VCs showed that 96% of the VCs were overconfident.

Overconfidence rises when VCs are in unfamiliar context where they face decisions involving alien decision cues. In such context, their levels of confidence do go down, but they do not go down enough, and therefore they become overconfident, and their accuracies in evaluation subsequently go down. The reduced accuracies are results of less active information search and use, caused by overconfidence.

Similarity Bias. A specific type of similarity bias is local bias, which arises from geographic similarity. Coval & Moskowitz define and measure local bias using the average geographic distance between the VCs and their investment [17]. VCs will have a bigger local bias if they invest more into investment near to them.

Investors can have easier access to information to ventures closer to them [17]. The access to information is the reason why investors may feel more comfortable investing in ventures close to them [18], because they can more

easily get familiar with the new ventures, and being familiar, as explained by Franke et al. earlier, affects the investment decisions [25].

Factors affecting local bias were studied by Cumming & Dai, who study VCs investment from 1980 to 2009 and find that about 50% of the investments are within 233 miles from the VCs [18].

VCs with better reputation, wider or more diversified networks exhibit less local bias, because they are in a better position to get information even for their distant investments. VCs investing in more technological industries tend to have more local bias, and Cumming & Dai attribute that to their needs to control the higher uncertainties associated with technology-based ventures [18]. VCs also exhibit more local bias when they are investing without other VCs or when are the lead VCs (i.e. they invest more than other VCs do in this new venture), because they would assume more roles and responsibilities in due diligence and monitoring, which are affected by the geographic distances between them and the investees.

Surprisingly, there has not been a study on how similarity and local bias affect the quality of the decision process of VCs.

Illusion of Control. Simon & Houghton find that entrepreneurs experience illusion of control when they perform an active search to introduce radically new products to market [49]. For introducing radically-new products, entrepreneurs usually would find little existing information available, and should they actively look for such information, they would likely encounter few competitive responses, and they may therefore underestimate possible competitor responses. Therefore, the authors propose that entrepreneurs have an illusion of control on competitive responses in the business context, as well as on their entrepreneurial capabilities and successful rate (two other evaluation attributes). This illusion of control biases the entrepreneurs' decision to pursue the opportunities [49].

In contrast, entrepreneurs carry out a passive search, which is characterized by individuals receiving information passively accept information, taking the environment as a given [49], would have less illusion of control, as they don't feel they are in control of their environment and context.

Law of Small Numbers. The search for information is limited by the amount of people that the entrepreneurs can interact from. Simon & Houghton propose that the law of small numbers bias may affect entrepreneurs [49]. Entrepreneurs could believe that their samples of people talked with are representative and generalize their findings to the general market.

The law of small numbers is suspected to lead to overestimation of demand [49], which in turn triggers entrepreneurs' new venture decisions.

Expected Return Under Risk

The expected return of investment, along with the risks associated with it, has not been strictly addressed by dynamic capability literature [21,51]. However, expected returns, as well as the role of risk and performance, are well studied in the empirical literature due to its terminal importance in the evaluation of startups. Especially the role of risk and the relationship between biases and the decision to pursue a venture has been studied within this attribute [33,47].

Law of Small Numbers. Simon et al. were one of the first to analyze the relationship among cognitive biases, risk perception and decision to form new ventures [48]. They propose law of small numbers, illusion of control, and overconfidence decrease a person's perception of risk in new ventures in an evaluation model. The authors used a sample of 191 MBA Students, using a case and a survey. The results show that law of small numbers and illusion of control decrease individuals' perception of the riskiness of new ventures, and those who perceive lower risk are more likely to decide to form those ventures.

Building upon Simon et al. [48], Keh et al. replicate the study with a sample of 77 owners of small and medium-sized enterprises in Singapore [33]. The results show that law of small numbers and illusion of control have significant relationships with opportunity evaluation. Keh et al. found that risk perception fully mediates the relationship between illusion of control and opportunity evaluation but not the relationship between law of small numbers and opportunity evaluation [33].

Simon et al. discover that law of small numbers affects is mediated by risk perception in its relationship with the decision to start a venture [48]. Keh et al. discover that law of small numbers has a direct effect on opportunity evaluation [33].

Illusion of Control. Besides the findings on illusion of control by Simon et al. and Keh et al. presented above [33,48], Carr & Blettner examine the impact of illusion of control on opportunity evaluation [14]. Their study finds higher levels of illusion of control lowers decision-making quality through founders of 192 small firms in US. Time stress and prior experiences are found to magnify the effect of illusion of control on decision quality.

Overconfidence. In the study by Simon et al., overconfidence is proposed to decrease entrepreneurs' perception of risk and risk perception acts as a mediator between overconfidence and opportunity evaluation [48]. However, the authors' results do not find them to be significant. Keh et al. confirmed the non-significance and explain that a possible reason is the lack of effectiveness of survey design [33].

In venture capital, Zacharakis & Shepherd found interesting results between overconfidence and opportunity evaluation [59]. In situations when the return predicted by the VCs are more extreme (predicting a new venture to be hugely successful or hugely not), the VCs are found to be more overconfident.

Representativeness. When evaluating entrepreneurial decisions, entrepreneurs use prior information, e.g. market knowledge acquired from their prior experiences, and they could assume their prior market knowledge to be representative and good for the evaluating the market for the new ventures [7].

Analysis of Specific Results and Proposals

In general, the studies on the bias of entrepreneurs and VCs are underdeveloped, as the review indicates, there are some existing studies on the bias of entrepreneurs and VCs on some decision criteria, but the numbers of studies are few, and there are still a lot of biases left unstudied on certain decision criteria, either for entrepreneurs or for VCs. So far relatively the study of biases and heuristics of entrepreneurs has been done more extensively than those of VCs.

In table 3 we have an overview of biases not studied yet for entrepreneurs and VCs and which we considerer must be studied promptly by researches. This overview was made after analyzing and classifying the findings in the different attributes used in our framework and identifying the gaps in the research that has been done. We specify the reason why we consider being relevant to study some of these biases in a decision-making context.

Decision makers	Bias	Attribute not studied	Importance	Reasons
Entrepreneurs	Similarity	Resources, Context and Return/Risk	Low	It may not be useful, because what is similar to what can often be unclear.
VCs	Similarity	Resources and Return/Risk	Low	As in entrepreneurs, it is unclear what is similar to what.
Entrepreneurs	Availability	Return/risk	High	Your available information on return or risk affects your evaluation.
VCs	Availability	Resources, return/risk	High	VCs have available past information that impacts decisions related to resources and investment.
Entrepreneurs	Illusion of Control	Resources	High	Entrepreneurs control certain resources that they have attention on, leading to the bias.
VCs	Illusion of Control	Resources, context, return/risk	High	VCs have certain impact through equity, and they could have illusion of control.
Entrepreneurs	Representativeness	Resources	High	Important to analyze if the attributes of the new venture resemble those in similar startups
VCs	Representativeness	All	High	Important to analyze if the attributes of the new venture resemble those in similar startups

Table 3: Analysis of Potential Future Works

The study of the impact of biases and heuristics in risk perception has been studied with clear conclusions in some cases (illusion of control), however the studies have not gone to the point of analyzing how they affect ultimately to the expected returns that entrepreneurs' have of their venture. This could be of highly importance for VCs when they are valuating new ventures and for entrepreneurs in order to calibrate their expectations about the possible outcome of their endeavor.

An attribute extremely important for VCs is the expected results under risk, however it hasn't been studied from a psychological point of view. Overconfidence has been indirectly mentioned in studies about performance and reliability of VCs decisions, but there is acknowledgement about the role of other biases. We strongly consider that future research must focus in this area.

In the case of VCs it is clear that studies about biases have not gone too broad, mainly have been focused on overconfidence and similarity.

Finally future work could be focus on determining the specific effect of biases such as availability and illusion of control in VCs when they are assessing characteristics of founders and entrepreneurs. Since in the entrepreneurs' perspective it's been proven strong correlations, we should expect to find them in the VCs decision-making as well.

If the table is completed, it enables us to do comparisons of the biases of VCs and entrepreneurs. Such studies are not available now. Such studies provide pieces of scarce evidences, the only piece of information we know of in this aspect is:

Overconfidence decreases as entrepreneurs get more experiences [24]. On the contrary to entrepreneurs, VCs exhibit more overconfidence as they accumulate experiences [59].

For example, this can help to explain whether increasing experience lead to better decisions. In the judgment/decision-making literature, increasing experiences do not always lead to better decisions [13]. However, entrepreneurship literature so far proposed experienced decision-makers perform superior decision processes relative to those with less experience [20,43].

DISCUSSION

An examination of new venture evaluation using the theory of heuristics and bias has found that biases are prevalent in the evaluation decision, but there is a severe lack of studies using heuristics and biases. The limited account of studies so far have yielded very interesting results to enable better understanding of new venture decisions, however, the few results are sometimes conflicting with each other, not connected to the general findings in the heuristics and biases literature. Also because of the lack of the studies, comparisons between decision makers, among evaluation criteria, among various biases cannot be done, and therefore the implication (the 'so what' questions) of the studies cannot be discussed in sufficient depth or width.

This article is the first to review the use of heuristics and bias in entrepreneurship decision-making, an area identified to be very important for entrepreneurship a few years ago [38]. Decision-making in entrepreneurship is very susceptible to the use of biases and heuristics, because those who have high level of biases and heuristics are the very ones who are likely to become entrepreneurs [46]. The ones who are less susceptible to biases, e.g. less willing to generalize, less likely to be overconfident, and etc, will be much likely to embark entrepreneurial journeys.

Our review deepens previous overviews about prior decision-making criteria VCs employ in the screening and evaluation phase of new ventures, which has been done by Franke et al. and Kollmann & Kuckertz [26,36]. Petty & Gruber take these overviews to analyze the criteria through the entire investment process of VCs [44]. Our study is inserted in this line of research, focusing in the cognitive perspective of decision-making of VCs as well as entrepreneurs.

Our review fills the gap that exists of a cognitive study of the VCs decision-making and complementing the review made by Sánchez et al. of a cognitive approach of entrepreneurs' [50], focusing directly and more specifically in the heuristics and biases that arise in the decision-making and evaluation of opportunities.

This review contributes to help to understanding how VCs are susceptible to heuristics and biases, connect to VCs decision-making/investment literature and analyze the impact that heuristics and biases have in their decisions.

Our findings give a systematic and organized view about entrepreneurs and VCs, helping to understand the differences between decision makers, as well as variances among evaluation criteria used from heuristics and biases for each decision maker.

In this article we help bring together the study of heuristics and bias to a body of people, who are highly susceptible to heuristic and biases in their decision-making and evaluation. Our findings do not rely on experiments of students, instead we mostly focus on empirical studies on some of the most important decisions that shape the future of our economy and society.

Complementary to the future work related to the missing heuristics and biases found in our results, our review can relate to work done by several authors in decision-making of entrepreneurs and VCs. Cumming & Dai did not study the impact of local bias in the quality of the VCs investment's decision [18], as well as Franke et al. and Murnieks et al. did not address the role of similarity in decision's quality [25,41], as Zacharakis & Shepherd did for overconfidence [59]. We consider that it is relevant to contemplate this research field as future research work, it will be possible to have a systematic understanding of the impact of local bias and similarity, in order to conclude that if they have a positive or negative effect for VCs and entrepreneurs.

As Carr & Blettner analyze the impact of illusion of control in the decision quality [14], we consider that future work should measure how the belief in law of small numbers and other heuristics, such representativeness, impacts the quality of the decision-making process.

The analysis of the role of resources, based on the resource-based view, in the entrepreneurs' evaluation of opportunities show us different results. In the study made by Haynie et al., they report that entrepreneurs would pursue opportunities that differ from their capabilities if they are rare, have limits on competition and depends on the age of the firm (as the firm gets more experience, they would look for distinctive opportunities) [29]. However, Kemmerer et al. prove that of the four main characteristics of the resource-based view, entrepreneurs use only three: value, rareness and value, however they establish a negative correlation between rareness and resource importance when they evaluate opportunities [34]. This is contradictory with what was proposed in the first study, which leads to a new opportunity for future research, to determine with exactitude the role of rareness in a resource when entrepreneurs are deciding to follow a new venture.

CONCLUSION

This article is the first comprehensive review on the heuristics and biases in entrepreneurial decision-making. We found five biases that have been studied the most in the literature of decision-making, and examine their usages in the most common evaluation criteria used in new venture decisions. This systematic review pointed out the interesting results that have been studied, the conflicting findings, and the specific future works that are needed to deepen and broaden our understanding of the entrepreneurial decision-making.

This paper reviewed on role of heuristics and bias, such as overconfidence, similarity, illusion of control, availability and representativeness, in the evaluation and decision making of VCs and entrepreneurs. In order to carry out a systematic review, we categorized bias used based on five evaluation attributes (entrepreneurs' capability, organizational resources, context and expected returns under risk). The attributes were setup in a dynamic capability model and found to be useful for identifying the gaps in existing research.

The studies of heuristics and bias in their real world applications have the potential to enrich the motherland of heuristics and bias -cognitive science, a field where people often lament about the overuse of student experiments and the lack of real world settings. The study of heuristics and bias are particularly interesting in the setting of entrepreneurs' decision-making, as they are biased to risk taking and prone to action and they face extremely uncertain and risky decision's environment.

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