

The Study of Bias in Entrepreneurship

Scholars use the theoretical lens of bias to research various behavioral phenomena in entrepreneurship. We assess this body of research, focusing on definitional issues and relationships. Furthermore, we discuss how the study of bias in entrepreneurship can be advanced, given the new development in related fields such as cognitive sciences. The assessments and discussions help reveal as well as address tensions in the literature, identify numerous research opportunities that may not be obvious by looking at previous work individually, and contribute to how the theory of bias can further help to understand entrepreneurship.

INTRODUCTION

Most decisions that concern the minds and hearts of entrepreneurs are computationally intractable (Mitchell et al., 2007). Consequently the research on bias, which refers to the systematic deviation from rationality or norms in judgment and decision-making (c.f. Baron, 2007; Haselton et al. 2005; Tversky & Kahneman, 1974), becomes relevant and interesting for entrepreneurship (Shepherd et al., 2015). The theory of biases provides a unique, practical, and empirically testable perspective on decision-making in entrepreneurship (Keh et al., 2002; Zacharakis & Shepherd, 2001).

Research on biases in entrepreneurship (hereafter entrepreneurial bias) has increased rapidly since its inception and has become an important area for entrepreneurship (Krueger, 2005). Many individual papers on entrepreneurial bias have become foundational to the development of the entrepreneurship field to date. Two decades of research have demonstrated bias as a widespread phenomenon in entrepreneurship. As studies on entrepreneurial bias accumulate, a

number of issues become critical, such as the consistency in definitions, the analysis of discrepancies among studies, and the overall direction of this stream of research. Scholars have pointed out the need to reveal, understand and resolve such issues, calling a review on entrepreneurial bias to advance this important area of research (Shepherd et al., 2015).

In order to generate cumulative progress and point to future directions, we assess the definitional issues, the relationships examined using biases, as well as the situations of entrepreneurial bias research in a context of other closely related research streams.

Entrepreneurial bias research has inherited from cognitive psychology a variety of definitions of biases with variations in both conceptualization and operationalization. For example, overconfidence has three distinct definitions (Moore & Healy, 2008), which have been used interchangeably, even within a single article. The variations in definitions impede our accumulation of knowledge on entrepreneurial bias.

Scholars have examined a wide range of relationships between bias and other key constructs in entrepreneurship. This has led to a rich but somewhat disconnected body of research. To synthesize existing studies, we organize them by a typology of biases (Baron, 2007) as well as the consequences and antecedents of biases. Such organization not only facilitates the comprehension and synthesis of existing literature, but it also uncovers numerous tensions and equivocal findings. For instance, the empirical evidence does not corroborate the numerous theorizing efforts on how experience could increase or decrease certain biases.

Moreover, we situate entrepreneurial bias research in the context of the development of entrepreneurial cognition and emotion that took place after the second millennium (Mitchel, 2002; Cardon et al., 2012) and ongoing debates on bias in cognitive science (Stanovich, 2009; Tetlock & Mellers, 2002). Situating entrepreneurial bias research into its related streams of

inquiry sheds light on how we interpret bias in entrepreneurship and opens the door to further research. For example, how do we scholars view entrepreneurial biases? To date, the explanations of entrepreneurial biases often compete between the original theoretical definition of bias as errors (Tversky & Kahneman, 1974) and the empirical ground that ‘if biases are bad, how could biased entrepreneurs have created so many wonderful companies?’. Drawing from ‘the great rationality debate’ (Stanovich, 2009; Tetlock & Mellers, 2002) and research on emotion and cognition, we posit that the interpretation of biases depends on the representations of individual entrepreneurial decisions as well as the extent of the match between decision ecologies and the evolutionarily adapted mechanisms that underlie the bias.

BIAS AND ENTREPRENEURSHIP

Bias refers to the systematic deviation from rational choice theory when people choose actions and estimate probabilities (Baron, 2007; Tversky & Kahneman, 1974). The theory of bias has had enormous influence, resulting in the creation of new fields such as behavioral economics (Kahneman, 2003) and behavioral law (Jolls et al., 2000). The theory of bias is also transforming many fields – see reviews of biases in medical decision-making (Bornstein & Emler, 2001), auditing (Solomon & Trotman, 2003), accounting (Ashton & Ashton, 1995), and public policy (Rachlinski, 2004).

Biases permeate decisions in entrepreneurship, and entrepreneurs display higher levels of bias than do managers in established organizations (Busenitz & Barney, 1997). This can be due to various factors including, but not limited to, high uncertainty, information overload and velocity, a lack of historical information and organizational routines, and time pressure (Busenitz & Barney, 1997; Baron, 2004; Hayward et al., 2006; Holcomb et al., 2009; Simon et al., 2000; Zacharakis & Shepherd, 2001). Meanwhile, more biased decision-makers are more comfortable

under ambiguous, uncertain and complex decision contexts (Gigerenzer & Gaissmaier, 2011); consequently, they have an easier time making entrepreneurial decisions and are more likely to become entrepreneurs (Busenitz & Barney, 1997; Busenitz & Lau, 1996). Another influential group of decision makers in entrepreneurship, Venture Capitalists (VCs), are similarly biased in their new venture evaluation and investment decisions (Zacharakis & Meyer, 2000; Zacharakis & Shepherd, 2001).

SEARCHING, SELECTING, AND CODING RESEARCH OF BIAS IN ENTREPRENEURSHIP

Before assessing entrepreneurial bias research, to set the stage, we first lay out how we search, select and code the existing literature. Following the procedure of a systematic review (Tranfield et al., 2003), we searched literature from 1973 (the year bias research started in psychology) to January 1, 2014 for articles and analyzed their contents. The rest of this section documents this procedure.

Searching for Articles

To systematically locate the relevant articles, we integrated the approaches of Grégoire et al. (2011), Kiss et al. (2012) and Klotz et al. (2014) in a two-stage search process (see more details of the search process including the search algorithm in Appendix 1).

First, we scanned the top entrepreneurship and management journals in the Financial Times journal list: *Academy of Management Journal*, *Academy of Management Review*, *Academy of Management Perspectives*, *Entrepreneurship Theory and Practice*, *Journal of Business Venturing*, *Journal of International Business Studies*, *Journal of Management Studies*, *Management Science*, *Organization Science*, *Organization Studies*, *Organizational Behavior &*

Human Decision Processes, with the addition of *Strategic Entrepreneurship Journal* (added by the authors).

Second, we checked the articles discovered in the first step to identify an inventory of biases to create an enhanced list of keywords. The keywords include entrepreneur, entrepreneurial, entrepreneurship, venture capital or venture capitalist and specific biases identified in the previous step, such as overconfidence and illusion of control. Appendix 1 contains the exact keywords used. Lastly, we searched the list of keywords in *Scopus* database, and found 286 published or in-press articles that contained the keywords.

It is possible that relevant articles may have escaped our sampling procedures despite the use of a large database (*Scopus*). There are two possible types of omissions: articles not written in English (because of the use of English keywords) and articles that either do not mention or use a different nomenclature for a particular bias in its abstract, title or keyword list. One example is Sandri et al. (2010), which studies status-quo bias but instead calls it ‘psychological inertia’. This article has been added to our analysis thanks to a reviewer.

Selecting and coding articles

We further selected and coded the articles through a selection and coding process (Grégoire et al., 2011; Moroz & Hindle, 2012) with the following questions in mind:

Selection:

- 1) Do the articles investigate decision-making in entrepreneurship?
- 2) Do the articles study biases as part of their central inquiries, containing biases as representation, attributes, antecedents, or consequences in their theoretical models (Grégoire et al. 2011)?

Coding:

- 3) Who possesses the biases (entrepreneurs or VCs)?
- 4) What is the level of analysis?
- 5) What is the research method?
- 6) What are the independent and dependent variables, if they are distinguishable?

- 7) What are the antecedents and consequences of entrepreneurial biases?
- 8) What are the findings and proposed future directions?

The first two questions aim to select articles that study biases as entrepreneurial phenomena instead of biases in general as in the field of psychology. To examine whether the articles study biases as part of their central inquiries, we chose articles that developed specific propositions, hypotheses, and models using biases, regardless of their methodological approaches. Articles that did not develop models using biases are not included, such as those mentioning biases generally or using biases to discuss possible (non)findings.

This selection procedure resulted in 41 articles that study biases as part of their central inquiry in entrepreneurial decision-making. The selection used the two selection questions indicated previously and involved three raters, with a reliability rating of 95% based on intra-class correlation (ICC) (McGraw & Wong, 1996). Table 1 lists all of these articles chronologically. A total of 32 are empirical papers, of which 18 (56%) carried out surveys, eight (25%) conducted (quasi) experiments (including conjoint analysis), three (9%) held interviews, three (9%) used a scenario technique in which respondents read hypothetical situations and stated their presumed behaviors or attitudes, two (6%) employed case studies, and eight (25%) analyzed secondary sources. As we did not limit our search based on methodology, we included also nine theoretical papers that developed specific propositions using biases (in *italic* in Table 1). As these theoretical papers do develop specific propositions, they are similar to the ‘frontend’ of empirical papers simply without empirical testing. The specific propositions, together with empirical papers, allow us to synthesize what the field has done on entrepreneurial bias and identify future opportunities. Lastly, we have not found any review articles on entrepreneurial bias to date. None of the conceptual or empirical papers to date has examined the body of entrepreneurial bias research in its entirety.

“Insert Table 1 here”

Entrepreneurship literature has introduced eleven biases to explain entrepreneurship phenomena (Table 2). While most of these biases were investigated in just a single study, several biases have been studied repeatedly in a few articles. An examination of such studies reveals discrepancies in the conceptualization and operationalization of some of the most researched biases in entrepreneurship. Our assessment aims to examine the most prominent definitional issues in entrepreneurial bias research.

“Insert Table 2 here”

DEFINITIONAL ISSUES

The issue with overconfidence. Although overconfidence appears to be a clear and precisely defined concept on its surface, an analysis of 365 overconfidence papers by Moore and Healy (2008) uncovered three routinely muddled definitions of overconfidence: (1) over-estimation of one’s actual performance, (2) over-placement of one’s performance relative to others (better-than-average effect), and (3) over-precision of one’s beliefs in an analysis.

Studies of entrepreneurial biases have incorporated all three definitions to conceptualize and measure overconfidence. A single paper may use one definition to conceptualize and another to operationalize. For instance, eight empirical papers conceptualized overconfidence as overestimation, yet only three out of the eight papers measured overestimation accordingly (Simon & Houghton, 2003; Simon & Shrader, 2012; Zacharakis & Shepherd, 2001). Instead, four of the eight papers measured overconfidence as over-precision (Busenitz, 1999; Busenitz & Barney, 1997; Forbes, 2005; Simon et al., 2000), and one paper measured it as over-placement (Grichnik, 2008).

Additionally, two concepts that may appear similar to overconfidence, confidence and entrepreneurial self-efficacy, often appear alongside overconfidence. Confidence denotes one's subjective certainty in his or her judgments, whereas overconfidence is the difference between one's subjective certainty and his or her objective accuracy (Busenitz, 1999; Gudmundsson & Lechner, 2013). Thus, while distinct, the two concepts are clearly related to each other, and their relatedness draws the attention of entrepreneurship scholars.

Koellinger et al. (2007), empirically observing an excessive amount of confidence in entrepreneurs, reasoned that entrepreneurs must experience overconfidence and hence theoretically developed their study on the notion of overconfidence. In a paper about the confidence of entrepreneurs, Hayward et al. (2010) argued that more confident entrepreneurs are better able to cope emotionally, cognitively, socially and financially, and that these 'second order' benefits can potentially outweigh the negative consequences of overconfidence in entrepreneurs.

Hayward et al. (2010) theorized using task-specific confidence, which resembles self-efficacy. "The construct of self-efficacy differs from the colloquial term confidence." Confidence refers to strength of belief; nonetheless, it does not necessarily specify what the certainty is about. Self-efficacy denotes a belief in one's specific capabilities to generate specific attainment, and the concept of entrepreneurial self-efficacy is concerned with the self-efficacy of individuals in performing entrepreneurial decisions (Chen et al., 1998; Zhao et al., 2005). Forbes (2005) proposed that entrepreneurs with higher levels of entrepreneurial self-efficacy would be more overconfident; however, his test did not find the relationship to be significant. To capture task-specific overconfidence in entrepreneurs, Simon & Shrader (2012) developed a context-specific measure of overconfidence in entrepreneurship, or 'over self-efficacy'.

The issue with overoptimism. The concept of overoptimism differs from but overlaps with overconfidence. Overoptimism (or overoptimism bias) refers to the notion that people overestimate the likelihood of positive events and underestimate the likelihood of negative events (Sharot, 2011). It overlaps with the over-estimation form of overconfidence in case of positive events only, but not in negative events. Another subtle but important difference is that while overconfidence is related to an individual's own capabilities and performance, and thus at least partially under the control of the individual, over-optimism can be completely detached from individual's own influence (e.g. I can be overoptimistic that my favorite sports team will beat the reigning world champion even if the odds are very low and I cannot influence this odd).

Due to the overlap between overoptimism and overconfidence, many studies on entrepreneurial overoptimism unsurprisingly drew on the overconfidence literature (Cassar, 2010; Lowe & Ziedonis, 2006). Occasionally, the conceptualization of overoptimism can be very broad, where it does not specifically refer to positive events, thus blurring the distinction between overconfidence and overoptimism. For example, overoptimism was conceptualized as an over-placement of entrepreneurs' performance relative to that of others (Lowe & Ziedonis, 2006), rendering it indistinguishable from the over-placement form of overconfidence.

In this section, we illustrate the most prominent issues in the conceptualization and operationalization of well-studied biases in entrepreneurship: overconfidence and overoptimism. The in-depth analysis of definitional issues is limited to these two particular biases, because a) their definitions are close to and can be confused with several other important concepts in entrepreneurship, and b) entrepreneurship literature has studied the two biases recurrently, but with varying conceptualization and operationalization. Such issues of inheriting conceptually and empirically distinct definitions and measures from cognitive sciences may not be limited to these

two biases. Even though other biases have not been studied recurrently in entrepreneurship to show evidence of such issues, they may be prone to similar problems, which we scholars need to be cautious about. The good news is that mechanisms to distinguish and clean-up such issues in the field of psychology are underway, and have already begun to resolve inconsistent findings and long-standing theoretical arguments such as on overconfidence (Kwan et al., 2004). We believe future entrepreneurial bias research could benefit from doing the same. Otherwise, the variability in the definitions of closely-related concepts and the multitude of conceptualization and operationalization possibilities would greatly perplex and hinder the analysis, comparison, and synthesis of findings to accumulate and advance knowledge. At the very least, we entrepreneurship scholars need to be aware of the key definitional issues, which exist in the studies of biases in entrepreneurship and psychology, or fields with new concepts in general, in our effort to theorize and test relationships.

KEY RELATIONSHIPS STUDIED USING BIAS

Entrepreneurship literature has examined the relationships between biases and a diverse range of constructs including perception of risk, decision to start a venture, evaluation of opportunities, and evaluation of start-up teams (Franke et al., 2006; Keh et al., 2002; Simon et al., 2000). Overall, the relationships cluster around two themes: what factors do biases affect and what factors affect these biases? This pattern is comparable to the inputs-mediators-outcomes framework in reviews on many topics, e.g., new venture teams (Klotz et al., 2014), multimarket competition (Yu & Cannella, 2012) and corporate social responsibility (Aguinis & Glavas, 2012).

For the purpose of theoretical identification, we introduce a typology of biases (Baron, 2007). The typology organizes biases theoretically into three types based upon the mechanisms that they

depart from normative models. To reflect these underlying mechanisms, we will name the three main types as: *make-happy*, *sketchy-attribute*, and *psycho-physics* and explain them one by one.

First, the '*make-happy*' type includes biases that result from the effects of goals or desires on beliefs (Baron, 2007). People often adopt beliefs that make them happy or comfortable. For example, people selectively expose themselves to evidence and assimilate positive evidence, happily neglecting neutral or negative evidence, at least before they suffer the consequences of acting on these beliefs. The mechanism of this type of bias invokes not just cognition but also emotion, coinciding with the current surge of interest in entrepreneurial emotion research (Baron & Tang, 2011; Baron, 2008; Cardon et al., 2012). Three biases of this type: overconfidence, overoptimism and self-attribution, have appeared in entrepreneurship literature.

Second, the '*sketchy-attribute*' type of bias describes the behaviors of attending to one attribute when other attributes are more relevant (Baron, 2007). The attribute in question captures our attention because it is the result of recent or memorable events, it is a good indicator for another attribute in another context, or it is mistaken as a salient or useful indicator due to humans' limited capacity for information processing (Bless et al., 2004). These biases largely arise from cognitive mechanisms, and many biases of this type (such as availability, representativeness, the illusion of control, similarity, local bias, the law of small numbers, status-quo, and hindsight bias) are found in the entrepreneurship literature.

Third, the '*psycho-physics*' type of bias refer to the distortion in our perception of quantitative attributes (Baron, 2007). Our sensitivity usually diminishes as intensity increases. The archetypal biases in this type include overweighting low probabilities (Kahneman & Tversky, 1984) and framing effects for gains/losses (Levin et al., 2002). This type of bias is highly relevant to entrepreneurship, as will be discussed in subsequent sections. Nevertheless,

our systematic search has not yielded studies on this type of bias in entrepreneurship literature to date, and there are many fascinating avenues of research that may be pursued.

We choose Baron's typology over other categorizations, such as Tversky and Kahneman (1974) and its updated version in Kahneman and Fredekerik (2002), because Baron's typology is based on how biases arise, different from other categorizations, which classify based on how biases are discovered, which is important for psychologists (Baron, 2007). In addition, the other categorizations cannot properly account for overconfidence bias, putting it into more than one category (Russo & Schoemaker, 1992; Sánchez et al., 2011). The use of the typology of biases as well as their consequences and antecedents as a framework helps to identify the skeleton of the existing literature and to reveal possible tensions. Figure 1 (a and b) gives an overview of the existing relationships between bias and many other constructs in entrepreneurship. As the figure illustrates, the entrepreneurship literature includes a wide range of these relationships. Our goal is not to catalog the merit of all the individual relationships exhaustively, but instead to interweave and highlight where the literature gravitates, where theoretical and empirical tensions surface, and where interesting future research opportunities are high.

"Insert Figure 1a and 1b here"

First, we will present the key issues in the consequences of each type of biases and then the issues in their antecedents. The presentation of consequences precedes that of antecedents because in general entrepreneurship literature first concerned with whether and how biases would matter in entrepreneurship, before pursuing the antecedents of the biases. Similarly to the definition issues we discussed, we will analyze key relationships in which tensions exist or possibilities to surface future research opportunities are high. Thus not all relationships or biases

will be analyzed in the following section. When necessary, we also provide short in-section remarks to summarize the nuanced tensions or to point to specific future opportunities.

‘Make-Happy’ Type of Bias

Consequences of Bias

On risk-taking. Entrepreneurship requires a significant amount of risk-taking, and entrepreneurs display a greater amount of overconfidence and overoptimism than non-entrepreneurs (Busenitz & Barney, 1997; Grichnik, 2008; Sánchez et al., 2011); therefore, scholars have attempted to use biases to explain entrepreneurial risk-taking. Scholars theorized that the biases of overconfidence and overoptimism make entrepreneurs overlook uncertainty and potential negative outcomes, thereby decreasing risk-perception and increasing risk-taking behaviors in new ventures (Cooper et al., 1989; Simon et al., 2000). However, the various attempts to test such reasoning have produced equivocal results to date.

Earlier studies uncovered that overconfidence empirically increased the likelihood of risky decisions, such as the decision to expand ventures (Mccarthy et al., 1993). Follow-up studies proposed that overconfidence would decrease risk perception (a mediator), thereby increasing new venture decisions (Simon et al., 2000) and boosted the evaluation of opportunities (Keh et al., 2002), however they were not empirically confirmed. Likewise, overoptimism failed to significantly explain entry decisions, – a key risky entrepreneurial decision (Lowe & Ziedonis, 2006). Nevertheless, evidence from international entrepreneurship research using data from Germany and the US confirmed that overconfidence decreases risk perception and consequentially induces riskier behaviors and decisions of entrepreneurs (Grichnik, 2008). In addition, research confirmed the relationships between overconfidence and project-level risk-taking behaviors, such as introducing riskier products (Simon & Houghton, 2003).

In a quasi-experiment, Wu and Knott (2006) separated the rational component of risk-taking behavior (to capture the real options values of risk-taking) and the irrational component of overconfidence. They found overconfidence to contribute to new business entry. However, in contrast, a later analytical study by Hogarth and Karelaia (2012) attribute the entry not to overconfidence or to any systematic bias, but instead to imperfect judgment.

Meanwhile, conceptually scholars continued to use overconfidence to develop theories of entrepreneurial risk-taking. For instance, Hayward et al. (2006) developed a well-recognized hubris theory proposing that more overconfident entrepreneurs display risky behaviors, such as starting ventures with fewer resources but committing greater resources of their own, underestimating the need for key resources, but overestimating their own abilities.

In summary, despite strong theorizing effort, research exploring the impact of bias on risk-taking has not yet amassed a consistent empirical foundation on which to build strong conclusions. The inconclusive relationships could be due to situational factors, as suggested by Grichnik (2008). Future research could dive deeper into person-situation interactionist models to identify specific situational factors that could interact with overconfidence to trigger risk-taking.

On performance measures. Overconfidence and overoptimism carry both positive and negative effects on performance; however, their positive effects and negative effect are due to distinct theoretical reasons.

The negative effects of overconfidence and overoptimism gain their theoretical foundation directly from the classical heuristics and bias research program, which originally deemed biases as systematic errors in decision-making (Kahneman & Tversky, 1996). If biases are errors, researchers in entrepreneurship consequently become interested in whether biases in entrepreneurial decisions impact new venture performance. Theoretical studies have argued that

overconfidence leads to underestimation of competitive response or overestimation of demand. The inappropriate estimations in turn generate riskier and less successful outcomes (Simon & Houghton, 2002). For instance, Hayward et al. (2006) reasoned that overconfident founders maintain low liquidity, which increases the likelihood of failure. This line of reasoning is also in line with evidence in many industries that involve high risk-taking, such as banking and market entry, where greater overconfidence causes failures (Wu & Knott, 2006; Camerer & Lovo 1999).

Empirical evidence in entrepreneurship confirmed that overoptimism prolongs entrepreneurs' unsuccessful development efforts, resulting in wasted resources, lower levels of employment and reduced revenues (Lowe & Ziedonis, 2006). In addition, overconfident entrepreneurs tend to underestimate competition, under-resource their ventures, rely less on external networks for relational resources, and introduce riskier products. All of these behaviors lower the likelihood of their ventures' survival (Gudmundsson & Lechner, 2013; Koellinger et al., 2007).

The positive effects of biases get their support primarily from theories on fast-and-frugal decision-making as well as theories on emotions. Motivational theories reason that overconfidence and overoptimism increase the motivation to initiate entrepreneurial action (Cassar, 2010; Simon & Shrader, 2012), heighten resilience and work effort, and help to cope with setbacks and failures during the entrepreneurial processes (Hayward et al., 2010). Overconfidence and overoptimism induce higher ability and outcome expectations, thereby enhancing performance (Van Eerde & Thierry, 1996). The interpretations of these biases will be further discussed later.

Antecedents of Bias

The role of experience. Past experiences in part influence human behaviors (Winter & Nelson, 1982). More experienced decision-makers rely more on intuition, thereby developing a sense of security and confidence that could potentially be unfounded (Macmillan et al., 1987). Following these theories, entrepreneurship scholars proposed various relationships between experience and bias but yielded inconclusive results. First, Zacharakis and Shepherd (2001) proposed a positive correlation between experience and overconfidence in VCs, but did not find it to be empirically significant. In another study using conjoint analysis, Shepherd et al. (2003) discovered that as the experience of VCs increased, their decision accuracy at first grew and then decreased after an optimal level of 14 years; their explanation is that VCs become more overconfident as they age. In a complementary vein, Hayward et al. (2006) proposed that entrepreneurs with prior experience in founding successful ventures become more overconfident, despite the fact that their new ventures differ from their previous ones.

Such reasoning is rejected by empirical results that younger entrepreneurs were more overconfident than older entrepreneurs (Forbes, 2005) and nascent entrepreneurs were more confident in their skills, knowledge, and experience than serial entrepreneurs (Koellinger et al., 2007). Forbes explained that older managers were less overconfident because they sought more information and took longer to make a decision than did younger managers (Taylor, 1975).

On the surface, the results of Forbes (2005) and Koellinger et al. (2007) seem to largely refute prior theoretical developments (Shepherd et al., 2003; Hayward et al., 2006). However, experience is a complex concept (Shepherd et al., 2003) that could mean many different things such as the number of past ventures, the number of successful ventures, years of business experience, or even age. In addition, one needs to consider the quality of the experience, e.g.

whether positive or negative. The roles of the decision makers (entrepreneurs, VCs, students in entrepreneurship programs, etc.) and the context of each experience could also matter. Therefore, the relationships between experiences and biases are inconclusive at best and offer an interesting avenue for further research at both between-person and within-person levels. An alternative direction is to investigate not only experience as an antecedent of overconfidence but also the interaction effect of experience and overconfidence on decision quality or performance.

The easiness/difficulty of decision tasks. The difficulty of a decision affects overconfidence in an interesting manner. When a task is easy, people choose to enter markets overconfidently because they believe that they are better than average (over-placement); when a task is difficult, they become under-confident about entering because they believe they are worse than average (under-placement) (Moore & Cain, 2007). On the contrary, in the case of another form of overconfidence, overestimation, people overestimate their performance when tasks are difficult and underestimate their performance when tasks are easy (Moore, 2008). Therefore the difficulty of decision task influences over-placement and overestimation in opposite ways.

Interestingly, many factors that could increase the difficulty of decision tasks have been proposed to positively correlate with overconfidence, such as environmental complexity and environmental dynamism (Hayward et al., 2006; Simon & Shrader, 2012), the riskiness of the contexts (Simon & Houghton, 2003), unfamiliar contexts (Zacharakis & Shepherd, 2001), pioneering of product introduction, and the hostility of the environment (Simon & Shrader, 2012). All these proposed relationships were supported by empirical evidence, except for environmental dynamism, which was negatively correlated with overconfidence in a sample of 55 owners of small computer companies (Simon & Shrader, 2012).

We need to note that all aforementioned relationships between contextual factors and overconfidence in entrepreneurship treat overconfidence exclusively as ‘overestimation’ (Simon & Houghton, 2003; Zacharakis & Shepherd, 2001; Simon & Shrader, 2012; Hayward et al., 2006). These contextual factors complicate decisions and increase the difficulty of decision-making; thus, they should increase overestimation and decrease over-placement. It can be interesting for management scholars to study also over-placement in situations of varying difficulty of decision tasks. It can also be important to formally examine how task difficulty might mediate the relationships between contextual factors and overconfidence.

The role of (dis)trust. Trust creates confident expectations, rendering the trusting party more comfortable about ambiguous or unclear situations (Rousseau et al., 1998). Along this line of logic, entrepreneurship research has proposed that the trust the entrepreneurs have in their networks increases overconfidence (De Carolis & Saporito, 2006).

Subsequently, Gudmundsson and Lechner (2013) revealed empirically that distrust (negative expectations in others) was positively associated with overconfidence. They reasoned that a distrusting entrepreneur would be reluctant to delegate tasks to or seek assistance from others (Gino & Moore, 2007), behaviors that could intensify miscalibration and lead to overconfidence. The contrasting relationships between (dis)trust and overconfidence in De Carolis and Saporito (2006) and Gudmundsson and Lechner (2013) appear to be a paradox. Still, while many studies equate distrust with lack of trust, treating them as opposites (Gans et al., 2001; Omodei & McLennan, 2000; Ziegler & Lausen, 2005), neuroscience evidence considers trust and distrust distinct phenomena (Dimoka, 2010): trust deals with positive expectations about the trustee’s beneficial conduct, and distrust deals with negative expectations about the trustee’s harmful conduct (Cho, 2006; Xiao & Benbasat, 2003). Trust and distrust should bear different

relationships with their antecedents and effects (Lee & Huynh, 2005). Thus, future research awaits to disentangle the relationships between trust, distrust and bias. An additional research opportunity is to study this relationship in the reverse direction, i.e. how overconfidence and overoptimism might influence trust or distrust, because more biased entrepreneurs might be more prone to trust or distrust others.

‘Sketchy-Attribute’ Type of Biases

Consequences of Bias

On risk-taking. Similarly to the ‘*Make-Happy*’ biases, scholars pay significant efforts to investigate how ‘*Sketchy-Attribute*’ biases influence risk-taking (see Figure 1b), theorizing that biases decrease the perception of uncertainty and thus increase risk-taking behaviors. Empirically, the various attempts to test such reasoning have thus far yielded inconclusive results. Simon et al. (2000) found that the biases of illusion of control and the law of small numbers decreased individuals’ perceptions of the riskiness of new ventures and hence increased new venture decisions. Simon et al. (2000) also proposed risk perception to fully mediate the relationships, but empirically the mediation turned out to be partial.

Building on research by Simon et al. (2000), Keh et al. (2002) studied the evaluation of opportunities instead of new venture decisions as the outcome variable in their models, and empirically found that risk perception fully moderates the relationship between the illusion of control and the evaluation of opportunities. Furthermore, Keh et al. also found that the law of small numbers had a direct effect on opportunity evaluation without the mediation of risk perception.

Building upon these findings, De Carolis and Saporito (2006) developed a conceptual model in which the illusion of control and representativeness decrease risk perception, thereby leading

to the exploitation of entrepreneurial opportunities. Part of the model was later tested and confirmed; illusion of control and risk propensity were found to positively correlate with the progress of a new venture (De Carolis et al., 2009).

Barbosa and Fayolle (2010) further extended the model to include an availability bias. The availability of new information expressed in negative (positive) terms was found to increase (decrease) the perceived risk associated with a new venture, thus reducing (increasing) individuals' willingness to start the venture.

On performance. Biases of the *sketchy-attribute* type have important implications on performance, since these biases originally denote errors in decision-making (Tversky & Kahneman, 1974). However, few researchers have examined these effects. To date, only the illusion of control has been linked to performance-related measures. Carr & Blettner (2010), citing evidence that bankers with greater illusions of control obtained worse trading results, tested the hypothesis that illusion of control lowers the performance of entrepreneurs in their decision-making. Similarly, De Carolis et al. (2009) found illusion of control to be positively correlated with new venture progress – a performance related measure. This stream of research is still incipient, with few articles largely disconnected from one another. Studies examining the performance implications of these biases need further development by assessing multiple and more direct performance indicators such as new venture survival and returns under uncertainty.

On new venture evaluation. Similarities between VCs and entrepreneurs, in demographic factors, work value congruence, and perceived power equality, were proposed to positively bias VCs' willingness to invest (Cable & Shane, 1997). Empirically, VCs evaluate more positively new ventures founded by entrepreneurs who have similar type of education and previous

working experience (Franke et al., 2006) or similar process and nature of decision-making (Murnieks et al., 2011).

Antecedents of Bias

Social capital. The social networks of entrepreneurs matter for biases. For instance, the structural holes in an entrepreneur's network enable access to various information sources, increasing the entrepreneur's beliefs about his or her knowledge base (Cohen & Levinthal, 1990). Adopting network theory on social capital, De Carolis and Saporito (2006) proposed that these structural holes could predict illusion of control and that the strength of network ties could predict representativeness bias. Later, De Carolis et al. (2009) theorized and empirically confirmed that the extent of an entrepreneur's social network and personal capital would enhance shared attitudes and mental models, which in turn would increase illusion of control. This line of study between network positions and entrepreneurial behaviors has enormous potential, because virtual entrepreneurship on social networks has been growing exponentially. Virtual entrepreneurs on a virtual social network "second life" in 2009 alone earned US\$55 million (Rosenwald, 2010). Virtual social networks contain 'big data', opening unprecedented new research opportunities in social, behavioral, and economic sciences (Bainbridge, 2007).

Looking through the literature, studies on the *sketchy-attribute* type of biases have produced fewer discrepancies and inconclusive results than have studies on *make-happy* type of biases, and this could be due to two reasons. First, the studies of *sketchy-attribute* biases are highly fragmented and disconnected to one another, thus having less opportunity to yield contrasting results (See Figure 1b for six different antecedents studied in the social capital theme alone). Second, biases in the *sketchy-attribute* do not carry as much emotional and motivational implications as the biases in '*make-happy*' do, and therefore the relationships are less complex.

‘Psycho-physics’ Type of Biases

Our search did not yield any research that studied biases of this type, and we believe that this represents a key gap for future research. We will use two short examples to illustrate the importance of research on *psycho-physics* type of biases.

The *psycho-physics* bias describes a distorted perception of probability in which one underestimates medium and high probabilities and overestimates lower probabilities (Kahneman & Tversky, 1979). Given the low probability of success of many entrepreneurial projects, especially those involving new and risky technology, future studies could describe whether entrepreneurs’ perceptions of new venture success are biased differently across ventures with different likelihoods of success (e.g. 0.001% vs. 0.1% vs. 10% vs. 50%).

Another instance of bias occurs when people perceive the difference between a prize of \$10 and \$20 subjectively to be larger than the difference between \$1,010 and \$1,020 (Baron, 2007). In entrepreneurship, we could ask “is there a difference in perception between a VC investing \$1 million or \$1.1 million in a start-up versus 0.1 million or 0.2 million? What is the impact of this difference?”

Entrepreneurship deals with numbers often in a manner of nested real options that are non-intuitive and often exceed the bounded rationality of decision makers (McGrath & Desai, 2010; Zhang & Babovic, 2011), thus the *‘psycho-physics’* type of biases, i.e. the study of the distortion in entrepreneurs’ perception of quantitative attributes, can be highly pertinent and a potentially rich source of future study.

Future Research Recommendations on Using Biases to Study Relationships

In assessing the biases and the relationships studied, we realized the paramount need to pay attention to even highly nuanced differences in defining biases. The inconsistent findings on

relationships to date, as reviewed above, could be in part due to high variation in the conceptualization and operationalization of biases. Prior research has often attributed empirical non-findings to measurement issues (e.g. Keh et al., 2002). Adopting precise and consistent definitions and measures may not only help resolve the outstanding controversies, but can also facilitate possible future meta-analysis and the inclusion of moderators to push forward finer models of the entrepreneurial phenomena using bias theory. As yet a vast majority of studies have limited themselves to the examination of direct effects. Few have studied the interactions between biases and other factors, such as risk perception (Grichnik, 2008; Keh et al., 2002; Simon et al., 2000) and prior experience (Carr & Blettner, 2010). Of additional interest is the possibility of nonlinear effects (e.g. Shepherd et al., 2003) to gain a more nuanced understanding.

To yield finer models, multilevel analysis in entrepreneurial decision-making presents a promising opportunity for future research (Shepherd, 2010). Multilevel studies can potentially reveal the biases of teams and biases of entrepreneurs in teams to reflect on how recursively biases operate within a team and feedback on those biases. This topic is very pertinent because teams, rather than individuals, make many entrepreneurial decisions, yet to date almost all studies on entrepreneurial biases are at the individual level (see Gudmundsson & Lechner (2013) for a rare exception). Future research may explore if and how team-based decision-making is biased and may also address how individual biases impact team decision-making. Future research should also examine how making decisions in a team may alter the biases of individuals; for example, individuals may exhibit different biases or different degrees of bias when making decisions in a team, versus making them alone.

Such multi-level research can also untangle the impact of cultural contexts. Existing research has examined several country settings outside of the US, including Singapore (Keh et al., 2002),

Australia (Shepherd et al., 2003), Austria (Franke et al., 2006), Germany (Burmeister & Schade, 2007; Franke et al., 2006; Grichnik, 2008), the Netherlands (Ebberts & Wijnberg, 2012), and Iceland (Gudmundsson & Lechner, 2013). These studies provide insights into the generalizability of findings across cultural and national borders. Future research could include international samples in their designs, as in Koellinger et al. (2007), who found that while biased perceptions had a crucial impact on new business creation across eighteen countries, people of certain cultures have a more natural tendency towards overconfidence than others. Similarly studies in cognitive sciences have reported persistent cross-cultural variations in overconfidence: for instance, people of Chinese culture on average are more overconfident (Yates et al 1997; Yates et al 1998). Cultural and institutional differences could moderate the relationships between biases and other entrepreneurial constructs.

Lastly, future research design on entrepreneurial biases may consider theorizing and measuring uncertainty, not just risk. When confronting risk, decision makers know the probabilities of all outcomes for all alternatives; however, when confronting uncertainty, probabilities are unknown or unknowable (Knight, 1921), which more appropriately reflect the decisions in entrepreneurship (Baron, 1998; Busenitz & Barney, 1997). On a neurological level, decision-making under risk differs from decision-making under uncertainty (Volz & Gigerenzer, 2012). Thus, entrepreneurial bias literature should adopt uncertainty in addition to risk.

SITUATING ENTREPRENEURIAL BIAS RESEARCH

Thirty years after the publication of the first article on bias (Tversky & Kahneman, 1974), the bias research program has progressed greatly in cognitive sciences; moreover, entrepreneurship as a field meanwhile has prospered and advanced on many fronts. In this section, we attempt to situate entrepreneurial bias research in the context of the research streams developed subsequent

to the original publication of bias, such as entrepreneurial cognition (Mitchell et al., 2002), entrepreneurial emotions (Cardon et al., 2012), the ‘great rationality debate’ (Stanovich, 2009; Tetlock & Mellers, 2002), and studies of biases in other fields. These streams of research have either taken off lately or have made substantial new development, holding fundamental implications for entrepreneurial bias research.

The Tie to Entrepreneurial Cognition Research

Entrepreneurial bias research started as one of the first works on entrepreneurial cognition in the mid-1990s (Bird, 1992; Busenitz & Lau, 1996; Mitchell et al., 2002). Entrepreneurial bias research much exemplifies entrepreneurial cognition research in general, which aims to understand how entrepreneurs consciously or subconsciously reject elaborate and complex decision-making procedures (Mitchell et al., 2007).

Bias, along with heuristic, intelligence and knowledge, are some of the most studied themes in cognitive psychology that can lend themselves easily to the studies of entrepreneurship (Frese, 2009; Frese & Gielnik, 2014). Heuristic, intelligence and knowledge all have inherent connections with bias.

Heuristics refer to simplifying shortcuts or principles that people use for problem solving and information processing (Baron, 2007; Kahneman & Tversky, 1982; Wilcox, 2011). Thus heuristics are fast-and-frugal, freeing people from making a complete and systematic processing of information, which can often be impossible in entrepreneurship or management in general (Manimala 1992; Bingham & Eisenhardt, 2001). Because heuristics simplify information processing, they are associated with biases: systematic departures from the normative rational theory (Kahneman & Tversky, 1982; Gilovich et al 2002). However the implications of many heuristics in entrepreneurship, such as those discovered early on (Manimala 1992), on biases are

unknown. Moreover, effectuation, a new theory in entrepreneurship, suggests that entrepreneurs use a set of heuristics to make decisions (Sarasvathy, 2001), and the relationships between these effectual heuristics and biases warrant theoretical discrimination and empirical identification. For example, intelligence correlates with the tendency to avoid some biases but not some others (Stanovich & West, 2008), yet to date, intelligence has been missing either as an antecedent or as a moderator in studies of entrepreneurial biases. Knowledge, especially “highly developed, sequentially ordered knowledge” known as entrepreneurial expert script, can bias entrepreneurs towards commitment engagement (Mitchell et al., 2000; Smith et al., 2009) and hence have important implications for entrepreneurial bias research (Mitchell et al., 2008).

In short, the study of biases has evolved to be a pillar of entrepreneurial cognition research, yet biases are not just cognitive phenomena; they also have roots in emotions.

Affect Matters, Especially For ‘Make-Happy’ Type of Biases

In folk decision analysis, emotion appears antithetical to rationality (Haidt, 2001); thus, unbiased thinking necessitates the eradication of the influences of emotion. In scientific studies on affect, which includes emotion, moods, and feelings, the absence of critical biases such as overoptimism leads to depression and anxiety, and the presence of overoptimism benefits physical health and is linked to greater activation (Sharot, 2011). Overconfidence produces a crucial byproduct, positive affect (Armor & Taylor, 2002; Lyubomirsky et al., 2005).

The role of affect in bias is particularly relevant to the *make-happy* biases. These *make-happy* biases arise not because people take inappropriate attributes (*sketchy-attribute* type), or distort large or negative numbers (*psycho-physics* type), but precisely because they produce positive affective benefits. *Make-happy* type of biases reduce anxiety and depression and increase action (Sharot, 2011). The benefits of positive affect due to the bias may compensate for short-term loss

in certain cases. Shepherd et al. (2009), in a similar vein, reasoned that many entrepreneurs do not immediately drop failed projects despite financial costs so as to better adjust their emotions for subsequent entrepreneurial actions.

Due to the mechanisms underlying the *make-happy* type of biases, affect has critical implications. While biases of this type could result in less optimal short-term decisions, the affective benefits could lead to better well-being and performance outcomes (Puri & Robinson, 2007). Future studies of the *make-happy* biases should examine these biases not only as cognitive phenomena but also as affective ones.

For *sketchy-attribute* type of biases, their mechanisms are primarily cognitive, and thus their relationships with affect are less direct and obvious. Even so, they still have indirect but fundamental connections with affect. First, emotions have adaptive regulatory effects on cognition that can facilitate or impede rationality (Stanovich, 2009) through the appraisal dimensions of affect (Foo, 2011). Furthermore, valence and activation theories posit that affect carries directive properties that influence cognition. For example, positive affect (such as joy) relates to the broadening of psychological processes, such as divergent thinking (Fredrickson, 2001). Negative affect (such as sadness) in contrast leads to the narrowing of attention and to activities that promote self-preservation (Clore et al., 1994). The activation function of emotions also impact cognition, as high activating emotions (such as excitement or anger) also correlate with the narrowing of psychological processes (Harmon-Jones & Gable, 2008). Whereas low activating emotions (such as relaxation or despondency) broaden psychological processes, leading to diffuse attention (such as detachment) (Gable & Harmon-Jones, 2010).

In the reverse direction, biases could influence the appraisal and therefore alter emotion. For instance, entrepreneurs can be overconfident in their appraisal of venture progress, judging a

setback in the eyes of a rational decision-maker as a normal pace of progress, and as a consequence the entrepreneurs will feel less negative emotions.

Since research has shown that emotions and biases both influence risk perception, entrepreneurial behaviors, and opportunity evaluation (Foo, 2011; Hahn et al., 2012; Podoyntsyna et al., 2012), the interactions between cognitive biases and affect on entrepreneurial actions offer potentially interesting new lines of inquiry (Foo, 2011).

In conclusion, various theories agree that affect influences heuristics and biases (e.g., Baron, 2007; Mackie & Worth, 1989; Park & Banaji, 2000), and thus research on entrepreneurial behavior and decision-making should not separate cognition from affect, another emerging stream of research in entrepreneurship (Baron, 2008; Foo et al., 2009; Foo, 2011; Shepherd et al., 2009; Cardon et al., 2012).

Do We Interpret Biases As Bad Or Good? - The ‘Great Rationality Debate’

As entrepreneurship scholars follow the path of cognitive scientists in documenting numerous biases and analyzing them, it is worthwhile to note that cognitive scientists have since started a huge debate about the interpretation of biases as decision errors.

Some scholars in cognitive sciences lament the pessimistic view of biases as errors and instead advocate biased decision-making as fast-and-frugal and well performing (Goldstein & Gigerenzer, 2002). New evidence suggests that biased decision-making, which relies on few cues and ignores most accessible information (e.g., recognition heuristic and “take-the-best”), leads to accurate judgments (Bröder & Eichler, 2006; Goldstein & Gigerenzer, 2002; Rieskamp & Otto, 2006; Todd & Gigerenzer, 2003, 2007).

Scholars reason that biased decision-making is a product of evolution: while it does not work well in artificial settings (such as working with probabilities), it is well-adapted to tackle

naturalistic decisions under constraints of time, knowledge, and computational capacity (Rieskamp & Hoffrage, 2008). As a consequence, cognitive biases have a beneficial evolutionary explanation and are not simply errors (see chapter 4 of Brase et al., 1998; Cosmides, 1996; Rode et al., 1999).

The academic debate on how much irrationality to attribute to human cognition has been so intensive and fundamental that cognitive scientists named it ‘the great rationality debate’ (Cohen, 1981; Gigerenzer, 1996; Kahneman & Tversky, 1996; Stanovich, 1999; Stein, 1996; Winterfeldt & Edwards, 1986).

To date, the ‘great rationality debate’ has largely not propagated to entrepreneurship research. Other than the notable exception of Bryant (2007) that takes a positive stance towards bias using the ecological approaches to decision making, the majority of entrepreneurial bias studies explicitly or implicitly adopt the classical view of bias by Kahneman (1973). Studies adopting this view have examined the negative connotations of biases, such as on inadequate estimation of demand and competition (Simon & Houghton, 2002), and poor decision quality of entrepreneurs (Carr & Blettner, 2010) and VCs (Zacharakis & Shepherd, 2001). Nevertheless many papers on entrepreneurial bias have also discussed the possible benefits of biases (c.f. Cable & Shane, 1997; Coval & Moskowitz, 1999; Cumming & Dai, 2010; Sandri et al., 2010).

What Does The ‘Great Rationality Debate’ Mean To Entrepreneurship Research?

To examine better the pros and cons of bias in entrepreneurial decision-making, we think that it is timely to bring the ‘great rationality debate’ to the entrepreneurship field. The two camps of the ‘great rationality debate’ differ on two fundamental issues: *decision ecology* and *decision representation*.

Decision ecology matters - whether biased decision-making serves us well depends on the ecology of the decision. In situations where the decision ecology and ancient evolutionary ecology overlap, biased decision-making tends to work. For example, the general public performed equally as well as experts in predicting the winners of 2003 men's Wimbledon tennis tournament, even though the public adopted just one simple recognition heuristic: predict the player whose name you recognize more than the others. The same recognition heuristic however, when used in situations where the decision ecology is different, such as to choose financial services, overwhelmingly underperforms (Bazerman, 2001).

While our brain has evolved to make fast and frugal decisions for survival across the Pleistocene environment, at times our brain may be maladaptive in the modern world decisions. The key challenge is to identify the relevant ecology for each particular decision, in our case, each decision that entrepreneurs make in the contemporary world. For decisions that require entrepreneurs to work effectively with technological acceleration, network externality, virtual environments, a failure-tolerating culture, or optionality in venture growth, for instance, the ability to override our natural fast-and-frugal responses takes on great importance (Einhorn & Hogarth, 1981). In situations that require entrepreneurs to perform tasks that humans have been doing relatively consistently since Pleistocene era, such as building relationships, leading teams, or understanding customers, some of the biased fast-and-frugal decision-making could still serve us exceptionally well.

Decision representations matter too. Many experiments in cognitive science show that if the decisions are represented "in a format that meshes with the way people naturally think about probability, they can be remarkably accurate" (Pinker, 1997, p. 351).

We need to be cautious about the extent to which the representation of our current world meshes with our evolutionarily designed cognitive mechanisms. For example, while psychologists show that representing probability as frequency can eliminate bias, probability still abounds because it allows better algorithmic and statistical operations. The representations of information in many new venture decisions do not correspond with how *homo sapiens*' brains naturally respond. This discord between information representation and one's natural response may happen when entrepreneurs try to compare deals from VCs and banks, decide whether to develop or buy a technology, or securitize the footnote of legal documents of foreign suppliers. The modern world presents many abstract and non-naturalistic decision environments, which require us to override the natural representations that first take place.

However, the natural representations still function well enough for us to accurately discern faces, infer the intentions of others, and carry out many other computationally-heavy tasks without expending much cognitive effort. For countless tasks, our naturalistic representations perform at a level that the best artificial intelligence software today can only envy.

In summary, the performance of biased decision-making depends on decision ecologies and representations. Thus, the extent of the match between evolutionarily-adapted mechanisms and the representations called for in entrepreneurial decision situations, become essentially the puzzle which entrepreneurship research should seek to untangle.

In Light of the Study of Bias in Other Fields

Many other fields have similarly reviewed biases in decision-making in their respective flagship journals, such as medical decision-making (Bornstein & Emler, 2001; Elstein et al., 2002), jurisdiction (Langevoort, 1998), behavioral auditing (Shanteau, 1989), behavioral economics (Kahneman, 2003), and public governance (Rachlinski, 2004). Comparing the studies

of bias in those fields with ours in entrepreneurship, we identified the issue of debiasing (Pronin et al., 2002) to be notably missing in entrepreneurship research as well as management research in general (Milkman et al., 2009).

Simple cognitively effortful debiasing attempts can actually exacerbate bias, and such alleviating of bias involves cognitive and emotional capabilities (Hodgkinson & Healey, 2011). Often, biases can be altered instead by variation of setting, accessibility of content, experiences (Sanna & Schwarz, 2003), and entrepreneurial approaches such as effectuation and causation (Zhang et al., 2014). Decision aids, from simple checklists to expert systems, are popular debiasing tools for a wide range of applications such as health treatments, screening decisions (O'Connor et al., 1999; Stacey et al., 2011), and risk communication (O'Connor et al., 2003). In fact, practitioners of entrepreneurship do use decision aids in many forms. For example, VCs often use spreadsheets or evaluation forms containing lists of criteria to facilitate the systematic evaluation of new projects (Petty & Gruber, 2011). Many entrepreneurs use the *Business Model Canvas* to avoid omitting important aspects of business models. Studying the effects of decision aids on bias could be relevant and valuable for practicing communities.

Lastly, other fields such as finance and marketing have studied some biases that have yet to appear in entrepreneurship literature but could heavily shape the future of entrepreneurship research. For instance, the base rate fallacy, which describes the tendency to ignore base rate information and instead focus on specific information (Baron, 1994), and irrational escalation, a phenomenon by which people justify increased investment in a decision based on the cumulative prior investment and despite new evidence suggesting that the decision was probably wrong, could happen in new venture evaluation. Table 3 lists a number of biases unstudied to date for future research considerations.

“Insert table 3”

DISCUSSION AND CONCLUSION

Scholars have used the theory of bias to study various decision-making phenomena in entrepreneurship. While this body of research has yielded many interesting insights, it also is ridden with definitional disagreements, equivocal relationships, and overdue connections to advancements in other relevant research streams. In order to generate cumulative progress, we have critically examined this body of research and unveiled a range of interesting issues and future research opportunities.

Definitional disagreements are normally expected during the initial phase of new and important theories (Gladwin et al., 1995), but should be subsequently resolved both conceptually and operationally. Equivocal results signal the formation of certain initial common grounds of interest and suggest clear avenues for future research to reach convergence or breakthroughs. Moreover, it is beneficial to keep an eye on relevant adjacent research fields and leverage their new development to further the study of bias in entrepreneurship. In this regard, advances in cognitive sciences are particularly important in furthering theoretical development. For instance, entrepreneurship scholars have accumulated significant evidence both for and against biased decision-making in entrepreneurship. However, underlying such descriptive evidence, parsimonious and general theoretical explanations have not been easy to construct. This is clearly an area that can greatly benefit from stronger ties to the research of biases in cognitive sciences. Since the first article on biases (Tversky & Kahneman, 1973), significant progress has been made with respect to the pros and cons of biases, i.e. the ‘great rationality debate’. And we have pinpointed the exact connections that entrepreneurial bias research can make to benefit from nearby fields.

This study has made a number of contributions. First, this research answers the call by Shepherd et al. (2015) to provide the first critical examination of the studies of biases in entrepreneurship, carefully documenting discrepancies and dissonances in the literature to facilitate future cumulative progress. Second, in order to examine this body of literature, a structure by a typology of bias and input-mediator-output framework has been devised. This structure helps not only to unveil the tensions and opportunities for further research, but also to organize this growing body of research going forward. Third, we argue that the studies of bias in entrepreneurship could benefit from adjacent fields, such as the study of affect, as well as the rapid and exciting advances on biases in cognitive sciences. For instance, the implications of ‘the great rationality debate’ on entrepreneurship have been specifically examined in this text. Lastly, this article can serve as a synthesized base for future research theorizing using biases in entrepreneurship.

Bias has provided a captivating lens to study behavioral decision-making in entrepreneurship for the more than 20 years. This paper attempts to deliver an assessment and reflection on these studies: on the definitions of biases, the relationships studied, and the broader contexts. The 20 years of progress, as synthesized, generate even more fundamental and intriguing questions, both theoretical and empirical. We conclude by summarizing the most important future research opportunities (Table 4).

“Insert table 4”

These opportunities are only a partial list, as we continue realizing the potential of using bias as a theoretical lens through which to study entrepreneurship. By now, not only has bias occupied a central place in a complex net of entrepreneurial phenomena, but its theoretical foundation in cognitive sciences is also being reshaped actively. Thus the study of bias in

entrepreneurship is an intellectually fruitful endeavor that could help shape the future of our scholarships of entrepreneurship.

APPENDIX

“Insert Table 5”

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TABLES

Table 1. Selected Articles Studying Entrepreneurial Biases (The Italics Denote Conceptual Papers)

Author	Purpose	Method	Sample	Bias
McCarthy et al. (1993)	Examine the presence of escalation commitment in reinvestment decisions by entrepreneurs	Survey	1112 firms in the US	Overconfidence, escalation of commitment
Busenitz & Barney (1997)	Examine differences in the decision-making processes used by entrepreneurs and managers in large organizations	Survey and scenario technique	124 entrepreneurs and 95 managers in the US	Overconfidence, representativeness
<i>Cable & Shane (1997)</i>	<i>Study the decision to cooperate based on implicit similarities in the entrepreneur-VC relationship</i>	<i>Conceptual</i>	-	<i>Similarity</i>
Busenitz (1999)	Examine entrepreneurial risk through the lens of cognitive psychology and decision-making	Survey	176 entrepreneurs and 95 managers in the US	Overconfidence, representativeness
Coval & Moskowitz (1999)	Study the local equity preference in domestic portfolios	Secondary data	10 fund managers in the US	Local bias (similarity)
Simon et al. (2000)	Explore how individuals cope with the risks inherent in their decisions	Survey and scenario technique	191 MBA students in the US	Overconfidence, illusion of control, law of small numbers
<i>Bernardo & Welch (2001)</i>	<i>Analyze how overconfident behavior persists</i>	<i>Simulation</i>	-	<i>Overconfidence</i>
Zacharakis & Shepherd (2001)	Investigate if VCs are overconfident in their decision-making process	Conjoint analysis	51 VCs in the US	Overconfidence
Keh et al. (2002)	Examine opportunity evaluation under risky conditions	Survey and scenario technique	77 owners of SMEs in Singapore	Illusion of control, law of small numbers, overconfidence, planning fallacy

Simon & Houghton (2002)	Analyze the relationships among biases, misperceptions, and the introduction of pioneering products	Conceptual	-	<i>Illusion of control, law of small numbers</i>
Simon & Houghton (2003)	Examine the effects of overconfidence on ill-structured decisions	Survey and interview	55 managers of small computer companies in the US	Overconfidence
Wickham (2003)	Demonstrate the impact of representativeness on decision quality	Experiment	155 entrepreneurship students in the UK	Representativeness
Rogoff et al. (2004)	Analyze the existence of a self-serving attribution bias when entrepreneurs enumerate the factors that contribute to or impede their business success	Survey	425 owners of small business and experts in the US	Self-serving attribution
Forbes (2005)	Examine differences in the degree to which entrepreneurs exhibit the overconfidence bias	Survey	108 managers of new ventures in the US	Overconfidence.
Wu & Knott 2006	Analyze entrepreneurial risk propensity and market entry	Simulation and Secondary data	Banking sector in the US	Overconfidence
De Carolis & Saporito (2006)	Advance a model suggesting that entrepreneurial behavior is a result of the interplay of environments (social networks) and certain cognitive biases	Conceptual	-	<i>Overconfidence, illusion of control and representativeness</i>
Franke et al. (2006)	Analyze biases arising from similarities between a venture capitalist and the members of a venture team	Conjoint analysis	51 VCs in Munich, Berlin and Vienna	Similarity
Hayward et al. (2006)	Develop a hubris theory of entrepreneurship to explain why so many new ventures are created under high risk	Conceptual	-	<i>Overconfidence</i>
Lowe & Ziedonis (2006)	Analyze the impact of overoptimism on start-up performance	Secondary data	734 inventions from the University of California	Overoptimism
Bryant (2007)	Explore the role of self-regulation in decision heuristics	Conceptual	-	<i>Representativeness</i>
Burmeister & Shade (2007)	Examine whether the empirical finding that entrepreneurs are more biased than other individuals, is generally valid	Experiment	427 students, 135 bankers and 240 entrepreneurs in	Status-Quo (Representativeness)

Koellinger et al. (2007)	Study the antecedents of the decision to start a business	Survey and Secondary data	Germany 40.000 entrepreneurs in 18 countries	(Over)confidence
Moore & Cain (2007)	Aim to understand when and why people underestimate (and overestimate) the competition	Experiment	91 university students in the US	Overconfidence
Grichnik (2008)	Develop a model of entrepreneurial risk-taking behavior in different cultural settings	Experiment and survey	252 entrepreneurship students and entrepreneurs in Germany and the US	Overconfidence.
Parwada (2008)	Analyze the determinants of the decision of firm location and stock selection of fund managers	Secondary data	358 executives at 207 firms in the US	Local bias (similarity)
Cassar & Craig (2009)	Analyze how previous failures affect hindsight bias concerning the probability of venture formation	Survey	198 nascent entrepreneurs in the US	Hindsight bias (Representativeness)
De Carolis (2009)	Analyze the Influence of social capital and cognition in the progress of new venture creation	Survey	269 students entrepreneurs in the US	Illusion of control
Parker (2009)	<i>Analyze how overoptimism and self-serving attributions explain homophily in start-up teams</i>	Simulation	-	<i>Self-serving attribution</i>
Barbosa & Fayolle (2010)	Examine the effect of new information in risk perceptions and the decision to start a venture	Survey	Entrepreneurs and students (number not indicated)	Availability and anchoring
Carr & Blettner (2010)	Examine the effects of illusions of control on decision quality	Survey	163 small firm founders in the US	Illusion of control
Cassar (2010)	Examine the rationality of the expectations and overoptimism of nascent entrepreneurs.	Secondary data and interviews	386 entrepreneurs from “Panel Study of Entrepreneurial Dynamics”	Overoptimism
Cumming &	Examine local bias in VC investments	Secondary data	Investments from 1008	Local bias (similarity)

Dai (2010)			VCs in the US	
Hayward et al. (2010)	<i>Explain why more confident founders of failed new ventures are better positioned to start subsequent ventures</i>	<i>Conceptual</i>	-	<i>Overconfidence</i>
Sandri et al. (2010)	Investigate the disinvestment behaviors of entrepreneurs when choices are irreversible	Experiment	39 entrepreneurial students and 37 non-students	Psychological inertia (Status-Quo)
Murnieks et al. (2011)	Investigate the extent to which similarity in decision-making process might bias opportunities	Survey and conjoint analysis	60 VCs in the US	Similarity
Simon & Shrader (2011)	Identify which entrepreneurial actions are associated with an entrepreneur's failure	Interview and survey	55 managers of small computer companies in the US	Overconfidence
Ebbers & Wijnberg (2012)	Analyze if the individual reputations of founders of nascent ventures can function as important signals to investors	Case Study	141 films' ventures from Netherlands	Similarity
Hogarth & Karelaia (2012)	<i>Analyze if overconfidence causes excess entry and the high failure rates of market entry decisions</i>	<i>Simulation</i>	-	<i>Overconfidence</i>
Gudmundsson & Lechner (2013)	Build a multilevel model explaining the interplay of cognitive biases and cognitive make-up and its performance implications	Survey	115 founders of small firms in Iceland	Overconfidence
Khanin & Mahto (2013)	Analyze if venture capitalist have a continuation bias	Survey	51 VCs in the US	Continuation bias
Toft-Kehler et al. (2014)	Analyze the experience–performance relationship and the impact of contextual similarity	Secondary data	Swedish founder and managers	Similarity

Table 2. Biases Studied In Entrepreneurship

Bias	Behaviors of People in Decision-making
Overconfidence	Perceive a subjective certainty higher than the objective accuracy (Busenitz, 1999; Gudmundsson & Lechner, 2013).
Overoptimism	Overestimate the likelihood of positive events and underestimate the likelihood of negative events (Sharot 2011).
Self-serving attribution	Take credit for success while deny responsibility for failure (Rogoff et al., 2004).
Illusion of control	Overemphasize how much skills, instead of chance, improve performance (Langer, 1975).
The law of small numbers	Reach conclusions about a larger population using a limited sample (Haley & Stumpf, 1989).
Similarity	Tend to evaluate more positively those who are more similar to themselves (Byrne & Griffitt, 1973).
Availability	Make judgments about the probability of events based on how easy it is to think of examples (Tversky & Kahneman, 1974).
Representativeness	Use a familiar situation as a cognitive shortcut for making decisions (Wadeson, 2006).
Status-Quo	Repeat a previous choice overly often (Samuelson & Zeckhauser, 1988).
Planning fallacy	Underestimate the time needed for future tasks (Kahneman & Lovallo, 1993).
Escalation of commitment	Persist unduly with unsuccessful initiatives or courses of action (Staw, 1977).

Table 3. Unstudied Biases That Hold Potential Relevance to Entrepreneurship

Bias	Definition	Source
Illusory correlation	Inaccurately perceive a relationship between two unrelated events	Tversky & Kahneman (1974)
Irrational escalation	Use prior investment to justify increased investment decision	Staw (1976)
Base rate fallacy	Ignore base rate information and focus on specific information	Baron (1994)
Ambiguity effect	Avoid options whose probability seem "unknown" due to missing information	Baron (1994)
Belief bias	Evaluate the logical strength of an argument based on the believability of the conclusion	Klauer et al. (2000)
Confirmation bias	Search for, interpret, or recall information in a way that confirms one's beliefs or hypotheses	Oswald & Grosjean (2004)
Backfire effect	Either do not update existing beliefs or believe them to be stronger, in the face of contradictory evidence.	Sanna et al. (2002)
Consistency bias	Incorrectly remember one's past attitudes and behavior as resembling present attitudes and behavior	Cacioppo (2002)
Congruence bias	Overly rely on directly testing a given hypothesis as well as neglecting indirect testing	Iverson et al. (2008)
Pseudo-certainty effect	Make risk-averse choices if the expected outcome is positive, but make risk-seeking choices to avoid negative outcomes	(Hardman (2009)

Table 4. Summary of Main Future Research Directions

	Theme	Research Directions
Definition	Conceptualization & operationalization	To build future research on clear concepts (be especially cautious to distinguish three distinct forms of overconfidence).
Relationship studies	Risk-taking behavior	Processual path analysis on how biases impact risk-taking behaviors and performance via different paths based on different theories.
	Role of experience	The relationship between experience (a complex concept itself to be disentangled) and biases at both between-person and within-person levels, in consideration of the quality of experience (can be positive or negative).
	Decision difficulty	How task difficulty might mediate the relationships between contextual factors (e.g. dynamism, complexity, hostility) and the three forms of overconfidence.
	Network	The relationships between entrepreneurs' network positions and biases
	Biases unexamined to date	To study <i>psycho-physics</i> type of bias of the distortion in entrepreneurs' perception of quantitative attributes (e.g. overweighing low probabilities & perception of optionality). Also see table 3 for a list of potentially interesting biases for entrepreneurship research to cover in future.
	Research design	Multi-level research on bias (e.g. national level and team level). To distinguish, theorize and test biases under uncertainty from biases under risk.
Broader situation	Entrepreneurial cognition	Relationships between bias and other well-studied factors in cognitive psychology such as heuristics, intelligence, and knowledge.
	Entrepreneurial emotion	How does affect influence bias and how does bias influence affect? The interactions between cognitive biases and affect on entrepreneurial actions.
	Great rationality debate	The framing of entrepreneurial bias research based on recent advance in cognitive psychology (esp. the great rationality debate) The extent of the match between evolutionarily adapted mechanisms and the representations in entrepreneurship.
	Debiasing	Effect of decision aids (venture evaluation form or business model canvas) on biases.

Table 5. Procedures and Criteria of the Article Search

Procedure	Descriptions
1. We started the search with an initial set of keywords of biases, entrepreneur (and its various derived forms), and Venture Capital (VC) in Journals listed in <i>Financial Times</i> .	1. The top management journals in the <i>Financial Times</i> journal list are used to identify the most prominent publications relevant to the topic to start with. We read each of articles to identify the biases studied.
2. We identified the relevant articles from step 1, and locate the names of the biases studied in those articles. The names of the biases were added to the set of keywords. And we then used the enhanced list of keywords to search in relevant subject areas in Scopus. The end date of the search is 1 st Jan 2014.	2. The code we used in Scopus is the following: (title-abs-key(entrepreneur) or title-abs-key(entrepreneurial) or title-abs-key(entrepreneurship) or title-abs-key(venture capital) or title-abs-key(venture capitalist)) and (title-abs-key(bias) or title-abs-key(overconfidence) or title-abs-key(illusion of control) or title-abs-key(availability) or title-abs-key(self-serving attribution) or title-abs-key(status-quo) or title-abs-key(representativeness) or title-abs-key(overoptimism) or title-abs-key(planning fallacy) or title-abs-key(local bias) or title-abs-key(hindsight bias) or title-abs-key(law of small numbers) or title-abs-key(similarity bias) or title-abs-key(self-serving bias)) and (limit-to(language, "english")) and (limit-to(doctype, "ar") or limit-to(doctype, "ip")) and (limit-to(subjarea, "busi") or limit-to(subjarea, "soci") or limit-to(subjarea, "psyc") or limit-to(subjarea, "deci") or limit-to(subjarea, "mult") or limit-to(subjarea, "neur") or limit-to(subjarea, "undefined"))
3. One article that studied an entrepreneurial bias but did not name it using conventional terminologies of biases was later added to the list thanks to a suggestion.	

FIGURES

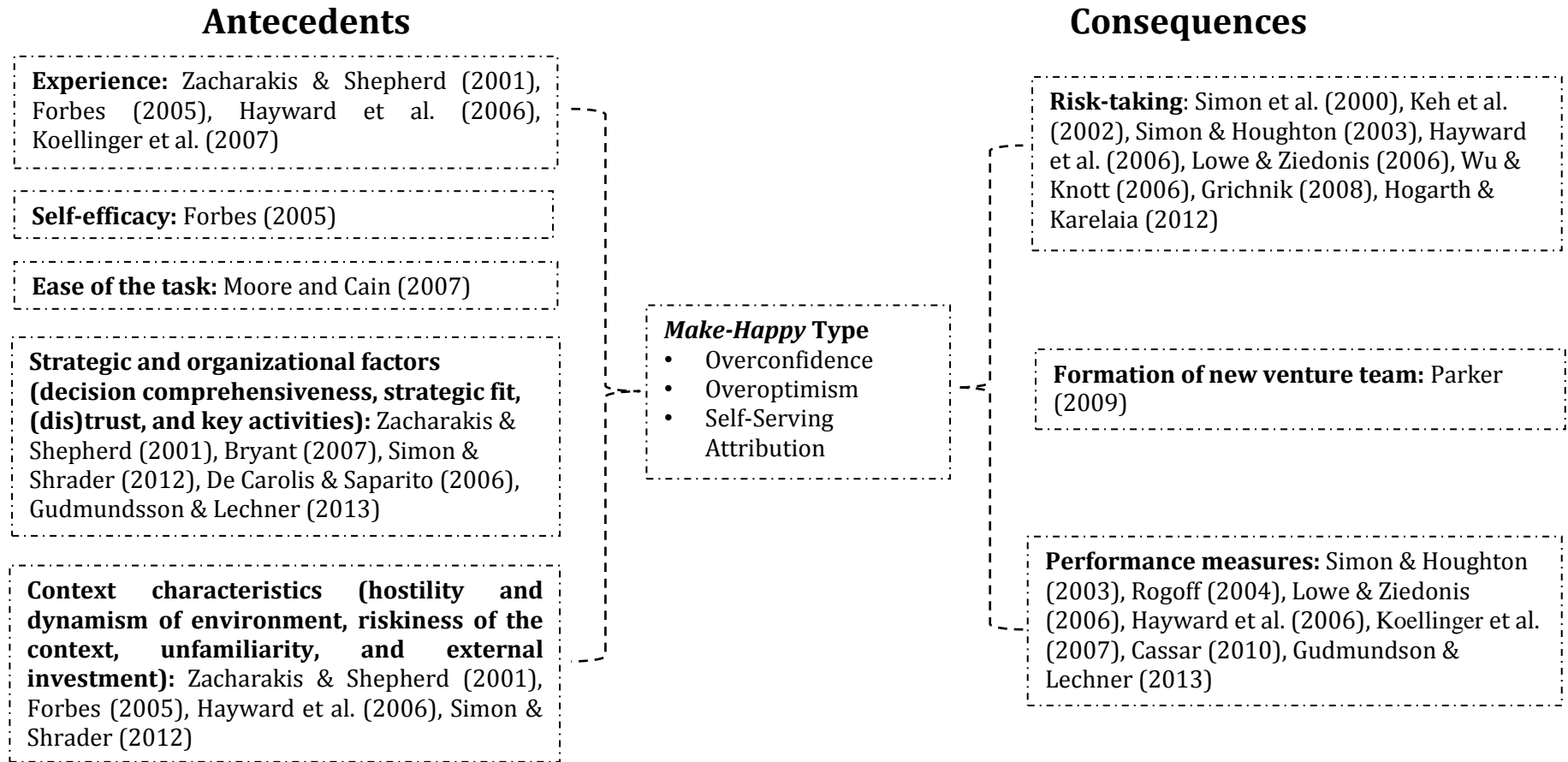


Figure 1a: Overview of the Antecedents and Consequences of *Make-Happy* Biases

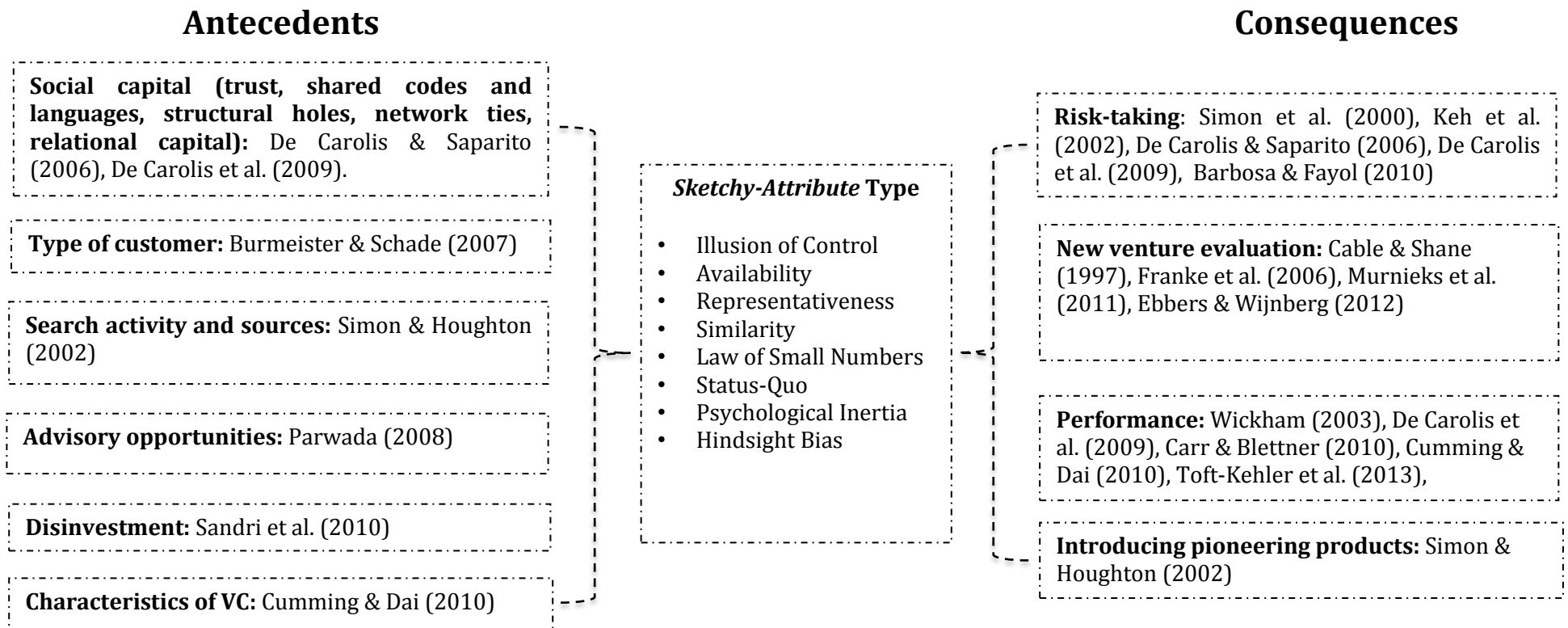


Figure 1b: Overview of the Antecedents and Consequences of *Sketchy-Attribute* Biases