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BIASED AND OVERCONFIDENT, UNBIASED BUT GOING FOR IT: HOW FRAMING AND ANCHORING AFFECT THE DECISION TO START A NEW VENTURE

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ABSTRACT

Cognitive heuristics, biases, and overconfidence have been suggested as an explanation for entrepreneurial entry. Nevertheless, empirical research on the subject has produced mixed findings and has under-explored the cognitive mechanisms leading to overconfidence in entrepreneurial settings. In two within-subject experiments, we focus on three cognitive heuristics—reference point framing, outcome salience framing, and anchoring in conjunctive events—and examine their effects on perceived risk, confidence, required and estimated probabilities of success, and the decision to start a new venture. Our findings show that reference point framing and outcome salience framing affect the decision to enter directly and indirectly via risk perception, but do not affect confidence. In addition, the effect of anchoring is contingent on the congruence between its semantic and its numeric influences. Overconfidence only obtains when the numeric and semantic influences of anchoring are aligned and aimed at enhancing the salience of potential positive outcomes, i.e., through high probabilities of success.

Keywords: Entrepreneurial decision; overconfidence; anchoring; framing; heuristics.

JEL codes: L26; J23; M13; D80; D81; G41.

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1. EXECUTIVE SUMMARY

Why do so many individuals enter entrepreneurship despite the high failure rates of new firms? One predominant explanation has been that nascent entrepreneurs are overly optimistic about their odds of success (e.g., Cassar, 2010; Hmieleski & Baron, 2009) and are overconfident (e.g., Hayward, Shepherd, & Griffin, 2006; Navis & Ozbek, 2016). Overconfidence is a cognitive bias that emanates from the "anchoring and adjustment" heuristic and refers to people's tendency to overestimate the correctness of their initial assessments when faced with moderate to difficult situations (Bazerman, 1994; Forbes, 2005). Overconfidence explains entry in experimental and non-experimental studies (Camerer & Lovallo, 1999; Moore, Oesch, & Zietsma, 2007) and serves as a basis for the "hubris theory of entrepreneurship" (Hayward et al., 2006). In theoretical accounts of entrepreneurial entry, overconfidence is often coupled with risk taking (e.g., Busenitz, 1999; Busenitz & Barney, 1997; Keh, Foo, & Lim, 2002).

However, theoretical accounts of entry based on overconfidence are challenged on theoretical and empirical grounds (Hogarth & Karelaia, 2012; Karelaia & Hogarth, 2010). Empirical studies have produced mixed results and suffer from serious methodological limitations. First, studies using very similar measures of overconfidence have found different results. For instance, Busenitz and Barney (1997) compared a sample of entrepreneurs and managers of large firms and found that the entrepreneurs are more susceptible to the overconfidence bias. Yet, studies investigating MBA participants (Simon, Houghton, & Aquino, 2000) and owners of small- and medium-sized enterprises (Keh et al., 2002) found no significant relationship with overconfidence and attributed this non-finding to the traditional measures of overconfidence that are generally disconnected from the focal venture and the entrepreneurial context. Indeed, measuring overconfidence has been a challenge (Olsson, 2014).[1]

[1] Several studies document methodological problems and statistical artifacts in (over)confidence research (e.g., Juslin, 1994; Juslin, Winman, & Olsson, 2000; Olsson, 2014). We have addressed them in our experimental design

Second, studies comparing entrepreneurs with other types of samples often suffer from serious threats to internal validity arising from the use of post-test-only research designs with nonequivalent groups (Cook & Campbell, 1979; Shadish, Cook, & Campbell, 2002). If two groups differ on a key dependent measure (i.e., overconfidence), it can be tentatively suggested that this difference is caused by the treatment variable (i.e., entrepreneurial experience). However, the validity of such causal inference is hindered by the comparison of two non-equivalent groups —that is, they differ on several dimensions, so a difference in overconfidence between the two groups could also stem from other dimensions. The point is that non-experimental cross-sectional comparisons across groups are unlikely to disentangle causal relationships.

Attempts to explain entrepreneurial entry based on cross-group comparisons and cognitive heuristics have failed to rule out an important alternative explanation for overconfidence, risk taking, and entry—namely, an explanation based on the existence of information asymmetries (Hayek, 1945; Shane & Vankataraman, 2000). Entrepreneurs may differ in their assessments and evaluations of an entrepreneurial opportunity based on the prior information they possess (Norton & Moore, 2002; Shane, 2000), which might explain why they pursue ideas that may seem very risky to others (Janney & Dess, 2006). Any study of entrepreneurial entry on heuristics and biases must control for information asymmetries to ensure entry decisions stem from differences in information processing and not from previous or private knowledge.

In the present study, we focus on heuristics susceptible to affect risk taking and to contribute to overconfidence, and we overcome prior research limitations through an experiment using repeated measures and a pre-test–post-test design. Specifically, we investigate how individuals process information about a new venture project and we analyze how three cognitive heuristics—reference point framing, outcome salience framing, and anchoring—influence perceived risk, confidence, estimates of a venture's probability of success, and decisions to join the new venture.

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by using measures that are directly related to the focal venture and by inferring overconfidence only when a full set of criteria are met. We discuss these issues in detail later in the paper.

We focus on framing and anchoring heuristics for several reasons. First, they are known to affect risk taking and constitute potential sources of overconfidence biases, but the cognitive mechanisms through which they might contribute to entrepreneurial entry are still largely unknown. Second, they are relatively under-researched in the entrepreneurship literature (Zhang & Cueto, 2017). Third, research has examined cognitive biases in isolation (i.e., separated from each other) and therefore overlooked the interplay of different cognitive heuristics in real life. Indeed, the framing and anchoring heuristics that we analyze are pervasive phenomena that are likely to work in tandem in real life. Adopting an experimental design allows us to disentangle their effects and to identify the specific combinations that are more likely to raise confidence, reduce perceived risk, yield biased estimations, and foster decisions to enter.

We found reference point framing and outcome salience framing affect the decision to enter both directly and indirectly via risk perception, but do not affect confidence. In turn, the anchoring effect is contingent on the congruence between semantic and numeric influences. When high probabilities of success are attributed to critical events necessary for the venture project completion, the numeric and semantic influences of anchoring are aligned and reinforce the salience of positive outcomes, generating overconfidence biases. However, when low probabilities of failure are attributed to the same events, the semantic influence of anchoring seems to conflict with its numeric influence, resulting in a scattered distribution of estimates of odds of success that are, on average, unbiased. We verified in this case an unexpected finding: decisions to enter still increased even with the average estimation being below the odds of success initially required by the participants to join the new venture.

2. INTRODUCTION

Decision making and entrepreneurship scholars have long been puzzled by the fact that people keep starting businesses despite the relatively high failure rates of new firms. For instance, “data from the U.S. Small Business Administration reveal that the correlation between the start-up rate and the failure rate across industries at the 3-digit level is approximately 0.77. That is, the industries that have the highest firm failure rates are also the ones that have the highest firm start-up rates” (Shane, 2008, p. 37). Although

explanations for this cross-industry correlation between start-up and failure rates exist[2], the overoptimistic odds of success nascent entrepreneurs perceive have also attracted scholarly attention. In a cross-sectional study, Cooper et al. (1988) found one out of three entrepreneurs was 100% sure of his or her venture success, and four out of five perceived their odds of success to be 70% or more. In a longitudinal study, Cassar (2010, p. 830) found "at the mean (median), nascent entrepreneurs believe there is an 81.0 percent (90 percent) chance that their nascent activity will result in an operating venture; however, only 47.8 percent of ventures actually achieve operation. . . . [Furthermore], of those that achieved operation and had available first-year sales information, significant overestimation of projected sales is observed, with 62 percent overestimating first-year sales."

Why are nascent entrepreneurs so optimistic about their chances of success, and are they systematically so? Answers for these questions diverge. On the one hand, overoptimistic beliefs can be the result of a rational choice based on noisy yet unbiased signals and information asymmetries (Cassar, 2010; Harrison & March, 1984; Van den Steen, 2004). Shane and Vankataraman (2000) argued that information asymmetries are a source of entrepreneurial opportunities given that information and knowledge are crucial to identifying and exploiting opportunities. In this sense, information asymmetries could explain why people differ in their risk perceptions associated with an entrepreneurial opportunity and why entrepreneurs pursue ideas that may seem very risky to others (Janney & Dess, 2006; Norton & Moore, 2002). Acting on favorable signals of returns from vocational activity may also yield overoptimistic beliefs to the extent that favorable signals are more likely to contain favorable errors (Harrison & March, 1984; Van den Steen, 2004).

On the other hand, cognitive research has emphasized bounded rationality (Goldstein & Hogarth, 1997; Kahneman, 2003) and entrepreneurs' use of heuristics (e.g., Busenitz & Barney, 1997; Manimala,

[2] Shane (2008, p. 37) offers two explanations: "First, many entrepreneurs start businesses in industries where they have worked before and therefore understand. On average, these industries tend to be the ones that employ the most people and are the most competitive. As a result, many entrepreneurs end up starting their new firms in industries that aren't the most attractive ones for start-ups. Second, many entrepreneurs start businesses in industries where starting a new company is easy, and businesses in industries in which it is easy to get started are more failure prone than other industries."

1992; Palich & Bagby, 1995; Shepherd, Williams, & Patzelt., 2015; Zhang & Cueto, 2017), suggesting "less rational" explanations for over-optimism and excess entry. One predominant explanation for entrepreneurs' optimism is overconfidence in their knowledge, ability to predict the future, and general personal abilities (Hayward et al., 2006). However, empirical research on overconfidence and entrepreneurial entry has produced mixed findings, suggesting that overconfidence can indeed foster market entry and can also lead new entrants to neglect competition (Camerer & Lovallo, 1999; Moore et al., 2007), but it is not a *sine qua non* for excess entry (Hogarth & Karelaia, 2012; Karelaia & Hogarth, 2010). Although some results suggest that entrepreneurs are more overconfident than non-entrepreneurs (Busenitz, 1999; Busenitz & Barney, 1997), the question of whether individuals' overconfidence contributes to self-selection into entrepreneurship or is enhanced through their entrepreneurial experience remains unanswered. Indeed, several studies were unable to find evidence of a relationship between overconfidence and the decision to found a firm (e.g., Keh et al., 2002; Lowe & Ziedonis, 2006; Simon et al., 2000).

Therefore, we investigated a third line of thought with the potential to reconcile these divergent views and mixed results with an explanation based on information processing, not on information asymmetries nor on heuristics as trait-like constructs. In so doing we treat heuristics as what they really are: simplifying strategies that individuals use to assess probabilities, make predictions, and make decisions (Tversky & Kahneman, 1974). In addition, our focus on information processing allows us to address the methodological challenges of inferring and measuring overconfidence (Olsson, 2014). Since we are interested in the cognitive roots of overconfidence and entrepreneurial entry, we investigate three heuristics that are likely to impact risk taking behavior: reference point framing, outcome salience framing, and anchoring in conjunctive events.

3. FRAMING

There are different ways to conceive framing and arguably different phenomena under the label "framing effects" (Levin, Schneider, & Gaeth, 1998). Here we follow Kuhberger (1998) and focus on two of them, distinguishing reference point from outcome salience manipulations. We adopt this distinction

because it has a long history in the decision-making and management literatures (e.g., Sitkin, 1992; Sitkin & Pablo, 1992; Sitkin & Weingart, 1995) and is directly linked to prospect theory (Kahneman & Tversky, 1979; Tversky & Kahneman, 1981).

3.1. Reference point framing

This first type of framing stems from prospect theory and refers to the phenomenon of outcomes being evaluated as deviations from reference points or levels of aspirations (Kahneman & Tversky, 1979). This type of framing is referred to as "risky choice framing" by Levin et al. (1998), because it involves variation in the description of a choice between a sure thing option and a risky option (generally in terms of gains or losses). Such framing has consistently yielded risk aversion in the domain of gains and risk seeking in the domain of losses, constituting one of the basic pillars of the "psycho-physics" of risk taking (Kuhberger, 1998; Levin et al., 1998; Lopes, 1997; Rieger, Wang, & Hens, 2015).

"Psycho-physics" type of biases have received little attention in entrepreneurship research (Zhang & Cueto, 2017), but the importance of aspiration levels and reference points has been widely recognized. For instance, managers' risk behavior has been reported as being highly contingent on their position relative to aspiration levels of performance (e.g., Lehner, 2000; March & Shapira, 1987). Managers situated just above a performance target tend to focus on avoiding actions that might place them below that target, showing much more risk aversion than managers who are right below the performance target and want to reach it (March & Shapira, 1987; Miller & Chen, 2004). The work of March and Shapira (1987, 1992) suggested that managers distinguish two reference points: an aspiration level of performance and a survival point. Gimeno, Folta, Cooper, and Woo (1997) demonstrated that failure to reach an aspired performance threshold leads to entrepreneurial exit even if the venture's performance is well above the survival point. Building upon these insights, Wennberg, Delmar, and McKelvie (2016) concluded that risk preferences change as a venture ages and increases in size: younger and smaller ventures are more likely to grow when above the aspiration reference point, whereas older and larger ventures are more likely to grow when below the aspiration reference point. Moreover, when close to the survival reference point, smaller ventures are more likely to exit, but older ventures are more likely to grow.

Researchers have suggested reference points are important for entrepreneurial entry. McCann and Folta (2012) proposed entry into entrepreneurship involves a comparison of expected economic returns in a venture to some threshold level of acceptable performance. They concluded "the entry decision is impacted by expected performance but not uniquely determined by it. Rather, individuals have different required thresholds, and entry is determined by whether performance falls above or below the threshold." (p. 796).

In line with these previous studies, we recognize that reference points are important for entry decisions. Unlike these studies, however, we build strongly on prospect theory and argue that in the absence of performance history, an individual's current situation provides an initial reference point for decision-making. Of particular importance is the individual's employment situation as it is largely used to distinguish between entrepreneurs with "pull" versus "push" motives (Thornton, 1999) as well as between necessity-based and opportunity-driven entrepreneurship (Baptista, Karaöz, & Mendonça, 2014; Caliendo & Kritikos, 2010; Thurik, Carree, Van Stel, & Audretsch, 2008). Being employed increases the opportunity costs associated with the decision to start a new business as the individual may have to give up a stable job in favor of a much more uncertain venture, especially if the individual has a job with which he or she is satisfied. Indeed, several of the displacement factors identified as triggers of entrepreneurial events are related to low job satisfaction (Shapero & Sokol, 1982). Having a satisfactory job that meets one's aspiration level decreases the likelihood that the individual will look for a better alternative through self-employment (J.-H. Lee & Venkataraman, 2006; L. Lee, Wong, Foo, & Leung, 2011). Individuals who have a satisfactory job are therefore less likely to become entrepreneurs as they tend to do so only for "pull" motives—that is, in pursuit of an attractive opportunity. Unemployed individuals and those unsatisfied with their current job are more likely to become entrepreneurs out of necessity (Baptista et al., 2014; Thurik et al., 2008).

From a prospect theory perspective, a satisfactory job increases the likelihood that the individual will view the option of keeping his or her job as a sure gain compared to the more uncertain option of starting a new venture, thereby increasing risk aversion. Consequently, the option of starting a new

business tends to be framed as more risky when the individual has a satisfactory job. Further, as opportunity costs are higher for individuals having a satisfactory job (compared to the unemployed), their required thresholds of performance to enter are also higher. Hence, we expect that individuals having a satisfactory job will require higher odds of success to join a new venture than individuals who are unemployed.

However, unemployed individuals might be less confident in their own capabilities than employed ones, as unemployment can affect individuals' self-esteem and emotional vulnerability (Kokko & Pulkkinen, 1998; McKee-Ryan, Song, Wanberg, & Kinicki, 2005), thus hindering self-efficacy beliefs (Virick, Basu, & Rogers, 2015). Unemployed individuals are often confronted with negative performance feedback because they face difficulties in finding a new job and often lack work experience. As such, they may start to believe they lack performance accomplishments and mastery experience, which are vital to strengthening self-efficacy beliefs (Bandura, 1997; Boyd & Vozikis, 1994). In contrast, employed individuals are more likely to gain mastery experience and have repeated performance accomplishments as well as develop a supportive social network that enables observational learning through modeling and enhances emotional stability—all factors that strengthen self-efficacy beliefs (Bandura, 1997; Boyd & Vozikis, 1994). Therefore, we hypothesize that having a satisfactory job increases one's confidence even though it also increases one's perception of risk associated with a potential entrepreneurial career. The net result remains an empirical question for us, but it is interesting to note that this line of thought suggests that unemployment fosters self-employment through a reduced risk perception but *not* through overconfidence.

Hypothesis 1. *Reference point framing: Employment status provides a significant reference point for individuals to frame entrepreneurship as a potential gain or a potential loss.*

Hypothesis 1a. *Having a satisfactory job increases the perceived risk associated with the option of starting a new venture.*

Hypothesis 1b. *Having a satisfactory job increases the required probability of success to start a new venture.*

Hypothesis 1c. *Having a satisfactory job increases the confidence associated with the option of starting a new venture.*

We labeled this first set of hypotheses as “reference point framing” hypotheses to indicate that they refer to the framing effects derived from a reference point (in our case, the individual’s employment status). This labeling corresponds to the main assertion of prospect theory—namely, that people normally perceive outcomes as gains and losses defined relative to some neutral reference point, which usually corresponds to their current asset position, and that they exhibit an attitude of risk aversion for gains and of risk seeking for losses (Kahneman & Tversky, 1979; Kuhberger, 1998; Rieger et al., 2015). Interestingly, adopting employment status as a proxy for the reference point suggests contradictory framing effects on the decision to start a new venture as having a satisfactory job increases simultaneously the perceived risk, the required odds of success, and the confidence associated with this decision. However, as Kahneman and Tversky (1979, p. 274) argued, “the location of the reference point, and the consequent coding of outcomes as gains or losses, can be affected by the formulation of the offered prospects.” This notion leads to the second type of framing effects derived from the way information is presented, or framed.

3.2. Outcome salience framing

Information framing significantly affects perceptions of risk, choice, and the confidence people exhibit in their choices. One way to manipulate information framing is by manipulating outcome salience. For example, in a classic study, preferences for alternative cancer therapies shifted depending on whether the outcomes were framed in terms of the probability of living or dying (McNeil, Pauker, Sox, & Tversky, 1982). Other studies have shown that events are more heavily weighted when described in terms of relative frequencies (i.e., how many) than when stated in more abstract terms of “chances” or “probability”. In fact, a field of study on risk communication has emerged over the past three decades (Gigerenzer et al., 2007; Kahneman, 2011; Slovic, Monahan, & MacGregor, 2000; Yamagishi, 1997). Nevertheless, the impact of outcome salience framing on entrepreneurial decisions is still underexplored.

Kuhberger (1998) called “risk manipulation by outcome salience” the manipulation produced when “the positive or negative aspects of a given alternative are made differently salient.” (p. 27). He built

upon the distinction made by Sitkin and his collaborators (Sitkin, 1992; Sitkin & Pablo, 1992; Sitkin & Weingart, 1995) between "problem framing"—the equivalent of the reference point framing —and "outcome history"—"the degree to which the decision maker believes that previous risk-related decisions have resulted in successful or unsuccessful outcomes" (Sitkin & Weingart, 1995, p. 1576). Kuhberger (1998, p. 27) then argued that making different outcomes salient "is to implicitly talk about outcome history."

We suspect the effects of outcome salience framing might be as relevant for entry decisions as the reference point because information about potential outcomes of an alternative course of action is likely to stimulate individuals' memory of previous decisions and their imagination about potential consequences. Information framed in negative terms is likely to enhance perceived risk and decrease confidence in a new venture because the mere allusion of potential negative decision outcomes often causes individuals to remember similar negative outcomes from the past and imagine undesirable consequences for the decision at hand, thus enhancing fear (Slovic, Fischhoff, & Lichtenstein, 1982). In contrast, information framed in positive terms is likely to diminish perceived risk and increase confidence in a new venture because positively framed information draws attention to the opportunities inherent in the situation, thus fostering optimism, confidence, and risk taking (Krueger & Dickson, 1994; Palich & Bagby, 1995; Sitkin & Pablo, 1992). As a result, the required probability of success is likely to increase when negative potential outcomes become more salient to the decision maker, and it is likely to decrease when the salience of positive potential outcomes increase. This reasoning leads us to our next hypotheses:

Hypothesis 2. *Outcome salience framing: The framing of potential outcomes of an entrepreneurial career path in general and about a new venture in particular affects entry decisions.*

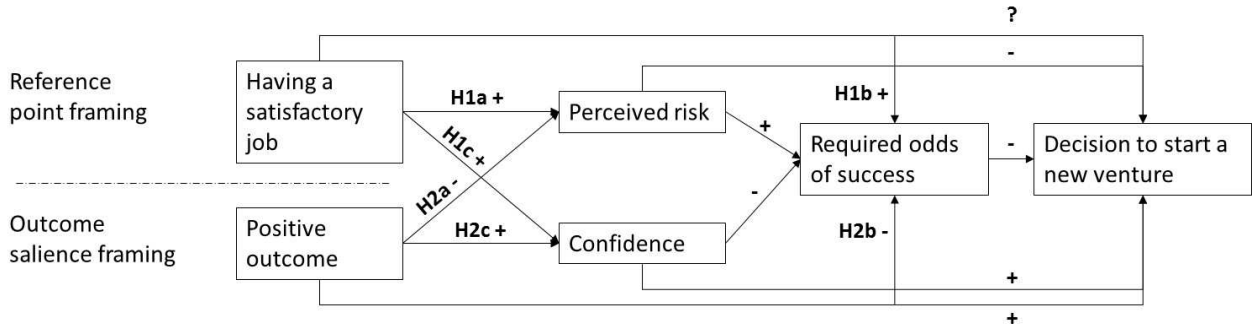
Hypothesis 2a. *Positively (negatively) framed outcomes decrease (increase) the perceived risk associated with the option of starting a new venture.*

Hypothesis 2b. *Positively (negatively) framed outcomes decrease (increase) the required probability of success to start a new venture.*

Hypothesis 2c. *Positively (negatively) framed outcomes increase (decrease) the confidence associated with the option of starting a new venture.*

Figure 1 summarizes our hypotheses and presents a theoretical model depicting how reference point and outcome salience influence the decision to start a new venture. We expect these framing effects to be partially mediated by perceived risk, confidence beliefs, and the required odds of success. Although we have formalized hypotheses only for the effects of framing on these mediators, we follow previous research and expect perceived risk and the required odds of success to be negatively related to the decision to start a new venture, whereas we expect confidence to be positively related to such decision. We also expect perceived risk to be positively associated with the required odds of success, whereas we expect confidence beliefs to be negatively associated with it. Finally, we expect a positive direct effect of outcome salience framing on the decision to start a new venture, as a consequence of hypotheses 2a, 2b, and 2c. However, we contend that the direct effect of reference point framing on the decision to start a new venture is *a priori* indeterminate, since having a satisfactory job increases perceived risk and required odds of success but also increases the confidence associated with venture startup.

Figure 1. Expected framing effects



4. ANCHORING

4.1. The cognitive mechanisms of anchoring

As initially described by Tversky and Kahneman (1974), the "anchoring-and-adjustment" heuristic is used when people make estimates by starting from an initial value and then adjusting that value to yield a final answer, with adjustments being insufficient to compensate for estimates' bias toward the initial value. The initial value may arise from the formulation of the problem at hand, a partial computation, an external person (e.g., the experimenter or the other person in a negotiation), or "self-

generation" (e.g., a company forecasts). In any case, although adjustments are made in light of the circumstances of the present situation, they are typically insufficient, and final estimates usually remain too close to the initial value.

More recently, psychologists have suggested that anchoring is produced by at least two distinct psychological processes and have provided theoretical accounts of this phenomenon within the framework of dual process theories of the mind (Epley, 2004; Epley & Gilovich, 2005, 2006). These accounts recognize two types of anchoring effects. The first type is referred to as "anchoring as accessibility" (Epley, 2004; Epley & Gilovich, 2005). The underlying psychological process for this type of anchoring is similar to the cognitive mechanism of outcome salience framing in that (even irrelevant) anchors increase the accessibility of anchor-consistent information (Mussweiler & Strack, 2001). For instance, people provide larger absolute estimates after being asked whether a target value is *more* than the anchor value than after being asked whether it is *less* than the anchor value (Mussweiler & Strack, 1999). Epley (2004) argued that this type of anchoring effect stems from automatic psychological processes that do not require attentional resources: "Explicitly comparing a target with an anchor value—even an irrelevant one—facilitates the recruitment of information consistent with the anchor value, creating an accessible pool of systematically biased evidence." (p. 245). This is the kind of psychological process that underlies most cognitive biases and is described in dual-process theories as rapid and autonomous, or "Type 1" process (Evans & Stanovich, 2013; Hogarth, 2010).[3] Overconfidence seems to be partly caused by people's failure to consider the likelihood that their responses are biased by the recruitment of response-consistent evidence (Block & Harper, 1991).

The second type of anchoring involves adjustment from an initial value and requires relatively more mental effort. In a series of studies, Epley and Gilovich (2001, 2004, 2005, 2006) argued that this

[3] Several scholars have followed Stanovich (1999, Stanovich and West, 2000) and adopted a terminology distinguishing two cognitive systems: System 1 and System 2 (e.g., Kahneman 2003, 2011). But Stanovich himself has more recently discouraged the use of this terminology, recognizing its ambiguity and that it suggests (falsely) that the two types of processes are located in just two specific cognitive or neurological systems (Evans & Stanovich, 2013). We thank one anonymous reviewer for emphasizing this and we adopt the dual-type terminology suggested by Evans and Stanovich (2013). Type 1 processes are broadly intuitive and have been described as "experiential" and "heavily emotional" (Hogarth, 2010), but for Evans and Stanovich (2013) their defining feature is that they are autonomous and do not require working memory (hence being typically fast).

type of anchoring involves psychological processes that are characterized as "deliberate," "analytic," or "controlled."[4] They suggest that self-generated anchors are more likely to activate serial adjustment than externally provided anchors. They found evidence that because the adjustment from a self-generated anchor value is conscious and deliberate, people can report utilizing this heuristic (Epley & Gilovich, 2001) and are susceptible to the influence of body postures (Epley & Gilovich, 2004), forewarning, and incentives to adjust more (Epley & Gilovich, 2005). None of these effects were found with externally provided anchors, which are more likely to produce anchoring effects through the automatic process of accessing anchor-consistent information. Still, adjustments from a self-generated initial anchor value tend to be insufficient because people stop adjusting once their estimates fall within an implicit range of plausible values. Thus, people's estimates tend to lie near the anchor side of this implicit range even though the true value is likely to lie closer to the middle of the range (Epley & Gilovich, 2006).

Taken together, these studies provide some important insights about the nature of anchoring and leave important questions unanswered. For instance, which factors trigger the conscious adjustment process in natural settings, to what extent do people engage in the effortful adjustment process even when confronted with externally provided anchors, and how do these processes affect whether and how an entrepreneurial project is undertaken?

4.2. The probability of conjunctive events: when anchoring leads to overconfidence

To shed some light onto these questions, we investigate an insight provided in the seminal work of Tversky and Kahneman (1974), who suggested anchoring leads to overestimating the probability of conjunctive events. According to the authors,

> Biases in the evaluation of compound events are particularly significant in the context of planning. The successful completion of an undertaking, such as the development of a new product, typically has a conjunctive character: for the undertaking to succeed, each of a series of events must occur. Even when each of these events is very likely, the overall probability of success can be quite low if the number of events is large. The general tendency to overestimate the probability of conjunctive events leads to unwarranted optimism in the evaluation of the likelihood that a plan will succeed or that a project will be completed on time. (Tversky & Kahneman, 1974, p. 1129)

[4] Type 2 processes in the terminology suggested by Evans and Stanovich (2013). For these authors, the defining feature of Type 2 processes is that they require working memory and a higher order reasoning involving cognitive decoupling and mental simulation.

Therefore, we suggest that anchoring and overestimations of the probability of conjunctive events contribute to overconfidence and the planning fallacy and are related to over-optimism (see also Cassar, 2010; Kahneman & Lovallo, 1993). If one frames the entrepreneurial process leading to the launch of a new venture as a series of conjunctive events, it is likely that he or she will overestimate the overall probability of success. An entrepreneurial undertaking is a process whose success depends on several individual events connected to each other. If one sees this process as a sequence of critical events—for example, identifying an opportunity, developing a prototype, raising capital, marketing the product, etc.—the overall success of the new venture will depend on the individual successes of each critical event. The probability of success for each single event might even be relatively high, but since the number of events that must occur to ensure the successful launch of a new venture is relatively large, people are likely to overestimate the overall probability of success if they neglect the conjunctive character of the venture-creation process.

The structure of conjunctive events is particularly interesting for the study of anchoring as it calls for mental effort and calculation even with externally provided anchors. In their seminal paper, Tversky and Kahneman (1974) reported on a study of intuitive numerical estimation where two groups of high school students had five seconds to estimate a numerical expression that was written on the blackboard. One group estimated the product of 1 x 2 x 3 x 4 x 5 x 6 x 7 x 8, and the other group estimated the product of 8 x 7 x 6 x 5 x 4 x 3 x 2 x 1. The median estimate for the ascending sequence was 512, whereas the median estimate for the descending sequence was 2,250. The correct answer is 40,320. Tversky and Kahneman (1974) offered these results as a demonstration that anchoring also occurs when estimations are based on the result of some incomplete computation, but we believe there is more to these results as they also suggest that estimations for conjunctive events are biased toward the numeric values provided. Furthermore, incomplete computation suggests some degree of effortful analytic thinking, but time pressure contributes to the fact that estimations must also be made intuitively to some extent.

We build on these previous insights and suggest that the venture process can be framed as a series of conjunctive events whose probabilities of success will anchor the estimation of an overall probability of success. Since overconfidence can emanate from either an overestimation of the odds of success or an underestimation of the odds of failure, we specifically investigate both options.

Hypothesis 3. *Anchoring in conjunctive events: High (low) probabilities of success (failure) for critical events necessary for the successful completion of a venture project anchor overall estimations of success (failure) and affect entry decisions such that:*

Hypothesis 3a. *High probabilities of success for critical events necessary for the successful completion of a venture project lead to an overestimation of the venture's overall probability of success.*

Hypothesis 3b. *Low probabilities of failure for critical events necessary for the successful completion of a venture project lead to an underestimation of the venture's overall probability of failure.*

In addition, we build upon research showing that anchors have both numeric and semantic influences (Jacowitz & Kahneman, 1995; Mussweiler & Strack, 1999, 2001) to suggest that such influences might be congruent or incongruent with each other. For instance, when investigating the psychological mechanisms of anchoring, Mussweiler and Strack (2001) propose a two-stage process in which numeric values have a relatively shallow and short-lived influence on the selection of a standard whose evaluation is then predominantly influenced by the semantic content that is activated by the anchor. We propose that anchoring processes do not necessarily need to have two stages, but anchors always have a numeric and a semantic aspect that can be congruent or incongruent with each other. This is particularly relevant in the context of probabilistic integration of conjunctive events, because of the ambiguity of single-event probabilities. Several studies have shown that even numerical probabilities can be interpreted in multiple and mutually contradictory ways (e.g., Gigerenzer et al., 2007; Gigerenzer et al., 2005). For instance, Hertwig and Gigerenzer (1999) found in a series of studies that participants associated a great majority of nonmathematical meanings to the word "probability," the most frequent interpretation being "possibility." Thus, single-event probabilities might be interpreted as mere possibilities that might be more or less strong depending on the numeric value in the probability. What is activated as a possibility, however, depends on the semantic content activated by the probability, i.e., the anchor's semantic influence.

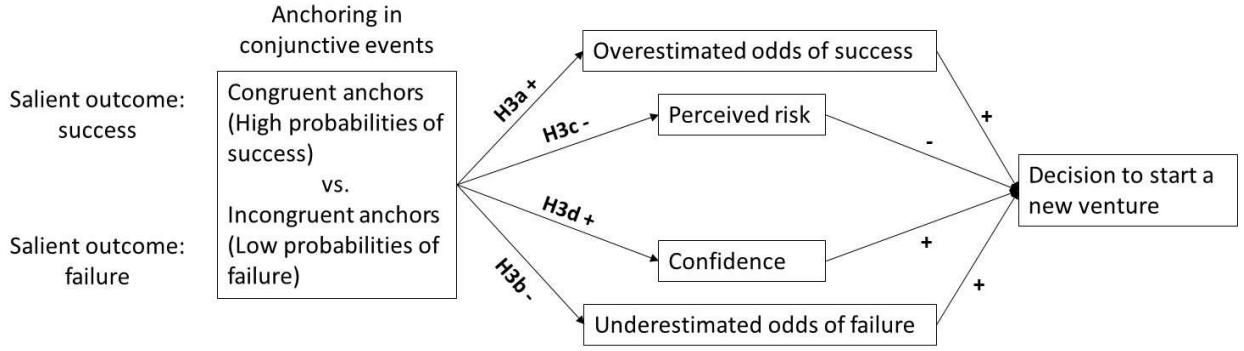
Following this reasoning, high probabilities of success for critical events in a venture project should drive attention to the possibility of success emphasized by the high numeric values. Such probabilities constitute congruent anchors. In contrast, low probabilities of failure for critical events in a venture project should drive attention to the possibility of failure. Such possibility is de-emphasized by the low numeric values. The semantic and the numeric influences of the anchor-probabilities are incongruent. We hypothesize that congruent anchors produce a much stronger anchoring effect than incongruent anchors, because semantic and numeric influences reinforce each other in the former and contradict each other in the latter. Therefore, we hypothesize:

Hypothesis 3c. *High probabilities of success for critical events necessary for the successful completion of a venture project lead to a larger decrease in perceived risk than low probabilities of failure.*

Hypothesis 3d. *High probabilities of success for critical events necessary for the successful completion of a venture project lead to a larger increase in confidence than low probabilities of failure.*

Figure 2 summarizes the hypothesized anchoring effects. Although we have not formalized hypotheses for the other relationships depicted in Figure 2, we still expect that perceived risk will be negatively associated with the decision to start a new venture whereas confidence beliefs will be positively associated with it. Both variables are expected to mediate the anchoring effects on the decision to start a new venture. Furthermore, estimated odds of success shall be positively associated with the decision to start a new venture, for they reflect the expected performance of the new venture (and *not* the required threshold of performance, which is reflected by the required odds of success).

Figure 2. Expected anchoring effects

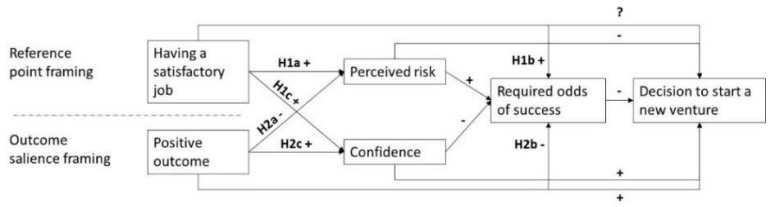


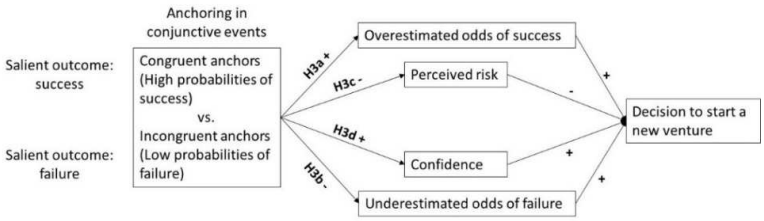
5. METHOD

5.1. Design overview

To test our hypotheses, we built a within-subject experiment allowing for manipulation of reference points, outcome salience, and anchor probabilities within a conjunctive structure of critical events. Specifically, we created a basic scenario in which subjects were invited by a friend to join a new start-up. After an initial description of the venture, they were asked to report their initial levels of perceived risk and confidence as well as their required odds of success to join the venture and their initial decisions. They were then provided with more information about the new venture (in the form of a conjunctive structure of critical events necessary for the successful launch of the venture) and were asked to report their final levels of perceived risk and confidence, as well as their estimated odds of success for the new venture and their final decisions. From this basic scenario we created four variants, allowing us to manipulate reference points, outcome salience, and anchors. Table 1 provides an overview of the research design, connecting the models previously depicted in figures 1 and 2.

Table 1. Research design

	Scenario A	**Scenario B**	**Scenario C**	**Scenario D**
Initial description: Outcome salience and reference point framing manipulated in a 2 x 2 design	Reference point: Employed Salient outcome: Success	Reference point: Unemployed Salient outcome: Success	Reference point: Employed Salient outcome: Failure	Reference point: Unemployed Salient outcome: Failure
Theoretical model tested: framing effects				
Additional information: conjunctive events anchored in order to either enhance the salience of success or reduce the salience of failure	High probabilities of success: 90% chance of developing prototype 80% chance of receiving funding 85% chance of having enough cash flow 80% chance of being first-mover	High probabilities of success: 90% chance of developing prototype 80% chance of receiving funding 85% chance of having enough cash flow 80% chance of being first-mover	Low probabilities of failure: 10% chance of no prototype 20% chance of no funding 15% chance of not enough cash flow 20% chance of being too late	Low probabilities of failure: 10% chance of no prototype 20% chance of no funding 15% chance of not enough cash flow 20% chance of being too late

Theoretical model tested: anchoring effects	

5.2. Study 1 – Student sample

5.2.1. Participants

After pre-testing our scenarios and measures with a convenience sample of students and professors at a Midwestern university, we conducted our first study. We mobilized colleagues teaching entrepreneurship at five American universities[5] and collected data over a six-month period. Students enrolled in entrepreneurship courses were invited to participate in an online experiment and were given extra course credit as an incentive to do so. The invitation was sent by the professor teaching the course, who was not part of the research team and was not aware of our research design, but supported the data collection process by asking students to participate in "a survey about risk perception and entrepreneurship." At one university, professors asked their students to complete the survey in class, giving them time to do so without allowing them to communicate with each other. In the other institutions, professors simply forwarded the link to the survey and asked their students to complete it. We found no significant differences in the responses (and results) provided by each group, and hence report results for the full sample. One important condition for students to receive extra course credit was that they should complete the whole questionnaire. This contributed to generate a perfectly balanced dataset with almost no missing values.

A total of 447 students (47% female) between the ages of 18 and 56 years old (M = 21.66, SD = 3.73) took part in the study. They were relatively heterogeneous in terms of level of study (64% undergraduates) and academic background (about 58% were majoring in business-related areas; the remaining had majors in diverse academic fields, such as art history, biology, sociology, psychology, etc.).

[5] Illinois State University, Miami University, Simmons College, University of Wisconsin–Eau Claire, and Western Washington University.

Despite being relatively young, the average participant had three-and-a-half years of employment experience. Nearly 45% of the participants had at least one parent with entrepreneurial experience. In addition, one out of 10 had already started a business themselves, and 39 (9%) were in the process of starting a business by the time of data collection. We controlled for all these personal characteristics in our main analyses and conducted robustness tests to check for differences across groups. The use of students as subjects is common practice in experimental research and in studies investigating antecedents of the startup decision (e.g., Krueger & Dickson, 1994; Zellweger, Sieger, & Halter, 2011). The presence of students with some entrepreneurial experience in our sample allows us to control for this variable.

5.2.2. Research instrument and measures

Participants completed a web-based questionnaire in which they were presented four scenarios in a repeated-measures experimental design (Chow, 2002; Cook & Campbell, 1979; Pedhazur & Schmelkin, 1991; Shadish et al., 2002). In the introduction of each scenario, respondents were encouraged to put themselves vividly in each situation. In a 2 x 2 design, initial scenario descriptions differed only in the current employment status of the respondent ("You just finished college and are looking for a job" versus "You have a job that gives you a reasonable salary and good perspectives of being promoted in the long run") and in the way the option of starting the venture was presented (emphasizing potential positive outcomes and the probability of success versus emphasizing potential negative outcomes and the probability of failure). Thus, in the initial description, we manipulated reference point framing and outcome salience framing in a 2 x 2 design. To control for numeric anchoring, we included an initial probability of success/failure "estimated by the friend" as "being around 50%." Two of the initial scenarios are below:

Scenario B. Reference point: Unemployment. Salient outcome: Success.
You just finished college and are looking for a job. A friend of yours, who is currently in the process of starting a new venture, invites you to join him in this adventure. He says that if the new business succeeds, both of you will be extremely rich. In addition, he emphasizes the incredible opportunities of learning in this new business as well as the advantages of being self-employed: independence, flexibility in terms of work schedule, etc. Even though there is a chance of the venture not succeeding, he argues that this experience (and the skills you will develop) will be invaluable to your career and overall employability. He estimates the probability of success being around 50%.

Scenario C. Reference point: Employment. Salient outcome: Failure.

> You have a job that gives you a reasonable salary and a future opportunity of being promoted in the long run. A friend of yours, who is currently in the process of starting a new venture, invites you to join him in this adventure. He says that if the new business succeeds, both of you will be extremely rich. However, failure may be costly since you two will have spent money, time, and a significant amount of personal effort in the project. Besides, you will have given up your job. He estimates the probability of failure being around 50%.

After the initial description, participants were asked to evaluate the option of joining the friend by indicating the level of risk they perceived in this option (on a nine-point Likert scale ranging from 1 = "Not risky" to 9 = "Very risky") and the level of confidence they had in their own capability to make this new venture a success (on a seven-point scale ranging from 1 = "I don't feel capable enough of making this venture a success" to 7 = "I feel totally capable of making this venture a success"). They were also asked to indicate whether or not they would actually join the friend (a yes-or-no question) and to provide the probability of success for the venture that they would require to join it.

For each scenario, this initial assessment was followed by additional information. The respondent was told that after talking with the friend and reading his business plan, the estimated probability of (1) having a prototype successfully developed (not having a prototype successfully developed) was 90% (10%), (2) receiving adequate funding (not receiving adequate funding) was 80% (20%), (3) having enough cash flow to stay in business (not having enough cash flow) was 85% (15%), and (4) being the first one in the market (arriving too late in the market) was 80% (20%). This provided a manipulation of the anchor values within each scenario. In order to foster overconfidence, the additional information provided was aimed to enhance the salience of a positive outcome (for scenarios whose initial description emphasized success) or to reduce the salience of a negative outcome (for scenarios whose initial description emphasized failure). Scenarios that were initially emphasizing success as a potential outcome received additional information providing high probabilities of success for the critical events to the successful launch of the venture:

> Now suppose you talk further with your friend and actually read his business plan. You realize that he is already developing a prototype for a very innovative product. There is a 90% chance that this prototype will be successfully developed. Moreover, there is an 80% chance that the business will receive adequate funding in order to launch the new product. There is a probability of 85% that this new venture will have enough cash flow to stay in business during its first years, and finally, there is a probability of 80% that the firm will be the first one to arrive in the market, having an important first-mover advantage.

In contrast, scenarios that were initially emphasizing failure as a potential outcome received additional information providing low probabilities of failure for the critical events necessary to the successful launch of the venture:

> Now suppose you talk further with your friend and actually read his business plan. You realize that he is already developing a prototype for a very innovative product. There is a 10% chance that this prototype will never be successfully developed. Moreover, there is a 20% chance that the business will not receive adequate funding in order to launch the new product. There is a probability of 15% that this new venture will not have enough cash flow to stay in business during its first years, and finally, there is a probability of 20% that the firm will arrive too late in the market, with the window of opportunity having already closed due to market changes.

Participants were asked to consider this additional information and then provide their estimation of the probability of success/failure for the new venture. Because we provided individual probabilities for four critical events (i.e., prototype development, fund raising, cash flow generation, and market entry) necessary for the success of a new business, the overall probability of success for the venture should be computed as the product of the individual probabilities (i.e., .90 x .80 x .85 x .80 = 48.96%).[6] Therefore, unbiased estimations should stay around the 50% odds of success "estimated by the friend" in the initial scenario description. However, we expected that the relatively high (low) individual probabilities of success (failure) provided for the four events would lead to an overestimation (underestimation) of the overall probability of success (failure), as stated in Hypotheses 3a and 3b.

Finally, participants were asked to re-evaluate the option of joining the friend in the new venture project and again indicate their level of perceived risk and confidence as well as their final decision. Perceived risk was again measured on a nine-point Likert scale (ranging from 1 = "Not risky" to 9 = "Very risky"), and confidence was measured in terms of project feasibility (participants were asked "How feasible do you think this new venture is?" and provided answers on a seven-point scale ranging from 1 = "Not feasible at all" to 7 = "Very feasible").[7] The final decision was again measured by a yes-or-no question ("Yes, I would join him" versus "No, I would keep looking for a job" or "No, I would keep my

[6] Participants could have also imagined other events necessary for the successful launch of the new venture although they were not explicitly encouraged to do so. The point is that the more events that are needed for the successful launch of a new business, the lower the overall probability of success as long as no event is sufficient per se.

[7] At the theoretical level, self-confidence (confidence in one's self) is different from feasibility. We have not empirically distinguished them in Study 1 and this is a limitation we overcome in Study 2. Importantly, we do not infer overconfidence solely from this variable.

job"), but we also collected a measure of the attractiveness of the option of joining the friend in the new venture for a reliability check (participants were asked "In the situation described above, how attractive is the option of joining your friend in this new venture?" and provided answers on a seven-point scale ranging from 1 = "Not attractive at all" to 7 = "Very attractive"). In addition, to further test the effect of reference point framing, we added a final question in each scenario, which took one of two forms: "Now suppose that your chances of finding a satisfying job are around 50%, would you join your friend in this new venture?" or, alternatively, "Now suppose that there is a chance of 50% that you will be fired due to a downsizing program in the company you work for. Considering the information above, would you join your friend in this new venture?"

The order in which the scenarios were presented was randomized, and different screens with other psychometric scales separated the introduction of one scenario from the next. In addition, participants could not go backwards to check their previous answers once they had validated each screen. This approach helps minimize practice and carryover effects from one scenario to the other (Keppel, 1991; Pedhazur & Schmelkin, 1991) but does not reduce carryover effects within each scenario (i.e., from the first measure of perceived risk, confidence, and decision to the second measure). However, in our repeated-measures research design, all carryover effects run against our hypotheses as they are supposed to reduce variation in respondents' perceptions and decisions. Therefore, such a design provides a strong test of our hypotheses.

5.3. Study 2 – Entrepreneurs' sample

5.3.1. Participants

Following our first study and to improve external validity, we set out to replicate the study with a sample of entrepreneurs.[8] To obtain our sample, we reached out to a number of members of an entrepreneurial ecosystem in a Midwestern city in the United States. Specifically, invitations to participate in the study were sent via e-mail from two entrepreneurial accelerators, an angel investor network, and a regional university to attendees of recent entrepreneurial events.

[8] We thank the Field Editor, Karl Wennberg, and three anonymous reviewers for encouraging us in this direction.

A total of 231 members of the entrepreneurial ecosystem began answering our survey, out of which 162 had already started or were in the process of starting at least one business. However, only 95 respondents provided useable data for a within-subject analysis. Out of those, sixty-eight (72%) had already started or were in the process of starting at least one business. Compared to our student sample, this sample had relatively less women (34%) and was older (*M* = 36.93, *SD* = 13.79). The vast majority had either a college (66%) or a professional degree (26%). Among those that were in a start-up process, about 53% were already generating revenues from sales and 69% were already employing other people. Their start-ups varied considerably in terms of number of employees (*M* = 12.03, *SD* = 36.44) and sector (a total of 32 different sectors were represented). Among those with entrepreneurial experience, about 75% were serial entrepreneurs, i.e., had already started more than one business in the past (*M* = 3.22, *SD* = 3.66). In addition, these entrepreneurs also displayed diversity of business size, both in terms of number of employees (*M* = 61.64, *SD* = 191.54) and annual revenues from sales (although a majority of 64% reported annual sales below $100,000 dollars, about 11% reported annual sales between $1,000,000 and $5,000,000 dollars, and 8% reported annual sales of more than $5,000,000 dollars). Finally, although 28% of our final sample declared to have neither previous nor current experience in starting a business, all of them declared to be either prospective entrepreneurs and/or investors in entrepreneurial businesses.

5.3.2. Research instrument and measures

For this second study, we kept the same experimental design of Study 1, using the same vignettes and the same four scenarios presented in a random order. We also improved our measurement scales especially related to confidence. In addition, after pre-testing the new online survey with a dozen members of the entrepreneurial ecosystem, we made a few slight modifications to make our scenarios and decision questions more gender neutral. The specific features of the instrument used in Study 2 are detailed below.

First, we measured all continuous variables on a nine-point Likert scale, in order to keep the same granularity of measurement. Thus, *perceived risk* was still measured on a nine-point scale (ranging from 1 = “Not risky” to 9 = “Very risky”), and so were our confidence variables. Second, we systematically distinguished between self-confidence or self-efficacy, feasibility, and confidence. *Self-efficacy* was

measured as the level of confidence participants had in their own capability to make the venture proposed by a friend a success (answers to the question "How capable do you think you are of making this new venture (proposed by your friend) a success?" were indicated on a nine-point scale ranging from 1 = "I don't feel capable enough" to 9 = "I feel totally capable"). *Feasibility* was assessed by the question "How feasible do you think this new venture is?" (answers ranged from 1 = "Not feasible at all" to 9 = "Very feasible"). *Confidence* was assessed by the question "How confident are you about this venture?" and answers ranged from 1 = "Not confident at all" to 9 = "Very confident." These three questions were systematically asked before and after the introduction of additional information in each scenario.

6. ANALYSES AND RESULTS

Table 2a. Descriptive results – Study 1: Students' sample

Outcome salience framing	**Reference point framing**	
	Employed	**Unemployed**
Positive	Initial perceived risk: *M* = 6.37, *SD* = 1.60 Initial confidence: *M* = 4.94, *SD* = 1.29 Initial decisions: Yes = 198; No = 249 Probability of success required to join: *M* = 68.19, *SD* = 17.23	Initial perceived risk: *M* = 5.86, *SD* = 1.80 Initial confidence: *M* = 5.05, *SD* = 1.19 Initial decisions: Yes = 277; No = 170 Probability of success required to join: *M* = 61.47, *SD* = 17.60
	Anchoring: High probabilities of success	**Anchoring: High probabilities of success**
	Estimated overall probability of success: *M* = 74.60, *SD* = 15.42 Perceived risk: *M* = 4.77, *SD* = 1.89 Confidence: *M* = 5.34, *SD* = 1.10 Final decisions: Yes = 331; No = 116	Estimated overall probability of success: *M* = 74.74, *SD* = 15.26 Perceived risk: *M* = 4.35, *SD* = 1.90 Confidence: *M* = 5.50, *SD* = 1.10 Final decisions: Yes = 384; No = 63
Negative	Initial perceived risk: *M* = 6.97, *SD* = 1.54 Initial confidence: *M* = 4.95, *SD* = 1.19 Initial decisions: Yes = 145; No = 302 Probability of success required to join: *M* = 71.27, *SD* = 16.95	Initial perceived risk: *M* = 6.45, *SD* = 1.69 Initial confidence: *M* = 4.85, *SD* = 1.32 Initial decisions: Yes = 203; No = 244 Probability of success required to join: *M* = 67.24, *SD* = 16.62
	Anchoring: Low probabilities of failure	**Anchoring: Low probabilities of failure**
	Estimated overall probability of failure: *M* = 50.84, *SD* = 23.43 Perceived risk: *M* = 6.55, *SD* = 1.90 Confidence: *M* = 4.28, *SD* = 1.42	Estimated overall probability of failure: *M* = 51.17, *SD* = 24.32 Perceived risk: *M* = 6.10, *SD* = 2.02 Confidence: *M* = 4.36, *SD* = 1.52

	Final decisions: Yes = 172; No = 275	Final decisions: Yes = 248; No = 199

Note. Manipulated variables in bold. Mean scores and standard deviations are presented for variables rated on a Likert scale. Frequencies are presented for decisions. *N* = 447 x 4 = 1,788 total observations.

Table 2b. Descriptive results – Study 2: Entrepreneurs' sample

Outcome salience framing	**Reference point framing**	
	Employed	**Unemployed**
Positive	Initial perceived risk: *M* = 5.89, *SD* = 1.92 Initial self-efficacy: *M* = 6.05, *SD* = 1.81 Initial feasibility: *M* = 5.42, *SD* = 1.54 Initial confidence: *M* = 5.25, *SD* = 1.67 Initial decisions: Yes = 48; No = 45 Probability of success required to join: *M* = 61.07, *SD* = 19.42	Initial perceived risk: *M* = 5.21, *SD* = 2.35 Initial self-efficacy: *M* = 5.91, *SD* = 1.86 Initial feasibility: *M* = 5.43, *SD* = 1.47 Initial confidence: *M* = 5.26, *SD* = 1.78 Initial decisions: Yes = 58; No = 34 Probability of success required to join: *M* = 54.92, *SD* = 20.54
	Anchoring: High probabilities of success	**Anchoring: High probabilities of success**
	Estimated overall probability of success: *M* = 71.13, *SD* = 20.61 Perceived risk: *M* = 4.15, *SD* = 1.85 Self-efficacy: *M* = 6.83, *SD* = 1.58 Feasibility: *M* = 6.87, *SD* = 1.52 Confidence: *M* = 6.90, *SD* = 1.41 Final decisions: Yes = 71; No = 22	Estimated overall probability of success: *M* = 71.35, *SD* = 17.53 Perceived risk: *M* = 4.03, *SD* = 2.16 Self-efficacy: *M* = 6.58, *SD* = 1.66 Feasibility: *M* = 6.70, *SD* = 1.57 Confidence: *M* = 6.84, *SD* = 1.47 Final decisions: Yes = 81; No = 13
Negative	Initial perceived risk: *M* = 6.40, *SD* = 1.97 Initial self-efficacy: *M* = 6.10, *SD* = 1.70 Initial feasibility: *M* = 5.43, *SD* = 1.49 Initial confidence: *M* = 5.07, *SD* = 1.78 Initial decisions: Yes = 42; No = 52 Probability of success required to join: *M* = 62.19, *SD* = 20.25	Initial perceived risk: *M* = 5.72, *SD* = 2.26 Initial self-efficacy: *M* = 5.35, *SD* = 2.00 Initial feasibility: *M* = 5.08, *SD* = 1.69 Initial confidence: *M* = 5.00, *SD* = 1.79 Initial decisions: Yes = 53; No = 39 Probability of success required to join: *M* = 56.09, *SD* = 22.17
	Anchoring: Low probabilities of failure	**Anchoring: Low probabilities of failure**
	Estimated overall probability of failure: *M* = 50.50, *SD* = 25.06 Perceived risk: *M* = 5.46, *SD* = 2.07 Self-efficacy: *M* = 6.00, *SD* = 1.84 Feasibility: *M* = 5.69, *SD* = 1.92 Confidence: *M* = 5.63, *SD* = 1.91 Final decisions: Yes = 54; No = 40	Estimated overall probability of failure: *M* = 48.77, *SD* = 26.76 Perceived risk: *M* = 5.25, *SD* = 2.19 Self-efficacy: *M* = 5.58, *SD* = 1.92 Feasibility: *M* = 5.62, *SD* = 1.86 Confidence: *M* = 5.55, *SD* = 1.96 Final decisions: Yes = 59; No = 32

Note. Manipulated variables in bold. Mean scores and standard deviations are presented for variables rated on a Likert scale. Frequencies are presented for decisions. *N* varies from 91 to 95 in each treatment condition because of missing values.

6.1. Overview and descriptive statistics

Tables 2a and 2b present an overview of descriptive results for our student and entrepreneur samples, with the mean scores (or frequencies) for each variable in each treatment condition. The tables provide a few preliminary insights worth noting. First, participant perceptions and decisions were generally consistent with a framing effect: perceived risk was highest and the number of decisions favorable to joining the venture was lowest when individuals were employed and the salient outcome was failure (lower-left quadrant). In contrast, the number of favorable decisions to join the start-up project was highest with the lowest level of perceived risk in the treatment condition when individuals were looking for a job and the salient outcome of the new venture was framed in positive terms (upper-right quadrant). The average probability of success needed to join the project also followed the same pattern: it was highest when outcome salience framing was negative and individuals were employed and was lowest when outcome salience framing was positive and individuals were looking for a job.

For the two treatment conditions where outcome salience was framed in positive terms, participants received high anchor values in the form of high probabilities of success for the critical events needed for the successful launch of the venture. Their estimates of the overall probability of venture success averaged 75% in the students' sample (Table 2a) and 71% in the entrepreneurs' sample (Table 2b), therefore surpassing the threshold of the probability they required on average to join the venture. Not surprisingly, the number of decisions favorable to joining the venture increased after the introduction of such additional information.

Interestingly, we did not find the same pattern in the two other treatment conditions in which outcome salience was negatively framed and participants received low anchor values (i.e., low probabilities of failure for the critical events necessary for launching the venture). Estimates of the overall probability of failure for the venture averaged 51% in Study 1 (Table 2a) and 51% and 49% respectively in the employed and unemployed treatment conditions in Study 2 (lower quadrants in Table 2b). In both studies, participants estimated probability of success thus remained below the mean probability they reported needing in order to join the venture. Yet, the number of decisions favorable to joining the venture

still increased in these situations after the anchor values were added. We further examine these somewhat puzzling results and test our hypotheses in the next sections. However, it is remarkable that all these patterns appeared in both studies.

Tables 3a and 3b show summary statistics and pairwise correlations for the variables used in our main analyses. In Study 1, we controlled for gender, age, entrepreneurial experience, current involvement in a start-up process, parental self-employment, years of professional experience, education level and academic background. In Study 2, we included six control variables: gender, age, entrepreneurial experience, current involvement in a start-up process, education level, and start-up knowledge (a self-reported assessment ranging from 1 = "Not knowledgeable at all" to 5 = "Extremely knowledgeable"). In addition, we compared results using our three confidence-related variables—self-efficacy, feasibility, and confidence—and found no substantive difference. In fact, these three variables were highly correlated (their pairwise correlations range from $r(368) = .63$ to $r(370) = .86$, $p < .001$). Therefore, we report results using confidence measured as confidence in the new venture.[9]

[9] Results for the other two measures were substantively very similar and are available from the authors.

Table 3a. Descriptive statistics and correlations – Study 1: Students' sample

Variable	Coding/Value range	M	SD	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Control																			
1. Gender	1 = male; 2 = female	1.47	0.50																
2. Age	Min. = 18; Max. = 56	21.66	3.73	**0.14**															
3. Entrepreneurial experience	1 = yes; 0 = no	0.11	0.31	**-0.13**	**0.22**														
4. Currently in a start-up process	1 = yes; 0 = no	0.09	0.28	**-0.08**	**0.18**	**0.26**													
5. Parents self-employed	1 = at least one parent; 0 = none	0.45	0.50	0.02	-0.00	0.05	0.04												
6. Employment experience (years)	Min. = 0; Max. = 31	3.46	3.81	**0.05**	**0.67**	**0.21**	**0.18**	-0.00											
Exogenous																			
7. Reference point framing	-1 = unemployed; 1 = employed	0.00	1.00	0.00	0.00	-0.00	-0.00	-0.00	-0.00										
8. Outcome salience framing	-1 = negative; 1 = positive	0.00	1.00	0.00	0.00	-0.00	-0.00	-0.00	-0.00	0.00									
9. Anchoring	-1 = low; 1 = high	0.00	1.00	0.00	0.00	-0.00	-0.00	-0.00	-0.00	0.00	1.00								
Endogenous																			
10. Initial perceived risk	1 = not risky; 9 = very risky	6.41	1.70	**0.18**	**-0.05**	**-0.06**	**-0.10**	-0.04	**-0.05**	**0.15**	**-0.18**	**-0.18**							
11. Initial confidence	1 = not capable; 7 = totally capable	4.95	1.25	**-0.11**	**0.08**	**0.05**	**0.13**	0.04	**0.13**	0.00	0.04	0.04	**-0.19**						
12. Initial decision	1 = yes; 0 = no	0.46	0.50	**0.23**	0.00	**0.09**	**0.13**	0.04	**0.05**	**-0.15**	**0.14**	**0.14**	**-0.47**	**0.38**					
13. Required probability of success	Min. = 1%; Max. = 100%	67.05	17.45	**0.24**	-0.02	-0.04	**-0.11**	**-0.05**	**-0.06**	**0.15**	**-0.13**	**-0.13**	**0.54**	**-0.33**	**-0.69**				
14. Estimated probability of success/failure	Min. = 0%; Max. = 100%	62.84	23.28	**0.10**	0.02	-0.04	-0.01	-0.00	0.02	-0.00	**0.51**	**0.51**	**-0.07**	0.05	0.04	0.01			
15. Final perceived risk	1 = not risky; 9 = very risky	5.45	2.13	**0.08**	**-0.05**	0.00	**-0.05**	-0.02	**-0.05**	**0.10**	**-0.41**	**-0.41**	**0.47**	**-0.13**	**-0.22**	**0.29**	**-0.22**		
16. Final confidence	1 = not feasible; 7 = very feasible	4.87	1.41	-0.02	0.04	0.00	**0.09**	0.04	0.04	-0.04	**0.39**	**0.39**	**-0.20**	**0.30**	**0.25**	**-0.24**	**0.19**	**-0.60**	
17. Final decision	1 = yes; 0 = no	0.64	0.48	**-0.08**	**0.05**	0.01	**0.11**	0.03	**0.06**	**-0.15**	**0.34**	**0.34**	**-0.32**	**0.25**	**0.46**	**-0.40**	**0.18**	**-0.58**	**0.59**

Note. All correlations in bold are significant at the 5% level.

Table 3b. Descriptive statistics and correlations – Study 2: Entrepreneurs' sample

Variable	Coding/Value range	M	SD	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Control																			
1. Gender	0 = male; 1 = female	0.34	0.47																
2. Age	Min. = 18; Max. = 76	36.93	13.79	**-0.17**															
3. Entrepreneurial experience	1 = yes; 0 = no	0.59	0.49	**-0.31**	**0.44**														
4. Currently in a start-up process	1 = yes; 0 = no	0.34	0.47	-0.04	**0.17**	0.05													
5. Education level	2 = High school graduate; 5 = Doctorate	3.32	0.60	-0.08	**0.44**	**0.30**	**0.18**												
6. Start-up knowledge	1 = not knowledgeable at all; 5 = extremely knowledgeable	3.33	1.05	**-0.31**	**0.45**	**0.42**	**0.12**	**0.29**											
Exogenous																			
7. Reference point framing	-1 = unemployed; 1 = employed	0.00	1.00	-0.00	-0.00	0.00	-0.00	0.00	-0.00										
8. Outcome salience framing	-1 = negative; 1 = positive	0.00	1.00	-0.00	-0.00	-0.00	0.00	0.00	-0.00	0.00									
9. Anchoring	-1 = low; 1 = high	0.00	1.00	-0.00	-0.00	-0.00	0.00	0.00	-0.00	0.00	1.00								
Endogenous																			
10. Initial perceived risk	1 = not risky; 9 = very risky	5.81	2.17	0.06	-0.03	-0.10	**-0.13**	-0.04	0.05	**0.16**	**-0.12**	**-0.12**							
11. Initial confidence	1 = not confident at all; 9 = very confident	5.14	1.75	-0.09	**0.16**	**0.17**	**0.13**	-0.04	-0.08	0.01	0.06	0.06	**-0.29**						
12. Initial decision	1 = yes; 0 = no	0.54	0.50	**-0.19**	**0.12**	**0.21**	**0.17**	-0.05	0.09	**-0.12**	0.06	0.06	**-0.40**	**0.56**					
13. Required probability of success	Min. = 0%; Max. = 100%	58.59	20.77	**0.37**	-0.09	**-0.18**	**-0.19**	-0.08	-0.07	**0.15**	-0.03	-0.03	**0.43**	**-0.31**	**-0.50**				
14. Estimated probability of success/failure	Min. = 0%; Max. = 100%	60.50	25.12	**0.17**	0.06	0.01	0.03	-0.05	**-0.11**	0.01	**0.43**	**0.43**	-0.09	0.08	0.04	**0.13**			
15. Final perceived risk	1 = not risky; 9 = very risky	4.72	2.16	-0.07	0.08	0.05	-0.01	0.10	**0.12**	0.04	**-0.29**	**-0.29**	**0.51**	**-0.18**	**-0.24**	**0.14**	**-0.11**		
16. Final confidence	1 = not confident at all; 9 = very confident	6.24	1.81	0.10	-0.03	0.01	0.08	**-0.16**	**-0.15**	0.02	**0.35**	**0.35**	**-0.13**	**0.45**	**0.35**	**-0.12**	0.05	**-0.47**	
17. Final decision	1 = yes; 0 = no	0.71	0.45	**-0.16**	0.03	**0.13**	**0.21**	-0.07	0.01	-0.10	**0.22**	**0.22**	**-0.27**	**0.37**	**0.55**	**-0.35**	0.06	**-0.34**	**0.58**

Note. All correlations in bold are significant at the 5% level.

6.2. Testing framing effects

Tables 4a and 4b show the results of multilevel mixed models testing our first two sets of hypotheses.[10] We also tested these hypotheses using the repeated-measures regression approach suggested by Lorch and Myers (1990) and repeated-measures analysis of variance (ANOVA). Since our design was balanced and sample size was relatively large, both approaches yielded results very similar to those obtained with multilevel mixed-effects linear regression, a general approach to modeling repeated-measures data that encompasses both ANOVA and repeated-measures regression approaches (Wallace & Green, 2002). However, linear mixed models also provide significant advantages in terms of flexibility, estimate accuracy, and the ability to handle multiple continuous and categorical independent variables (Misangyi et al., 2006; Noortgate & Onghena, 2006). Therefore, in Tables 4a and 4b, we report results of multilevel mixed-effects modeling for Study 1 and Study 2. In each table, Models 1 to 4 show regressions using the restricted maximum likelihood (REML) method for estimating covariance parameters. Models 5 and 6 show multilevel mixed-effects logistic regressions for the initial decision to join the new venture. In all models, random effects were estimated independently for each participant with all covariances assumed to be 0 as we had no particular reason to believe that random effects should co-vary between participants or that they should vary according to other variables (given the relevant control variables were already specified in the fixed-effects equation).[11] This approach enables the variance between and within subjects to be decomposed and provides reliable test statistics (Misangyi et al., 2006).

Our first set of hypotheses concerns reference point framing effects. Hypotheses 1a, 1b, and 1c assert that having a satisfactory job increases the perceived risk, the required odds of success, and the confidence associated with starting a new venture. Models 1 to 4 provide tests of these hypotheses. In both Tables 4a and 4b Model 1 shows that reference point has a statistically significant effect on the perceived risk associated with the option of starting the new venture. In Study 1, being employed had a treatment

[10] Full tables showing results for control variables are provided in the Online Appendix.
[11] We tested different specifications of the random-effects equation (e.g., with an unstructured covariance matrix) and found that our results are robust to these different specifications.

effect of .26 (p < .001, 95% CI [.20, .32]), whereas being unemployed had a treatment effect of -.26 (p < .001, 95% CI [-.20, -.32]).[12] Therefore, the students participating in our experiment exhibited an increase of .52 on average on a nine-point scale of risk perception (nearly 6%) as they shifted from the unemployed to the employed condition. This corresponds to an effect size of f^2 = .06, which is small according to Cohen (1988),[13] but still relevant given our research design. Hypothesis 1a is thus supported in Study 1. It is also supported in Study 2, where reference point framing obtained a statistically significant effect (β = .34, p < .001, 95% CI [.18, .50]) representing a variation of nearly 8% in perceived risk between the unemployed and the employed condition (Cohen's f^2 = .06).

Hypothesis 1b asserted that having a satisfactory job increases the required probability of success to start a new venture. Models 3 and 4 in Tables 4a and 4b show statistically significant and positive coefficients for reference point framing on the required probability of success, thus corroborating Hypothesis 1b. The coefficient shown in Model 3 in Table 4a (β = 2.70, p < .001, 95% CI [2.22, 3.17]) indicates that the probabilities of success required by the students' sample to join the venture were on average over 5% higher in the employed condition, relative to the unemployed condition (Cohen's f^2 = .10). In the entrepreneurs' sample (see Model 3 in Table 4b), the probabilities of success required to join the venture were about 6% higher (β = 3.10, p < .001, 95% CI [1.96, 4.25]) on average in the employed condition (Cohen's f^2 = .10).

Hypothesis 1c, however, is not supported by our experimental results. Model 2 in Table 4a shows that reference point framing did not have a statistically significant effect on students' confidence in their own capability to make the new venture a success. Model 2 in Table 4b shows that reference point framing did not have a statistically significant effect on entrepreneurs' confidence about the new venture.

[12] As suggested by Pedhazur and Schmelkin (1991), we used effect coding for our factorial design.

[13] We calculated Cohen's f^2 effect size following the method described by Selya *et al.* (2012). According to Cohen's (1988) guidelines, $f^2 \geq 0.02$, $f^2 \geq 0.15$, and $f^2 \geq 0.35$ represent small, medium, and large effect sizes, respectively. Given that our within-subject, repeated-measures design is likely to reduce effect sizes (because of carryover effects) and provide a more robust test of our hypotheses, we believe that even a small effect size in our design might have practical relevance.

Contrary to our expectations, having a satisfactory job did not increase the confidence associated with business start-up in neither of our studies, regardless of the confidence measure adopted.

Table 4a. Multilevel mixed-effects modeling—Framing effects (Study 1: Students' sample)

	Dependent variable					
	Initial perceived risk	Initial confidence	Required odds of success		Initial decision	
Independent variable	(1)	(2)	(3)	(4)	(5)	(6)
Control variables included	Yes	Yes	Yes	Yes	Yes	Yes
Exogenous						
Reference point framing	.26*** (.03)	.01 (.02)	2.70*** (.24)	1.86*** (.23)	-1.58*** (.17)	-.87*** (.23)
Outcome salience framing	-.30*** (.03)	.05* (.02)	-2.15*** (.24)	-1.07*** (.23)	1.33*** (.17)	.43* (.22)
Endogenous						
Initial perceived risk				3.20*** (.20)		-.63*** (.11)
Initial confidence				-2.46*** (.30)		.91*** (.13)
Required odds of success						-.19*** (.02)
Log restricted likelihood	-2,864.06	-2,240.33	-6,225.00	-6,056.64	-767.42	-419.38
Wald χ^2	303.00***	143.21***	334.31***	799.76***	152.12***	210.34***
Df	84	84	84	86	61	64
No. of observations	1,647	1,648	1,643	1,642	1,556	1,552
No. of groups/participants	412	412	412	412	389	389

Note. All models include control variables and random effects for participants. Models 1 to 4 are multilevel mixed-effects RELM regressions. Models 5 and 6 are multilevel mixed-effects logistic regressions. Fixed-effects parameters are reported with standard errors in parentheses. *p < 0.05; **p < 0.01; ***p < 0.001.

Table 4b. Multilevel mixed-effects modeling—Framing effects (Study 2: Entrepreneurs' sample)

	Dependent variable					
	Initial perceived risk	Initial confidence	Required odds of success		Initial decision	
Independent variable	(1)	(2)	(3)	(4)	(5)	(6)
Control variables included						
Exogenous						
Reference point framing	.34*** (.08)	.02 (.06)	3.10*** (.59)	2.03*** (.55)	-.48*** (.15)	-.27 (.21)
Outcome salience framing	-.26** (.08)	.11 (.06)	-.64 (.59)	.16 (.55)	.25 (.15)	.15 (.20)
Endogenous						
Initial perceived risk				3.16*** (.38)		-.55*** (.15)

Initial confidence				-.60 (.48)		1.62*** (.27)
Required odds of success						-.09*** (.02)
Log restricted likelihood	-764.29	-673.90	-1,508.36	-1,466.44	-198.11	-115.94
Wald χ^2	33.88***	22.82**	56.55***	144.50***	24.64**	50.20***
Df	8	8	8	10	8	11
No. of observations	371	371	371	369	371	369
No. of groups/participants	95	95	95	95	95	95

Note. All models include control variables and random effects for participants. Models 1 to 4 are multilevel mixed-effects RELM regressions. Models 5 and 6 are multilevel mixed-effects logistic regressions. Fixed-effects parameters are reported with standard errors in parentheses. *p < 0.05; **p < 0.01; ***p < 0.001.

Our second set of hypotheses concerns outcome salience framing, asserting that positively framed outcomes decrease the perceived risk (Hypothesis 2a) and the required odds of success to start a new venture (Hypothesis 2b), but increase the confidence associated with it (Hypothesis 2c). Again, Tables 4a and 4b provide tests of these hypotheses. In both tables, Model 1 shows a statistically significant treatment effect for outcome salience framing (Table 4a: $\beta = -.30$, p < .001, 95% CI [-.36, -.25]; Table 4b: $\beta = -.26$, p = .002, 95% CI [-.41, -.10]), indicating that positive framing decreased perceived risk whereas negative framing increased it. In Study 1, perceived risk was on average nearly 7% lower in the treatment conditions where the salient potential outcomes were positively framed (Cohen's f^2 = .08). In Study 2, the effect size of outcome salience framing on perceived risk was smaller (Cohen's f^2 = .04); still, perceived risk was nearly 6% lower when potential outcomes were positively framed. The effect sizes are small but still corroborate Hypothesis 2a.

Hypothesis 2b is supported only in Study 1. In Table 4a, both Models 3 and 4 show negative and statistically significant coefficients for outcome salience framing on the required odds of success (Model 3: $\beta = -2.15$, p < .001, 95% CI [-2.62, -1.67]; Model 4: $\beta = -1.07$, p < .001, 95% CI [-1.53, -.62]). When potential outcomes were positively framed and the salient outcome was success, students' required probability of success to join the venture was about 4% lower than in the treatment conditions with negative outcome salience framing (effect sizes of f^2 =.06 for Model 3 and f^2 =.02 for Model 4). However,

in Table 4b, both Models 3 and 4 show no statistically significant coefficients for outcome salience framing on the required odds of success. Hypothesis 2b is not supported in Study 2.

In Table 4a Model 2, the coefficient of outcome salience framing on confidence is statistically significant at the .05 level but also substantively small. The effect size of outcome salience framing on confidence was f^2 = .005 in Study 1, which is below the threshold used by Cohen to distinguish between a small effect size and a "triviality" (1988, p. 413). In addition, in Table 4a Model 2 (the full model) provides only a slight improvement over a model including only control variables (see Online Appendix), indicating that the inclusion of our framing variables adds little to explain variance in confidence ($\Delta \chi^2$ (2) = 5.69; significant only at the 0.1 level). In Study 2, outcome salience framing had no statistically significant effect on confidence (see Model 2 in Table 4b). Therefore, we conclude framing effects were particularly relevant for shaping perceived risk but not confidence in both of our studies. Hypothesis 2c is not supported.

In Tables 4a and 4b, Models 5 and 6 estimate fixed effects for determinants of the initial decision to join the new venture. Although we did not formalize hypotheses, it is worth noting that perceived risk, confidence, and the required odds of success are significantly related to the decision to join the new venture. All relationships are consistent with the signs displayed in Figure 1. Participants who perceived more risk demanded higher probabilities of success and were less likely to join the venture, whereas participants who were more confident demanded lower probabilities of success and were more likely to join.

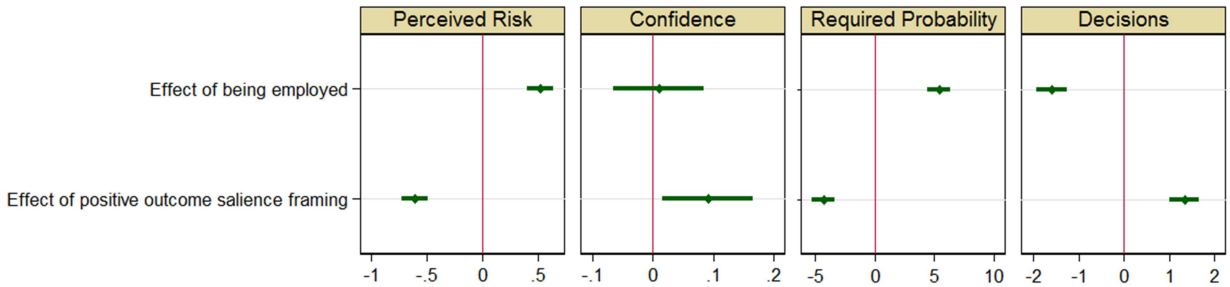
Interestingly, framing effects were not fully mediated by perceived risk or confidence in Study 1. For reference point framing, the results from the mixed-effects logistic regression (Model 6 in Table 4a) suggest that when students went from the unemployed to the employed condition, the odds of starting a new business decreased by about 58% ($\beta = -.87$, p < .001, OR = .42, 95% CI [.27, .65]). For outcome salience framing, when given positively framed outcomes, students' odds of starting a new business were 54% higher than when they were provided with negatively framed outcomes ($\beta = .43$, p = .047, OR =

1.54, 95% CI [1.01, 2.36]). Thus, both types of framing effects (reference point and outcome salience) affected the decision to start a business both directly and indirectly (via risk perception) in Study 1.

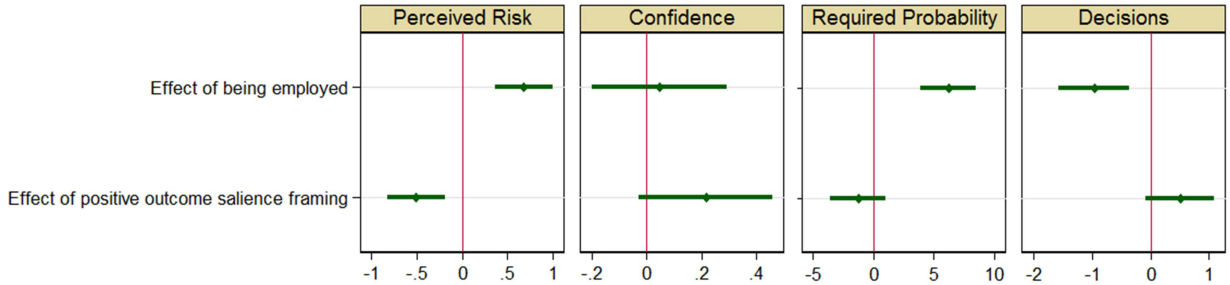
In Study 2, framing effects were not as strong as in Study 1. Outcome salience framing had no statistically significant direct effect on decisions, whereas reference point framing had a significant direct effect (Model 5 in Table 4b), but the effect became non-significant when perceived risk and required odds of success were added (Model 6, Table 4b). Since reference point framing significantly affected perceived risk (Model 1) and the required odds of success (Models 3 and 4), we interpret the pattern shown in Models 5 and 6 as a sign of full mediation. Graphic 1 below shows coefficient plots with 95% confidence intervals, providing a visual summary of the framing effects we found in both experiments.

Graphic 1. Framing effects (Coefficient plots with 95% confidence intervals)

Study 1: Students' sample



Study 2: Entrepreneurs' sample



6.3. Testing anchoring effects

Our third set of hypotheses suggests that given the conjunctive nature of the venture process, the probabilities attributed to critical events necessary for the completion of the venture project will anchor overall estimates of success and failure of the new venture. Hypothesis 3a asserts that high probabilities of

success attributed to these events would lead to *overestimation* of the venture's probability of *success*, whereas Hypothesis 3b suggests that low probabilities of failure attributed to these events would lead to *underestimation* of the venture's probability of *failure*. Tables 5a and 5b report mean comparisons of participants' estimates of the overall probability of success and failure.

Specifically, we conducted one-sample t-tests to compare participants' estimates with what would be the "correct" estimate generated by basic principles of probability (i.e., the estimate one should provide if he or she realized the conjunctive nature of the events at hand and hence computed the overall probability of success by multiplying the events' individual probabilities of success). The "correct" overall probability of success was 48.96% (= .90 x .80 x .85 x .80), and the "correct" overall probability of failure was 51.04% (= 1 – .4896).

Table 5a (Study 1) shows that in the treatment conditions where students were provided high probabilities of success for the critical events necessary for project completion, the overall probability of success was indeed overestimated—that is, students estimated the probability of the venture's success significantly higher than 48.96%: for Treatment Condition A, the mean estimate was 74.60% ($t(445) = 35.12$, $p < .001$, 95% CI [73.16, 76.03]), and for Treatment Condition B, the mean estimate was 74.74% ($t(444) = 35.63$, $p < .001$, 95% CI [73.32, 76.16]). Notice that these estimates are also significantly superior to the probabilities participants reported (on average) needing in order to join the new venture (see the last four columns of Table 5a).

Table 5b shows that entrepreneurs in Study 2 also overestimated the overall probability of venture's success when provided high probabilities of success for the critical events necessary for project completion: for Treatment Condition A, the mean estimate was 71.13% ($t(92) = 10.37$, $p < .001$, 95% CI [66.89, 75.37]), and for Treatment Condition B, the mean estimate was 71.35% ($t(93) = 12.39$, $p < .001$, 95% CI [67.76, 74.94]). Again, these estimates were also significantly superior to the probabilities entrepreneurs reported (on average) needing in order to join the new venture (see the last four columns of Table 5b).

Table 5a. Mean comparisons of participants' estimations of probability of success/failure (Study 1: Students' sample)

Treatment condition	Framing	Anchoring	Estimated probability	Correct estimation [a]	*T* [b]	*df*	*p*	Probability of success to join	*T* [c]	*df*	*p*
A	Positive salient outcome; employed	High probabilities of success	*M* = 74.60% *SD* = 15.42	Success: 48.96%	35.12	445	.000	*M* = 68.19% *SD* = 17.23	5.84	876.30	.000
B	Positive salient outcome; unemployed	High probabilities of success	*M* = 74.74% *SD* = 15.26	Success: 48.96%	35.63	444	.000	*M* = 61.47% *SD* = 17.60	12.02	870.55	.000
C	Negative salient outcome; employed	Low probabilities of failure	*M* = 50.84% *SD* = 23.43	Failure: 51.04%	-0.18	444	.859	*M* = 71.27% *SD* = 16.95	-14.92	808.60	.000
D	Negative salient outcome; unemployed	Low probabilities of failure	*M* = 51.17% *SD* = 24.32	Failure: 51.04%	0.11	444	.910	*M* = 67.24% *SD* = 16.62	-11.51	784.12	.000

[a] The "correct" overall probability of success for the venture should be computed as the product of the individual probabilities provided in the scenario description (i.e., .90 x .80 x .85 x .80 = 48.96%). Hence, the overall probability of failure must be 1 – .4896 = 51.04%.[b] One-sample t-test.[c] Two-sample t-test with unequal variance.

Table 5b. Mean comparisons of participants' estimations of probability of success/failure (Study 2: Entrepreneurs' sample)

Treatment condition	Framing	Anchoring	Estimated probability	Correct estimation [a]	*T* [b]	*df*	*p*	Probability of success to join	*T* [c]	*df*	*P*
A	Positive salient outcome; employed	High probabilities of success	*M* = 71.13% *SD* = 20.61	Success: 48.96%	10.37	92	.000	*M* = 61.07% *SD* = 19.42	3.43	183.36	.001
B	Positive salient outcome; unemployed	High probabilities of success	*M* = 71.35% *SD* = 17.53	Success: 48.96%	12.39	93	.000	*M* = 54.92% SD = 20.54	5.86	178.30	.000
C	Negative salient outcome; employed	Low probabilities of failure	*M* = 50.50% *SD* = 25.06	Failure: 51.04%	-0.21	92	.834	*M* = 62.19% *SD* = 20.25	-3.51	176.40	.001
D	Negative salient outcome; unemployed	Low probabilities of failure	*M* = 48.77% *SD* = 26.76	Failure: 51.04%	-0.81	91	.418	*M* = 56.09% *SD* = 22.17	-2.02	175.91	.045

[a] The "correct" overall probability of success for the venture should be computed as the product of the individual probabilities provided in the scenario description (i.e., .90 x .80 x .85 x .80 = 48.96%). Hence, the overall probability of failure must be 1 – .4896 = 51.04%.[b] One-sample t-test.[c] Two-sample t-test with unequal variance.

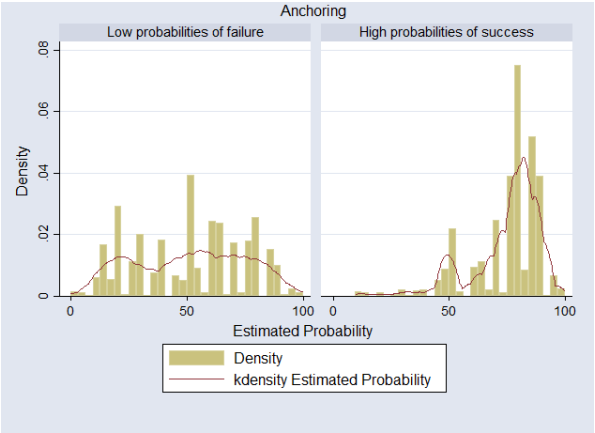
These results clearly indicate that the anchor values included in the information provided in these two treatment conditions biased estimations upwards. The high probabilities of success attributed to the four critical events highlighted in the information added to each scenario (90%, 80%, 85%, and 80%, respectively) provided anchor values that were higher than the initial estimation of 50% "made by the friend" in the initial scenario description and were also superior to the self-generated value of the probability of success required to join the new venture. Therefore, Hypothesis 3a is supported in both Studies 1 and 2.

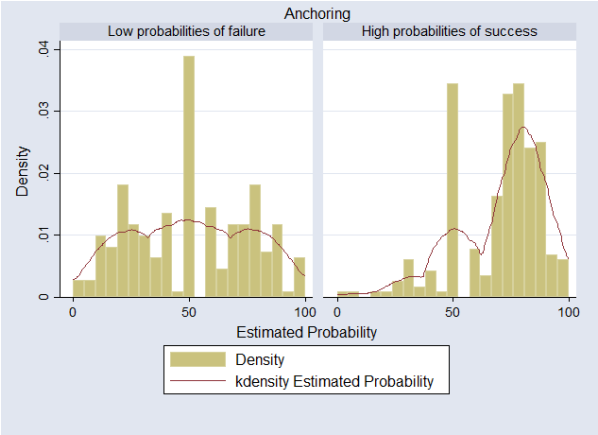
However, Hypothesis 3b is not supported in either study. As shown in Table 5a (Study 1), in Treatment Conditions C and D, where low probabilities of failure were provided in the additional information about the fictitious venture, participants' estimates of the overall probability of failure (50.84% and 51.17%, respectively) were not significantly different from the "correct" estimation of 51.04% ($t(444) = -0.18$ and 0.11, respectively; *n.s.*). Similarly, in Study 2 (Table 5b) estimates of the overall probability of failure were not significantly different from 51.04% neither in Treatment Condition C ($t(92) = -0.21$, $p = .83$, 95% CI [45.33, 55.66]) nor in Treatment Condition D ($t(91) = -0.81$, $p = .42$, 95% CI [43.23, 54.31]). Thus, on average, the venture's overall probability of failure was not underestimated in these treatment conditions.

Graphic 2 below shows histograms with kernel density plots for each type of anchoring. The distribution pattern is similar across Studies 1 and 2. On the one hand, it corroborates Hypothesis 3a showing that when high probabilities of success were provided most of the estimated probabilities were indeed biased upwards. On the other hand, when low probabilities of failure were provided the distribution of estimated probabilities was much less concentrated: estimations were unbiased *on average*, as a result of individual estimations' scattering.

Graphic 2

Study 1 : Students' sample **Study 2: Entrepreneurs' sample**





The remaining hypotheses supposed that anchoring would influence the decision to join the new venture through its influence on perceptions of risk and confidence. Moreover, we argued that anchoring effects should be stronger when anchors' semantic and numeric influences are congruent with each other, that is, when high probabilities of success are given. Specifically, Hypotheses 3c and 3d suggested that high probabilities of success for critical events necessary to the completion of the venture project would lead to a larger decrease in perceived risk and to a larger increase in confidence, respectively, than low probabilities of failure for these same critical events. In order to have a direct test of these hypotheses, we run a series of mixed-effects RELM regressions whose results are presented in Tables 6a and 6b.

Table 6a. Multilevel mixed-effects modeling—Anchoring effects (Study 1: Students' sample)

	Dependent variable			
	Final perceived risk	Final confidence	Estimated odds of success	Final decision
Independent variable	(1)	(2)	(3)	(4)
Control variables	Yes	Yes	Yes	Yes
Endogenous				
Initial perceived risk	.44*** (.03)			
Initial confidence		.24*** (.03)		
Required odds of success			.10** (.04)	
Estimated odds of success				.01 (.01)
Final perceived risk				-.95*** (.09)
Final confidence				1.24*** (.13)

Exogenous				
Anchoring	-.76*** (.04)	.53*** (.03)	12.10*** (.45)	.20 (.12)
Log restricted likelihood	-3,104.71	-2,541.96	-6,914.41	-523.70
Wald χ^2	963.65***	665.03***	843.68***	199.28***
Df	84	84	83	63
No. of observations	1,647	1,648	1,639	1,551
No. of groups/participants	412	412	411	389

Note. All models include random effects for participants. Models 1 to 3 are multilevel mixed-effects RELM regressions. Model 4 is a multilevel mixed-effects logistic regression. Fixed-effects parameters are reported with standard errors in parentheses. *p < 0.05; **p < 0.01; ***p < 0.001.

Table 6b. Multilevel mixed-effects modeling—Anchoring effects (Study 2: Entrepreneurs' sample)

	Dependent variable			
	Final perceived risk	Final confidence	Estimated odds of success	Final decision
Independent variable	(1)	(2)	(3)	(4)
Control variables	Yes	Yes	Yes	Yes
Endogenous				
Initial perceived risk	.41*** (.05)			
Initial confidence		.34*** (.05)		
Required odds of success			.14* (.07)	
Estimated odds of success				.01 (.01)
Final perceived risk				-.55** (.20)
Final confidence				1.35*** (.23)
Exogenous				
Anchoring	-.53*** (.08)	.60*** (.06)	10.88*** (1.07)	-.03 (.27)
Log restricted likelihood	-720.70	-658.24	-1,652.52	-107.64
Wald χ^2	158.08***	168.36***	126.34***	45.07***
Df	8	8	8	10
No. of observations	370	370	370	370
No. of groups/participants	95	95	95	95

Note. All models include random effects for participants. Models 1 to 3 are multilevel mixed-effects RELM regressions. Model 4 is a multilevel mixed-effects logistic regression. Fixed-effects parameters are reported with standard errors in parentheses. *p < 0.05; **p < 0.01; ***p < 0.001.

Models 1 and 2 in Tables 6a and 6b lend support to Hypotheses 3c and 3d, respectively. In these models, anchoring was effect coded as 1 for "high probabilities of success" and -1 for "low probabilities of failure". The

results in Model 1 show a statistically significant negative coefficient for anchoring both in Study 1 ($\beta = -.76$, $p < .001$, 95% CI [-.83, -.68]) and in Study 2 ($\beta = -.53$, $p < .001$, 95% CI [-.68, -.38]). In Study 1, the decrease in perceived risk was about 17% higher on average in treatment conditions in which high probabilities of success were provided, compared to treatment conditions in which low probabilities of failure were provided, due to anchoring (Cohen's $f^2 = .30$). In Study 2, anchoring provoked a decrease in perceived risk that was nearly 12% higher in the former treatment conditions, compared to the latter (Cohen's $f^2 = .18$). Thus, in both studies we observe a medium to large effect size of anchoring on perceived risk. Hypothesis 3c is supported.

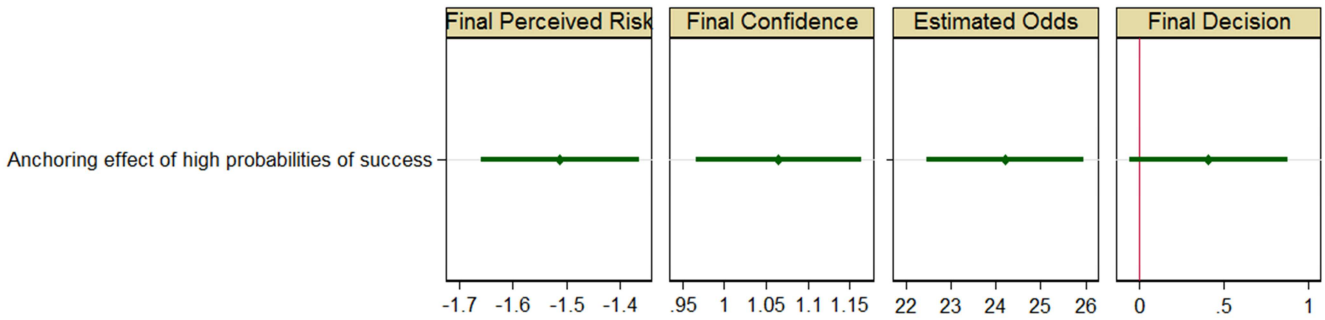
The results in Model 2 show a statistically significant positive coefficient for anchoring on confidence in Study 1 (Table 6a: $\beta = .53$, $p < .001$, 95% CI [.48, .58]) and in Study 2 (Table 6b: $\beta = .60$, $p < .001$, 95% CI [.48, .73]). In Study 1, confidence decreased after the introduction of additional information with the low probabilities of failure (see lower quadrants in Table 2a) and increased in treatment conditions where high probabilities of success were provided (upper quadrants in Table 2a). On average, anchoring provoked an increase in confidence that was about 15% higher in Treatment Conditions A and B, relative to Treatment Conditions C and D, in Study 1 (Cohen's $f^2 = .33$). In Study 2, confidence increased after the introduction of additional information with low probabilities of failure, but such increase was on average about 13% smaller than the increase in confidence in the treatment conditions where additional information provided high probabilities of success (Cohen's $f^2 = .32$). In both studies we observe a medium to large effect size of anchoring on confidence. Hypothesis 3d is supported.

Tables 6a and 6b also show results of mixed models predicting participants' estimated odds of success for the new venture as well as their final decisions. Model 3 shows a statistically significant effect of anchoring on participants' estimations, both in Study 1 (Table 6a: $\beta = 12.10$, $p < .001$, 95% CI [11.23, 12.98]) and in Study 2 (Table 6b: $\beta = 10.88$, $p < .001$, 95% CI [8.78, 12.98]). Thus, in Study 1 (2) estimated odds of success were on average 24% (22%) higher in Treatment Conditions A and B relative to Treatment Conditions C and D. The effect size of anchoring on participants' estimated probabilities was large in Study 1 ($f^2 = .52$) and medium to large in Study 2 ($f^2 = .32$). In both studies the effect of anchoring on participants' final decision was fully mediated by their levels of perceived risk and confidence (as shown in Model 4 in Tables 6a and 6b—see also the Online

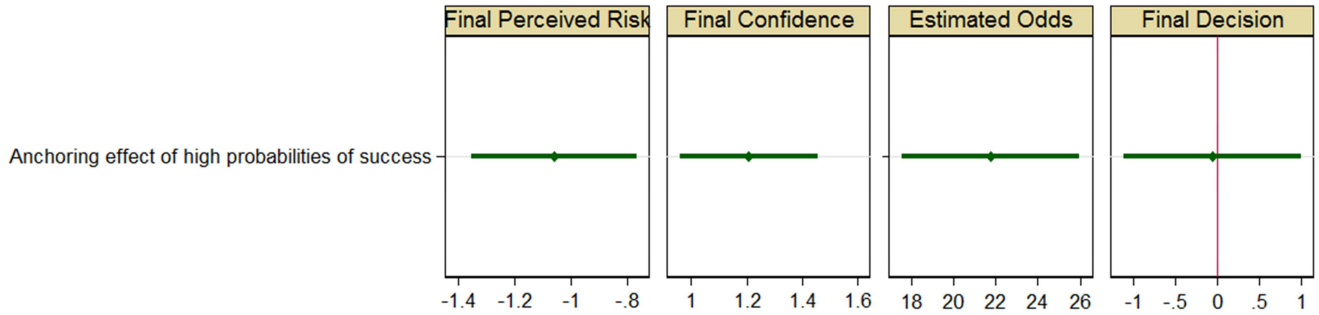
Appendix). Graphic 3 below provides a visual summary of the anchoring effects we found in both experiments, showing a negative effect on the final perceived risk, positive effects on both confidence and estimated odds, and a non-statistically significant effect on the final decision (zero appears within the 95% confidence interval).

Graphic 3. Anchoring effects (Coefficient plots with 95% confidence intervals)

Study 1 : Students' sample



Study 2: Entrepreneurs' sample



6.4. Post-hoc analyses and robustness tests

We conducted a series of robustness tests, varying estimation methods and including venture attractiveness as a dependent variable. Overall, we obtained substantively similar results. To further test the effects of reference point framing, we investigated shifts in the final decision when the alternative option of keeping a job was rendered much less sure (with a 50% chance of being fired) and when the option of looking for a job was given a 50% chance of finding a satisfactory job. In both cases the number of entry decisions increased, but more so when the sure alternative option of keeping a job became uncertain. To further test anchoring effects, we adopted a difference-in-difference approach that again corroborated the results previously shown. We also conducted separate analyses with sub-samples of entrepreneurs and non-entrepreneurs in each study. In Study 1,

the entrepreneur group included all participants who declared that they had either started a venture in the past or were in the process of starting a venture. In total, 72 participants (out of 447) qualified as entrepreneurs in our students' sample, yielding 288 observations. The smaller sample size of the entrepreneur group resulted in less significant differences for this group, but most results were very similar for both groups of entrepreneurs and non-entrepreneurs in Study 1. In Study 2, we conducted separate analyses excluding the investors and prospective entrepreneurs who had never started a business and were not currently in a start-up process. This yielded a restricted sample of 68 current and former entrepreneurs. Despite the smaller sample size, results for this sub-sample were still very similar to those reported here for the full sample. We have also tested the robustness of our findings to the use of different confidence-related measures: replacing our confidence variable by self-efficacy or feasibility in our data analysis of Study 2 did not substantively alter the results. Finally, we have also investigated Variance Inflator Factors (VIFs) in order to test for multicollinearity. Since obtaining VIFs is not straightforward in mixed models, we run multiple regression analyses with the variables included in each model. Results were again substantively consistent with those reported in this article and we found no sign of multicollinearity. In Study 1 mean VIFs ranged from 1.67 to 1.70, whereas in Study 2 mean VIFs ranged from 1.24 to 1.70. Overall, our findings were robust to different model specifications, analytic methods, and variations in sampling and measurement.[14]

7. DISCUSSION

Overconfidence has been largely suggested as an explanation of the decision to start a new venture in the face of (and despite) high rates of entrepreneurial failure, but the cognitive mechanisms generating overconfidence in entrepreneurial settings have been overlooked. In this paper we go beyond trait-like (Busenitz & Barney, 1997) and context-driven (Baron, 1998) views of overconfidence to explore the role of cognitive heuristics in the potential generation of overconfidence and in the decision to start a new venture. Specifically, we focus on three cognitive heuristics—reference point framing, outcome salience framing, and anchoring in conjunctive events—and examine their effects on perceived risk, confidence, required and estimated probabilities

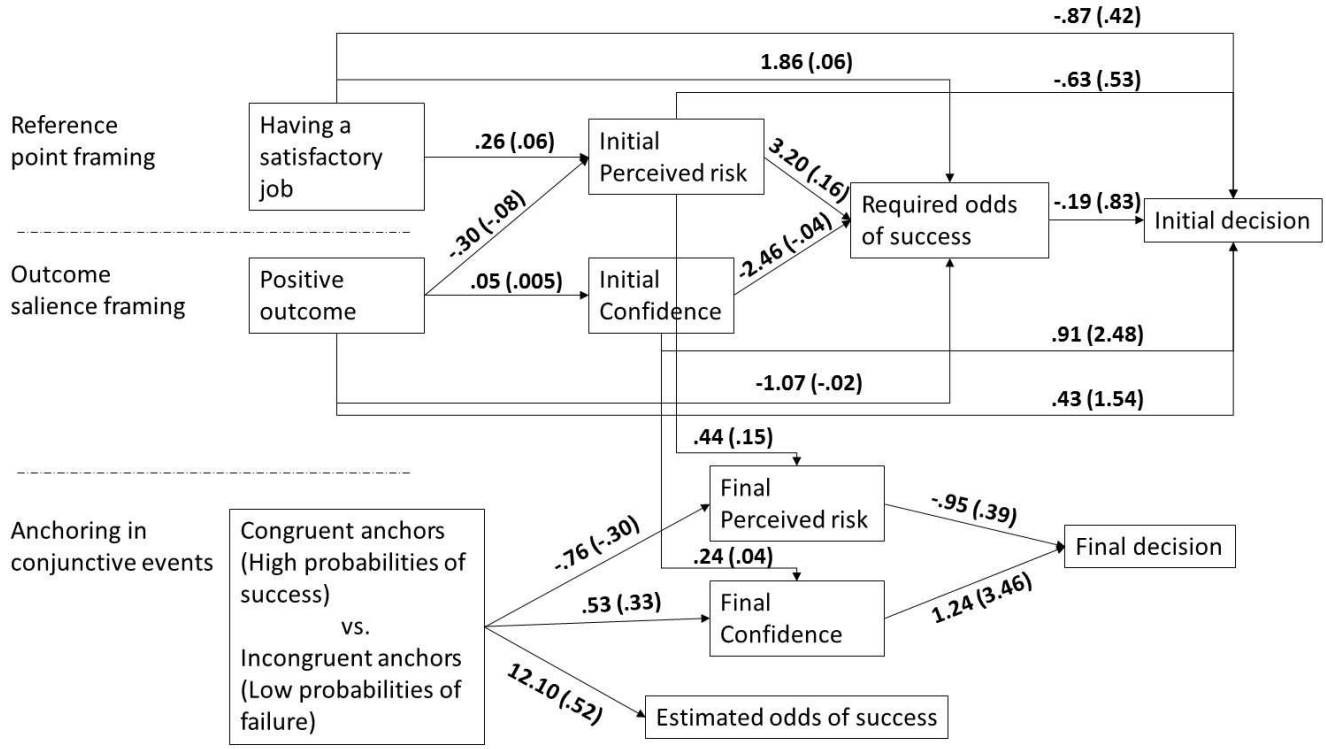
[14] Detailed results from robustness tests and post-hoc analyses are available from the authors upon request.

of success, and the ultimate decision to start a new venture. Our results are summarized in Table 7 and Figures 3a and 3b below.

Table 7. Summary of findings

Hypothesis: Main IV	Hypothesized relationship	Results	
		Study 1	Study 2
H1: Reference point framing	H1a: Satisfactory job → ↑ Perceived risk	Supported	Supported
	H1b: Satisfactory job → ↑ Required odds of success	Supported	Supported
	H1c: Satisfactory job → ↑ Confidence	Not supported	Not supported
H2: Outcome salience framing	H2a: Positive outcome → ↓ Perceived risk	Supported	Supported
	H2b: Positive outcome → ↓ Required odds of success	Supported	Not supported
	H2c: Positive outcome → ↑ Confidence	Not supported	Not supported
H3: Anchoring in conjunctive events	H3a: High probabilities of success → ↑ Overestimated odds of success	Supported	Supported
	H3b: Low probabilities of failure → ↓ Underestimated odds of failure	Not supported	Not supported
	H3c: Congruent anchors > Incongruent anchors → ↓ Perceived risk (High probabilities of success) > (Low probabilities of failure)	Supported	Supported
	H3d: Congruent anchors > Incongruent anchors → ↑ Confidence	Supported	Supported

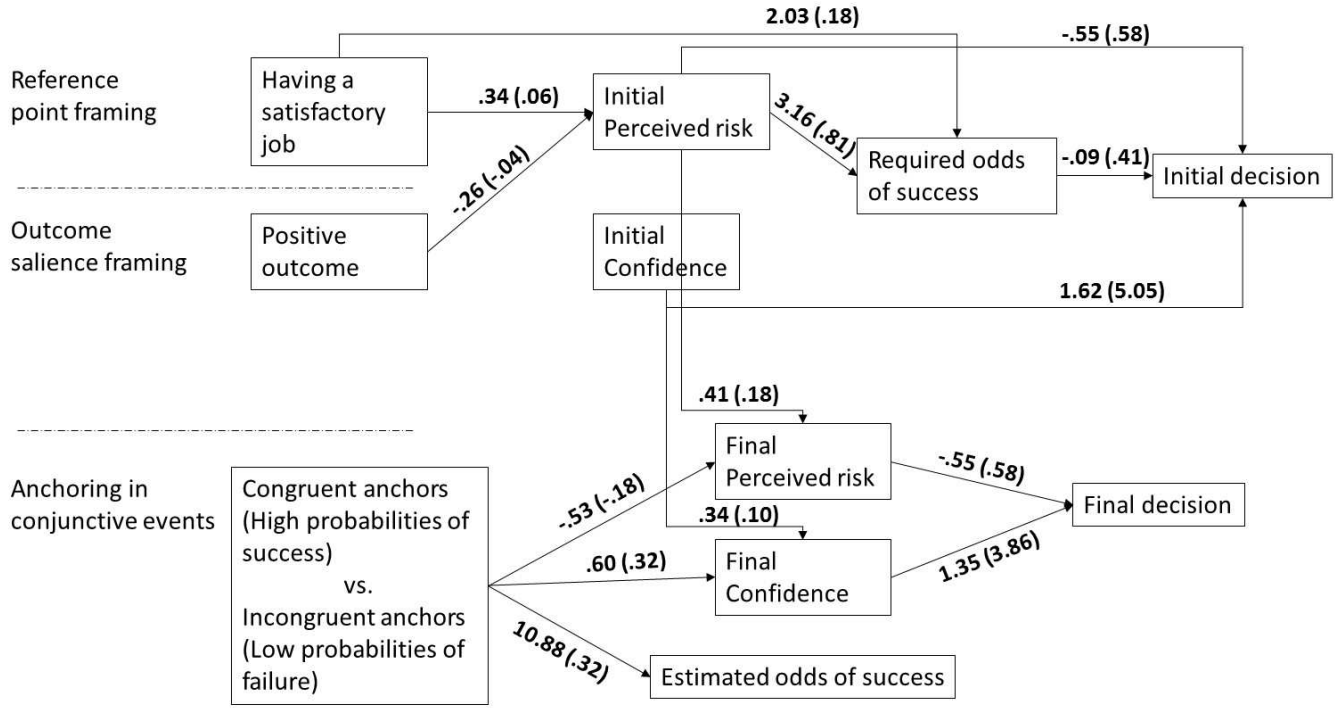
Figure 3a. Statistically significant results – Study 1



Note. All paths shown are significant at *p < 0.05. Coefficients shown come from full models reported in Tables 4 and 6. Hence, antecedents of continuous variables (perceived risk, confidence, and odds of success) are given coefficients from multilevel mixed-effects

RELM regressions, whereas antecedents of dummy variables (initial and final decision) are given coefficients from multilevel mixed-effects logistic regressions. Numbers in parentheses are Cohen's f^2 effect sizes for antecedents of continuous variables and odds ratios for antecedents of the decision variables.

Figure 3b. Statistically significant results – Study 2



Note. All paths shown are significant at $*p < 0.05$. Coefficients shown come from full models reported in Tables 4 and 6. Hence, antecedents of continuous variables (perceived risk, confidence, and odds of success) are given coefficients from multilevel mixed-effects RELM regressions, whereas antecedents of dummy variables (initial and final decision) are given coefficients from multilevel mixed-effects logistic regressions. Numbers in parentheses are Cohen's f^2 effect sizes for antecedents of continuous variables and odds ratios for antecedents of the decision variables.

7.1. Framing through deep reference points and shallow outcome salience

Our results for reference point framing are consistent with prospect theory (Kahneman & Tversky, 1979) and with a threshold reasoning on entrepreneurial entry (McCann & Folta, 2012). In Study 1, a satisfactory job decreased the likelihood of starting a new business by 58%, increased the perceived risk associated with it by 6%, and increased the required odds of success to join the new venture both directly and indirectly (via perceived risk) by 5%. In Study 2, we obtained similar results, but the effects of reference point framing on the decision to start a new business were fully mediated by the perceived risk and the required odds of success. Interestingly, reference point framing did not have a statistically significant effect on confidence in either study. At the methodological level, these results raise the question about whether and how confidence can be manipulated in experimental conditions, suggesting that confidence levels might be less susceptible to experimental manipulations than risk

perceptions. At the theoretical level, these results suggest that the "psycho-physics" of risk taking contribute to determine entrepreneurial entry both directly and indirectly via risk perceptions, but *not* through overconfidence. This is an interesting finding that should be further explored by future research.

Our results for outcome salience framing are also in line with previous research on risk taking (Kuhberger, 1998; Palich & Bagby, 1995; Sitkin & Weingart, 1995; Slovic et al., 1982). In Study 1, when potential outcomes were positively framed and success was more salient, perceived risk and the required odds of success to join the new venture decreased, and the likelihood to enter increased by 54% (relative to the negative framing condition). Similar to reference point framing, these results suggest most of outcome salience framing's influence on the decision to start a new venture occurs both directly and indirectly via risk perception, but *not* through an inflation of participants' confidence. In Study 2, outcome salience framing produced weaker effects than in Study 1, significantly affecting only perceived risk. These results suggest confidence and perceived risk might have different roots. These results also reveal the entrepreneur sample was less susceptible to outcome salience framing than the student sample, which is consistent with research that entrepreneurs are not necessarily more susceptible than others to cognitive biases (Burmeister & Shade, 2007).

Taken together, these results suggest overconfidence is unlikely to stem from manipulations of reference points and/or outcome salience, but that such manipulations still affect risk perceptions and decisions in a significant way. In our experimental design, our outcome salience manipulation was relatively shallow, as it consisted simply in selectively emphasizing different potential outcomes in the initial scenario description. Moreover, this shallowness becomes readily visible in a within-subject experiment. Yet, this relatively shallow manipulation still had a significant influence in perceived risk in our sample of entrepreneurs and affected even more significantly perceived risk, required odds of success, and decisions in our students' sample. Compared to our outcome salience manipulation, our reference point manipulation was much deeper as it encouraged participants to put themselves in different life situations, one with a stable job and reasonable career perspectives, another recently graduated and looking for a job. Despite the fictitious nature of this manipulation, it had significant effects in both samples.

7.2. Anchoring with congruent and incongruent anchors

Our results for anchoring show that it might be a complex heuristic deserving further investigation in entrepreneurship. We investigated anchoring in the context of conjunctive events and purposefully manipulated anchors to increase confidence. Our rationale was that overconfidence might stem from one of two possible mechanisms: (i) high individual probabilities of success for the critical events necessary to the venture project completion, leading to an overestimation of the venture's odds of success; (ii) low individual probabilities of failure for those critical events, leading to an underestimation of the venture's odds of failure. In our experiment, only the former was verified. Compared to scenarios with low probabilities of failure, high probabilities of success for the conjunctive events significantly decreased perceived risk, increased confidence, and increased estimations of the venture's odds of success yielding biased estimates. This suggests the conjunctive character of an undertaking can indeed lead to "unwarranted optimism in the evaluation of the likelihood that a plan will succeed" as suggested by Tversky and Kahneman (1974, p. 1129), but only if the anchor probabilities attributed to the conjunctive events are high probabilities of success. The same result does not obtain with low probabilities of failure.

These findings call for further research on the conjunctive character of the new venture creation process specifically examining how it can impact confidence and risk perception and eventually produce biases. To fuel such research efforts, we offer a tentative explanation based on the congruence of anchors' numeric and semantic influences. We argue that high probabilities of success for the conjunctive events constitute congruent anchors, since they provide a consistent numeric influence that emphasizes the possibility of success. In contrast, low probabilities of failure constitute incongruent anchors, since their numeric influence is inconsistent with their semantic influence: the latter emphasizes the possibility of failure whereas the former deemphasizes it. As a consequence, we predicted and found that high probabilities of success for the conjunctive events of the venture process loom larger that low probabilities of failure in both reducing perceived risk and increasing confidence.

This explanation is consistent with the difficulties and ambiguity involved in understanding single-event probabilities and with the vague and multiple nonmathematical interpretations of probability in psychological

research (Gigerenzer et al., 2007; Gigerenzer et al., 2005; Hertwig & Gigerenzer, 1999). This explanation is also consistent with dual-process theories of higher cognition (Evans & Stanovich, 2013), although it does not necessarily require a dual-process account. In a simple rule-based account (Kruglanski & Gigerenzer, 2011), it suffices that individuals recognize the (in)congruence between the numeric and the semantic aspects of an anchor and adopt as a rule-of-thumb that incongruent anchors must be downplayed. As long as individuals place more weight upon congruent than incongruent anchors, high probabilities of success will loom larger than low probabilities of failure in the probabilistic integration of conjunctive events and in perceptions of risk and confidence associated with a new venture project.

In a dual-process account (Evans & Stanovich, 2013; Kahneman, 2011), we suggest that congruent anchors do not require controlled attention, being autonomously processed, whereas incongruent anchors might trigger the intervention of Type 2 reflective reasoning. Indeed, high anchor probabilities of success for the conjunctive events of the venture process provide internally consistent information, since the numeric influence of anchoring is consistent with its semantic influence: both emphasize the high probability of a very positive event. However, low anchor probabilities of failure for the conjunctive events of the venture process provide information that might appear inconsistent for Type 1 intuitive reasoning: the numeric values indicate low probabilities that should decrease the salience of failure but the semantic influence of the enumeration of events that might go wrong contributes to enhance the salience of failure. This type of inconsistency might trigger intervention of more analytic Type 2 processes (Evans & Stanovich, 2013; Kahneman, 2011). Such intervention could indeed explain the unbiased estimations produced in Treatment Conditions C and D, but does not explain the fact that the number of decisions favorable to joining the new venture increased even though the mean estimated odds of success were below the required odds of success. If the unbiased estimations produced were the result of a purely reflective-analytic thinking, then perceived risk, confidence, and decisions should have remained stable. Yet, both perceived risk and confidence decreased and the number of favorable decisions to enter increased after the addition of conjunctive events with low probabilities of failure in Study 1. In Study 2, confidence increased, perceived risk decreased, and the number of favorable entry decisions increased. Therefore, it is unrealistic to believe reflective

Type 2 processes would take over and override intuitive thinking. Incongruent anchors might well trigger intervention from Type 2 processes, but this intervention seems to be punctual and heterogeneous across individuals, since in both studies the introduction of incongruent anchors yielded a very scattered distribution of estimations.

7.3. On assessing overconfidence and making sense of estimations

Previous attempts to assess overconfidence have been challenged. In the psychology literature, several scholars have demonstrated that overconfidence biases identified in laboratory studies are at least in part resulting from a series of methodological and statistical artifacts (e.g., Juslin, 1994; Juslin, Winman, & Olsson, 2000; Olsson, 2014). In the entrepreneurship literature, overconfidence measures have been criticized for being based on general knowledge questions that were unrelated to entrepreneurship or the focal venture (Keh et al., 2002; Simon et al., 2000). By focusing on framing and anchoring processes as cognitive sources of overconfidence, we departed from traditional ways of assessing overconfidence in an attempt to overcome such methodological challenges.

Previous research acknowledges at least three different definitions of overconfidence and approaches to measure it (Cain, Moore, & Haran, 2015; Olsson, 2014): (i) overestimation of one's absolute performance (measured by comparing one's performance with one's belief of own performance), (ii) overplacement (measured by confidence in one's skill relative to that of others and a comparison of one's performance with others' performances), and (iii) overprecision or calibration of subjective probabilities (measured by comparing subjective probability judgments with the corresponding objective probabilities). We have not contemplated overplacement in our experiments, but we did measure one's belief of own performance (self-efficacy or self-confidence) and we compared subjective probability judgments with a more 'objective' probability integration of conjunctive events. However, in our view none of these measures alone can characterize overconfidence. We infer that overconfidence emerged in our experiments only when confidence levels were significantly inflated, perceived risk decreased, *and* odds of success were overestimated. In both studies, these three criteria were simultaneously met only after the introduction of information containing high probabilities of success for critical

events in Treatment Conditions A and B. Overconfidence only yielded in our experiments after the introduction of congruent anchor values.

Was this overconfidence irrational? Not necessarily. Research in the heuristics and biases tradition argues that deviations from normative models should not necessarily be attributed to insufficiencies of the human mind, but may instead constitute intelligent inferences made through efficient cognitive processes, conscious or unconscious, that ignore or downplay part of the information (e.g., Gigerenzer & Gaissmaier, 2011; Hertwig & Gigerenzer, 1999). This line of thought sees heuristics as adaptive tools and offers reasonable explanations for the overestimated odds of success we observed in Treatment Conditions A and B. For instance, it is possible that some participants judged one or two critical events as being more important for overall success than the other events, and hence estimated higher probabilities by weighing such events disproportionately more.[15] This might be questionable from a normative perspective but still be a valid heuristic in an entrepreneurial process where probabilities are often unknown (Knight, 1921). However, if participants overweighed specific critical events in a consistent manner, probabilities of failure would have been underestimated in Treatment Conditions C and D. Since this was not the case, one still needs to acknowledge the distinctive incongruent nature of the anchors provided in these treatment conditions. The congruent anchors provided in Treatment Conditions A and B had stronger anchoring effects than the incongruent anchors in Treatment Conditions C and D because the former offered consistent semantic and numeric influences whereas the latter did not. In our studies, congruent anchors significantly reduced perceived risk, increased confidence, and yielded overestimated odds of success. Hence, we infer the congruent anchors generated overconfidence. From a normative perspective, such overconfidence looks like a logical error, but from a bounded rationality perspective it might be reasonably justified.

Yet, these results offer two paradoxes for researchers interested in the cognitive processes underlying entrepreneurial decisions. The first paradox is that the overestimated odds of success in Treatment Conditions A and B, which look like logical errors from a normative perspective, offer a logical reason for participants to join the new venture since they exceed the odds of success that the participants themselves declared to require to make

[15] We thank two anonymous reviewers for bringing up this possibility.

the decision to enter. After all, judgment can be fallible without being irrational. The second paradox is that the (on average) unbiased estimations of odds of success in Treatment Conditions C and D, which satisfy logical standards from a normative perspective, make participants' decisions to enter look irrational because they are on average well below the odds of success that the participants themselves declared requiring to make the decision to enter (see Tables 5a and 5b). These findings are difficult to reconcile with any form of rationality, unless we take into account the ambiguity and the diverse nonmathematical interpretations associated with the notion of probability (Gigerenzer et al., 2007; Gigerenzer et al., 2005; Hertwig & Gigerenzer, 1999). If participants indeed interpreted the polysemous term "probability" in the nonmathematical sense of "possibility," "plausibility," "conceivability," or "credibility" for instance, then the numerical probabilities they provided (their required and estimated odds of success) should not be taken as exact estimations, but rather as approximations expressing a global appreciation of the focal venture. In this case, even the "required odds of success" could well change after the introduction of additional information about the venture.

7.4. Academic contributions

During the 90's, the cognitive approach to entrepreneurship research emerged in opposition to "trait-based" research (Busenitz & Barney, 1997; Palich & Bagby, 1995). Nonetheless, cognitive heuristics have been largely treated as personal traits by entrepreneurship scholars, despite suggestions that they might also be fostered by elements of the entrepreneurial experience and context (Baron, 1998; Forbes, 2005). We contribute to the study of heuristics in entrepreneurial settings by focusing on information processing and by analyzing how individuals estimate probabilities, perceive risk, assess their own confidence, and ultimately make decisions, when confronted with the option of starting a new venture. Using a within-subject experimental design and mixed models with repeated measures, we fully control for personal traits and individual differences in entrepreneurial experience, thereby overcoming previous studies' methodological limitations. By manipulating the information about a fictitious venture, we also rule out asymmetries of information that are likely to influence results in natural settings.

We focused on three heuristics overlooked by most entrepreneurship research (Zhang & Cueto, 2017). In our experiment, both reference point and outcome salience framings significantly affected entry decisions both directly and indirectly (via perceived risk and required odds of success), but none did so through overconfidence. In order to generate overconfidence, we manipulated additional information with different anchors. Exploring the conjunctive character of a new venture creation process, we found that congruent anchors (high probabilities of success for critical events in the process) led to inflated levels of confidence, reduced levels of perceived risk, and overestimation of overall probability of success, thereby fostering entry decisions. In contrast, incongruent anchors (low probabilities of failure for critical events) led to scattered estimations that were unbiased on average, having significant smaller effects than congruent anchors on confidence, perceived risk, and decisions. Surprisingly, the number of entry decisions increased after the introduction of incongruent anchors, despite the fact that the average unbiased estimated odds of success were below the odds of success that participants reported to require in order to enter. We offered a tentative explanation for these findings based on the (in)congruence between the semantic and numeric influences of anchors and in light of recent psychological research on heuristics and dual-process theories. We also discussed the rationality issues underlying our findings and how the ambiguity of the term 'probability' may help to explain them.

The anchoring heuristic has been suggested as a potential source of overconfidence bias (Bazerman, 1994; Forbes, 2005), but it had not been investigated as such in entrepreneurship, to the best of our knowledge. Framing biases have also been relatively absent of entrepreneurship research (Zhang & Cueto, 2017). But more than filling a gap, we hope that the two studies reported in this article will provide food for thought and foster research on the roots of overconfidence as well as on the micro-dynamics of cognitive heuristics in entrepreneurial decision making.

7.5. Specific avenues for further research

The systematic research design adopted in both of our studies has potential limitations to be addressed by future research. First, since most participants in both samples were not unemployed in their real lives, further research is needed to test whether our results hold for specific populations with different opportunity costs such as

the unemployed. Second, this line of research could benefit from an ecological approach using more representative designs (Dhami, Hertwig, & Hoffrage, 2004). Ideally, such designs should include random sampling of real stimuli from (prospective) entrepreneurs' environments in order to make research design and task closer to their realities. Finally, albeit statistically significant, several of the framing effects we found had small effect sizes according to Cohen's (1988) criteria. We argue that our systematic design contributed to these results, but researchers must be careful in interpreting them and should not hesitate to explore such effects outside of the laboratory.

7.6. Practical implications

Experiments are particularly suitable for making causal inferences, and repeated measures provide robust tests for hypotheses. The internal validity of such experimental designs is necessary if we are willing to improve our understanding of the psychological mechanisms and mental shortcuts—heuristics—individuals use when confronted with the option of starting a business, net of their individual differences in personal traits, private knowledge, previous experience, and access to information (among other sources of hidden heterogeneity). Understanding such mental processes is important in order to improve our intervention tools and strategies.

Manipulation through outcome salience framing and anchoring is available and accessible to negotiators in a private equity funding discussion, professors in a classroom, mentors in incubators, and policy makers promoting entrepreneurship, to mention just a few. Among other potential outcomes, these heuristics can be used to blindly promote entrepreneurship. In fact, they can almost work on their own to promote entrepreneurship, with the potential entrepreneur selectively focusing attention on the positive potential outcomes of the venture and on high probabilities of success for the conjunctive events that characterize the entrepreneurial process (without realizing their conjunctive character). They can also work on their own to refrain individuals from becoming entrepreneurs, when the person focuses attention on the negative potential outcomes of the venture and on the probabilities of failure of the events necessary to its success.

If our goal is to promote entrepreneurship in a responsible way, avoiding overconfidence, wishful thinking, planning fallacy, and other biases that are so common in the creation of new businesses and that

contribute to their failure—then we have a lot to gain from improving our understanding of cognitive heuristics and of how they generate such biases. Attention to the conjunctive character of the entrepreneurial process, adoption of an external view, and attention to probabilities of failure are certainly potential remedies to prevent overconfidence. But, they might not be enough. Absent overconfidence, decisions to enter augmented after the introduction of additional information in two of our experimental scenarios, despite yielding unbiased average estimations of odds of success which were well below those initially required to join the new venture. Indeed, unbiased estimations might not be the result of a computation made through deliberative processes of the mind; they may simply result from intuitive processes in which cognitive heuristics yield contradictory effects that cancel each other out. In other words, accuracy might not result from ability but from luck. But, luck in estimating a probability does not necessarily translate into luck in launching a new business.

Finally, the fact that we produced overconfidence and biased estimates in two within-subject experiments with repeated measures should not be taken lightly, because our experimental design is likely to decrease treatment effects and activate reflective reasoning in (at least some) subjects as they see different formulations of the same problem. Real life, however, "is usually a between-subjects experiment, in which you see only one formulation at a time." (Kahneman, 2011, pp. 329). As Kahneman pointed out, it would take an exceptional cognitive effort "to generate alternative formulations of the one you see and to discover that they evoke a different response." (pp. 330). Entrepreneurs might not attribute subjective probabilities to the critical events that seem necessary to the success of their real ventures, since not only the objective probabilities are unknown but many of the events themselves can be unknown to the entrepreneurs. However, the possibilities they see, and the subsequent actions they take, are still shaped by frames and anchors that need to be understood in order to be dealt with in a reasonable way.

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