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Decision biases and entrepreneurial finance

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Abstract We study the effects of three cognitive biases by the entrepreneur on obtaining funding. We find planning fallacy to increase funding amounts, whereas optimism and overconfidence by the entrepreneur have no effects on funding amounts from others. Further, planning fallacy positively impacts the probability of strong-tie (inside) investments but negatively impacts the probability of weak-tie (outside) investments. Mediation analyses further show that planning fallacy positively impacts venture performance through both self and other investor funding amounts. Our findings are not consistent with the pecking order theory of informal finance and suggest positive effects of at least one cognitive bias on entrepreneurial business success through increased funding.

Keywords Entrepreneurship · Decision biases · Cognitive biases · Entrepreneurial finance · Informal finance · Fundraising · Social ties · Venture performance

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1 Introduction

Most entrepreneurs try to persuade potential investors to fund their new ventures. To this end, entrepreneurs turn both to their weak and strong ties (Shane and Cable 2002); weak ties refer to formal relationships such as banks and venture capitalists, whereas strong ties refer to informal relationships like family and friends. Entrepreneurs' persuasiveness, however, depends on whether they are able to appeal (Bohner and Dickel 2011) to these potential investors. Recent research suggests that entrepreneurs who strike investors as well prepared are more persuasive (Chen et al. 2009; Nagy et al. 2012; Pollack et al. 2012) and that at least one cognitive bias affects both persuasive attempts and outcomes (Schwardmann and Van der Weele 2016).

The persuasive appeal of entrepreneurs need not depend on entrepreneurs being accurate. Entrepreneurs who provide investors with accurate projections of venture success are certainly appealing to investors. However, entrepreneurs who believe that they are providing investors with accurate projections of venture success—when in fact they are not—can also be appealing to investors. Specifically, we propose

that cognitively biased entrepreneurs who project greater probabilities of venture success (than they should), lower risk (than the real risk), and shorter time to commercialization (than what can be expected) could appeal to investors. However, investors who are motivated to conduct thorough evaluations and have the appropriate expertise and experience in evaluating nascent ventures should be less susceptible to the persuasion cues of cognitively biased entrepreneurs.

Cognitive biases are typically thought of as perception and reasoning errors that cause judgment and decision making to systematically deviate from normative rationality (Kahneman 2011; Kahneman and Tversky 1996). For example, cognitive biases lead entrepreneurs to overestimate essential factors such as demand and to ignore possible competitor threats and misjudge the importance of complementary assets (Camerer and Lovallo 1999; Simon and Houghton 2002). Nevertheless, cognitively biased entrepreneurs could attract greater investor funding if their biases—through providing persuasive appeal (Bohner and Dickel 2011)—positively affect investor beliefs that the venture will be successful. That is, we argue that the benefits of cognitive biases may be social in nature.[1] Since entrepreneurs with good projects may often be capital constrained in the start-up phase (Evans and Jovanovic 1989), cognitive biases may, in addition, through the raising of external funds also positively affect business performance. This study will therefore contribute new insights into the little we know about the benefits entrepreneurs' cognitive biases may have through affecting *others'* decisions in the venturing process.[2]

In this paper, we examine the relationship between three cognitive biases and potential investors' decision to invest in the new venture. We propose that entrepreneurs that are optimistic, overconfident, or commit the planning fallacy will provide cues that are biased toward a more positive view of the venture than in reality. First, optimism will bias the expected probability of success upward. Second, overconfidence will reduce the expected variance, which will be judged positively by investors who worried about downside losses. And finally, planning fallacy will reduce the believed time to commercialization.

We test our ideas with a sample of independent inventor-entrepreneurs, i.e., entrepreneurs who developed business ventures based on their own inventions. (For brevity, we refer to them as *entrepreneurs* from here on.) We find positive effects of increased planning fallacy on outside investment amounts. Controlling for the total investment amounts, we find planning fallacy to positively affect the probability of strong-tie (friends and family) investor funding and negatively affect the probability of weak-tie (not family or friends) investor funding; optimism also has a negative effect on the probability of weak-tie investor funding. Finally, we find that investor funding mediates the relationship between planning fallacy and venture performance such that the biases have significant positive benefits on business success.

This paper makes three empirical contributions. First, we find a general positive impact of at least one cognitive bias—planning fallacy—on raising funds from others. Second, we find that the planning fallacy positively impacts the probability of strong-tie investments but negatively impacts the probability of weak-tie investments. We propose that this second finding is due to that strong ties are more likely to be convinced by persuasion tactics of the entrepreneur, while weak ties have greater experience evaluating entrepreneurs and are in fact adversely disposed to biased plans and forecasts. Third, we find that business performance is enhanced the more biased the entrepreneur. This is entirely explained by the bias increasing fundraising, and increased funds in turn increase business performance. Our research reveals a previously unexplored positive impact of decision-making bias on business success and supports newer theories of informal finance which consider the social cost of obtaining financing from friends and family.

2 Theory development and hypotheses

Fundraising is a key activity during the start-up phase. Nevertheless, previous research shows that

[1] We cannot in this paper infer whether the entrepreneurs engage in self-deception or not. For an experimental paper on the role of overconfidence, self-deceptive beliefs, and persuading others, see Schwardmann and Van der Weele (2016).

[2] An exception is a working paper by Dushnitsky (2009), which at a more aggregate level of analysis correlates country-level optimism with the country-level valuation of start-ups by venture capitalists. Also, Dushnitsky (2010) and Van den Steen (2004) have formally modeled the potential effects of entrepreneurial optimism on potential investors' valuations of an entrepreneur's venture ideas.

investments in start-ups in large part come from entrepreneurs themselves (Åstebro et al. 2007; Robinson and Robb 2014). For example Robinson and Robb (2014) report that in a representative cross section of US start-ups, the entrepreneur on average invests $27,365 equity. Investments also come from other investors, both in the form of equity and debt arrangements that may involve family, friends, "angel investors," business partners, venture capitalists, banks, institutional investors, and others (e.g., Åstebro and Serrano 2015; Robinson and Robb 2014; Wong et al. 2009). Robinson and Robb (2014) provide some useful data on the typical sources of equity and debt for US start-ups. Only about five percent of the sample relies on equity from a spouse or other family members, and the overall average amount of equity from friends and family is only about two percent of the average funding. The mean value of debt from friends and family, primarily in the form of personal loans, is also modest, at $7605. Most funding instead comes from outside debt $31,255 where most is in the form of owner-backed debt. The average new firm thus has approximately $78,000 of financial capital of which roughly half comes from outside sources, and the insider funding sources primarily comes from the entrepreneur. Outside funding is thus extremely important. As with self-investments, investor funding contributes to higher venture performance for constrained operations because they raise operating efficiency (Evans and Jovanovic 1989) and often come with managerial support (Hellmann and Puri 2002).

How do entrepreneurs successfully persuade potential investors? Potential investors will invest when they believe that the new venture has a high likelihood of success. Conditional on an independent judgment of the basic opportunity, investors may further be affected by the entrepreneurs' persuasions (Chen et al. 2009; Nagy et al. 2012; Pollack et al. 2012). Persuasion stems in part from being overconfident in one's ability (Schwardmann and Van der Weele 2016). Schwardmann and Van der Weele (2016) test and find empirical evidence in support of Robert Trivers's argument that overconfidence serves as a social bias that helps one persuade others of one's abilities (Trivers 1985; Von Hippel and Trivers 2011) in a more convincing manner, or help hiding any verbal or nonverbal cues to the contrary (Gibson et al. 2014). Simply put, entrepreneurs with greater persuasive appeal raise more funds from investors.

Persuasion may be defined as the formation or change of attitudes through information processing in response to a message about the attitude object (Bohner and Dickel 2011, p. 403). Attitude research points to both stable and situationally variable aspects of attitudes. For example, in a qualitative analysis of business plan presentations from "Shark Tank" and "Dragons Den," Pollack et al. (2012) showed that the positive relationship between entrepreneurs' persuasiveness (message)—e.g., *the presentation was coherent and logical*—and investor funding was mediated by cognitive legitimacy (source expertise)—e.g., *I envision this business having a top management team that will benefit the organization.*

What increases an entrepreneur's persuasive appeal? First, we theorize that cognitive biases can endow entrepreneurs with cognitive legitimacy that indicates source expertise (Bohner et al. 2008a) and—in the context of persuasive appeal—give the impression that they well understand the venture they are working on. As message recipients, the investors on the other hand have limited cognitive resources that make it difficult for them to process the details of every piece of persuasive information in depth. In effect, source expertise from entrepreneurs' cognitive biases will influence the level of effort investors will put into the processing of persuasive information because it depends on their motivation and ability to process the given information (Bohner and Dickel 2011). Second, persuasion research further shows that the processing sequence of information presented also impacts decisions (Bohner et al. 2008b; Bohner and Dickel 2011) such that the quality of initial arguments biases the processing of subsequent arguments (Erb et al. 2007). Thus, entrepreneurs' cognitive biases can impact investor funding even when the investors plan to be objective because biases of the entrepreneur can affect the motivation and ability of the investor as well as the processing sequence of the information received.

Cognitive legitimacy consists of both task-focused and outcome-focused aspects (Taylor et al. 1998). The task-focused aspects shape entrepreneurs' beliefs in their efficacy to successfully complete tasks, whereas the outcome-focused aspects shape their confidence

and optimism in attaining desired payoffs. The distinction between task-focused and outcome-focused aspects of entrepreneurs' beliefs about the future success of their new ventures corresponds to the following cognitive biases: task-focused planning fallacy, which relates to the evaluation of the length of time it takes to complete tasks (Baron 1998; Keh et al. 2002); outcome-focused optimism, which relates to the evaluation of future outcomes (Arabsheibani et al. 2000); and outcome-focused overconfidence, which relates to the overestimation of one's own abilities compared to actual abilities (Fischhoff et al. 1977; Griffin and Tversky 1992; Oskamp 1965). We reason that since entrepreneurs' cognitive biases correspond to their persuasive appeal, which in turn affects investor funding (Chen et al. 2009; Nagy et al. 2012; Pollack et al. 2012), then we might expect the cognitive biases of planning fallacy, optimism, and overconfidence to have effects on investor funding. In effect, we expect these biases to endow entrepreneurs with task-focused and outcome-focused cognitive legitimacy that is capable of providing a sense of source expertise to encourage potential investors to fund their ventures.

2.1 Planning fallacy and fundraising

Planning fallacy is the tendency to underestimate how much time is needed to complete a future entrepreneurial task despite knowledge of how long such tasks have previously taken (Baron 1998; Buehler et al. 2010). Planning fallacy is prevalent when entrepreneurs need to make forecasts into an uncertain future (Baron 1998), especially when they choose to ignore lessons from previous venture failures that are relevant to their new venture (Buehler et al. 2010; Kahneman and Lovallo 1993).

The planning fallacy, despite a variety of downsides (Buehler et al. 2010), has at least one great upside. As a natural consequence of scenario thinking (Buehler et al. 1994), it serves the functional purpose of reducing perceived uncertainty and greatly simplifying contingency planning. Planning fallacy therefore drives a commitment to new ventures in that it biases entrepreneurs' beliefs about their abilities to complete the necessary tasks associated with the future success of their new ventures. These biased beliefs may serve as cues about the entrepreneurs' knowledge of how quickly returns could be generated and thus influence investors' funding decisions at low levels of processing effort. According to persuasion research, if these beliefs are very persuasive and are perceived before more objective evaluation is conducted, then the beliefs can influence the investors to fund the venture since investors are often interested in the turnaround time for their investment—even at high levels of processing effort. If entrepreneurs' task-focused beliefs persuade investors, then a greater level of planning fallacy should induce a greater amount of investor funding.

H1 Planning fallacy is positively related to investor funding amounts.

2.2 Optimism and fundraising

Optimism is the stable inclination to expect the most favorable outcomes (Scheier et al. 2001). Optimism is prevalent when entrepreneurs need to create new ventures (Dushnitsky 2010), especially when these ventures are pioneering and require more resources (Simon and Shrader 2012). Thus, optimism occurs when entrepreneurs maintain a positive belief in the future success of their new ventures despite evidence of the contrary.

Optimism, as one might expect from a cognitive bias, produces negative effects on entrepreneurial outcomes if it reaches extreme levels (Arabsheibani et al. 2000; Åstebro et al. 2007; Cassar 2010; Hmieleski and Baron 2009; Puri and Robinson 2007). For example, optimistic entrepreneurs spend 166 % more money than pessimists on venture propositions without promise (Åstebro et al. 2007). Despite the downsides of extreme optimism, optimism is adaptive in that constructing optimistic expectancies help motivate entrepreneurs to be persistent should negative events occur (Armor and Taylor 1998). This outcome-focused bias should therefore motivate potential investors to invest. The dual process of persuasion (Petty and Cacioppo 1986) suggests that optimistic estimates could inhibit investors from conducting objective analysis even though they might have an earlier motivation to be objective. Persuasion research suggests that overly optimistic estimates may affect persuasion at low levels of processing effort because it resonates with investors. Likewise even if the investor is engaged in high processing effort, compelling overoptimistic estimates might influence

later information evaluated by the investor. If optimistically biased entrepreneurs are able to persuade investors that their projections are in fact realistic, then it follows that investors should be willing to invest greater amounts with greater entrepreneurial optimism. This is because a greater subjective probability of success should increase the perceived investment return to investors.

H2 Optimism is positively related to investor funding amounts.

2.3 Overconfidence and fundraising

Overconfidence is the tendency to overestimate one's ability to achieve successful performance outcomes (Griffin and Tversky 1992; Moore and Healy 2008). Overconfidence is prevalent when entrepreneurs commit to proceeding with a new venture given limited information about the opportunity to be exploited (Busenitz and Barney 1997). Overconfidence occurs when entrepreneurs overestimate their own ability to achieve future success—despite limited information about new ventures—when making entrepreneurial entry decisions (Camerer and Lovallo 1999). Overconfidence manifests in several ways, including a more narrow credibility interval of future outcomes based on own ability compared to others' abilities, a smaller judged variance in own judgment precision than one's true judgment precision, and a greater assessment of own ability compared to others' ability (Moore and Healy 2008).

Overconfidence, despite reducing the survival chances of new ventures (Koellinger et al. 2007), may, however, be adaptive because it motivates entrepreneurs to commit to uncertain new ventures that they otherwise would not have committed to. Since overconfidence is most related to perception of own ability, the entrepreneur will be able to strongly influence the investor's perception of source expertise as a cue. Since the entrepreneurs are presenting novel concepts, their projections of their own abilities may resonate with investors in ways that prevent investors from conducting objective due diligence of the funding request. This is because overconfidence serves as a social bias that occurs either through the entrepreneur delivering a more convincing message to investors or through the entrepreneur minimizing or masking any verbal or nonverbal cues to the contrary (Gibson et al. 2014). This outcome-focused bias should therefore motivate potential investors to invest. In addition, biased projections that involve reduced variance in outcomes as a function of entrepreneurs' overconfidence will persuade investors to increase funding amounts if the investor is worried about downside losses.

H3 Overconfidence is positively related to investor funding amounts.

2.4 When cognitive biases may not help fundraising

Entrepreneurs turn to both weak and strong ties to raise funds (Shane and Cable 2002). Weak ties refer to formal infrequent relationships like professional contacts and investors that provide access to funds and non-redundant expertise. In contrast, strong ties refer to informal frequent relationships with strong social valence, such as with family and friends (Granovetter 1974). [In finance, one instead uses the term "insiders" for friends and family and "outsiders" for all other financiers (e.g., Robinson and Robb 2014)]. While entrepreneurs depend on both weak and strong ties for funding, weak-tie investors expect a significantly greater return on investment compared to strong-tie investors (Lee and Persson 2015). This is because weak-tie investors typically enter a formal limited liability contract with the entrepreneur where weak-tie investors have limited legal recourse should the new venture fail. As a consequence, weak-tie investors tend to approach their investments decisions with greater analytical reasoning and business acumen. In contrast, strong-tie investors most often enter an informal unlimited liability contract and in turn accept relatively poorer—sometimes negative—returns on their investment. However, this risk comes with a social obligation should the venture fail; Lee and Persson (2015) call this post-failure social obligation a shadow cost that "never really goes away" (p. 3) as it lacks limited liability.

Lee and Persson (2015) distinction between strong and weak ties on investments allows for the baseline probability of funding to differ between strong and weak ties, due to differences in familiar support and/or availability of financing from these sources. In fact, their model predicts that weak-tie investments will be more prevalent than strong-tie investments even

though weak ties require a higher rate of return on invested capital because of the cost of the lingering social obligation to pay back investments from friends and family and because taking money from family reduces the opportunity for having family insurance funds for alternate uses. While our data will address this prediction, we are, however, interested more precisely in how the biases of the entrepreneur affect the funding probabilities of weak versus strong ties. From persuasion research, it is clear that the differences in effects between strong and weak ties will not be merely due to familial considerations and supply of funds, but also the likelihood of the entrepreneur's biases impacting investors as a result of investor motivation and experience.

Drawing from research on financial intermediation (Casamatta 2003), we can ascertain that weak-tie investors typically draw from a larger and better comparative information base than strong-tie investors to assess the prospects of a new venture idea. Moreover, even if both weak-tie and strong-tie investors drew from the same comparative information base, research on expert decision making indicates that experts make better use of information than novices, a finding that also applies to expert versus novice entrepreneurs (e.g., Dew et al. 2009; Shanteau 1988, 1992). Our review of persuasion research suggests that weak ties will be more motivated to conduct in-depth evaluation due to the need for professional, objective analysis in their profession. In addition, weak ties are more likely than strong ties to have greater professional investing experience. That is, weak ties are more likely to have the professional training or experience to detect cognitive biases such as overconfidence and to accurately identify the ability of the entrepreneur, as evidenced by Schwardmann and Van der Weele's (2016) finding that those trained to detect lies are less likely to be fooled by overconfidence and more likely to spot true ability. Hence, we surmise that weak ties will be more difficult to persuade since they will be more motivated to conduct in-depth evaluation and will often need a high level of processing effort to be persuaded. Thus, weak-tie investors should be less reliant on entrepreneurs' planning, optimism, and confidence in their venture for information when deciding whether to invest. In fact, we propose that weak-tie investors would be considerably unimpressed by entrepreneurs' inflated venture projections that are not backed by reality, to the point where cognitive biases would in fact decrease the likelihood that weak-tie investors will invest.

In contrast, strong-tie investors are more reliant on entrepreneurs' cognitive biases for information because they have a smaller comparative information base than weak-tie investors. As a result, strong-tie investors perceive entrepreneurs as more unique than the norm and therefore confer cognitive legitimacy on them. Moreover, given Lee and Persson's (2015) argument that strong-tie investors often expect little or negative return on their investment because of the expected social debt should the new venture fail, it may be that strong-tie investors invest in order to maintain a prior or ongoing social relationship with the entrepreneur. Aside from familiarity and social obligation with the entrepreneur, strong ties may be more susceptible to the entrepreneurs' cognitive biases due to their low-level motivation for objectivity in the persuasion process. This means that they may reduce their cognitive evaluation of the persuasion message and thus be more easily persuaded. Thus, faced with a limited comparative information base and greater social pressure, strong-tie investors are more likely to make funding decisions by relying on entrepreneurs' planning, optimism, and confidence in their venture.

H4 Planning fallacy, optimism, and overconfidence will have a positive effect on the probability of strong-tie investor funding but a negative effect on the probability of weak-tie investor funding.

3 Methods

3.1 Data description

We use a sample of inventor-entrepreneurs who developed business ventures based on their own ideas. The entrepreneurs are identified through their use of the Inventors' Assistance Program (IAP) at the Canadian Innovation Centre (CIC).[3]

Survey responses were obtained through the Survey Research Center at the University of Waterloo, with 780 fully completed responses for an overall adjusted

[3] The CIC evaluates potential entrepreneurs and their venture ideas at an early stage and provides diagnostic feedback. For more information about the CIC and its evaluation process, see, for example, Åstebro and Koehler (2007).

response rate of 61 %.[4] We clean the data by removing observations where the intellectual property was sold or licensed rather than commercialized through the entrepreneurs' business venture. We also remove observations with missing item responses on commercialization sales and investments, reducing the analysis sample to 755 observations when analyzing venture performance and 764 otherwise.

Missing item responses on independent variables are imputed five times using multiple imputation, and we further develop inverse sampling weights to correct for sampling and non-response patterns.[5] But analyzing multiple imputed dataset is not possible simultaneously with using weights. We therefore report analysis using weighted observations and one full dataset. In alternate analysis, available from authors on request, we report consistent results when using five full datasets but without weighting for sampling and survey non-response.

The inventor-entrepreneurs' modal age is 45–54, and the modal educational attainment is high school, although approximately 26 % of the entrepreneurs have some professional or graduate education. Only 16 % of the entrepreneurs report they were unemployed, homemakers, retired, disabled, or on sick leave during the time that they developed their focal invention. Most of the entrepreneurs (58 %) are full-time employees, while 32 % are self-employed when developing their inventions. Eleven percent of the entrepreneurs develop their invention as part of their normal duties at work. While 26 % of the entrepreneurs are stimulated by something at work, the majority of that percentage (73 %) is not required to innovate at work. Descriptions of some of the inventions reveal that most of them are "user-driven." The sources of invention are thus quite varied. The plurality of the inventions are sports and leisure products (28 %), followed by 16 % security or safety applications, 14 % industrial equipment, 14 % automotive, 14 % medical or health, and 13 % that have environmental or energy applications. Inventions involving high technology (9 %) are also relatively frequent. To provide a few examples, the commercially successful inventions include a new milk container design, a washable sanitary pad, and a home security light timer that imitates typical use.[6]

3.2 Dependent measures

Own and others investments were $30,500 and $52,700, respectively (Cdn. 2015 values, weighted for sampling and response bias). Note that among the entrepreneurial projects, we study only 11 % reach the market, while 89 % fail to do so. Even so, average investment was substantial, comparable in size to investments in US start-ups in general (Robinson and Robb 2014). Approximately half of the investments in this sample were in RandD, while the other half were for commercialization purposes. We compute investment by outside investors as the natural logarithm of the dollar amount that was invested in the venture by those other than the entrepreneur himself. Self-investment is similarly computed as the natural logarithm of the dollar amount invested in the venture by the entrepreneur himself/herself.

To determine the types of investor that provide funding, we ask the entrepreneur: "I will now read a list of sources of funds that you may have used to pay for the costs of developing your invention. Please tell

[4] All of the data except for the IAP evaluation were collected through a telephone survey. We developed a list of 6405 inventor-entrepreneurs who had submitted ideas for IAP review between 1994 and 2001. Of this number, we were able to trace 1352 current addresses. Of these, 1272 addresses led to actual contacts. The adjusted response rate was calculated by the Center as the contact rate (1272/1352) multiplied by the cooperation rate (830/1272). The Center follows the statistical methods and best practices of the American Association of Public Opinion Research, http://www.aapor.org. For further information about the survey procedure, please contact the authors.

[5] We imputed the missing item responses five times, assuming data were missing at random (MAR), using a switching regression approach that is described in van Buuren et al. (1999). For an introduction to multiple missing data imputation, see Graham and Hofer (2000).

[6] To better understand the composition of the entrepreneur sample, we further draw a comparison sample from the general Canadian population. Using random digit dialing, we queried a sample of 300 Canadians from the general population based on sampling quotas for province, employment, and gender, to reflect the similarities in the aggregate with the entrepreneurs on these three variables. Comparisons are then made on background characteristics (results available upon request). The combined samples from the general population matched with the entrepreneurs contain unusually a high proportion reporting that they are self-employed (63 %) or that they have owned a business (60 %). However, the rate of entrepreneurship is much higher for the entrepreneur sample than it is for the general population sample.

me for each source whether you have actually used it or not." We aggregate the answers as follows: strong ties = 1, if from friends and family, 0 otherwise; weak ties = 1 if from business partner(s), federal, provincial or municipal government, angel investor, venture capitalist, university or other research center, supplier or customer, 0 otherwise. The coding of strong and weak ties follows directly from the original definition by Granovetter (1974). We check whether regression results are sensitive to individually recoding each of the weak-tie sources that are listed above as a strong tie, reflecting that a specific weak tie might in fact be a friend. The results are not sensitive to this alternate coding.

Sixteen percent (15 % unweighted) answered that they had obtained funding from strong ties, while 23 % (19 % unweighted) replied that they had obtained funding from weak ties. An "other" category contained 8 % replies in affirmative. Finally, 75 % reported no outside investment, confirming prior result that the entrepreneur himself/herself is the major investor in entrepreneurial ventures. The data are empirically consistent with Robinson and Robb (2014) and consistent with the prediction of Lee and Persson (2015) stating that entrepreneurs obtain outside start-up funding more often from weak rather than strong ties because funding from strong ties carries unlimited liability, reduces family insurance, and increases lingering social obligations.

For our additional analysis, we also compute a measure for venture performance by using business revenues. Venture performance represents the natural logarithm of the sum of the present value of all future revenues. We ask detailed questions on the dollar value of revenues for each year of revenues. Regression estimates are based on reported sales data.[7] These data are discounted to a common starting year using the Canadian CPI.

[7] Sales data are truncated by survey date for some observations. If data truncation is correlated with independent variables, coefficient estimates may be biased. In an alternate analysis, we therefore forecasted future sales that were conditional on truncation using exogenous parameters. This implies that the forecast was uncorrelated with covariates and should not produce biased regression parameters, but it may introduce more noise, thus increasing the standard errors. We used the Bass diffusion with exogenous parameters to forecast sales. Results of this analysis are consistent with those reported in text. Contact the authors for detailed methods and results.

3.3 Independent measures

To minimize common method and order bias, the items that form the three key independent variables are placed within filler items and randomly re-ordered for each phone interview. The respondents would therefore find it difficult to figure out the purpose of these questions. As opposed to mail surveys, there is no opportunity for the respondents to go back and revise their responses, nor is there any way for them to know what the next item would be. The dependent variables are asked prior to and are separated from the key independent variables by several other questions.

3.4 Planning fallacy

Researchers consistently measure the fallacy as the relation between how long people predict a task will take versus how long it actually takes (e.g., Buehler et al. 1994). Since our respondents experienced planning fallacy related to the venture prior to the survey and at different times, we developed a general measure modeled after the work of Buehler et al. (1994). In developing this measure, we sought face validity of our measure from an expert on measuring planning fallacy. We thus ask: "When I guess how long some work will take, it usually takes..." 1 = less than half of the time, 2 = between one half and about the time I estimated, 3 = between the time I estimated and twice the time I estimated, 4 = between twice and four times the time I estimated, and 5 = over four times the time I estimated. Survey design experts suggest that a single-item measure is appropriate when the construct is clear, sufficiently narrow such that it can be easily and uniformly imagined by the respondent (Wanous and Hudy 2001). We believe the measure we use is extremely simple to grasp and sufficiently precise to elicit an appropriate estimate by the respondent. Our results suggest that our sample did not attempt to bias their responses by providing socially favorable answers. Seventy-four percent of the sample admits to being usually overdue on projects. This proportion is considerably larger than it has been in previous (mostly experimental) studies, where it was estimated to approximately 50 % (e.g., Buehler et al. 1994).

3.5 Optimism

To measure optimism, we choose six optimism items from the 10-item International Personality Item Pool

(IPIP) personal attributes survey (Oregon Research Institute 2001; Scheier et al. 1994).[8] For example, two statements used are: "I just know that I will be a success" and "I am often in a bad mood." Reliability test gave $\alpha = 0.67$.

3.6 Overconfidence

Similar to Fischhoff et al. (1977), Busenitz and Barney (1997), Moore and Healy (2008), and many others, we ask respondents to judge which one of two cities has the larger population and to indicate their confidence in the accuracy of their judgment on a half-range probability scale (50–100 % certain) for five pairs of cities. Overconfidence is constructed as, $\sum_k a_{ik} - c_{ik}/5$, where a_{ik} is respondent i's estimated confidence of being right on judgment k, and $c_{ik} = 1$ if i is correct on judgment k, else $c = 0$. A t test rejects that the respondents are, on average, unbiased in their assessments of their ability to answer the city size judgment task accurately ($t = 16.7$, $p < 0.001$). They overestimate the likelihood that they are accurate by 14 percentage points on the half-range probability scale.

3.7 Personal and demographic characteristics and other variables

We measured age, education, years inventing, whether an individual had ever been self-employed, whether they have managerial experience, and finally invention quality. Invention quality is measured through an extensive process at the CIC (for details, see Åstebro and Koehler 2007).

3.8 Analyses methods

We run a Tobit model when the dependent variable is either the log of investments or the log of discounted business revenues. For determining whether a project is invested in by weak and strong ties, we have data on two binary outcome variables which are determined jointly. To analyze that data, we use the bivariate probit. These are all standard models which can be found in textbooks such as Greene (2003). We also conduct several additional analyses. We conduct a mediation test for the effects of self-investment as a mediator between the effects of the biases and investors' funding.[9] Further, we also consider the direct effects of the biases, self-investment, and investors' funding on venture performance.

4 Results

Table 1 shows pairwise correlations (Spearman's rank correlations if binary data, correlations above $r = 0.07$ are significant at $p < 0.05$ or better). Overconfidence is positively correlated with optimism and negatively correlated with planning fallacy. Planning fallacy is positively correlated with strong ties and outside investors' funding, while optimism is correlated with investors' funding. Overconfidence is not correlated with funding. Optimism and planning fallacy are individually positively correlated with venture performance, while overconfidence is negatively correlated with performance. Finally, an entrepreneur's own funding and investors' funding are positively correlated with venture performance.

Table 2 provides results from a maximum likelihood Tobit regression model for testing H1, H2, and H3 controlling for alternative explanations such as the quality of the venture idea. We find a significant positive relationship between planning fallacy and investors' funding amounts ($\beta = 0.692$, $p < 0.01$) supporting H1. There was no significant relationship between optimism and overconfidence and funding amounts, respectively. Hence H2 and H3 are not supported.

[8] Pretests results indicated respondents' difficulty with the items "I feel blue' and 'I dislike myself.' After careful deliberations on the possible effects of the two items on the questionnaire response and reliability, we decided to exclude these items and two other items that are matched with them—hence the 6 items out of the original 10 items.

[9] While following the basic principles for establishing mediation as implemented for OLS (Baron and Kenny 1986), our tests are performed within a more general statistical estimation framework (see Clogg et al. 1995) as follows. The correlation between the focal independent variable and the dependent variable is estimated without the mediator, while including all covariates. The model is then re-estimated adding the mediator. This generates two sets of parameter vectors and variance–covariance matrices. A Chi-square test on the difference in the target coefficient between the two estimations, given the differences in the parameter vectors and variance–covariance matrix between the two estimations, is computed to test whether there is mediation. The *suest* routine in Stata is used for this purpose (Weesie 1999).

Table 1 Means, standard deviations, and bivariate correlations (unweighted)

	Mean (SD)	1	2	3	4	5	6	7	8	9	10	11	12	13
1 Performance	0.82 (2.79)													
2 Log (own)	5.68 (3.54)	0.31												
3 Log (investors)	1.64 (3.57)	0.33	0.38											
4 Strong ties	0.15 (0.35)	0.17	0.29	0.49										
5 Weak ties	0.18 (0.38)	0.21	0.32	0.64	0.34	0.34								
6 Planning fallacy	2.77 (0.80)	0.10	0.16	0.13	0.09	0.03								
7 Optimism	1.07 (0.56)	0.06	0.10	0.03	0.03	−0.06	−0.02							
8 Overconfidence	0.15 (0.11)	−0.07	−0.02	−0.06	−0.03	−0.04	−0.10	0.10						
9 Invention quality	0.22 (0.41)	0.22	0.36	0.31	0.11	0.21	0.06	0.07	−0.05					
10 Age	49.78 (9.76)	0.00	0.08	−0.10	−0.05	−0.03	0.09	−0.05	0.02	−0.08				
11 Years of schooling	15.17 (2.22)	0.12	0.11	0.14	−0.00	0.09	0.07	0.14	0.23	0.11	−0.16			
12 Years inventing	6.66 (4.55)	0.06	0.19	0.09	0.01	0.08	0.10	0.02	0.02	0.08	0.10	0.04		
13 Self-employed	0.71 (0.45)	0.07	0.20	0.12	0.03	0.11	0.01	0.07	0.02	0.10	0.02	0.01	0.06	
14 Managerial experience	0.57 (0.50)	0.07	0.13	0.12	−0.00	0.09	−0.03	0.14	0.07	0.08	0.02	0.19	0.01	0.26

(n, 755) All correlations greater or equal to 0.07 (Pearson r) are significant ($p < 0.05$ or lower). Means and correlations are unweighted. Means, standard deviations, and correlations are drawn from one of the five complete datasets chosen randomly

For H4 we compute a bivariate probit model reported in Table 3 to assess the probability of obtaining funding from strong ties and the probability of obtaining funding from weak ties with regard to the three decision biases, while controlling for the total amounts of funding obtained and other control variables. The coefficients for planning fallacy and optimism are quite different between strong and weak ties. The results show a positive, and weakly significant, effect of planning fallacy on the probability of strong-tie investment ($\beta = 0.169$, $p < 0.10$) and a negative significant effect of planning fallacy on the probability of weak-tie investment ($\beta = -0.255$, $p < 0.01$). A comparison between the magnitudes of the coefficient for planning fallacy shows a strong statistically significant difference between investors with strong and weak ties ($\chi^2 = 11.69$, $p < 0.01$). In terms of optimism, there is a positive but not a significant effect on investors with strong ties ($\beta = 0.094$, *n.s.*) and a negative and significant effect on the probability of investors with weak ties investing ($\beta = -0.412$, $p < 0.01$). The difference in magnitudes of the coefficient for optimism between investors with strong and weak ties is statistically significant ($\chi^2 = 8.91$, $p < 0.01$). There is no difference in coefficients for overconfidence. We therefore find support for H4 with regard to planning fallacy and optimism.

For our additional analysis, we first evaluate self-investment as a mediator between the biases and

Table 2 Maximum likelihood Tobit analysis: the effects of cognitive biases on investor funding

Dependent variable	Outside investor funding
Constant	−1.639
	(1.594)
Planning fallacy	0.529***
	(0.188)
Optimism	0.050
	(0.274)
Overconfidence	−0.016
	(1.273)
Invention quality	1.234***
	(0.429)
Self-investment	0.271***
	(0.056)
Age	−0.054***
	(0.016)
Schooling	0.129*
	(0.075)
Years inventing	0.013
	(0.031)
Self-employed	0.155
	(0.325)
Managerial experience	0.638**
	(0.323)
Adj R^2	0.279
N	764

All regressions include seven year dummies and ten industry dummies. Results are weighted for sampling and non-response bias using method in Holt et al. (1980). Results featured for one dataset randomly chosen out of five complete datasets. Note: The sample is 764 when performance is not included in the model

*** $p < 0.01$; ** $p < 0.05$; * $p < 0.10$

Table 3 Maximum likelihood bivariate probit analysis: the effects of cognitive biases on the probability of investment by strong- and weak-tie investors

Dependent variables	Strong-tie investors	Weak-tie investors
Constant	−0.529	−1.353*
	(0.772)	(0.814)
Planning fallacy	0.169*	−0.255***
	(0.091)	(0.097)
Optimism	0.094	−0.412***
	(0.129)	(0.139)
Overconfidence	0.059	0.342
	(0.644)	(0.598)
Invention quality	−0.222	−0.233
	(0.188)	(0.177)
Entrepreneur's self-investment	0.160***	0.111***
	(0.029)	(0.028)
Investors' investments	0.180***	0.224***
	(0.02)	(0.02)
Age	−0.007	0.007
	(0.008)	(0.008)
Schooling	−0.124***	−0.023
	(0.036)	(0.036)
Years inventing	−0.042**	0.012
	(0.017)	(0.017)
Self-employed	−0.139	0.084
	(0.195)	(0.180)
Managerial experience	−0.173	0.108
	(0.155)	(0.154)
Athrho	0.259**	
	(0.112)	
N	764	

All regressions include seven year dummies and ten industry dummies. Results are weighted for sampling and non-response bias using method in Holt et al. (1980). Results featured for one dataset randomly chosen out of five complete datasets. Note: The sample is 764 when performance is not included in the model

*** $p < 0.01$; ** $p < 0.05$; * $p < 0.10$

others' funding to assess whether effects found may be mediated by self-investment instead of a direct influence of entrepreneur's cognitions on investors' decisions. As shown in Table 4, we find a significant positive relationship between planning fallacy and an entrepreneur's own and outsiders funding ($\beta = 0.601$, $p < 0.01$ and $\beta = 0.692$, $p < 0.01$, respectively), but no effects of optimism and overconfidence on an entrepreneur's self and others funding. Others' funding is then regressed on cognitive factors and the mediator: an entrepreneur's self-investment. Self-investment is also positively related to others' funding ($\beta = 0.271, p < 0.01$). Following the mediation steps described above in the methods section, we compare the coefficients for the cognitive factors for the model without self-investment with the mediation model for which it was included; we find the coefficient for planning fallacy ($F(1) = 8.18$, $p < 0.01$) to change significantly. Thus, self-investment seems to partly explain the influence of planning fallacy on others' funding.

Table 4 Maximum likelihood Tobit regression: the effects of cognitive biases on self-investments and investors funding

Dependent variable	Entrepreneur's self-investment	Investors' funding	Investors' funding
Models			
Constant	−2.501*	−2.316	−1.639
	(1.362)	(1.686)	(1.594)
Planning fallacy	0.601***	0.692***	0.529***
	(0.159)	(0.185)	(0.188)
Optimism	0.252	0.118	0.050
	(0.230)	(0.268)	(0.274)
Overconfidence	0.240	0.049	−0.016
	(1.039)	(1.338)	(1.273)
Invention quality	2.403***	1.885***	1.234***
	(0.338)	(0.428)	(0.429)
Self-investment			0.271***
			(0.056)
Age	0.045***	−0.042**	−0.054***
	(0.014)	(0.017)	(0.016)
Schooling	0.067	0.147*	0.129*
	(0.063)	(0.078)	(0.075)
Years inventing	0.083***	0.035	0.013
	(0.030)	(0.033)	(0.031)
Self-employed	1.067***	0.444	0.155
	(0.315)	(0.334)	(0.325)
Managerial experience	0.771***	0.847***	0.638**
	(0.273)	(0.324)	(0.323)
Adj R^2	0.290	0.235	0.279
N	764	764	764

All regressions include seven year dummies and ten industry dummies. Results are weighted for sampling and non-response bias using method in Holt et al. (1980). Results featured for one dataset randomly chosen out of five complete datasets. Note: The sample is 764 when performance is not included in the model

*** $p < 0.01$; ** $p < 0.05$; * $p < 0.10$

For the analysis of effects on venture performance, we run several models reported in Table 5. The column for cognitive biases with no controls shows that planning fallacy and optimism are both positively and significantly correlated with venture performance ($\beta = 0.33$, $p < 0.05$ and $\beta = 0.52$, $p < 0.05$, respectively). These effects weaken with the inclusion of the control variables ($\beta = 0.26$, $p < 0.10$ and $\beta = 0.39$, $p < 0.10$, respectively). In terms of self-investment and others' funding, both are positively related to venture performance whether controlling for the cognitive biases or not. We also follow the steps for computing mediation effects to investigate the potential mediation effects of self-investment and others' funding. We look for a decrease in the size of the coefficients for decision biases when either an entrepreneur's own or others' investments are added to the model. The *suest* tests provided support for observed significant decreases. The effect of planning fallacy on venture performance is mediated by an entrepreneur's self-investment ($F(1) = 10.97, p < 0.01$) and others' funding ($F(1) = 5.87$, $p < 0.05$), as the coefficient for planning fallacy is significantly reduced when an entrepreneur's own or investors' funding are introduced into the model. Optimism and overconfidence on the other hand are not mediated.

5 Discussion

We study the effects of entrepreneurial planning fallacy, optimism, and overconfidence on inside and outside funding of start-ups. We argue that entrepreneurs' cognitive biases generally provide investors with persuasive cues about themselves or their new venture. Persuasion research suggests that investors are naturally susceptible to these cues because of limited cognitive capacity to evaluate all the details of funding proposals. Their susceptibility will likely lead them to be influenced by cues concerning the prospects of the venture, such as underestimations of completion times, inflated market outcomes, and exaggerated entrepreneurial abilities. However, we find that only planning fallacy affect fundraising from investors in this study.

Since investors have different motivations, we further study how weak-tie and strong-tie investors might differently be influenced by entrepreneurs' cognitive biases as cues in the persuasion process. We argue that differences in investor motivation and experience will explain variance in funding likelihoods as a function of entrepreneurial biases, beyond the baseline differences in probabilities of funding from weak and strong ties. Specifically, we predict that

Table 5 Maximum likelihood Tobit regression: the effects of cognitive biases and investments on venture performance

Dependent variable	Performance (log of sales)	Performance (log of sales)	Performance (log of sales)	Performance (log of sales)	Performance (log of sales)
Models	IVs without controls	IVs without investments	Investments without IVs	Without investors' funding	Without self-investment
Constant	−0.353	−3.392**	−2.462*	−2.981**	−2.979**
	(0.528)	(1.410)	(1.336)	(1.363)	(1.322)
Planning fallacy	0.334**	0.265*		0.172	0.147
	(0.165)	(0.160)		(0.161)	(0.158)
Optimism	0.525**	0.394*		0.353*	0.380*
	(0.210)	(0.204)		(0.213)	(0.197)
Overconfidence	−0.948	−1.062		−1.133	−1.051
	(0.849)	(0.891)		(0.914)	(0.875)
Invention quality		1.002***	0.409	0.586*	0.666**
		(0.310)	(0.317)	(0.334)	(0.304)
Self-investment			0.129***	0.162***	
			(0.049)	(0.046)	
Investor funding			0.146**		0.168***
			(0.064)		(0.057)
Age		0.012	0.010	0.004	0.018
		(0.016)	(0.014)	(0.015)	(0.015)
Schooling		0.139**	0.122**	0.129**	0.116**
		(0.059)	(0.058)	(0.059)	(0.056)
Years inventing		0.014	0.001	0.001	0.009
		(0.020)	(0.019)	(0.019)	(0.020)
Self-employed		0.186	−0.023	−0.004	0.090
		(0.262)	(0.230)	(0.244)	(0.251)
Managerial experience		0.139	−0.068	0.022	−0.000
		(0.263)	(0.261)	(0.262)	(0.258)
Adj R^2	0.048	0.079	0.131	0.107	0.118
N	755	755	755	755	755

All regressions include seven year dummies and ten industry dummies. Results are weighted for sampling and non-response bias using method in Holt et al. (1980). Dependent variable is observed sales. Results are featured for one dataset randomly chosen out of five complete datasets. Note: The sample is 755 when performance is included in the model

*** $p < 0.01$; ** $p < 0.05$; * $p < 0.10$

the likelihood of obtaining funding from strong-tie investors would increase the more biased the entrepreneur, because strong-tie investors are more inclined to process invalid cues from the entrepreneur. In contrast, the likelihood of obtaining funding from weak-tie investors would decrease the more biased the entrepreneur, because weak-tie investors are more likely to be more motivated to apply the appropriate levels of expertise and experience and to reject invalid cues. Our findings indicate that both planning fallacy and optimism have these differential effects on the probability of investor funding between strong-tie and weak-tie investors.

We believe investors were responding to the specific elements of the cognitive biases, as differences in familiarity (and other exogenous factors such as differences in supply) would be absorbed by the estimated baseline probabilities of funding for weak and strong ties, respectively. In particular, we suggest that weak-tie investors are able to compare cues from

entrepreneurs with cues from a representative population of nascent entrepreneurs because weak-tie investors typically have considerable prior experience evaluating nascent entrepreneurs who seek funding. This prior experience helps weak-tie investors to be more accurate at assessing the true ability of entrepreneurs and thereby reducing susceptibility to entrepreneurs' cognitive biases such as overconfidence (e.g., Schwardmann and Van der Weele 2016). In the vernacular of Kahneman and Tversky (1972), weak-tie investors are able to take an *outside view* on the venture, while strong-tie investors are constrained to take an *inside view* as proposed by entrepreneurs.

Even though these investments are not optimal in the sense that they rely on false premises, we show that investments driven by entrepreneurial bias increase venture performance. This is not because the false premises become true, but because most start-ups are credit constrained. Thus, in a world of credit constraints, any investment raises venture performance, irrespective of whether the reason for the investment is biased or not. In particular, we find planning fallacy to positively affect venture performance through both self and investor funding. We offer the explanation that planning fallacy increases entrepreneurs' *skin in the game* which consequently increases investors' funding. We used the coefficients from Table 4 to calculate the *skin in the game* effect which is approximately 24 % of the total mediation effect (i.e., 24 % of the mediated effect of the biases on venture performance through investors' funding occur because the planning fallacy affects self-investments which in turn affect investor funding).

Our results are not supportive of the traditional pecking order theory of informal financing in start-ups. The thrust of the pecking order theory is that because of information asymmetries and moral hazard, friends and family will be the majority investors because they know more about the entrepreneur than outside weak-tie investors and their better knowledge reduces transaction frictions. Instead, our findings are consistent with newer theory on informal investments which takes into account the social liability of getting help from friends and family (Lee and Persson 2015). In this new theory of start-up financing, investments from friends and family have a social shadow cost, where the overhang of strong-tie investments never really disappear, and where investments from family in addition reduce family insurance funds for a rainy day. Strong-tie investments are therefore socially costly, driving entrepreneurs to prefer weak-tie investments even though these typically demand a higher rate of return. Our results are further consistent with a stronger amount of professionalism in investments from weak ties, lending support to such common wisdom as "think twice before borrowing from family" (Business Week 2006, as cited by Lee and Persson 2015).

We suggest that our findings offer some useful insights into helping entrepreneurs raise funds from investors. Advisory services in venture accelerators and business development offices should provide guidance regarding the cognitive aspects of fundraising, since cognitively biased entrepreneurs apparently are more likely to persuade strong-tie investors but less likely to persuade the potentially more important weak-tie investors. While raising funds from friends and family may be cheaper, obtaining funds from weak-tie investors may come with more unbiased professional evaluation of the opportunity, better investor motivation, and higher past investment experiences. Entrepreneurs are also more likely to receive more appropriate managerial support from weak-tie investors. Advisory services should therefore consider such knowledge gaps when designing support programs for nascent ventures.

In conclusion, most entrepreneurs try to persuade potential investors to fund their new ventures. In this paper, we have shown that planning fallacy plays an important role in influencing investor funding, with strong-tie investors particularly susceptible. We also showed that the planning fallacy—in having an effect on fundraising—has a direct effect on venture performance. Thus, we believe that future research can uncover new insights by going beyond the negative consequences of the planning fallacy—and perhaps other cognitive biases—to understand how cognitive biases in a social setting provide investors with persuasive information about entrepreneurs' beliefs and venturing skills.

References

Arabsheibani, G. D., de Meza, D., Maloney, R. J., & Pearson, B. (2000). And a vision appeared unto them of a great profit: Evidence of self-deception among the self-employed. *Economic Letters, 67*, 35–41.

Armor, D. A., & Taylor, S. E. (1998). Situated optimism: Specific outcome expectancies and self-regulation. *Advances in Experimental Social Psychology, 30*, 309–379.

Åstebro, T., Jeffrey, S. A., & Adomdza, G. (2007). Inventor perseverance after being told to quit: The role of cognitive biases. *Journal of Behavioral Decision Making, 20*(3), 253–272.

Åstebro, T., & Koehler, D. (2007). Calibration accuracy of a judgmental process that predicts the commercial success of new product ideas. *Journal of Behavioral Decision Making, 20*(4), 381–403.

Åstebro, T., & Serrano, C. (2015). Business partners: Complementary assets, financing and the commercialization of inventions. *Journal of Economics and Management Strategy, 24*(2), 228–252.

Baron, R. A. (1998). Cognitive mechanisms in entrepreneurship: Why and when entrepreneurs think differently than other people. *Journal of Business Venturing, 13*, 275–294.

Baron, R. M., & Kenny, D. A. (1986). The moderator–mediator variable distinction in social psychological research: Conceptual, strategic and statistical considerations. *Journal of Personality and Social Psychology, 51*, 1173–1182.

Bohner, G., & Dickel, N. (2011). Attitudes and attitude change. *Annual Review of Psychology, 62*, 391–417.

Bohner, G., Dykema-Engblade, A., Tindale, R. S., & Meisenhelder, H. (2008a). Framing of majority and minority source information in persuasion. When and how "consensus implies correctness. *Social Psychology, 39*, 108–116.

Bohner, G., Erb, H. P., & Siebler, F. (2008b). Information processing approaches to persuasion integrating assumptions from the dual- and single-processing perspectives. In D. W. Crano & R. Prislin (Eds.), *Attitudes and attitude change* (pp. 161–188). New York: Psychology Press.

Buehler, R., Griffin, D., & Peetz, J. (2010). Chapter one—The planning fallacy: Cognitive, motivational, and social origins. In P. Z. Mark (Ed.), *Advances in experimental social psychology* (Vol. 43, pp. 1–62). Cambridge: Academic Press.

Buehler, R., Griffin, D., & Ross, M. (1994). Exploring the "planning fallacy": Why people underestimate their completion times. *Journal of Personality and Social Psychology, 67*, 366–381.

Busenitz, L. W., & Barney, J. W. (1997). Differences between entrepreneurs and managers in large organizations: Biases and heuristics in strategic decision-making. *Journal of Business Venturing, 12*(6), 9–30.

BusinessWeek. (2006). *Think twice before borrowing from family*, April 19, 2006.

Camerer, C. F., & Lovallo, D. (1999). Overconfidence and excess entry: An experimental approach. *American Economic Review, 89*, 306–318.

Casamatta, C. (2003). Financing and advising: Optimal financial contracts with venture capitalists. *Journal of Finance, 58*, 2059–2086.

Cassar, G. (2010). Are individuals entering self-employment overly optimistic? An empirical test of plans and projections on nascent entrepreneur expectations. *Strategic Management Journal, 31*(8), 822–840.

Chen, X.-P., Xin, Y., & Kotha, S. (2009). Entrepreneur passion and preparedness in business plan presentation: A persuasion analysis of venture capitalists' funding decisions. *Academy of Management Journal, 52*(1), 199–214.

Clogg, C. C., Petkova, E., & Haritou, A. (1995). Statistical methods for comparing regression coefficients between models. *American Journal of Sociology, 100*, 1269–1293.

Dew, N., Read, S., Sarasvathy, S., & Wiltbank, R. (2009). Effectual versus predictive logics in entrepreneurial decision-making: Differences between experts and novices. *Journal of Business Venturing, 24*(4), 287–309.

Dushnitsky, G. (2009). *A cross-country study of entrepreneurial optimism and valuations*. Working paper http://dushnitsky.com/research.html

Dushnitsky, G. (2010). Entrepreneurial optimism in the market for technology inventions. *Organization Science, 21*(1), 150–167.

Erb, H.-P., Pierro, A., Mannetti, L., Spiegel, S., & Kruglanski, A. W. (2007). Biased processing of persuasive information: On the functional equivalence of cues and message arguments. *European Journal of Social Psychology, 37*, 1057–1075.

Evans, D. S., & Jovanovic, B. (1989). An estimated model of entrepreneurial choice under liquidity constraints. *Journal of Political Economy, 97*(4), 808–827.

Fischhoff, B., Slovic, P., & Lichtenstein, S. (1977). Knowing with Certainty: The Appropriateness of extreme confidence. *Journal of Experimental Psychology: Human Perception and Performance, 3*(4), 552–564.

Gibson, R., Tanner, C., & Wagner, A. F. (2014). Preferences for truthfulness: Heterogeneity among and within individuals. *American Economic Review, 103*, 532–548.

Graham, J. W., & Hofer, S. M. (2000). Multiple imputation in multivariate research. In T. D. Little, K. U. Schnabel, & J. Baumert (Eds.), *Modeling longitudinal and multiple-group data: Practical issues, applied approaches, and specific examples* (pp. 201–218). Hillsdale, NJ: Erlbaum.

Granovetter, M. (1974). *Getting a job: A study of contacts and careers*. Cambridge, MA: Harvard University Press.

Greene, W. H. (2003). *Econometric analysis* (5th ed.). New Jersey: Prentice Hall.

Griffin, D., & Tversky, A. (1992). The weighing of evidence and the determinants of confidence. *Cognitive Psychology, 24*, 411–435.

Hellmann, T., & Puri, M. (2002). Venture capital and the professionalization of start-up firms: Empirical evidence. *Journal of Finance, 57*(1), 169–197.

Hmieleski, K. M., & Baron, R. A. (2009). Entrepreneurs' optimism and new venture performance: A social cognitive perspective. *Academy of Management Journal, 52*(3), 473–488.

Holt, D., Smith, M. F., & Winter, P. D. (1980). Regression analysis of data from complex surveys. *Journal of the Royal Statistical Society. Series A (General), 143*(4), 474–487.

Kahneman, D. (2011). *Thinking, fast and slow*. London: Penguin.

Kahneman, D., & Lovallo, D. (1993). Timid choices and bold forecasts: A cognitive perspective on risk-taking. *Management Science, 39*, 17–31.

Kahneman, D., & Tversky, A. (1972). Subjective probability: A judgment of representativeness. In D. Kahneman, P. Slovic, & P. Tversky (Eds.), *Judgment under uncertainty: Heuristics and biases*. Cambridge: Cambridge University Press.

Kahneman, D., & Tversky, A. (1996). On the reality of cognitive illusions: A reply to Gigerenzer's critique. *Psychological Review, 103*, 582–591.

Keh, H. T., Foo, M. D., & Lim, B. C. (2002). Opportunity evaluation under risky conditions: The cognitive processes of entrepreneurs. *Entrepreneurship Theory & Practice, 27*(2), 125–149.

Koellinger, P., Minniti, M., & Schade, C. (2007). I think I can, I think I can—Overconfidence and entrepreneurial behavior. *Journal of Economic Psychology, 28*(4), 502–507.

Lee, S., & Persson, P. (2015). *Financing from family and friends*. (September 10, 2015). IFN Working Paper No. 933; NYU Stern Working Paper FIN-12-007; ECGI—Finance Working Paper No. 358. http://ssrn.com/abstract=2086625.

Moore, D. A., & Healy, P. J. (2008). The trouble with overconfidence. *Psychological Review, 115*(2), 502–517.

Nagy, B. G., Pollack, J. M., Rutherford, M. W., & Lohrke, F. T. (2012). The influence of entrepreneurs' credentials and impression management behaviors on perceptions of new venture legitimacy. *Entrepreneurship Theory and Practice, 36*(5), 941–965.

Oregon Research Institute. (2001). *A scientific collaboratory for the development of advanced measures of personality traits and other individual differences*. http://ipip.ori.org/.

Oskamp, S. (1965). Overconfidence in case-study judgements. *Journal of Consulting Psychology, 2*, 261–265.

Petty, R. E., & Cacioppo, J. T. (1986). The elaboration likelihood model of persuasion. *Advances in Experimental Social Psychology, 19*, 123–205.

Pollack, J. M., Rutherford, M. W., & Nagy, B. G. (2012). Preparedness and cognitive legitimacy as antecedents of new venture funding in televised business pitches. *Entrepreneurship Theory and Practice, 36*(5), 915–939.

Puri, M., & Robinson, D. T. (2007). Optimism and economic choice. *Journal of Financial Economics, 86*(1), 71–99.

Robinson, D., & Robb, A. (2014). The capital structure decisions of new firms. *Review of Financial Studies, 27*(1), 153–179.

Scheier, M. F., Carver, C. S., & Bridges, M. W. (1994). Distinguishing optimism from neuroticism (and trait anxiety, self-mastery, and self-esteem): a reevaluation of the Life Orientation Test. *Journal of Personality and Social Psychology, 67*(6), 1063.

Scheier, M. F., Carver, C. S., & Bridges, M. W. (2001). Optimism, pessimism, and psychological well-being. In E. C. Chang (Ed.), *Optimism and pessimism: Implications for theory, research, and practice* (pp. 189–216). Washington, DC: American Psychological Association.

Schwardmann, P., & Van der Weele, J. J. (2016). *Deception and self-deception*. Tinbergen Institute Discussion Paper, TI 2016-012/I. Available at SSRN: http://ssrn.com/abstract=2734736.

Shane, S., & Cable, D. (2002). Network ties, reputation, and the financing of new ventures. *Management Science, 48*(3), 364–381.

Shanteau, J. (1988). Psychological characteristics and strategies of expert decision makers. *Acta Psychologica, 68*(1–3), 203–215.

Shanteau, J. (1992). How much information does an expert use? Is it relevant? *Acta Psychologica, 81*(1), 75–86.

Simon, M., & Houghton, S. M. (2002). The relationship among biases, misperceptions and introducing pioneering products: Examining differences in venture decision contexts. *Entrepreneurship Theory and Practice, 27*, 105–124.

Simon, M., & Shrader, R. C. (2012). Entrepreneurial actions and optimistic overconfidence: The role of motivated reasoning in new product introductions. *Journal of Business Venturing, 27*(3), 291–309.

Taylor, S. E., Pham, L. B., Rivkin, I. D., & Armor, D. A. (1998). Harnessing the imagination: Mental simulation, self-regulation, and coping. *American Psychologist, 53*(4), 429–439.

Trivers, R. (1985). *Social evolution*. Menlo Park, CA: The Benjamin-Cummings Publishing Company.

Van Buuren, S., Boshuizen, H. C., & Knook, D. L. (1999). Multiple imputation of missing blood pressure covariates in survival analysis. *Statistics in Medicine, 18*, 681–694.

Van den Steen, E. (2004). Rational overoptimism (and other biases). *The American Economic Review, 94*(4), 1141–1151.

Von Hippel, W., & Trivers, R. (2011). The evolution and psychology of self-deception. *Behavioral and Brain Sciences, 34*(1), 1–16.

Wanous, J. P., & Hudy, M. J. (2001). Single-item reliability: A replication and extension. *Organizational Research Methods, 4*, 361–375.

Weesie, J. (1999). Seemingly unrelated estimation and the cluster-adjusted sandwich estimator. *STATA Technical Bulletin, STB, 52*, 34–47.

Wong, A., Bhatia, M., & Freeman, Z. Freeman. (2009). Angel finance: The other venture capital. *Strategic Change, 18*, 221–230.