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CAN COGNITIVE BIASES EXPLAIN VENTURE TEAM HOMOPHILY?

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Although venture teams whose founders are dissimilar (heterophilious) tend to outperform teams whose founders are similar (homophilious), most new venture teams are characterized by homophily. I try to explain this puzzle with a learning model in which founders are prone to two cognitive biases: overoptimism and self-serving attributions. Founders choose cofounders with similar beliefs as themselves because they expect this to promote the most effective allocation of effort to the venture. Self-serving bias reinforces and perpetuates these beliefs. In principle, informed outsiders (e.g., practitioners or hands on investors) can improve venture team composition compared with private choices by founders. Copyright © 2009 Strategic Management Society.

INTRODUCTION

If founders of new ventures (*entrepreneurs*) are prone to cognitive biases, what sort of teams are they likely to form? And what are the implications of entrepreneurs' team formation choices for subsequent venture performance? In particular, do entrepreneurs form teams that maximize their objective performance, or are they liable to make misinformed team formation choices?

This article proposes a simple modeling framework designed to answer these questions. Addressing them is timely, given the growing interest within the strategic entrepreneurship literature about the endogenous formation by entrepreneurs of their social relations in general and of venture teams in particular (Stuart and Sorenson, 2007; Foss *et al.*, 2008). It is often claimed that teams enjoy access to diverse skills and information that stimulates entrepreneurial learning and generates superior performance compared with solo start-ups (Cooper, Gimeno-Gascon, and Woo, 1991; Schutjens and Wever, 2000; Klepper, 2001; Headd, 2003). The *composition* of new venture teams is an integral part of this story, because it determines access to these resources. Of particular importance is the extent to which teams are characterized by *homophily* or *heterophily*. Homophily is usually described as the tendency of *birds of a feather to flock together* (Ruef, Aldrich, and Carter, 2003). In terms of teams, it implies that entrepreneurs start new ventures with founders who are similar to themselves in some important respects. In contrast, heterophilious teams are comprised of founders who are dissimilar.

Much of the extant literature on homophilious teams argues that both entrepreneurs and the population at large inhabit dense social clusters containing numerous internal social connections but few *bridging* ties with external clusters (Kim and Aldrich, 2005; Aldrich and Kim, 2007). As a result, people tend to search for partners in personal and business endeavors among members of their own social network. Social networks are often organized along the lines of familiarity and similarity, dominated by friendship and kinship ties. Dense social networks,

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it is argued, promote conformity and trust and inhibit the desire of members to search for contacts outside of their group (Coleman, 1988; Ruef *et al*., 2003; Aldrich and Kim, 2007). Consequently, people are obliged to form homophilious relationships with members of their social groups. According to this theory, entrepreneurs form homophilious venture teams because this is all dense social networks allow.

The present article approaches the homophily issue from a different perspective. It asks: rather than entrepreneurs forming homophilious teams because they have to, are there any grounds for believing that they do so because they *want to*? If so, this might provide a different and complementary explanation for homophily. It is also an important question because, as we argue below, if this alternative view is valid, then any efforts to promote heterophily by weakening network constraints might be unsuccessful or even counterproductive. The reason is that, faced with a wider array of potential partners to choose from as a result of weakened network constraints, entrepreneurs who seek homophily might find it even easier to achieve this objective.

The fact that founders prefer to form homophilious rather than heterophilious teams goes against the grain of much recent thinking in entrepreneurship research and social network theory. It is commonly asserted, for example, that balanced skills are conducive to good venture performance, and entrepreneurs are cognizant of these benefits when they form their teams (Hannan, Barron, and Burton, 1996; Bruton, Fried, and Hisrich, 1997; Kim and Aldrich, 2005). But I want to argue that if entrepreneurs are prone to cognitive biases, this argument can break down, and homophily then emerges as a preferred form of new venture organization.

These ideas are explored below in a model that recognizes the importance of entrepreneurial effort for venture performance (Lévesque and MacCrimmon, 1997), in an environment where entrepreneurs are uncertain about the true returns to their effort (Parker, 2006) and are prone to cognitive biases. Two particular cognitive biases are considered in this article: overoptimism (Busenitz and Barney, 1997; Camerer and Lovallo, 1999) and self-serving attributions (Baron, 1998; Rogoff, Lee, and Suh, 2004). These biases have been widely studied in the entrepreneurship literature, where it is sometimes argued that they are a natural response to the uncertain market environments in which creative new opportunities are fomented (Busenitz and Barney, 1997; Alvarez and Barney, 2007; Baron, 2007). As we will see, these two cognitive biases also carry interesting implications for new venture team composition and performance, as well as for entrepreneurial learning and the persistence of biased beliefs. My model predicts that these biases jointly induce entrepreneurs to form and persist with homophilious founding teams, in which overoptimistic founders want to *match* with other overoptimists.

The model also predicts that homophilious teams underperform heterophilious teams. This poses an obvious puzzle: why would founders form homophilious teams when heterophilious teams deliver superior performance? Social network theory proposes an answer based on the idea that dense social networks that promote homophily inhibit access to novel information and resources, which is directly responsible for venture underperformance. But a complication with this argument is that trust and social capital are, presumably, most easily leveraged within homophilious teams occurring within dense local networks—and these might be expected to enhance, rather than inhibit, venture performance. Cognitive biases, in contrast, offer a nice solution to the puzzle, because they can explain why entrepreneurs form teams with favorable subjective attributes but unfavorable objective performance outcomes. Furthermore, unlike previous explanations of homophily based on constrained choice, this resolution to the puzzle is predicted to also (perhaps especially) apply in broader social networks where entrepreneurs have greater leeway to choose their preferred partners.

The combination of overoptimism and self-serving bias is illuminating as well because it turns out that self-serving bias can establish overoptimism as a persistent, and even permanent, cognitive state. This helps explain another prominent finding from the literature: the finding that long-lasting overoptimism is resistant to counterfactual refutations (Weinstein, 1980; Wright, Robbie, and Ennew, 1997; Landier and Thesmar, 2008). Several implications follow from this insight. One is the possibility that entrepreneurs *never* learn from their poor team composition choices. In other words, they might not even come to learn the hard way but are, instead, doomed to repeat the same mistakes over and over again. Another implication is that it becomes desirable to modify models of rational (Bayesian) learning by incorporating behavioral elements. Independent evidence from behavioral researchers shows that

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experimental subjects often behave contrary to Bayes' Rule and more in accordance with behavioral theory (Kahneman and Tversky, 1973; Grether, 1980). As a constructive step forward in this regard, I propose a *Modified Bayesian Learning* (MBL) model in which agents do not accurately incorporate new information and rationally update their beliefs, but instead draw selectively from the pool of available information in a self-serving manner. The MBL model assumes that entrepreneurs respond to feedback from events in an iterative and path-dependent fashion, consistent with a growing consensus about processes of entrepreneurial learning in the scholarly literature (Alvarez and Barney, 2007; Miller, 2007; Parker and Alvarez, 2008). It is shown how this can entrench or even exacerbate initial biases, inducing agents to adopt ever more biased positions, which lock them into *self-confirming equilibria* (Ryall, 2003). To the best of my knowledge, the marrying of *behavioral* with *rational* (Bayesian) learning in this way is a novel extension of the entrepreneurial learning literature.

The next section fleshes out the background literature to which the present article refers. The section afterwards sets out the assumptions and notation of the model and then derives and discusses the key results. The final section closes with a discussion of limitations of the present article and some prospects for future research.

BACKGROUND LITERATURE

This article draws on several strands of literature. These include (1) studies of teams and how team members' beliefs about the value of opportunities bear on the opportunity development process; (2) the uncertain nature of opportunities and the existence of overoptimistic and self-serving attribution biases; and (3) the roles of effort and learning in the venture development process.

Beliefs about opportunities are integral to any analysis of how they are developed and exploited. As a recent contribution put it, 'Although (opportunity) beliefs are becoming increasingly recognized as fundamental to understanding entrepreneurial cognition and strategic action, little is understood about the mechanisms that are responsible for the formation and evolution of these beliefs' (Shepherd, McMullen, and Jennings, 2007: 75). An important aspect of this question concerns cognition within teams rather than simply that of individuals undertaking solo start-ups—including team founders' awareness of their cofounders' psychological predispositions and beliefs. Such awareness can facilitate communication, information sharing, and understanding and help founders assess and successfully exploit new opportunities. It can also help founders identify and reconcile areas of potential conflict by enhancing the planning process (Stewart *et al*., 1999; Ensley and Pearce, 2001). Taking this reasoning a step further, West (2007) claims that collective cognition mediates between individual cognitions and actions and venture performance. Moreover, evidence shows that open communication between team members is associated with perceptions of team viability and member satisfaction (Foo, Sin, and Yiong, 2006). Building on these arguments, an important feature of the model developed below is its incorporation of awareness of cofounders' beliefs. However, it will be seen that this is not sufficient to engender successful team composition choices when cognitive biases are present.

The composition of new venture teams is central to an understanding of team performance. Homophily appears to play a key role in this respect. The sociology literature identifies two forms of homophily: *status* and *value* homophily (Lazarsfeld and Merton, 1954; McPherson, Smith-Lovin, and Cook, 2001). Status homophily refers to founders having similar social status characteristics, such as occupation or educational qualifications. Value homophily, in contrast, refers to the tendency of people to match with others who think in similar ways, or who believe similar things, regardless of any differences in status. Value homophily implies similarity of beliefs and values and is likely to be especially pertinent for explaining opportunity exploitation by new venture teams. That is because beliefs shape strategies for exploiting new opportunities, and strategies, in turn, determine the performance of new ventures (Alvarez and Barney, 2007; Miller, 2007; Rindova, Petkova, and Kotha, 2007).

Consistent with this argument, there is an emerging consensus that diverse beliefs and ideas within venture teams promote innovation and superior performance (Fiol, 1994; West and Meyer, 1998). There are several reasons for this. Conflicts and disagreements can be a source of creative tension, provided there is a shared framing of the issues which is broad enough to encompass members' differences without the team breaking up. And there can be productive interactions between different managerial *mental models* culminating in superior collective outputs

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compared with solo venturing (Foss *et al*., 2008). Reflecting the prominence of this stream of research in the organizational science and entrepreneurship literatures, the model developed in this article concentrates on value homophily rather than status homophily. It is probably safest not to overdo the distinction between them, though, because if people of similar status hold similar beliefs, the differences between value and status homophily need not be very pronounced (Forbes *et al*., 2006). This issue will be covered more later on.

The available evidence strongly supports the notion that human beings form homophilious relations with each other in a wide variety of social settings (McPherson *et al*., 2001). The evidence, which is based on various status attributes, suggests that the same is true of new venture teams. For instance, a large nationally representative sample of new venture starts in the U.S.—the Panel Study of Entrepreneurial Dynamics (PSED)—reveals that homophily is pronounced and that, if anything, larger teams display an even greater tendency towards homophily than smaller ones do (Ruef *et al*., 2003). The dimensions of homophily explored by Ruef *et al*. include gender, ethnicity, and occupation. There is less evidence about value homophily in this context (Forbes *et al*., 2006).

Despite the prevalence of homophilious new venture teams, heterophily apparently endows teams with key organizational and performance advantages. With regard to organization, for example, Boeker and Wiltbank (2005) observe that functionally diverse top management teams are more temporally stable and undergo fewer changes to their structure and composition over time. More diverse teams also tend to be those whose founders perceive the greatest degree of viability (Foo *et al*., 2006). Homophilious teams, in contrast, seize fewer valuable opportunities, as has been observed, for example, in the medical and surgical instruments industry (Kor, 2003). With regard to performance, Eisenhardt and Schoonhoven (1990) observed that semiconductor firms with more heterophilious founding teams enjoy faster organizational growth, while in a study of 161 young high-tech firms in Silicon Valley, Beckman, Burton, and O'Reilly (2007) showed that diverse prior experience of the top management team members is associated with superior access to venture capital (VC) financing and a greater likelihood of achieving an IPO.

As noted earlier, evidence that entrepreneurs form homophilious teams—in spite of the fact that heterophily confers organizational and performance advantages—poses something of a puzzle. Dense social networks might explain the existence of homophily and limited access to novel information. On the other hand, one would also expect dense networks to promote trust and social capital, which are likely to enhance, rather than inhibit, venture performance. Therefore, a different explanation might be needed. As noted earlier, the one explored below is based on cognitive biases.

Overoptimism is one of two cognitive biases considered in this article. There are several reasons why entrepreneurs are unusually prone to overoptimism. Evidence from the psychology literature (Weinstein, 1980) shows that overoptimism tends to be most prevalent when individuals have emotional commitments to outcomes, when they believe outcomes are under their control, and when there is relatively little hard evidence about the likelihood of an endeavor's success. As de Meza and Southey (1996) point out, these conditions all commonly apply to entrepreneurs. Other psychological studies suggest that complex tasks that lack fast clear feedback—such as new venture creation—are also ripe grounds for overoptimism (Schade and Koellinger, 2007). Furthermore, the environments in which entrepreneurs operate are typically so noisy and overloaded with information that heuristics embodying cognitive biases (like overoptimism) may be necessary to cope with them (Baron, 1998; Forbes, 2005; Schade and Koellinger, 2007). Hence, innately overoptimistic people are likely to self-select into entrepreneurship (Busenitz and Barney, 1997).

The available evidence supports the view that entrepreneurs have a high propensity toward overoptimism. Cooper, Woo, and Dunkelberg (1988) reported that 68 percent of respondents to a U.S. National Federation of Independent Business survey claimed that the odds of their business succeeding were better than for others in the same sector, while only 5 percent thought their odds were worse. Similar evidence has been cited by researchers in other countries, too (Arabsheibani *et al*., 2000; Landier and Thesmar, 2008; Koellinger, Minniti, and Schade, 2007). It is not just entrepreneurs who are already in business who exhibit overoptimism, either. According to Astebro's (2003) study of more than 1,000 Canadian inventions between 1976 and 1993, the chance of a new innovation reaching the market is only 7 percent. Of these *lucky* 7 percent, some 60 percent realize negative returns, and the average realized return among those who commercialize

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their inventions is –7 percent, even ignoring the cost of the inventor's often enormous efforts. Business performance is impaired because overoptimism is associated with attenuated growth rates and lower returns on assets and equity (Landier and Thesmar, 2008). Furthermore, overoptimistic entrepreneurs run the risk of deploying their resources too precipitately and rejecting valuable venture liquidity opportunities by being unwilling to share equity—all making their ventures more prone to failure (Hayward, Shepherd, and Griffin, 2006). Indeed, it is commonly asserted that overoptimism is consistent with persistent entrepreneurial entry into markets despite low returns and high industry exit rates (de Meza and Southey, 1996; Moore, Oesch, and Zietsma, 2007).

Evidence from the psychology literature shows that many people are prone to another deviation from rationality, called *self-serving attribution bias*. This type of bias involves a tendency for people to attribute positive outcomes to internal causes, such as their own skill and sagacity, while blaming negative outcomes on external causes, such as bad luck or other factors beyond their control (Brown and Rogers, 1991; Baron, 1998). It has been argued that entrepreneurs are especially prone to self-serving bias because of their pronounced preference for exerting personal control over events and the prominent role played by self-efficacy (Baron, 1998; Shaver and Scott, 1991). Empirical evidence suggests that entrepreneurs experience little *ex post* regret and give little consideration to counterfactual explanations of past events.

Consequently, they are more susceptible to self-serving attribution bias than non-entrepreneur experts are (Baron, 1998; Rogoff *et al.*, 2004).

Less explored in the literature to date have been the implications of self-serving bias for the ways that entrepreneurs absorb information and learn from events (Baron, 2007). For instance, an overoptimistic self-serving entrepreneur might attribute poor sales to bad luck and place little weight on this information in their learning process. Yet the same entrepreneur might attribute good sales to innate skill, placing a lot of weight on this more welcome information in their learning process. As a result, their learning is skewed and merely perpetuates and entrenches what they already know. An optimistic entrepreneur not prone to self-serving bias would, in contrast, treat the two types of outcomes in a symmetric manner, giving them equal weight and using both to learn about the true nature of the demand for their venture's product.

At this juncture, we should qualify the foregoing discussion in two respects. First, it is not being claimed that every person, or every entrepreneur, is overoptimistic. While many (possibly most) are, some appear to be realistic, while others are pessimistic. Depressed persons in particular have a greater predisposition to be realists, as reflected in the subtitle of the article by Alloy and Abrahamson (1979), *Sadder and Wiser*. Second, overoptimism and self-serving attributions are just two of numerous documented deviations from full rationality. Others include: (1) bounded rationality, whereby entrepreneurs do not know what they do not know (Cooper, Folta, and Woo, 1995); (2) *animal spirits* (Marchionatti, 1999); (3) subjective feelings of control (Sarasvathy, Simon, and Lave, 1998); and (4) a tendency to deploy short-term planning horizons and avoid counterfactual thinking (Baron, 2000; Bluedorn and Martin, 2008). Entrepreneurs also appear to be readier than nonentrepreneurs to extrapolate from small samples of information, which can form the basis for starting new ventures in the first place (Simon, Houghton, and Aquino, 2000). Deviations from rationality can thrive under conditions of uncertainty—where there is a lack of objective information to eliminate them (Alvarez and Barney, 2007). This can help explain why entrepreneurs hold prior beliefs that embody both optimistic and self-serving biases.

One might wonder how cognitive biases affect entrepreneurs' behavior in terms of how they choose to develop new opportunities within their ventures. Germane to this question is the issue of entrepreneurs' investment choices. Entrepreneurs invest both material resources and their own effort in startups (McCarthy, Krueger, and Schoenecker, 1990; Aldrich, 1999). Entrepreneurs form expectations about the likely returns to their costly effort and respond to incentives on the basis of these expectations (Lévesque and MacCrimmon, 1997; Bitler, Moskowitz, and Vissing-Jørgensen, 2005; Lévesque and Schade, 2005). Hence, investment of effort is tied to beliefs. If effort yields outcomes from which entrepreneurs can learn, their beliefs are susceptible to change, leading to modifications of their behavior and potentially giving rise to different paths of opportunity development (Parker, 2006; Alvarez and Barney, 2007). The practice of consciously adjusting effort to explore and learn about their business environment is known as *active learning* (Frank, 1988; Parker, 2006). In contrast, *passive learning* merely entails entrepreneurs receiving information

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without effort and using it to decide whether they should continue trading or quit the market (see, e.g., Jovanovic, 1982). Although there are limits to active learning, such as constraints on entrepreneurs' time, cognitive processing power, attention, and resources (Busenitz and Barney, 1997; Ravasi and Turati, 2005), the available evidence suggests that, in practice, entrepreneurs perform both active and passive learning (Baldwin and Rafiquzzaman, 1995). Consistent with the entrepreneurship literature that analyzes how entrepreneurs allocate effort based on their beliefs, the model in this article focuses on active rather than on passive learning. The structure and outcomes of the model are explained next.

A MODEL OF TEAM FORMATION WITH COGNITIVE BIASES

Some opportunities by their very nature can only be properly developed by teams of entrepreneurs. In particular, ambitious venture ideas sometimes require more manpower, knowledge, or resources than one founder can supply alone (Zucker, Darby, and Armstrong, 2002; Aldrich and Kim, 2007; Foss *et al*., 2008; Parker and Alvarez, 2008). The present article follows Parker and Alvarez (2008) by confining attention to such opportunities and supposing (for simplicity) that just two founders are needed to start a new venture. This is, in fact, the modal number of founders in actual start-ups (Ruef *et al*., 2003). Although the analysis and results below generalize naturally to teams with more than two founders, it is convenient for the exposition to work with this particular case.

This section presents the model. The first subsection outlines some simplifying assumptions and establishes notation. The second analyzes entrepreneurs' initial choices of who to found a team with and how much costly effort to supply to the venture. The third subsection models Bayesian updating and the role of self-serving bias. It is seen how optimistic beliefs can emerge and persist in this setting. The fourth subsection analyzes venture performance. Four key results are derived in the course of the analysis, and their logic is explained and discussed.

Assumptions and notation

Founders typically operate a venture whose duration spans several time periods. Every period, each founder freely and independently chooses how much effort to supply to it. A venture's output is an increasing function of both founders' efforts. Each period, t, only a fraction of a venture's output, θ^t, is actually sold: $0 \leq \theta^t \leq 1$ in all t. Because demand is subject to unexpected shocks, the fraction θ^t varies randomly. Entrepreneurs typically do not know what demand will be at the time they commit their effort (Parker, 2006), so they must use the sequence of observations $\{\theta^t\}$ to form expectations (and learn) about the true, but unknown, *mean value* denoted by θ, where $0 < \theta < 1$ is fixed.

From a continuum of founders, consider just two, denoted by j and k. Denote their effort levels at time t by e_j^t and e_k^t. Revenue is the product of two components: (i) the scale of service offered per customer, denoted by $f(e_j^t, e_k^t)$, and (ii) the number of customers x^t (out of a known potential maximum population of n) who buy the service during t. The output price is unity.

Take (i) first. The scale of service offered per customer is an increasing and concave function of effort by both founders. It is assumed to take the form $f(e_j^t, e_k^t) = (e_j^t, e_k^t)^\alpha$, where $0 < \alpha < ½$ is a parameter. As shown below, the restriction on α ensures that entrepreneurial effort remains bounded (i.e., does not become infinite). The functional form of f treats the founders symmetrically and embodies effort complementarity.

Turning to (ii), define $\theta^t = x^t/n$ as the sales 'hit rate' at t, i.e., the proportion of potential customers who actually buy at t. As noted above, $0 \leq \theta^t \leq 1$ for all t. Operating in a risky environment, x^t and, hence, θ^t vary stochastically from period to period. Combining (i) and (ii), revenues of a new venture are $\theta^t n(e_j^t, e_k^t)^\alpha$.

No entrepreneur knows θ, so they choose how much costly effort to supply on the basis of their *beliefs* about it. Denote an entrepreneur j's prior beliefs (called *priors*) about θ at time t by $p_j^t(\theta)$. Priors can be thought of as the subjective probability distribution over all feasible θ values (i.e., the unit interval) held by j at t. Denote the expected value of this distribution for j by $E_j^t(\theta)$.

In general, priors can be expected to differ among potential founders. An overoptimistic entrepreneur overestimates the expected demand for his/her product (relative to the true, but unknown, mean), while a realistic entrepreneur estimates it accurately, and a pessimist underestimates it (Parker and Alvarez, 2008). Formally, a founder a is more optimistic than b if

DOI: 10.1002/sej

$$E_a^t(\theta) > E_b^t(\theta) \quad (1)$$

In what follows, *a* is assumed to be *overoptimistic*, in the sense that their expectation of θ is too high [i.e., $E_a^t(\theta) > \theta$]. If *b* is *pessimistic*, $E_b^t(\theta) < \theta$. Bear in mind that while much of the discussion below relates to just two different entrepreneurs, there is, in general, a continuum of them.

As noted in the previous section, even though entrepreneurs have a tendency to be relatively overoptimistic, this does not preclude the possibility of realism or pessimism among some of them. And even pessimists who underestimate future demand might still hold expectations that are consistent with entrepreneurship being an attractive career occupation. For example, they might be even more pessimistic about their next-best career option outside entrepreneurship.

Both optimistic and pessimistic prior beliefs could be grounded in other cognitive biases, including those mentioned earlier. Rather than digging deeply into the origins of biased priors, I will instead ask how beliefs evolve over time, as entrepreneurs observe a sequence of market demand realizations. Previous research has analyzed *rational* (i.e., Bayesian) learning in this context, whereby entrepreneurs utilize all available information to update their beliefs in an ongoing manner (Parker and Alvarez, 2008). Under Bayesian Learning (BL)—described in detail below—observations of $\{\theta^t\}$ are used to update prior beliefs to yield *posterior* beliefs $p_j^{t+1}(\theta)$ which differ from the priors $p_j^t(\theta)$. For example, the datum θ^1 is used in BL models to update the initial priors $p_j^0(\theta)$ to generate the posterior $p_j^1(\theta)$. If learning takes place, $p_j^1(\theta) \neq p_j^0(\theta)$, and more generally, $p_j^{t+1}(\theta) \neq p_j^t(\theta)$. On average, with random sampling of data $\{\theta^t\}$, posteriors can be expected to provide a more accurate (in an objective sense) guess of θ than priors do. In fact, a logical implication of BL is that even an entrepreneur who is very ill informed initially is eventually bound to learn the true value of θ (Lee, 1995). As intimated earlier, this rather strong assumption is relaxed in this article, in favor of a more behavioral approach, called Modified Bayesian Learning (MBL).

The MBL structure proposed here allows founders not only to possess heterogeneous degrees of optimism (and pessimism), but also to vary in terms of their susceptibility to self-serving attribution bias. Informed by the discussion in the preceding section, this bias is operationalized in terms of self-serving founders updating their prior beliefs with new information *only* if that new information is viewed *favorably*. By *favorably*, I mean *in a way that is consistent with high future levels of demand*. So, for example, a founder is willing to learn from random market demand outcomes that are high, since these are consistent with good performance for which the founder can take credit. But they are unwilling to learn from random market demand outcomes that are low, because these are inconsistent with good performance and can be simply blamed on *bad luck*.

To fix these ideas, suppose that the most optimistic agent, *a*, behaves with self-serving bias, whereas *b* does not. Consistent with the discussion earlier, self-serving bias is assumed to manifest itself in the following subjective decision rule:

> *If datum x^t that is less favorable than a's expectation [i.e. if $x^t < nE_a^t(\theta)$] arrives, then attribute this datum to uninformative bad luck and discard it. That is, a does not use it to update their beliefs. But if datum x^t is no less favorable than a's expectation [i.e., if $x^t \geq nE_a^t(\theta)$] then a attributes the information to an informative, well-deserved outcome and uses it to update their beliefs in a Bayesian fashion.*

In contrast to a BL model where good and bad outcomes are weighted equally, self-serving founders in the MBL model give less weight to data indicating low market demand outcomes than to data indicating high demand outcomes. In principle, any number of unequal weighting schemes could be proposed in a modeling context. To make my point most clearly without skewing the results in any way, I will specifically consider the case of a MBL model where self-serving founders give full weight to information that is consistent with good performance, judged relative to their priors; and give zero weight to information that is inconsistent with good performance, judged relative to their priors. In particular, entrepreneurs update their beliefs using data on market demand if that data is no less than their prior expectation of demand; otherwise, the data are ignored. Nothing essential depends on the precise form of this assumption: identical (but analytically messier) qualitative results would be obtained in an alternative specification with unequal, but less dissimilar, weights.

The description of the model so far has focused entirely on the demand side. Turning to the supply side, venture costs are assumed to be increasing functions of the founders' effort levels, on the

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grounds that effort entails greater usage of costly resources, such as capital and materials. (There might also be a personal utility loss from effort in terms of foregone leisure, though this is not the focus of interest here: see, Lévesque and Schade, 2005, for an analysis of that issue.) The total effort cost of founders j and k is $e_j^t + e_k^t$. Both founders are taken to share in the venture's profits and seek to maximize the performance of the venture. Total venture profits at time t are $\Pi^t = \theta^t n(e_j^t, e_k^t)^\alpha - (e_j^t + e_k^t)$. It is sufficient to consider only two periods in what follows, so entrepreneurs seek to maximize total profits $\Pi^1 + \Pi^2$. As previous researchers have pointed out, entrepreneurs want to continue in entrepreneurship after period 2 only if their profits exceed some threshold, T, associated with an outside option (Cooper *et al*., 1992). If $\Pi^1 + \Pi^2 > T$, the venture is assumed to continue after period 2. If it does not, the entrepreneurs close the venture and exit (there is no *option value of waiting*). Hence, profitability is associated with survival prospects for new ventures.

At the initial founding time, entrepreneurs choose who to found a new firm with. They choose from a continuum of potential founders. As noted in the previous section, the focus in this article is on value homophily. So to simplify the exposition, entrepreneurs are taken to differ in terms of their beliefs, but not in any other relevant respect. The concluding section of this article briefly discusses implications of relaxing this assumption.

I will consider two different scenarios about the information which founders possess about potential cofounders. In the first scenario, founders are supposed to have access to plentiful information and so are able to choose a cofounder freely. This should be interpreted as an *ideal* scenario because, in practice, one might expect dense social networks to restrict access to cofounders situated outside their own network; and searching along every possible path might not only be very costly, but also potentially fruitless if social clusters contain a lot of redundant information (Aldrich and Kim, 2007). Thus, the first scenario is essentially designed to analyze what founders would *want* to do in terms of matching, if they could. It contrasts with a second scenario, in which founders possess imperfect information about potential cofounders, and so face the possibility of having to form a team with a cofounder who would not be their ideal preferred choice. This scenario is consistent with Aldrich and Kim's (2007) argument that limited social networks make searching for an *ideal* cofounder costly; and search cannot be prolonged for very long before a match has to be made. For instance, many market opportunities have to be seized rapidly to prevent their value from being competed away by competitors. Notice that this second scenario does *not* necessarily imply homophily. Indeed, unless social networks are completely homogeneous—in which case, by definition, only homophilious teams could ever arise—this scenario can be associated with *heterophily*. This will turn out to be a key distinction in the ensuing discussion.

In both of these two scenarios, the model allows founders who become disappointed with their team's performance to dismantle it and start a new one. It is interesting to observe that in practice, though, most new venture teams are characterized by relatively stable homophilious structures (Ruef *et al*., 2003; Kim and Aldrich, 2004; Beckman and Burton, 2008). For example, Kim and Aldrich (2004) reported that only one-eighth of new ventures identified in the first wave of the PSED underwent any change in team composition over the four annual waves of that panel. Hence, team stability appears to be something of a *stylized fact* of which a plausible model needs to be able to take account. Social network theory can explain team stability by assuming that social networks are temporally stable, since this is the pool from which replacement cofounders would be drawn. It will be seen below how my model speaks to this stylized fact.

At this juncture, it is worth emphasizing that my model deliberately abstracts from issues of trust and social networks. Trust and networks can enhance venture team performance and learning processes by enabling entrepreneurs to exploit indirect ties to access resources, as well as social and emotional support (Aldrich and Kim, 2007). These issues are not ignored here because they are deemed to be unimportant. Rather, they are set to one side in order to illuminate most clearly the implications of cognitive biases for team composition and performance. The concluding section of this article will say more about how the model can be enriched and extended in future research.

Having described the ingredients of the model, it is now possible to trace out its implications for team composition, effort, the persistence of cognitive bias, and venture performance. I will commence by analyzing the first scenario described above, in which founders possess plentiful information about potential cofounders' beliefs. This enables founders' *preferences* for team composition to be derived. The implications of relaxing this informational

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assumption, giving rise to the second scenario, are considered at the end. As noted above, the second scenario has been associated with constrained choice in social network theory.

Initial choices of cofounder and effort: why homophily is chosen

I first show that a founder's effort depends monotonically on their beliefs, in the sense that there is a one-to-one mapping between them. I then analyze a founder's choice of cofounder in terms of the effort (and, hence, beliefs and cofounder type) they would find most desirable for a cofounder to provide. Given the one-to-one mapping between beliefs and effort, if the other's desired effort level is different, their beliefs will be, too. This identifies a *heterophilious* team. But if the desired effort of a cofounder is the same as the other founder, their beliefs will be, too. This identifies a *homophilious* team.

It is easy to show that effort depends on beliefs. To do so, rearrange *j*'s first-order condition (FOC) from the maximization of $E_j^1\Pi^1$, taking a cofounder *k*'s effort e_k^0 as given. The FOC is $\alpha n E_j^0(\theta)(e_j^0, e_k^0)^\alpha / e_j^0 = 1$, from which we obtain *j*'s optimal effort (given cofounder *k*) of $e_{jk}^{*0} = [\alpha n E_j^0(\theta)(e_k^0)^\alpha]^{1/(1-\alpha)}$. Effort is, therefore, monotonic increasing in $E_j^0(\theta)$, establishing the one-to-one mapping between them. Using (1), the more optimistic founder $j = a$ will choose to exert more effort than a pessimistic (or merely less optimistic) cofounder $k = b$. However, before this can be stated as a result, one must recognize that effort is conditional on team membership; and teams have not yet been chosen. So we must first determine which *k* a founder *j* chooses to match with, and vice versa.

This problem can be analyzed by considering what effort a founder *j* would like *k* to provide. Drop the time superscript temporarily for ease of notation and denote the desired effort by e_k. To this end, define λ as a parameter such that $e_k = \lambda e_j$. If $\lambda < 1$, then *j* wants a founder *k* who is less optimistic than *j* is, and so provides less effort. If $\lambda > 1$, then *j* wants a founder *k* who is more optimistic than *j* is, and so provides more effort. Both eventualities entail *j* forming a heterophilious team. Finally, if $\lambda = 1$, then *j* wants a founder *k* who is exactly as optimistic as *j* is, and so provides an identical level of effort. This case entails *j* forming a homophilious team. Our task below is to solve for *j*'s choice of λ.

Because the choice of λ fixes the cofounder's effort as explained above, *j* chooses λ as well as e_j to satisfy the following objective: $\max_{\lambda, e_j}\left[nE_j(\theta)\lambda^\alpha e_j^{2\alpha} - e_j(1+\lambda)\right]$. The FOCs for λ and e_j are respectively:

$$\alpha n E_j(\theta)\lambda^{\alpha-1} e_j^{2\alpha} - e_j = 0 \tag{2}$$

$$2\alpha n E_j(\theta)\lambda^\alpha e_j^{2\alpha-1} - (1+\lambda) = 0 \tag{3}$$

Solve (3) to obtain $e_j^* = \left[2\alpha n E_j(\theta)\lambda^\alpha\right]^{\frac{1}{1-2\alpha}} (1+\lambda)^{\frac{1}{2\alpha-1}}$. Substitute this into (2) to obtain

$$e_j^* = \alpha n E_j(\theta)\left[\frac{2\alpha n E_j(\theta)\lambda^\alpha}{1+\lambda}\right]^{-1}\lambda^{\alpha-1} = 1 \tag{4}$$

Simplifying (4) yields the solution $\lambda^* = 1$. This implies that founders form teams comprised of people with the same beliefs and effort levels as themselves. Because this is true for any and all *j,* we are able to state the first result of the article:

Result 1 (Homophily): Founders who can freely choose among potential cofounders form new venture teams with cofounders who possess identical beliefs.

Next, putting $\lambda = 1$ in (4) and using (1), we obtain

$$e_a^* = \left[\alpha n E_a(\theta)\right]^{\frac{1}{1-2\alpha}} > \left[\alpha n E_b(\theta)\right]^{\frac{1}{1-2\alpha}} = e_b^*$$

since *a* is more optimistic than *b*. (Note the need for $\alpha < ½$ here.) This yields the next result:

Result 2 (Effort and optimism): More optimistic entrepreneurs supply greater effort to their ventures than less optimistic entrepreneurs.

The remainder of this subsection explains and discusses the logic for these first two results.

Relatively optimistic entrepreneurs supply high levels of costly effort because they anticipate high demand and, hence, higher returns from their effort. They are, therefore, more willing to bear the costs of working harder and using more resources in order to satisfy anticipated demand (Result 2). This makes them unwilling to form teams with cofounders who are less optimistic than they are. Such cofounders, being less optimistic, will choose lower levels of effort. Optimistic founders do not want to form teams with less optimistic cofounders because they

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know they would have to compensate by exerting greater levels of effort than they desire. Founders also reject cofounders who are more optimistic than themselves. In their opinion, a cofounder of this kind would overinvest in effort, increasing venture costs above levels the founder thinks are appropriate. Therefore, everyone wants to form a team with someone holding identical beliefs as themselves. This is the basis of the homophily result (Result 1).

It is notable that homophily does not arise because founders belong to closed social networks containing only people like themselves. In that case, homophily arises because founders *have to* match with people like themselves; and it perpetuates itself by ensuring that connections remain deeply bounded within existing social clusters. In contrast, Result 1 shows that even if people inhabit large open social networks (akin to what Aldrich and Kim, 2007, call *random networks*), homophily can still occur if founders *want to* match with people like themselves. Although this argument neglects issues of different competencies and experiences (*status heterophily*) that disparate team members can bring to new ventures, to the extent that entrepreneurs seek to match on the basis of beliefs and outlooks, value homophily remains a relevant new firm organizing principle.

The reason homophily arises in the model is linked to the concept of *assortative matching*. A well-known example of assortative matching is *homogamy*, whereby people with similar characteristics and preferences have a pronounced tendency to marry each other (Kalmijn, 1994). Another example, which seems somewhat closer to our case, is assortative matching of workers of given skills in some production processes (Kremer, 1993). In this case, workers paired with others like themselves are less likely to make mistakes that reduce their productivity and, hence, the payoffs received by each member of the group. The common feature which drives preferences for assortative matching is complementarity of inputs yielding a desired output. In my model, high levels of effort from one founder increase the marginal productivity of the other founder. A similar logic applies in the worker skill case. In the case of marriage, higher levels of a desirable attribute (education or wealth) by one person are taken to increase the utility of the spouse. Selection (by competition) of scarce universally agreed desirable types then ensures that *likes* end up marrying *likes*.

Bayesian updating and self-serving bias: explaining the persistence and emergence of optimism

Recall that x^t is the random number of successful sales at t out of n trials. So, again dropping the t superscript temporarily for notational ease, the probability a given x is observed given (θ, n) is

$$p\left(x\middle|\theta\right)=\binom{n}{x}\theta^{x}\left(1-\theta\right)^{n-x},\quad x=0,1,\ldots,n$$

A property of this (binomial) distribution is that $E(x) = \theta n$.

It is convenient (but not necessary) to assume that entrepreneurs hold the following specific priors:

$$p_j\left(\theta\right)=\frac{\Gamma\left(\gamma_j+\beta_j\right)}{\Gamma\left(\gamma_j\right)\Gamma\left(\beta_j\right)}\theta^{\gamma_j-1}\left(1-\theta\right)^{\beta_j-1}\quad 0\le\theta\le 1, \quad (5)$$

where $\Gamma(y) = (y - 1)!$ is the gamma function and (γ_j, β_j) are parameters regulating the nature of j's beliefs. The prior (5) is that of the beta distribution, a very flexible statistical distribution. It is convenient because it is a *conjugate prior* (Lee, 1995), making the exposition below simpler. To see how its parameters relate to optimism, note that the expected value of this distribution is $E_j(\theta) = \gamma_j/(\gamma_j + \beta_j)$. Hence, higher values of γ_j and/or lower values of β_j translate into greater optimism about the true value of θ.

Entrepreneurs without self-serving bias perform Bayesian learning. Upon receiving data x^t, founders update their priors using Bayes' Theorem to obtain posterior beliefs:

$$p_j^{\,t+1}\left(\theta\middle|x^t\right)\propto p_j^{\,t}\left(\theta\right)p\left(x^t\middle|\theta\right)\propto\theta^{\gamma_j+x^t-1}\left(1-\theta\right)^{\beta_j+n-x^t-1}.$$

The expected value of the posterior at time t is $E_j^{\,t}\left(\theta\right)=\dfrac{\gamma_j+\sum_{\tau=1}^{t}x^{\tau}}{\gamma_j+\beta_j+tn}$. It is easy to show that $\lim_{t\to\infty}E_j^t(\theta) = \theta$. That is, entrepreneurs devoid of self-serving bias eventually lose their optimism as they learn the true value of θ.

Founders prone to self-serving bias behave very differently. The decision rule governing the learning of these agents yields the following posteriors at $t = 1$:

$$p_j^1\left(\theta\middle|x^1\right)\begin{cases}=p_j^0\left(\theta\right) & \text{if } x^1<nE_j^0\left(\theta\right)\\ \propto p_j^0\left(\theta\right)\theta^{x^1}\left(1-\theta\right)^{n-x^1} & \text{if } x^1\ge nE_j^0\left(\theta\right)\end{cases}$$

DOI: 10.1002/sej

Hence,

$$E_j^1(\theta) = \begin{cases} E_j^0(\theta) & \text{if } x^1 < nE_j^0(\theta) \\ \dfrac{\gamma_j + x^1}{\gamma_j + \beta_j + n} > E_j^0(\theta) & \text{if } x^1 \geq nE_j^0(\theta) \end{cases} \quad (6)$$

It follows directly from (6) that $E_j^1(\theta)$ does not change if the venture receives a *bad* draw x^1 (i.e., below the prior expectation). Conversely $E_j^1(\theta)$ increases if the venture receives a 'good' draw x^1 (i.e., above the prior expectation). It follows that $\lim_{t\to\infty} E_j^t(\theta) = 1 \geq E_j^0(\theta)$. Hence, optimism remains intact or increases when founders suffer from self-serving bias. This is true for both initially optimistic and pessimistic founders. This proves the next result:

> *Result 3 (Persistence and emergence of optimism): Optimists who are prone to self-serving bias can remain overoptimistic indefinitely, while initially pessimistic founders who are prone to self-serving bias can become (and then remain) overoptimistic.*

Result 3 follows directly from the MBL framework. Founders who exhibit self-serving bias can no longer be relied upon to learn the true state of the environment they operate in. Indeed, these founders may *never* come to learn it. They do not sample randomly from the information that arrives, but instead adopt a selective and self-serving strategy towards it. Occurrences of high levels of market demand are regarded as justifying optimistic priors, whereas low levels of demand are written off as just *bad luck*. As a result, optimistic biases of such founders either remain entrenched or become ever more pronounced over time, as they continue to discard adverse information that would change the mind of an otherwise identical founder who does not fall prey to self-serving bias. Interestingly, self-serving bias can also turn pessimists into optimists, as these founders also overweight positive market signals and wrongly revise their beliefs about market demand upwards, beyond objective (realistic) levels.

Result 3 is similar to, but distinct from, Ryall's (2003) notion of *self-confirming equilibrium* (SCE). Ryall assumes managers take actions that generate selective data consistent with their priors and, thus, are uninformative. As a result, managers never obtain data that disconfirms their beliefs, so they do not change them, but continue to take the same actions and remain permanently locked into the same level of ignorance. In contrast, the MBL model treats a different setting where self-serving bias explains *why* only selective (i.e., positive) data are given any credence. The selection entails entrepreneurs filtering the data to be most consistent with their notions of good performance.

The prediction that founders can hold expectations that become ever more positive is consistent with independent evidence that entrepreneurs are prone to *escalation of commitment*. According to this view, entrepreneurs who follow an unsuccessful venture development path often do not pull back their effort—which would appear to be the sensible strategy—but instead pour ever more time and resources into the path they are taking (McCarthy, Schoorman, and Cooper, 1993). By combining Results 2 and 3, it follows directly that the MBL model predicts self-serving overoptimistic entrepreneurs will commit even more effort to their venture, although they were already overinvesting in their venture. This reduces venture profits, and thereby places these ventures in jeopardy. This closely resembles an escalation of commitment, implying that the MBL model is consistent with another well-known feature of observed entrepreneurial behavior.

There is an additional implication of Result 3. If, far from learning that they are overinvesting in their ventures, founders hold beliefs which become ever more entrenched, they will never see the need to question the composition of their teams. Objectively speaking, founders of homophilious teams could do better by dissolving their team and finding an alternative (heterophilious) partner. But the model predicts they will choose not to do so because their subjective posterior beliefs (misleadingly) confirm their initial team composition choices. Hence, the MBL model can also explain the *stylized fact* of structural stability of new venture teams—noted by Kim and Aldrich (2004) and Beckman and Burton (2008)—including those which ultimately fail owing to sustained underperformance. Yet, the founders of such ventures would never accept that their own investments of effort and cofounder choices were to blame. A potential, alarming implication is that if they try again as a *serial* entrepreneur, they are not more likely to do any better next time around. The available evidence is consistent with the prediction that serial entrepreneurs resemble novice entrepreneurs in many important respects, including venture performance (Westhead and Wright, 1999).

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Venture performance: the superiority of heterophily

Under homophily for all teams j, actual venture profits are given by $\Pi^1_j = x^1(e_j{}^{*0})^{2\alpha} - 2e_j{}^{*0}$ and $\Pi^2_j = x^2(e_j{}^{*1})^{2\alpha} - 2\,e_j{}^{*1}$, where $e_j^{*0} = \left[\alpha n E_j{}^0(\theta)\right]^{\frac{1}{1-2\alpha}}$ (see above) and $e_j^{*1} = \left[\alpha n E_j{}^1(\theta)\right]^{\frac{1}{1-2\alpha}}$. Using the result in the previous subsection that $E_j^1(\theta) \geq E_j^0(\theta)$, we know that self-serving optimists a choose $e_j{}^{*1} = e_j{}^{*0}$ if their posteriors do not change (bad draw) and choose $e_j{}^{*1} > e_j{}^{*0}$ if their posteriors do change (good draw).

Below we are interested in *objective* (rather than subjective) performance, measured in terms of profits and survival. The question we ask is: would founders benefit from imperfect information about matching that prevented them from identifying identical cofounders? In such a case, team formation would be (at least partly) random. Effectively, some entrepreneurs would have to form heterophilious teams.

To analyze this question, consider the atemporal problem of choosing a team that maximizes *objective* profits, i.e., on the basis of the *true* θ. Set aside chronology for now and define μ as a parameter such that $e_k = \mu\, e_j$. The choice of μ is determined below as the cofounder type k who maximizes profits of the venture that j cofounds. The interpretation is that if $\mu < 1$, j does best with a cofounder k who is less optimistic than j is, and so provides less effort. If $\mu > 1$, then j does best with a cofounder k who is more optimistic than j is, and so provides more effort. Both eventualities entail j forming a heterophilious team. And if $\mu = 1$, then j does best with a founder k who is exactly as optimistic as j is, and so provides an identical level of effort. This case entails j forming a homophilious team. To maximize objective profits, one solves the problem $\max_\mu\{n\theta\mu^\alpha e_j^{2\alpha} - e_j(1+\mu)\}$ taking e_j as given, noting that given objectively optimal team composition j solves the problem $\max_{ej}(nE_j(\theta)\mu^\alpha e_j^{2\alpha} - e_j(1+\mu))$ taking μ as given. The FOCs for these problems are respectively

$$\alpha n\theta e_j{}^{2\alpha}\mu^{\alpha-1} = e_j$$
$$2\alpha n E_j(\theta) e_j{}^{2\alpha-1}\mu^\alpha = 1+\mu$$

We obtain from the second of these equations that $e^*_j = [2\alpha n E_j(\theta)\mu^\alpha]^{1/(1-2\alpha)}(1+\mu)^{1/(2\alpha-1)}$. Substitute this into the first of these equations and simplify to obtain

$$\frac{1+\mu}{\mu} = 2\left[\frac{E_j(\theta)}{\theta}\right] \tag{7}$$

Now the ratio on the RHS of (7) is greater than unity if j is an optimist, less than unity if j is a pessimist, and equal to unity if j is a realist. This implies μ^* is less than, greater than, and equal to 1, respectively. What that means is that objective profits are maximized when optimists form heterophilious teams with pessimists. They earn lower profits from forming homophilious teams. Heterophily is advantageous because pessimists underprovide effort, which compensates for the excessive effort of optimists, and vice versa. So heterophily is associated with greater profits $\Pi^1 + \Pi^2$, and, hence, superior survival prospects after 2 (given threshold T). Only realists do best under homophily. That is, defining $\Pi_{ab}{}^t = x^t(e_a{}^{*t}\, e_b{}^{*t})^\alpha - (e_a{}^{*t} + e_b{}^{*t})$, we have that $\mu^* < 1 \Rightarrow \Pi_{ab}{}^t > \Pi_{aa}{}^t$. Likewise with b pessimistic, $\mu^* > 1 \Rightarrow \Pi_{ba}{}^t > \Pi_{bb}{}^t$, while $\mu^* = 1 \Rightarrow \Pi_{bb}{}^t > \Pi_{ba}{}^t$. This proves the final result:

> *Result 4 (Superior objective performance of heterophilious ventures): Heterophilious ventures comprised of both optimists and pessimists enjoy a performance advantage compared with homophilious ventures comprised only of optimists or only of pessimists.*

Homophily is associated with poor performance in Result 4 because it amplifies suboptimal effort investment choices made by its members. Overoptimists overestimate the returns from their effort, and so devote *excessive* amounts of effort to their ventures. This form of over-investment is amplified in teams formed with other over-optimists, since they also overinvest. Overinvestment inflates a venture's cost base, reduces its profitability and, thereby, endangers its viability. Conversely, when pessimists are matched with other pessimists, they underinvest in effort, depressing output, reducing profitability, and, likewise, endangering the viability of their ventures.

Thus, in a scenario where founders can freely choose to match with cofounders, the model predicts that although they can do better objectively by forming heterophilious teams, they will choose, instead, to form homophilious teams. Paradoxically, this explains why a second scenario—one in which entrepreneurs possess imperfect information about (and access to) cofounders—could actually benefit

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them. Small and dense social networks might actually be advantageous for entrepreneurs by preventing founders from accessing cofounders with identical views as could be achieved in larger, more open networks. Provided there is at least some diversity of views within social networks, greater, rather than lesser, degrees of heterophily might be forthcoming in small and closed, rather than large and open, networks. This is because *choices* of homophilious cofounders are more limited in small and closed, compared with large and open, networks.

To see the logic for why nonassortative matching can enhance venture performance, suppose founders are paired with cofounders who possess the opposite bias to themselves. Thus, a moderately optimistic founder is paired with a moderately optimistic cofounder, while a highly optimistic founder is paired with a highly pessimistic cofounder. In these pairings, the combined effort input is just right, avoiding overinvestment (among paired optimists), as well as underinvestment (among paired pessimists).

When founders are matched with cofounders holding beliefs that are different, but less diverse, than this, the benefits can be more subtle. To see how, consider, for example, the matching of a highly optimistic founder with a moderately optimistic cofounder. This match displays some heterophily, and the more optimistic founder benefits from lower costs and higher profits. But the less optimistic cofounder loses from this partnership compared with a homophilious partnership with someone like themselves—and even more compared with a heterophilious partnership with someone even less optimistic than themselves. This might provide another reason why homophily is so common in practice. If less optimistic cofounders benefit by rejecting team starts with more optimistic founders, they will, instead, wait and search for a more suitable (homophilious or even less optimistic) partner. Of course, if all founders can search and delay venture formation until they locate a preferred cofounder—possibly identified from a different social network—the information about the set of possible cofounders gradually becomes more complete, and we revert to the case of free choice and perfect homophily characterized by Result 1.

DISCUSSION

This article has argued that even when founders of new ventures possess complete freedom to form teams with any cofounders of their choosing, they cannot be relied upon to choose the most suitable cofounders. The environments in which venture teams are founded often lack abundant information about the viability of new ventures formed to exploit new opportunities. This can be conducive for the emergence of cognitive biases that induce entrepreneurs to make suboptimal team composition choices. In contrast to social network theory, which contends that limited access to potential cofounders can promote homophily, the present article argues that limited access of this kind might actually serve as a valuable check on cognitively biased entrepreneurs' freedom to found unsuitable teams, i.e., with people whose beliefs are identical to their own. In this sense, dense and limited social networks could be relatively benign settings for team formation compared to large, open social networks—provided that dense networks are not completely homophilious.

In the model presented in this article, homophily is directly related to venture underperformance. This problem is exacerbated because self-serving attribution bias distorts learning and ensures that biased expectations (optimism or pessimism) leading to suboptimal team composition choices are perpetuated in the future. Unlike social network theory, this result does not depend on founders' social networks being temporally stable. Self-serving attribution bias is a necessary ingredient of this model because without it, Bayesian learning would ensure that both overoptimism and homophily would evaporate as time went on.

An important practical question is whether external advisors can help entrepreneurs avoid homophily. Social network theorists tend to be quite optimistic on this front, recommending that nascent entrepreneurs develop more diverse social networks by utilizing technological assistance (e.g., Internet matching tools) or by actively participating in voluntary business associations (Davis, Renzulli, and Aldrich, 2006; Aldrich and Kim, 2007; Parker, 2008). But if homophily is based on preferences rather than constraints (i.e., *wanting* to rather than *having* to form homophilious teams), these activities could be not just ineffective, but potentially counterproductive. For if broadening a founder's social network makes it easier for him/her to access someone like him/herself, these activities could increase, rather than decrease, the risk of homophilious team formations—with all the negative implications for objective venture performance which that entails.

DOI: 10.1002/sej

Instead, our model implies that in cases where team composition is driven by value homophily, clear-sighted external advisors should *actively* encourage biased founders to form teams with people holding beliefs and outlooks that are contrary to their own. The difficulty of persuading entrepreneurs to listen to and act upon such advice should not be underestimated, although venture capitalists or other types of *hands on* investors might be able to stipulate heterophilious team composition as a precondition of venture finance. As noted in the previous section, the greatest beneficiaries from such matches are founders prone to the most severe optimistic and self-serving attribution biases.

The present study suffers from several limitations. One limitation is the rather narrow perspective suggesting that cognitive biases invariably cause unfavorable outcomes. This might be unwarranted. For instance, greater effort from overoptimists might offset the underprovision of effort owing to moral hazard considerations (Manove, 2000), making finance more, rather than less, accessible for optimistic (than for realistic) entrepreneurs. And overoptimistic entrepreneurs may be less likely to imitate their peers and more likely to explore their environment, thereby revealing new innovations which *realists* would never look for (Bernardo and Welch, 2001). Furthermore, it is becoming increasingly well understood that deviations from rationality are an integral aspect of acts of entrepreneurial creation (Alvarez and Barney, 2007). More generally, cognitive biases associated with creativity might be necessary for new venture ideas to emerge in the first place, even though they sometimes lead to ultimately unfavorable outcomes. An ongoing challenge for entrepreneurship scholars is to understand why and when some forms of rationality are more productive than others. Miller (2007) provides a timely discussion of this issue, arguing that entrepreneurs are not bound to one type of rationality and might be able to switch between different types depending on the context.

Another limitation of the present article is its focus on value homophily. Status homophily might generate different insights. An open question is whether value and status homophily are positively or negatively related. If, as we suspect, they are positively related, introducing status homophily into a richer model might generate additional results, but is unlikely to overturn the main insights from this article. If, on the other hand, value and status homophily are negatively related, they might offset each other with intriguing, but as yet unexplored, implications for new venture performance.

Future theoretical work might also explore the possibility that *heterophily* can entail performance limitations as well. For instance, founders holding beliefs which are so different that they are irreconcilable might simply be unable to work together at all, threatening the very viability of the venture (Baron, 1998). In cases like these, homophily—with all its limitations—might be preferred to extremely heterophilious teams. From an empirical standpoint, this point might help explain why homophilious teams are so frequently observed in practice: i.e., homophilious teams might simply be the artifact of a type of *survivorship bias*.

Another issue not explored in this article was the possibility that founders are unsure about potential cofounders' beliefs and have to learn about them at the same time as they learn about demand conditions. My assumption of perfect observability of founders' beliefs by others certainly simplified the modeling of team stability. Relaxing this assumption would no doubt complicate the modeling framework, but could generate some interesting analytics relating to strategic interactions between founders.

Finally, future research might also examine some of the testable predictions of the model. Most pressingly, the available evidence relates to status homophily, rather than value homophily on which the present article is based. Empirical research about the prevalence and relative importance of value homophily is urgently needed. There is at least some evidence, though, that overoptimistic entrepreneurs work longer hours and retire later than their less optimistic counterparts (Landier and Thesmar, 2008)—a finding which accords with Result 2 above. And there is evidence that VCs do play an important role in shaping top management teams and creating *balanced* teams (Hannan *et al*., 1996; Bruton *et al*., 1997). Both of these pieces of evidence are consistent with predictions and implications of the model. However, it is less clear whether VCs promote heterophily in venture teams based on the beliefs of founders or on their relative competencies. There are reasons to think that balanced beliefs may be more important than balanced competencies, because whereas VCs can bring the specialized competencies themselves, the influence of their beliefs on entrepreneurs could be mitigated by the latter's lack of trust about VC motives. But the analysis of this and related issues are tasks which must be left for another day.

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