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STRATEGIC NETWORKS AND ENTREPRENEURIAL VENTURES

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Much research suggests that social networks shape the emergence and development of nascent ventures. Scholars have argued that founders' and firms' networks influence innovation and the identification of entrepreneurial opportunities, as well as facilitate the mobilization of resources for growth and the harvesting of value from fledgling firms. It is not an exaggeration to claim that existing empirical findings point to the centrality of networks in every aspect of the entrepreneurial process. However, with exceptions so few they may be counted on one hand, this research untenably treats network structures as exogenous—in other words, as if entrepreneurs and enterprises do not pursue valuable connections. In this article, we review the literature on networks in entrepreneurial contexts, argue that it disproportionately focuses on the consequences of networks at the expense of research on their origins, and consider the implications for the literature of the fact that most entrepreneurs and young ventures are strategic in their formation of relations. We then articulate a research agenda composed of five areas of inquiry we consider critical to a better understanding of networks and entrepreneurship. Copyright © 2008 Strategic Management Society.

INTRODUCTION

'Strategic entrepreneurship is entrepreneurial action with a strategic orientation' (Hitt *et al*., 2001: 480). In this article, we consider the implications of this statement for a topic of large and growing interest to entrepreneurship scholars: the role of social networks in shaping the entrepreneurial process and outcomes. To foreshadow our conclusion, we argue that if we seriously believe actors—regardless of whether we mean individual entrepreneurs, founding teams, or entrepreneurial ventures—behave strategically when forming their social networks, we must revisit much of what we think we know about how networks affect the entrepreneurial process. Moreover, researchers will need to confront a set of challenging questions that have, thus far, garnered little attention in the entrepreneurship, strategy, and sociology literatures on social networks and their effects.

Assuming that entrepreneurial actors form their networks strategically, we articulate five issues central to a research agenda aimed at enriching our understanding of strategic networks. First, if actors are both strategic and differentially able to construct ties, then positions in social networks almost certainly arise in part as a function of the outcome variables of interest in the entrepreneurship and strategy literatures. Extant research has almost entirely ignored this rampant endogeneity problem and, as a result, bias likely contaminates many (if not most) of the

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existing estimates of network effects. Second, we continue to know little about the emergence or evolution of networks. In the entrepreneurial domain, with its inherent focus on the establishment of new enterprises, it is particularly important to address questions such as: how do fledgling firms gain initial entry to established networks, and how do entrepreneurs themselves build effective networks? Third, if actors construct networks strategically, they must negotiate an ever-shifting social topology, as actors simultaneously search for advantageous connections and possibly endeavor to thwart the competing attempts of rivals. This dynamic tango potentially adds enormous complexity to the actor-level tie formation process, which is unconsidered in all but a few studies. Fourth, we must develop a much clearer theory of who a strategic actor is. For instance, when does a founder or founding team become a firm, and consequently, when is the individual, founding team or organization the appropriate unit of analysis? Finally, if networks do confer competitive advantage in entrepreneurial settings, do all actors enjoy equal access in the competition for relationship-based resources, or do ascriptive characteristics affect an actor's ability to acquire a network-based advantage?

The next two sections detail our argument. We begin by briefly reviewing five social mechanisms—information access, brokerage, status, embeddedness, and sanctions—that are thought to fundamentally shape the entrepreneurial processes of opportunity identification and resource mobilization.[1] We highlight research questions related to each of these mechanisms that we believe merit scholarly attention. Following this abbreviated review of the existing literature, we then outline the five areas of research we consider to be critical to a research program aimed at forwarding our understanding of strategic networks in entrepreneurial contexts.

SOCIAL MECHANISMS AND THE ENTREPRENEURIAL PROCESS

Research in social networks has been exploding. Once only a subject of study in the purview of sociologists and a few mathematicians, the subject has recently attracted economists, organization theorists, political scientists, and even biologists and physicists, all arguing that connections matter in understanding a wide range of physical and social phenomena. With respect to the entrepreneurship literature, however, five mechanisms developed in now-classic sociological studies provide the dominant explanations for why networks influence social and economic outcomes of interest. These mechanisms are: information access, brokerage, status, embeddedness, and sanctions.[2]

In reviewing the extant literature, we find it convenient to divide the entrepreneurial process into two stages. In the first stage, entrepreneurs identify opportunities for profit, while in the second stage, they assemble resources to build firms that develop and deliver products and services. Although one could reasonably view these activities as sequential, accounts of the origins of firms suggest that sometimes an entrepreneur's efforts to create a firm precede any specific idea of what that firm will do (e.g., Hewlett-Packard; Packard, 1995; cf. Katz and Gartner, 1988). We believe all five social mechanisms come into play at both stages of the entrepreneurial process. However, because we feel that doing so best accentuates the unique contributions of network-based research to the entrepreneurship literature, we emphasize information access and brokerage as figuring most prominently in the opportunity recognition stage; social status as bridging the two stages, and embeddedness and sanctions as being more relevant to the resource mobilization phase.

Information access, brokerage, and opportunity identification

The Austrian School's influential conception of entrepreneurial opportunity, in which opportunities arise from the uneven distribution of information in

[1] Because the 'networks and entrepreneurship' literature has been reviewed recently, we offer only an abbreviated review. See Hoang and Antoncic (2003) and Street and Cameron (2007) for more extensive treatments.

[2] Though we consider these five mechanisms most prevalent in the literature, our list is not exhaustive. For example, Brüderl and Preisendörfer (1998) and others have argued that social relations represent critical sources of support in the emotionally taxing entrepreneurial process, and Saxenian (1994) has asserted that culture, which presumably relies on social networks for transmission, regulates regional differences in rates of entrepreneurship.

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society, shares an obvious commonality with one of the most basic tenets of social network analysis: the pathways that weave together a social network provide the pipes through which private information flows. To the extent that individuals occupy heterogeneous network positions, they vary in their access to the bits of information moving through the network (c.f. Marsden, 1983). And to the degree that the recognition of opportunities hinges on access to this private information, person-to-person differences in positions can thus influence who recognizes attractive opportunities for new ventures and who does not (e.g., Aldrich and Zimmer, 1986).

The general argument, then, is that opportunity recognition involves access to private information, and that social networks, as the conduits of information flow, have a large influence on who knows what—and when they know it. Despite the potential for exploring how network structures affect opportunity recognition, to our knowledge, little has been done beyond importing to entrepreneurial settings the now well-trodden debate between brokerage (Granovetter, 1973; Burt, 1992) and cohesion (Coleman, 1988) as alternative mechanisms more or less conducive to the outcome under study. There are probably hundreds of studies that pit cohesion against brokerage in a horse race for explanatory power, with a bewildering array of contingencies to contextualize the potential benefits of one versus the other. However, given the influence of Schumpeter's (1934) conception of innovation as the novel recombination of inputs and the Austrian view that opportunity recognition hinges on access to scarce information, it is of little surprise that entrepreneurship scholars have gravitated to the idea that individuals with diverse networks do better.

Before reviewing individual articles, we should note that most studies of egocentric network structure and entrepreneurial activity examine aggregate data in which the researcher cannot distinguish the network's effect on opportunity identification from its influence on resource mobilization. With this shortcoming in mind, the most prevalent argument in network-based entrepreneurship studies simply parrots the broader literature on the value of weak or bridging ties: nascent entrepreneurs with structurally diverse networks more commonly encounter promising opportunities, and hence, more frequently engage in entrepreneurship. Studying female graduates from a prestigious MBA program, for example, Burt and Raider (2002) found higher rates of transitioning to self-employment among those with diverse networks. Renzulli, Aldrich, and Moody (2000) similarly demonstrated that would-be entrepreneurs with networks that spanned 'multiple domains of social life' founded new firms with greater frequency. Among academic scientists, Stuart and Ding (2006) discovered that those with broad collaboration networks more frequently started new companies and joined early-stage ventures as scientific advisors. And in a detailed case study that *could* disentangle opportunity recognition from resource mobilization, Elfring and Hulsink (2003) found evidence that weak ties facilitated opportunity identification. Needless to say, more work isolating particular network structures' roles in opportunity identification would be a worthwhile addition to the literature.

We consider the *evidence* to date to fall short of establishing as a stylized fact the idea that diverse networks (those rich in structural holes) enhance opportunity recognition. That said, given the strength of the theoretical rationale for this relationship and the frequency with which the literature invokes it, this claim appears relatively uncontroversial among entrepreneurship scholars.

Before concluding this section, let us note that the information-transmission properties of a network also affect the process of acquiring the resources necessary to build a firm. We could frame this argument in terms of almost any of the resources required in creating new firms, including financial and human capital, business partners, new customers, and so forth. For sake of illustration, we limit our description to the case of financial capital. Much as entrepreneurs recognize opportunities by aggregating information available in their networks, investors identify promising investment candidates in part by searching their networks (Sorenson and Stuart, 2001). As a result, more-connected founders with broader-reaching networks not only identify entrepreneurial opportunities more readily, but are also more likely to attract the attention of capital holders searching for investments. Thus, assuming only that resource holders use their contact networks to help inform the deployment of their capital, a nascent entrepreneur's position in the information network also becomes a basis for differentiation in the resource acquisition process.

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Social status, opportunity identification, and resource mobilization

Podolny (1993) developed the idea that evaluators treat an actor's social status as a signal of its quality.[3] This idea has been influential in the entrepreneurship literature because a great deal of uncertainty surrounds a new organization's prospects (Stinchcombe, 1965; Aldrich and Auster, 1986) and, faced with this uncertainty, resource providers find it difficult to assess the quality of these ventures, particularly during their earliest life stages (Stuart, Hoang, and Hybels, 1999). As a result, one might expect firms with high-status founders, employees, or affiliates to enjoy an advantage in the competition for resources, and, therefore, that these high-status actors' entrepreneurial endeavors would attract more financing, higher quality human resources, better-known lead customers, and so forth.

We can classify the empirical literature on this mechanism in terms of level of analysis—some consider the prominence of the individuals associated with firms, while the majority explores status dynamics at the firm level. At the *individual* level, Burton *et al*. (2002) found that new firms started by founders from entrepreneurially prominent prior employers attract more external financing for their ventures, and Higgins and Gulati (2003) showed that private firms with high-status executives attracted more prestigious investment banks to underwrite their IPOs. Meanwhile, Stuart and Ding (2006) found that prestigious academic scientists more frequently started or joined the scientific advisory boards of upstart biomedical companies.

Given the difficulty of finding information on founders in large samples, a much larger literature examines the role of *firm*-level affiliations in enhancing the legitimacy of young companies. For instance, Baum and Oliver (1992) demonstrated that organization-to-institution ties signal conformance to institutional prescriptions, and thereby aid young firms in their attempts to acquire legitimacy and other resources (see also Aldrich and Auster, 1986; Rao, 1994). In an examination of the rates at which private biotechnology companies experience IPOs, Stuart *et al*. (1999) found that young firms in particular benefited from connections to high-status alliance partners. And in an interesting paper that exploits the logic of these earlier papers but flips the empirical analysis on its head, Hsu (2004) demonstrated that high-status venture capital firms realize returns on their reputations by investing in startups on more favorable terms than do less prominent investors. This finding nicely reflects the 'oft repeated industry adage that: it isn't getting the money, it's who the money comes from' (Sorenson and Stuart, 2001: 1554). Recognizing the advantages they bring to portfolio companies, prominent venture capital firms appear to exchange their status-conferring affiliations for better investment terms.

Up to now, however, little research has considered how social status affects opportunity recognition, which strikes us as a missed opportunity. In particular, models of social influence developed in sociology consider the process by which the (weighted) opinions of socially relevant alters mold an individual's attitudes (e.g., Coleman, 1964, Chapter 11; Marsden and Laumann, 1984; Friedkin, 1998). The positional characteristic most commonly associated with the strength of influence of an alter's views on the attitudes of a focal actor is the alter's prestige. For example, Cole (1970) found that scientific ideas diffused most rapidly when published by high-status scientists. Similarly, Stuart and Ding (2006) demonstrated that academic scientists become entrepreneurs at a higher rate when socially proximate to high-prestige colleagues who themselves had been entrepreneurs (see also Calabrese, Baum, and Silverman, 2000). Thus, despite the sparse empirical evidence, both casual observation and sociological theory suggest that would-be entrepreneurs pay particular attention to the actions and attitudes of high-status actors. One could therefore imagine that nascent entrepreneurs' perceptions of opportunity shift with the statements and actions of prominent members of the community. In Silicon Valley, for instance, the frequency with which new ventures of a given type are formed and the flow of investment dollars across areas of technology may respond to the investment decisions of prominent venture capitalists, such as John Doerr of Kleiner Perkins. In this regard, high-status actors may serve as (metaphoric) directors of the opportunity recognition process.

Embeddedness, sanctions, and resource mobilization

The work on the embeddedness of economic transactions offers a fourth perspective on why

[3] The concept of social status did not originate in the research on social networks, but following Podolny's (1993) use of Bonacich's (1987) two-parameter centrality measure (computed from an affiliation matrix, preferably of deference relations) to proxy for actors' statuses, research on status has *de facto* become associated with social network analysis.

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networks affect entrepreneurial dynamics. The general argument here is that personal relationships inevitably develop alongside economic exchanges, and that these relationships promote trust between, and feelings of obligation toward, trading partners. As a consequence, transgressing the terms of an embedded economic exchange can become tantamount to cheating a friend (Granovetter, 1985), with the implication that narrow conceptions of self-interest cannot explain conduct in these contexts. In elaborating on this idea, Uzzi (1996) argued that embedded ties facilitate information exchange and joint problem solving, and foment trust that substitutes for rigid contracts and active monitoring, and, therefore, that embedded exchange engenders economic efficiency (though for evidence to the contrary, see Sorenson and Waguespack, 2006). This possibility, of course, has implications for the patterns of exchange that occur in market contexts: if embedded exchange benefits both parties, then actors should favor transactions with those with whom they have entrenched relationships, with implications for the development and evolution of economic networks (see The origins of networks section).

A relatively large literature applies this idea in entrepreneurial settings. As an illustration, consider the fundraising process for new ventures. Investors worry that entrepreneurs may provide unreliable—or even knowingly misleading—information in an attempt to secure funds (Amit, Glosten, and Muller, 1990). However, when investors and entrepreneurs share overlapping social networks, the investor can, through mutual acquaintances or direct observation of prior conduct, acquire otherwise difficult-to-discover information about an entrepreneur, including assessments of the entrepreneur's reliability, integrity and business acumen.[4] Also, when an investor's *trusted* contacts offer assessments of an entrepreneur, these evaluations often escape the taint of bias that discredits information provided directly by the entrepreneur. And, if the investor has had previous dealings with the founder, he or she may have non-economic reasons for trusting the veracity of the information provided by the entrepreneur. In this way, the professional relationships that have developed during previous employment spells, as well as family, neighborhood, school and other community ties, form the foundation upon which entrepreneurs recruit resources.

In the venture capital industry at least, one sees strong evidence of these effects. Venture capitalists appear to prefer to invest in fledgling firms they learn of through referrals by close contacts, including entrepreneurs they have previously sponsored, fellow venture capitalists, family members, and other professional contacts (Fried and Hisrich, 1994; Shane and Stuart, 2002). These close contacts have incentives to provide accurate and complete information about entrepreneurs, as well as to bring high quality ventures to the attention of the venture capitalist, because they enjoy an ongoing exchange relation with the venture capitalist from which they presumably derive some benefit. The conveyance of inaccurate information or referrals to unreliable individuals ultimately undermines the credibility of the referrer, and thus jeopardizes the continuance of the relationship (Coleman, 1990).

As many have observed, the embeddedness argument has implications not just for who transacts with whom; the existence of a social structure that runs parallel to business exchanges also influences the management of transactions. A very large literature, with myriad foundations in sociology, including the writings of Macauley (1963), Blau (1964), Granovetter (1985) and Powell (1990), argues that social control commonly contributes to the governance of embedded business partnerships. As in Larson's (1992) account of the formation of partnerships in entrepreneurial ventures, the robust finding is that transactions between firms with social connections have greater flexibility and informality, relying on social control rather than detailed contracts to manage the terms of trade.

A small literature at the intersection of sociology and economics also extends this perspective to the network's influence on forward-looking actors. This research assumes actors have reputations that, if positive, create value. If actors prefer to transact within embedded relationships, this alone creates

[4] The information diffusion and embeddedness mechanisms cover common ground, but the latter is more general. The embeddedness argument considers the multifaceted implications of overlapping social and business relationships for market-related outcomes, and therefore, also encompasses information-transmission based accounts. In particular, the embeddedness perspective highlights differences in the reliability of market-related information exchanged across the network as one consequence of either a history of prior exchange between two parties, or the sharing of a mutual contact, kinship relation, or some other form of pre-established social connection.

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an incentive for actors to preserve and extend their reputations. Independent of trust or feelings of obligation that arise in embedded exchange, the potential reputation costs apply a separate brake on actors' opportunistic behavior. Rational choice models rely on the incentives created by the possibility of future exchange to explain how the network should affect patterns of trade (see especially Raub and Weesie, 1990, and Greif, 1993). Because the network effectively expands the observability of actors' conduct, actors must weigh the potential gains from violating the spirit of a current transaction against the future gains that might be lost if the offended trading partner informs his or her affiliates of the infringement.

Building from this insight, Raub and Weesie (1990) develop a model that relates the connectedness of a network to the potency of reputational incentives. Robinson and Stuart (2007) found empirical support for this idea in the governance of alliance contracts involving entrepreneurial biotechnology firms. They argued that the connectedness of biotechnology and pharmaceutical firms in the industry's alliance network proxies for both the ability of firms to sanction malfeasance (because central firms can credibly disseminate information to a wider range of potential, future partners) and the risk firms face from a partner's sanction. Løvås and Sorenson (2008) exploit variation in the incentives for malfeasance to demonstrate that similar dynamics operate in the trading of favors among employees within a consulting firm.

As a bridge to the next section, Robinson and Stuart (2007) also highlight the econometric challenges of isolating the effect of any particular network mechanism on transaction governance. They note that studies of alliance governance primarily have investigated how the characteristics of firms and alliance pairs affect the allocation of control by estimating regression equations on a sample of observed alliances (e.g., Gulati, 1995; Pisano, 1989). This approach implicitly assumes that the factors influencing the contractual terms of an alliance do not affect the probability that two firms formed an alliance in the first place (i.e., the characteristics that select an alliance into a sample). Yet, the embeddedness arguments invoked to explain the network's effect on transaction governance almost certainly also influence the decision of two actors to enter an alliance. Failure to account for this influence thus imparts a sample-selection bias to analyses of the network's effect on the content or structure of the actual partnership.[5]

STRATEGIC NETWORKS VERSUS SOCIAL NETWORKS: A RESEARCH AGENDA

Based on our reading of the literature, there is little doubt that entrepreneurship scholars believe heterogeneity in social capital endowments give rise to performance differences across firms. The preponderance of evidence supporting this contention provides a *prima facie* case for placing the study of social networks front and center in research on strategic entrepreneurship. Moreover, in addition to the possibility that certain network configurations directly benefit entrepreneurial performance, they may have indirect effects. If better-networked entrepreneurs recognize superior opportunities or assemble higher quality resources, research on organizational endowments suggests that these entrepreneurs' enterprises may enjoy sustained, superior firm performance. Therefore, entrepreneurship researchers see the roots of competitive advantage in differences in social capital among the founders and firms at or near the time of formation. Building on this intriguing possibility, we outline an (admittedly incomplete) agenda for research on social networks and strategic entrepreneurship.

Addressing endogeneity problems

Our review of the literature should make it clear that scholarly interest in social networks in entrepreneurial settings emerges from researchers' beliefs that the five network-based mechanisms described have a *causal* influence on outcomes of interest—often performance—in entrepreneurship. However, virtually all the papers reviewed remain silent on one assumption critical to the reliability and validity of the evidence presented in this work. Simply put, the assumption is that networks are *exogenous*—they are neither caused by the dependent variable (e.g., performance) nor are they correlated with unobserved attributes of actors that affect it. In other words, we can treat actors as being randomly assigned to

[5] To address this problem, Robinson and Stuart (2007) perform a two-stage regression analysis in which the first stage estimates the probability that two firms enter an alliance as a function of network characteristics and an exclusion restriction.

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network positions. Yet, if we accept the notion that entrepreneurs and entrepreneurial ventures behave strategically, this assumption is, at best, questionable and, at worst, violated in the vast majority of cases.[6]

The basic problem is easy to comprehend—if difficult to solve—and has been discussed at length by a variety of authors in the context of the general challenges of identifying social capital or peer effects (Blalock, 1984; Manski, 1993; Durlauf and Fafchamps, 2004; Mouw, 2006). In particular, if actors believe the possession of particular relationships enhances their odds of success, then they have incentives to manipulate their way into those valuable positions. We would expect nothing less of strategic actors. If actors also differ in their ability to create or benefit from certain types of connections, apparent network effects may stem from underlying, unobserved characteristics of individual actors. In fact, as Manski (1993) describes, one can typically explain observed outcomes in studies of social interaction by many different processes—including processes that exclusively operate on individuals in isolation. Because of potential omitted variables, one can construct an asocial explanation for virtually any observed network effect.

For a concrete example, let us apply this critique to some of our own past research. Stuart *et al.* (1999) and Stuart (2000) argued that endorsements of entrepreneurial ventures by high-status exchange partners reduce the uncertainty surrounding these ventures' future prospects, and thereby facilitate the process of mobilizing resources and, ultimately, the success of these firms. In these papers, Stuart and his co-authors attempt to isolate the transfer of social status that occurs through the implicit certification conferred by a partnership with a high-status actor, such as when a prominent venture capital firm invests in a young company. In each of these papers, however, an alternative explanation exists. Entrepreneurs widely believe partnerships with prominent individuals and organizations bring performance benefits (and that these benefits often outweigh the concessions required to win deals with prestigious actors). Therefore, the demand for deals with high-status actors outstrips the capacities or willingness of those actors to enter partnerships with entrepreneurial ventures. If prominent affiliates only accept pairings with actors of high quality, however, the estimated endorsement effects may simply reflect otherwise unmeasured heterogeneity in the quality of ventures. Indeed, Stuart *et al.* (1999) contend that beliefs that prominent actors choose their partners carefully actually enhance the endorsement quality of transactions with these partners. The Stuart papers, nevertheless, fail to isolate econometrically the effect of endorsements from the possibility that unobserved quality differences among firms drive the observed results.[7]

This discussion naturally leads to a second issue in the estimation of network effects, concerning unobserved dimensions of strategic actors' preferences for partners. A basic tenet of sociology is that actors prefer *homophilous* affiliates—they choose to transact with others like themselves. If the researcher does not know all the dimensions along which actors prefer to match, however, we may again misidentify social capital effects. In essence, regression estimates might confound the effects of partner characteristics with those of unobserved actor characteristics.[8] This

[6] The sociological research on which much of this literature has built aimed to understand the origins and consequences of friendship networks. In such a setting, the (implicit) assumption that relationships arise for non-instrumental purposes seems more plausible (but surely violated in some cases). Although some people undoubtedly do choose their friends on the basis of what information or resources they believe those friends might provide, such relationships may be short-lived. As Burt (1992: 24) colorfully asserts, 'Judging friends on the basis of their efficiency is a social flatulence from which friends will flee.'

[7] Stuart (2000) does include firm fixed effects in regressions of the influence of alliance partner prominence on the revenue growth of the firms, thereby accounting for *time stationary* quality differences across firms (even if unobserved). These fixed effects, however, do not guarantee clean identification of social network effects because the quality of firms may change over time in ways meaningful both to their success and their ability to attract prominent partners. Despite their ability to deal with some types of unobserved heterogeneity, fixed effects are no panacea.

[8] A simple set of equations presented in Mouw (2006) illustrates the problem. In Mouw's setup, equation (a) describes a preference for homophily on two actor characteristics: x_i, which is observed, and w_i, which is not observed. The equation implies homophily because the probability of an *i–j* match declines with the absolute value of the difference between their characteristics,

$$I_{ijt} = -\beta_1 |x_i - x_j| - \beta_2 |w_i - w_j| + \varepsilon_{ijt}, \qquad \text{(a)}$$

where ε_{ijt} is an error term and I_{ijt} represents the preference that the individuals i and j have for one another as partners. For instance, in considering the likelihood that venture capitalists i and j jointly participate in an investment syndicate (cf. Sorenson and Stuart, 2001), x might measure status in the industry and w might represent firm age. Actors near in status and age more commonly co-invest.

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problem seems most acute in research on brokerage and embeddedness because the characteristics of partners matter in these perspectives.

Accurately identifying social network effects in regression is hard. We can, however, offer a few general recommendations. In particular, we see three broad approaches to addressing the endogeneity problem. First, the researcher can attempt to identify research settings where actors' connections arise exogenously to the outcomes under study. The gold standard is an experiment in which relationships have been randomly assigned to subjects by the researcher. Although the opportunities for generating deep insights regarding many of the mechanisms described above in experimental settings seem limited (but see Kollock, 1994), variation in positions does arise exogenously in some cases. For example, relationships sometimes existed before the actors involved could reasonably understand their value. For an extreme case, consider a lottery winner. If those with prior connections to the winner benefited from access to these unexpected resources, one could reasonably assume that these connections had not formed in the expectation of the lottery being won. In other cases, relationships arise in the context of the external assignment to teams or common quarters; examples include classroom and freshmen dorm assignments at many schools (Festinger, Schacter, and Back, 1950; Sacerdote, 2001), some project teams in companies, groups in executive education courses, and so on.

Second, the analyst can explore not just the relationship between network position and entrepreneurial outcomes, but also the mechanisms through which the relationship emerges. An example of this type of approach comes from research on the effects of embeddedness. As noted earlier, the embeddedness perspective assumes that both parties benefit from repeated transactions through joint problem solving and the sharing of reduced transaction costs (Uzzi, 1996). But both parties may not benefit. Studying the interactions between film distributors and the teams that produce movies, Sorenson and Waguespack (2006) found that film distributors advertised more heavily and scheduled more favorably the movies produced by teams of talent with whom they had prior experience. Since both of these investments contribute to the success of a film, movies produced by teams that had worked together in the past appeared more successful, but the success was an illusion. After controlling for the higher levels of investment in their projects, repeated collaborations were disadvantageous for distributors.

One could easily imagine similar dynamics in entrepreneurial settings. For example, if an investor and entrepreneur share a successful history of prior interactions, Sorenson and Waguespack (2006) speculated that the investor might tender more money for a smaller share of equity in an entrepreneur's venture than she would if she had no prior tie with the entrepreneur. This lower cost of capital might, in turn, contribute to the success of the new venture—thereby confirming the investor's expectations and introducing a positive correlation between repeated exchange and firm performance. Studies that simply relate embedded exchange to better firm performance cannot distinguish this self-confirming dynamic from the reduction of search and/or enforcement costs as an explanation for superior performance, but work that examines the mediating processes more directly may be able to identify the mechanism at work.

In a similar approach, Sorenson and his coauthors examined the value of social relationships to information transmission more directly by examining how the value of relationships vary as a function of the qualities of the information being transmitted. For example, Sorenson and Singh (2007) demonstrated that social proximity increases the diffusion of information across the collaboration network of inventors only when the knowledge in question has not been codified and published. Sorenson, Rivkin, and Fleming (2006) similarly found that the value of relationships to information transmission declined when the knowledge in question either proved so

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If we then think of a firm-level outcome Y as a function of actor characteristics and the average characteristics of the actors' partners,

$$Y_{it} = \alpha_1 + \alpha_2 x_{-it} + \alpha_3 x_i + \alpha_4 w_i + \varphi_{it}, \quad \text{(b)}$$

x_{-it} (the average x of i's partners at time t) represents a network effect. Continuing with the venture capital example, Y_{it} might represent the IRR of the firm, and the hypothesis might be that firms with high-status syndicate partners perform better. Because the researcher does not observe w, however, the estimated regression equation is not (b), but rather:

$$Y_{it} = a_1 + a_2 x_{-it} + a_3 x_i + \phi_{it}. \quad \text{(c)}$$

The problem of correlated unobservables occurs when an unobserved factor w correlates with both actors' matches and the outcome variable. Thus, if w_i is correlated with x_i (VC age and status are correlated) and $\alpha_4 \neq 0$ (VC age affects IRR), the estimate of a_2 (the coefficient on x_{-it}, the status of the firm's syndicate partners) will be biased. See Mouw (2006) for a more detailed discussion and simulation results.

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simple that recipients could easily replicate the information without special access or so complex that attempts at transmission generally failed.

Third, the analyst can employ statistical procedures that explicitly address the endogeneity problem. The ability of researchers to use these techniques will improve as researchers increasingly gather longitudinal data on social networks and entrepreneurial outcomes. Too many studies in entrepreneurship examine cross-sectional data—or worse, they measure networks following the outcomes of interest. Time-varying data allow researchers to establish appropriate lag structures and incorporate actor-fixed effects. Using this approach, Fleming, Mingo, and Chen (2007) as well as Lee (2007) call into question the value of brokerage to opportunity recognition by examining the performance of inventors as a function of their positions in the collaboration network of inventors. As in most studies, without controls, they found positive effects to *structural holes*; those with broader reach in the network of collaborators patent more often and appear to have higher-quality patents (because their patents receive more citations on average). After incorporating fixed effects to account for the time-invariant characteristics of the inventors, however, the effect of structural holes on patent productivity goes to zero. (But as we note in Footnote 7, the inclusion of fixed effects does not necessarily remedy the endogeneity problem.)

One approach to dealing with endogeneity through estimation comes from trying to find exogenous sources of variation in network positions. These exogenous factors can serve as instrumental variables to identify network effects. Though we cannot point to any examples in the entrepreneurship literature, scholars interested in other phenomena have begun to discover settings in which instrumental variables can identify network effects. For instance, Ingram and Roberts (2000) use them to study the effect of friendship networks on pricing decisions, and Munshi (2003) employs a similar procedure to estimate the magnitude of the network effect on the migration decisions of Mexican migrant workers to the U.S.

Another approach attempts to minimize the problem of unobserved heterogeneity through *selection on observables* econometric techniques, such as propensity score matching (Dehejia and Wahba, 2003) and inverse probability of treatment weighting (Robins, 1999) procedures. In this approach, the researcher first develops a model of the self-selection of actors into relationships and then uses the estimates from this model to adjust estimation of the effect of the relationships on some outcome in a second stage. These approaches, however, have an inherent limitation: researchers have no means of testing the validity of the assumption that they have not omitted any important predictors of relationship formation that might also affect the second stage outcomes (cf. Azoulay, Ding, and Stuart, 2007). The possibility of employing these types of into-relationship-selection-correction techniques naturally leads into a discussion of the second area that we believe merits attention.

The origins of networks

In their efforts to launch new ventures, virtually all entrepreneurs consider networking important. Despite a cottage industry in advice peddling on how to network smart and the burgeoning scholarly literature we have reviewed on network effects, we have very little systematic knowledge of how strategic actors construct their networks. In developing empirical and theoretical research on the formation of networks, we see two possible units of analysis—the individual actor or the dyad (pair of actors)—two types of explanations—within the network and outside it—and two social domains—the physical and the online world.

In the organizational sociology literature, research has migrated from actor-level explanations to dyad-level analyses, and from outside- to within-the network theories of network evolution. Actor-level theories of relationship formation, which dominated early perspectives on interorganizational relationships, posit that the impetus for establishing new ties resides with a single actor. A firm, for example, forms a strategic alliance because it desires access to resources that it lacks. Dyad-level perspectives, by contrast, focus on pair-level explanations, such as resource complementarities, trust, homophilous characteristics, and so forth. The appeal of the dyadic approach is that it inherently addresses the fact that virtually all forms of inter-actor interaction arise from a two-sided matching process: actors enter agreements willfully, and, therefore, both counterparties to an exchange must agree to it.[9]

[9] On the other hand, in situations in which one party can offer a payment for the relationship to the other, one could easily imagine actor-level explanations having purchase (Ryall and Sorenson, 2007). For instance, entrepreneurs appear able to compensate high-status venture capitalists for forming investment relationships with them by accepting contractual terms more favorable to the venture capitalist (Hsu, 2004). But still, would-be partners may vary in their openness to accepting such side payments.

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Research has also migrated from focusing on outside-the-network explanations for relationship formation (e.g., strategic alliances arise among pairs of firms with complementary resource profiles) to within-the-network explanations. By within-the-network, we mean that the explanation for the shape of the network or the formation of any network substructure at a given time t comes from the lagged structure of the network itself. For instance, Gulati's (1995) article on the formation of alliances, in which he argues that organizations engage in repeated ties and that first connections emerge from referrals through mutual acquaintances, provides one example of a dyad-level analysis that offers a within-the-network explanation for new ties (others include Podolny, 1994; Stuart, 1998; Kossinets and Watts, 2006).

Dyad-level analyses offer the advantage of appropriately treating pairings as two-sided matches. In critiquing this line of research, Podolny and Page (1998), however, observe that within-the-network models of relationship formation—those that explore how the ties in a network in one period become the platform upon which future relationships emerge—inherently beg the question: where does the network come from in the first instance? This observation is emblematic of the general paucity of research on the emergence of social structures in many domains of sociology (Coleman, 1986). Although the recent literature has clearly contributed to an understanding of the processes by which already established inter-actor networks evolve through the addition of new ties, the existing literature has not adequately addressed the logically prior questions: How do inter-actor networks emerge? And, how do organizations outside of a network gain admission to it?

We consider these questions a vital area for research. First, despite the empirical issues described earlier, acceptance of the findings that different positions in social and business networks have dramatic consequences for individuals' abilities to recognize entrepreneurial opportunities and for early-stage firms' capacities to acquire resources, the question of from whence these network endowments come is of central importance to understanding everything from prospects for individuals' social mobility to the early stages of competitive differentiation among firms (see Founders versus firms section). Second, knowledge of how networks emerge may suggest policy options that could increase rates of entrepreneurship within communities—whether socioeconomic or sociodemographic groups, or geographic regions. Third, if we better understand the antecedents of social networks, we will have a far better capacity to address the endogeneity problems described earlier. As a general rule, sound instrumental variables have their grounding in solid theory and empirical evidence regarding how and why they influence the potentially endogeneous variable—in this case, network formation.

Only a few recent studies address these issues in entrepreneurial settings. In one effort, Hallen (2007) examined the pairing of venture investors to early-stage firms in the Internet security industry (see also Shane and Stuart, 2002). He explored whether inheritance or accomplishment more strongly attracts high-status investors to new firms. Essentially, Hallen asked whether successfully networked organizations are born with silver spoons, in the sense that well-connected founders start them, or whether merit-based matching occurs, in which stellar firm performance attracts high-quality partners. Perhaps unsurprisingly, he found that pre-existing founder-investor connections matter more in earlier venture financing rounds and firm accomplishments dominate in later rounds. Consistent with Hallen's findings, Larson (1992), describing the process of tie formation among a small group of high-growth companies, also found that pre-existing relationships between principles at the companies in her study set the stage for the formation of interfirm relationships.

While not questioning the importance of these findings, if, in fact, founders endow their organizations with network resources that become firm-level social capital, then the competition for network resources unfolds before firms ever enter the picture; we therefore require a deeper understanding of the formation of person-to-person networks among would-be entrepreneurs. In fact, this precise possibility led us to write a series of articles arguing that social network-based processes can explain the geographic clustering of industries (Sorenson and Audia, 2000; Sorenson, 2003; Stuart and Sorenson, 2003a, 2003b). Especially in capital- or technology-intensive industries in which the creation of new firms depends on the mobilization of resources, having a population of potential founders with the necessary network connections catalyzes the gestation of new ventures. In turn, because most people have geographically localized networks, the current location of high-potential founders constrains the geographic distribution of new firms.

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Little research to date has examined the role of online and electronic (e.g., e-mail) networks. While one could once view web-based networking merely as an opportunity for entrepreneurial activity rather than as a significant influence on the social structures from which new ventures emerge, can we continue to dismiss it as such? There are clearly many reasons to doubt that computer-mediated connections give rise to the obligation-laden exchanges important to many entrepreneurial outcomes (though some computer-mediated networks such as Kiva.org offer interesting counterexamples). At the same time, the Internet has dramatically decreased the costs of communication and of acquiring certain information, so one could easily imagine that it might facilitate opportunity identification. The importance of these technological changes and the permanence of online relationships, however, have yet to receive much serious scholarly attention.

Founders versus firms

As Aldrich and Ruef (2006) emphasize, entrepreneurship is a process, not an event. In the literature on network effects in entrepreneurship, however, little theory guides the distinctions between founders and firms (one notable exception appears in Katz and Gartner, 1988). When do the early endeavors of a founder or a founding team constitute a firm? A basic tenet of organization theory holds that firms amount to more than the sum of the individuals populating them (March and Simon, 1958). Firms are legal entities in contracting; they develop organizational processes and routines that persist independently of individual employees; they gain organization-level capabilities; they develop corporate cultures; they respond to organization-level interests that depart from those of different stakeholders; they define and maintain boundaries; and so on. Yet, much research on the effect of networks on economic outcomes ultimately posits interpersonal interactions. Firms do not feel sentiments of trust and obligation. Though they do have status, at what point does a firm's status become independent from that of its founder(s) or employees?

The earlier discussion about the endowment of new firms with founder networks begs the questions: at what point, and to what end, do we distinguish the networks of early-stage ventures from those of their founders and key recruits, and how should we think about employees' professional networks that span firm boundaries (e.g., Rosenkopf, Metiu, and George, 2001)? At the moment, researchers appear to adopt positions on these questions for their convenience in fitting with the available data. When the researcher can measure firm networks, networks become properties of firms. In the less frequent instances in which the researcher has information on founders' ties, they become the units of measurement, even though outcomes typically occur at the firm level (e.g., Shane and Stuart, 2002; Hallen, 2007). Conceptually, then, in entrepreneurial contexts, how do individual and firm networks differ?

Network resources on shifting social topographies

The complexities of a world in which many actors simultaneously engage in strategic searches for valuable relationships are daunting to contemplate. The imagery is that of an ever-shifting social topology: each focal actor strives for optimal ties in a relational structure in which other actors engage in the same search and in which the optimal tie configuration for any focal actor depends on those achieved by its potential partners. Simultaneous strategic searching raises many questions. At a basic level, what degree of rationality should one attribute to searchers? How broad a purview of the macrostructure can we assume that individual actors possess as they construct their networks? And, if indeed actors do form relationships strategically, under what conditions should we expect valuable positions in the network to exist in a steady state?

Though a theoretical literature on network evolution has been developing in economics (for a review, see Jackson, 2005), thus far at least, research in this area has had relatively little to say about *strategic* networks. The disconnect comes in part from the fact that most economic models require that actors either follow a simple behavioral rule, such as favoring connections to the most central actors (e.g., Barabasi and Albert, 1999; Gould, 2002), or that they maximize a utility function that does not map easily onto the social mechanisms featured in the entrepreneurship literature (Jackson and Wolinsky, 1996; Goyal and Joshi, 2003). But, in part, it also comes from the fact that economic models have been designed to determine whether efficient networks emerge in equilibrium. By contrast, strategy and entrepreneurship scholars really want to know whether positions of competitive advantage can exist in equilibrium.

To address these issues, Ryall and Sorenson (2007) adopted a biform game approach in which actors

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first attempt to form relationships based on their expectations of the value of those relationships and then, in a second stage, cooperate and compete to create and appropriate value. Imagine, for example, an entrepreneur attempting to form relationships with resource holders and using those connections to build a firm. They then used this framework to ask a relatively specific question: Can a broker who brings nothing more to the table than her connections capture value, or will the counterparties brought together by the broker disintermediate her? The model identifies three conditions that must hold for competitive scarcity to guarantee a profit to the broker: (1) The actors being intermediated must not have other means of coordinating among themselves (i.e., substitute brokers), or equally attractive alternatives that do not involve the broker; (2) The broker must have connections that allow it to intermediate between at least three other actors. If the broker links only two actors, then it has no outside alternative and cannot credibly threaten to exit the coalition; and (3) The outside options available must offer sufficient value so the broker can wield them as credible threats in its negotiations with other parties.

The question then becomes: can such a valuable position of brokerage emerge endogenously? In other words, if actors form relationships strategically in response to their expectations of how they would influence their ability to appropriate value, will network topologies that bestow competitive advantages on brokers materialize? Ryall and Sorenson (2007) essentially conclude that it depends on the nature of the relationship formation process. If actors sequentially consider and accept or decline relationships one at a time, then brokers can enjoy stable competitive advantages. Venture capital syndication networks appear to be one such setting, as opportunities to form relationships arise sequentially. On the other hand, if actors have the ability to consider simultaneously a portfolio of potential relationships, then some actor always has an incentive to close the structural holes that others attempt to open. Establishing an effective brokerage position in a setting with a high frequency of relationship formation—for instance, the exchange network on a stock-trading floor—appears far less likely.

The analysis of the equilibrium conditions in these networks spotlights the complexity of the shifting topology of a social network of strategic actors. Because each actor's incentives depend not only on their own moves but also on those of many others, strategic actors face a vexing problem. On the one hand, this fact should generate some healthy skepticism that actors can succeed in establishing valuable positions, even if they could exist in equilibrium. On the other hand, it suggests that studies of relationship formation, such as those discussed in The origins of networks section, may need to incorporate an explicit consideration of these interdependencies. Whereas researchers have tended to consider the question of relationship formation at a dyadic level, these strategic interdependencies argue for a broader unit of analysis.

Generally, we believe the biform game approach offers a promising infrastructure for considering how features of the environment might interact with a relational network to determine the distribution of rewards. Several potential extensions come to mind. First, brokerage represents just one of the five mechanisms discussed earlier. For instance, the embedded network connections of today are in large measure the byproduct of past strategic decisions to interact. If actors are strategic and forward-looking in their formation of ties, how does the expectation of a web of embedded exchanges affect present-day conduct? Formal treatment of this and other dynamic mechanisms could yield considerable insight. And even within the mechanism of brokerage, there is ample room for extensions. For example, though Ryall and Sorenson (2007) model a setting in which actors know with certainty the future value of each network configuration, most empirical settings in which researchers have examined the effects of social networks involve considerable uncertainty. Therefore, one could imagine adding randomness to the second stage of the model.

Restricted access—inequality in founder and firm networks

The very idea that networks have effects because they restrict access to valuable resources to those advantageously positioned within them raises the specter of significant ascriptive group and other actor-level differences in network-based advantages. This issue has been a recurrent theme in both the sociology and entrepreneurship literatures, but we believe it merits additional attention.

One line of research examines the dynamics of entrepreneurship within immigrant communities (for reviews, see Aldrich and Waldinger, 1990; Portes and Sensenbrenner, 1993). This literature has examined the unusually high levels of entrepreneurship among certain ethnic groups. The focus of this

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literature, however, has been less to compare and contrast different ethnic groups in their abilities to found firms, but rather to examine the processes through which ethnic enclaves enable entrepreneurship as an employment avenue open to those excluded from the primary labor market. The mechanisms of embeddedness, trust, and sanctioning within ethnically homogenous and geographically localized communities have formed the leitmotif of this research (Portes and Sensenbrenner, 1993).

Meanwhile, a separate line of research has focused on gender differences in the rates of entrepreneurship. Overall, the statistics indicate that men founded new businesses at approximately twice the rate of women (Small Business Administration, 2001), although the gender-based self-employment gap has declined in recent years (Devine, 1994). The disparity between the sexes in these rates and in the occupancy of high-level managerial positions nevertheless appears to increase with the technological intensity of the sector. In a study of Silicon Valley startup firms, Baron *et al*. (2001) report that women held only 10 percent of the engineering and scientific jobs at firms in their sample, and a recent study found that a meager six percent of the $69 billion in venture capital funding dispensed in 2000 went to companies with a female chief executive officer (Brush *et al*., 2001). Not surprisingly given this last statistic, Ding, Murray, and Stuart (2006) found that women faculty members in the life sciences joined fewer scientific advisory boards and founded companies less frequently.

In our view, the extent to which inequality in social capital accounts for some of these differences remains an open question. Ethnic groups and men and women vary in the networks they form. For example, Marsden (1987) reported that women typically have a higher proportion of kin and neighbors in their discussion networks than men. Because of homophily, moreover, actors tend to have high proportions of same-sex and same-ethnicity ties (McPherson and Smith-Lovin, 1986; Ridgeway and Smith-Lovin, 1999). However, relatively little research has examined how these differences in network composition influence entrepreneurship. In one exception, Renzulli, Aldrich, and Moody (2000) found that in a sample of 353 would-be entrepreneurs, women had fewer diverse networks than men, and that the lack of multiplicity in women's networks impeded the identification of entrepreneurial opportunities and the transition to company formation (see also Weiler and Bernasek, 2001). Nonetheless, it is easy to imagine how the general differences in networks described above might affect the resource mobilization process. Consider, for instance, that most surveys report that less than five percent of angel investors are women (Harrison and Mason, 2007). In data we have collected but not yet analyzed, we find that less than 10 percent of U.S.-based venture capitalists are female, and less than two percent of managing general partners at venture capital firms are women. If nascent entrepreneurs have gender homophilous networks, then the typical would-be female entrepreneur has few pre-established relationships with early-stage investors. One reason then why women may participate infrequently in entrepreneurship is that, compared to men, they are poorly positioned in the networks that facilitate entrepreneurial activity (causing what Waldinger, 1995, refers to as the *other side* of embeddedness).

Similar processes of exclusion may operate at the firm level, although analyses of competitive exclusion in entrepreneurial contexts are few and far between. In one thought-provoking example, Hochberg, Ljungquist, and Lu (2006) argued that dense syndicate networks among venture investors serve as entry barriers that deny would-be newcomers access to the deal flow controlled by network members. Whether this result stems from some form of informal cooperation to exclude outsiders (and thereby control the local supply of venture capital) versus merely from the social inertia inherent in embedded exchange networks is not clear from the paper. Nevertheless, it is apparent that ample opportunities exist for research on how competitive behaviors facilitate the formation of ties for some actors—and systematically exclude others.

CONCLUSIONS

We have forwarded five areas of investigation that we consider essential to a research agenda in networks and strategic entrepreneurship. First, we must develop research designs and statistical approaches that address the endogeneity problems that draw into question the findings of the existing literature. Until this happens, we will not have reliable estimates of the magnitude (or even necessarily the direction) of the effects of social networks on outcomes of interest in the entrepreneurial process. Second and third, two issues become immediately important under the assumption that estimated network effects prove robust to improved identification strategies. One is

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that we need to improve our understanding of how networks form, and a second is that we must better understand how ascriptive group membership and processes of competitive exclusion shape access to network-based resources.

Fourth, the literature remains unclear concerning the role of founder and key employee networks, versus the networks of firms. This lack of clarity gives rise to a constellation of related questions: How do we distinguish the networks of founders from those of the firms they create? What are the relative effects of founder and firm networks on new venture performance? To what extent does organizational mobility occur such that firms may develop advantageous network positions even if their founders did not possess such positions, and what conditions enable such mobility?

Finally, the most explicitly strategic issue on our proposed agenda is a better understanding of how actors interact when attempting to attain positions of advantage. These interactions have strong implications not only for the settings in which one would expect to see actors successfully manipulate the network, but also for the factors influencing relationship formation as actors engage in a dynamic dance, hoping to step toward positions of advantage, but realizing all the while that the movements of other actors within their social arenas may influence the appeal of their structural positions.

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