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**THE CONTINGENT EFFECTS OF SOCIAL NETWORK SPARSENESS AND
CENTRALITY ON MANAGERIAL INNOVATIVENESS**

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The Contingent Effects of Social Network Sparseness and Centrality on Managerial Innovativeness

Abstract

Prior research has highlighted that network sparseness and network centrality enhance innovativeness through access to information and influence respectively. We advance this perspective by exploring the extent to which individual actions are needed to mobilize information and influence accessed through social networks, and whether such information and influence would mutually reinforce to enhance managerial innovativeness. Our findings found partial support for the idea that actions are needed to actualize potential resources embedded in social networks, as centrally positioned managers enjoy higher innovativeness when they engage in ambassador activities. We also found that advice network sparseness and advice network centrality had independent, not interactive relationship with managerial innovativeness, suggesting that they offer distinct routes to achieving managerial innovativeness. Overall, our research clarifies the relationships of two important social network attributes on managerial innovativeness and, also sheds new light on how managerial action matters in realizing social network advantages for innovative ends.

Key words: boundary spanning, managerial innovativeness, social network, social network centrality, and social network sparseness

Innovation occupies a central domain in many disciplines including economics (Schumpeter, 1934), sociology (Rogers, 1995) and management (Tushman and Moore, 1988). Traditionally, innovators and managers occupy different roles in the organization. Innovators create new ideas, and seek support from managers to implement those ideas (Baer, 2012; Day, 1994; Kimberly and Evanisko, 1981). Recent studies have shown that, in addition to supporting the idea implementation process, managers can also be sources of good ideas (e.g., Burt, 2004). Indeed, managers fulfill an important innovative role in organizations because they not only provide resources for new ideas but also engage in boundary-spanning activities that make them ideal candidates for new idea generation.

Recognizing that innovation is characterized as the “development and implementation of new ideas by people” (Van de Ven, 1986, p. 590), we define managerial innovativeness as the extent to which managers are successful at generating and implementing new ideas. The social network perspective has emerged as an important line of inquiry to advance our understanding of individual innovativeness (Burt, 2004; Ibarra, 1993; Obstfeld, 2005; Rodan, 2002; Rodan and Galunic, 2004). Two main arguments explain the value of social networks to enhancing managerial innovativeness. The first argument posits social relationships as conduits for *diverse information access*. A sparse social network structure exposes managers to a broad range of information (e.g., about technologies, practices, and so on) that they can combine to create new ideas or creatively transfer practices from one context to another (Burt, 2004; Rodan and Galunic, 2004). The second argument focuses on the value of social relationships as conduits for *social influence*. Due to their social reach and prestige, central individuals are in positions of influence to signal the quality of their ideas (Nerkar and Paruchuri, 2005) or receive more resources from their peers (e.g., Bonacich, 1987; Brass, 1984). As a result, they are more effective at garnering both information and support for successful innovations (Ibarra, 1993; Lam and Schaubroeck, 2000; Paruchuri, 2010).

Implicit in the social network perspective of individual innovativeness, however, is the assumption that people in advantaged social positions *will* appropriate the resources for innovative ends. Agency, conceptualized as individual capacity to take purposeful actions to appropriate the resources afforded by their structural conditions (Emirbayer and Goodwin, 1994), is assumed to be taken by individuals occupying such positions. Findings from recent studies question this simplifying assumption. For instance, individual propensity to leverage information in their social networks depends on individual motivation such as need for cognition (Anderson, 2008) and openness to experience (Baer, 2010). Various studies have also shown that the positive effects of social networks on creativity are contingent on individual motivation and ability (e.g., Baer, 2012; Reinholt, Pedersen and Foss, 2011). These studies suggest that advantageous social networks offer *potential* resource access but the realization of such potential is contingent on individual capacity to take action.

Despite these insights, there is surprisingly an absence of attention to the nature of individual activities required to mobilize potential resources in social networks for innovation. As highlighted by Burt (2004, p. 354), “(n)etworks do not act, they are a context for action”, foreshadowing the need to explicate individual actions for appropriating resources in social networks. Research at the inter-firm level also urges a consideration of conduct to reveal how network value is captured (e.g., Afuah, 2013). Actions to search for information (Katila and Ahuja, 2002) or garner support from stakeholders (Dutton, Ashford, O’Neill and Lawrence, 2001a) have been pivotal to understanding innovation in organizations, but surprisingly not been linked to the social network perspective in innovation research. Our first research goal is to address this gap by considering the possibility that managers in the same advantaged social network position can make different behavioral choices which affect whether they can effectively realize the potential resources for innovation. As the boundary spanning perspective highlights individual strategies of actions to acquire resources from

people outside of their unit for innovation (Ancona, 1990; Faraj and Yan, 2009; Fleming and Waguespack, 2007), we draw upon this perspective to posit how managerial actions impact the extent to which they can successfully appropriate information and influence from their social network for innovation purposes.

In addition, most studies have not juxtaposed the two streams of social network research examining diverse information access and influence to investigate the extent of their complementarity. However, innovations might have a higher likelihood of success when individuals not only harness the diverse information from their networks for good ideas but also signal the credibility of those ideas by occupying an influential network position. Nerkar and Paruchuri (2005) study found that inventors are more likely to select and use knowledge that has been created by inventors who not only are centrally positioned but also cultivate non-redundant collaborative ties. Although our study focuses on managerial innovativeness, we might also expect sparse and central social networks to complement each other to enable successful administrative innovations. Merit of an idea alone may not lead to widespread support among constituents, especially when uncertainty inherent in organizational change threatens vested interests. Similarly, influence to garner support for an initiative may be less effective when the initiative is not inspired by timely and diverse information about organizational needs in the first place. Yet, inter-relationship between network sparseness and network centrality on managerial innovativeness has thus far been unexplored. Our second research goal is to investigate whether and how social network sparseness and centrality are complementary in enabling managerial innovativeness.

Our study samples top-ranked managers in a large emergency response services firm; thus the domain of innovation pertains to administrative innovations such as revising or creating new routines for safety, knowledge exchange, training and logistics. We examine the boundary-crossing social network of managers, that is their ties to other departmental

managers in the organization, since ties that cross departmental boundaries facilitate access to diverse information, support and advocacy for innovation (e.g., Ancona and Caldwell, 1992b; Hansen, 1999). We also focus on the advice network of managers because advice ties have been highlighted as conduits for information (Marsden, 1988; Podolny and Baron, 1997), and channels to influence colleagues on work-related issues (Ibarra and Andrews, 1993).

Our research makes two unique contributions to the social network perspective of individual innovativeness. First, we respond to Phelps, Heidi and Wadhwa's (2012) call for more research that investigates how strategic motives of actors would influence knowledge creation and adoption by exploring whether boundary-spanning activities would matter in appropriating resources from advantaged social networks. Prefiguring our findings, we found that the role of individual agency in social networks is more nuanced than commonly perceived – while active effort is required to mobilize influence from central social positions, such effort is less important in appropriating information from sparse social networks. Second, by examining the joint relationship of network sparseness and centrality on managerial innovativeness, our study provides theoretical clarity on whether successful managerial innovations depend on access to both diverse information and influence acting in simultaneity. Our results did not support the joint effect of network sparseness and centrality on managerial innovativeness, suggesting that they offer two distinct structural routes to promoting managerial innovativeness.

THEORETICAL BACKGROUND

The value of sparse social networks to individual innovativeness is premised on the logic that non-redundant contacts provide *access to diverse information*. As contacts who are not connected to one another are likely to span distinct social circles where different kinds of information circulate, sparse social networks tend to be sources of diverse information (Burt, 1992). Exposed to a variety of information, one can be more generative of novel ideas from

resourceful combination of technology (e.g., routines or systems) from different contexts, and analogical transfers of technology from one context to another (Burt, 2004; Fleming, Mingo and Chen, 2007; Rodan and Galunic, 2004). Under this perspective, diverse information access is underscored as the key mechanism that accounts for the benefit of sparse social networks on individual innovativeness. Although prior research emphasizes the value of sparse social networks in inspiring creative ideas, we may also expect sparse social networks to provide information that lead to good, practical ideas that are more acceptable to diverse constituents in the organization. Managers positioned at the nexus of information flows across departmental boundaries are not only informed about the different practices or solutions in other departments but also their problems and preferences; increasing their tendency to initiate change (Battilana and Casciaro, 2012). With heightened access to information, managers are advantaged in generating ideas that are adapted to fit the needs and constraints of different constituents in the organization, which in turn increases the constituents' propensity to support the ideas.

Notably, other studies have pointed out the potential disadvantage of a sparse social network to innovativeness, as the lack of dense, interlocking ties among individuals inhibit the building of shared understanding and trust, which is important for deep knowledge integration in new product creation (Obstfeld, 2005; Tortoriello and Krackhardt, 2010). The tradeoff in the effect of a sparse network on innovativeness may be reconciled by considering the nature of innovation the individuals are involved in. Technological innovations involving interdisciplinary knowledge integration accentuate the importance of dense, cohesive ties. As each technological domain involves knowledge with specialized vocabulary and disciplinary-specific problem-solving approaches, the process of combining these different technological domains typically entails deep and intense knowledge exchange to enable cross-fertilization of ideas (Bechky, 2003; Hansen, 1999). In contrast, administrative innovations, as is the case

in our study, refer to changes in administrative processes and practices (Ibarra, 1993), which are less subject to specialized terminology and methodology. Relative to technological knowledge, administrative knowledge places less demand on intensive and repeated social interactions for its transfer and integration. However, as changes in any administrative system or process may have implications on workflow processes in other departments, extensive organizational knowledge is critical to develop new routines or systems that would be culturally appropriate in the organization.

The innovation process has also been examined as a sociopolitical process (Dutton, Ashford, O'Neill and Lawrence, 2001b; Frost and Egri, 1991; Ibarra, 1993), where successful innovations are premised upon individual capacity to garner resources to help with their implementation, and influence others to develop positive attitudes toward those ideas. This sociopolitical process highlights innovations as risky endeavors which are resisted by employees when their vested interests are threatened (Howell and Shea, 2001; Janssen, Van de Vliert and West, 2004; Kanter, 1982; Yuan and Woodman, 2010). Objective merit of an idea is less important than the sociopolitical support the idea obtains (Kanter, 1988; Kijkuit and Ende, 2007). Administrative innovations bring about risk, producing skepticism and hesitation on the part of stakeholders in the organization. New initiatives can involve changing practices and policies, implying that existing power structures within an organization might be threatened (Janssen et al., 2004). Scarcity of resources, inter-unit interdependency and heterogeneity of unit goals imply a higher likelihood for conflicts to occur among stakeholders about the value of new initiatives (Markham, 2000).

This stream of research underscores the value of individual centrality in the social network as affording *social influence* to gain support and resources from stakeholders. Individuals with higher advice in-degree centrality¹, which refers to the extent to which they are targets whom other people go to for advice, enjoy greater informal influence or power in

the firm due to their greater social reach and prestige (e.g., Brass, 1984; Brass and Burkhardt, 1992). There are two main reasons why the greater influence enjoyed by centrally positioned individuals in the advice network help in achieving successful innovations. First, the extensive social reach of central actors (Bonacich, 1987) enhances their perceived influence, increasing the likelihood that more people would go to them for information. To the extent that information about the needs and activities of peers can surface in these information exchanges, they have a greater probability of coming up with good ideas (e.g., Paruchuri, 2010; Tsai, 2000) that take into account the strengths and constraints of stakeholders. As such, their ideas are likely more palatable to affected stakeholders. Second, their status and prestige in the advice network lend signals of quality and credibility to their ideas (Paruchuri, 2010; Tichy, Tushman and Fombrun, 1979), which will attract more attention and respect, increasing the likelihood that stakeholders would support their ideas. Central individuals, for example, have been shown to influence the use of new consumer products (e.g., Baumgarten, 1975; Venkatraman, 1989), affect innovation implementation in an advertising agency (Ibarra, 1993), and influence the introduction of a new service-quality initiative in a bank (Lam and Schaubroeck, 2000).

In essence, advice network sparseness and advice network in-degree centrality offer distinct resource advantages for innovation – the former via access to diverse information and the latter via social influence. Implicit in these arguments, however, is the notion that action is endogenous to social network structure. Yet, resource access does not necessarily lead to resource mobilization. Managers may inherit advice central positions from the organization of workflow in the organization or from possession of specialized expertise. While they may enjoy potential social influence as a consequence, they may not purposefully harness such influence for innovation purposes. Even if managers with a sparser network and higher centrality tend to be, on average, more susceptible to discovering and implementing new

ideas, greater predictive power can be achieved if we investigate strategies of action that mobilize social networks in ways that promote managerial innovativeness.

COMPLEMENTARY RELATIONSHIP BETWEEN SOCIAL NETWORK AND BOUNDARY-SPANNING ACTIVITIES

Boundary spanning – engaging in interactions with actors outside of one’s units – is a critical aspect of the innovation process (Ancona and Caldwell 1992). As successful innovation relies upon obtaining resource support such as external information, manpower, financial support and sponsorship, boundary spanning activities such as scouting for information, coordinating tasks and harnessing support at both the team-level (Ancona, 1990; Ancona and Caldwell, 1992a; Faraj and Yan, 2009) and individual-level (Fleming and Waguespack, 2007; Tushman, 1977; Tushman and Scanlan, 1981) – have been demonstrated to impact team and individual effectiveness.

At the individual-level, entrepreneurial leaders or managers can be boundary spanners who mediate the interface between their unit and external actors (Druskat and Wheeler, 2003). They are proactive in garnering resources for the new initiatives of their units, including acquiring needed resources (Kanter, 1982), building awareness and advocacy (Howell and Boies, 2004), and engaging in “issue selling” (e.g., Dutton and Ashford, 1993). Team leaders who proactively scout the organization for information, persuade and publicize to external stakeholders about their team’s initiatives are more successful at getting requisite resources for their team (Ancona and Caldwell, 1992a; Druskat and Wheeler, 2003; Maitlis, 2005). Because boundary spanning can refer to any activity aimed at managing interactions with external actors, it encompasses a wide range of activities. Our theoretical model pertains to the actions managers take to mobilize information and influence, hence we focus on two boundary-spanning activities that relate to these actions, scout and ambassador activities (Ancona, 1990).

Network Sparseness and Scout Activities

Scout activities are directed toward gathering and searching information about expertise and technology outside of one's unit. In contrast to task coordinator activities, which are about managing work coordination with external actors, scouting is aimed at general search for new ideas and information about the external work-unit environment. As purposeful search activity, scouting focuses individual attention on learning about opportunities toward new or different technology (e.g., Li, Maggitti, Smith, Tesluk and Katila, 2013).

We argue that scouting moderates the effect of sparse advice network on innovativeness by focusing managerial attention on opportunities, thus enabling managers to be more effective at mobilizing the rich information from their sparse advice networks for new initiatives. As Herbert Simon's (1947) seminal work has noted, it is not the amount of information but the capacity to attend to information that is the scarce resource in organizations. Managers have limited information-processing capacity, having to attend to information regarding the management of current tasks and employees, coordination of inter-unit interdependencies, solving day-to-day operational problems, and so on. Consequently, people choose how to allocate cognitive capacity (Fiske and Taylor, 1991), with some allocating more entrepreneurial attention to acquiring and discovering new activities relative to managing ongoing concerns (March and Simon, 1958).

A sparse advice network exposes managers to rich and varied stimuli, but managers respond selectively to stimuli – attending to some and ignoring others. By investing attention in discovering new expertise and activities, individuals are more likely to recognize new opportunities that arise (Grégoire, Barr and Shepherd, 2010). In contrast, managers who are disinterested in scouting may ignore information about new activities of other units even if they receive such information as a result of seeking advice about the issues in their unit.

Stimuli that are attended to are more likely to be interpreted and integrated into the individual's cognitive structure (Posner and Snyder, 1975), which facilitates making inferences about connections between stimuli and in turn combining different stimuli to generate innovations. As Li and colleagues (2013) noted in their study on new product development, "search that directs attention toward new information and knowledge or enables the discovery of new ways to combine knowledge leads the searcher to develop new behaviors, interactions, strategies, and processes" (p. 896). More search and thus recognition of new knowledge, for instance, has been found to enhance innovation (Katila and Ahuja, 2002). If managerial action is a consequence of managerial attention to certain issues (Ocasio, 1997), then we would expect scout activities to amplify the effects of sparse social networks on innovativeness. By heightening managers' attention to novel stimuli, scout activities enhance managerial capacity to leverage the diverse information that they receive from their sparse advice networks for innovation.

Hypothesis 1: The positive relationship between advice network sparseness and managerial innovativeness is stronger when managers engage in higher levels of scout activities.

Network Centrality and Ambassador Activities

Ambassador activities are directed toward persuading external actors for support, protecting the team from outside pressure, and lobbying resources for new initiatives of the unit. Responding to the sociopolitical nature of organizations where interests of stakeholders vary, ambassador activities canvass for support from stakeholders to advance new initiatives.

Although more centrally positioned managers tend to be more influential in the firm, research on championing of innovations and issue-selling highlight that, in the swirl of scarce resources and competing goals within the firm, successful innovations involve the use of appropriate tactics to garner support for the innovations. Such tactics include coalition

building (Kanter, 1982, 1983), proactive use of influence tactics (Howell and Higgins, 1990), and framing the initiative in a way that is responsive to stakeholders' concerns (Howell and Shea, 2001). In addition, managers need to engage in "issue-selling" via connecting the initiative to organizational relevance, bundling the initiative with other important issues, and orchestrating the involvement of the right people at the right time (Dutton and Ashford, 1993; Dutton et al., 2001b). These studies suggest that proactive efforts to approach contacts for coalition building and resource support as well as to convince stakeholders about the viability of one's initiatives are critical to improving the probability that one's new initiative would come into fruition.

Managers who are more proactive in promoting to and persuading their peers about their unit's initiatives are in fact amplifying the social reach and prestige arising from their central network position. Structural sources of power are distinct from behavioral strategies to influence (Brass and Burkhardt, 1993). Structural influence, such as that arising from central network positions, derives power from their extensive reach and prestige. Behavioral strategies such as ambassador activities gain influence through attempts to persuade, to gain visibility, and to lobby for resources. We argue that the ability of centrally positioned managers to gain widespread support for their initiatives is enhanced when they also engage in ambassador activities to sell and promote these initiatives to stakeholders in the firm. Through ambassador activities such as issue-selling, managers are actively using the latent influence of their position to build visibility of their initiatives among their social contacts, persuade them about the positive impact of these initiatives, accumulate supporters and prevent opposition to their cause, thus securing sociopolitical support for their initiatives on a timely basis. Centrally positioned managers who engage in higher ambassador activity can therefore more effectively exercise the potential influence embedded in their network position for innovative purposes than those who remain passive.

Hypothesis 2: The positive relationship between advice network in-degree centrality and managerial innovativeness is stronger when managers engage in higher levels of ambassador activities.

COMPLEMENTARY RELATIONSHIP BETWEEN NETWORK SPARSENESS AND NETWORK CENTRALITY

As we have highlighted, prior literature suggests that advice network sparseness and advice network in-degree centrality offer distinct pathways to enhancing innovativeness. The information argument emphasizes the objective merit of ideas toward getting support and adoption within the firm while the influence argument underscores the importance of sociopolitical strength to marshal resources for ideas.

Yet, both network advantages can mutually complement each other to further enhance managerial innovativeness. Although sparse social networks expose managers to rich information that inspires good ideas that are attractive to constituents in the firm, any new idea brings an element of uncertainty. Creative, good ideas are not necessarily implemented (Sohn and Jung, 2010). Uncertainty that surrounds a new idea provokes resistance, especially when stakeholders' interests are negatively affected by organizational changes that follow the adoption of the idea (Baer, 2012). People have a preference for the status quo (Eidelman, Crandall and Pattershall, 2009), thus they can reject new ideas that are creative (West, 2002). Ironically, the more novel an idea, the greater the potential for its negative evaluation since there is greater uncertainty around creative ideas (Mueller, Melwani and Goncalo, 2012). To the extent that outcomes of new initiatives involve projection into the future, there is a limit as to how much information can be gathered in advance to alleviate uncertainty.

However when new initiatives are voiced by someone of higher esteem or prestige in the firm, they are likely to gain greater credence and trust. Novel initiatives that entail greater

uncertainty and potential for resistance have greater credibility when voiced and advocated by a central manager. Facing uncertainty in the quality of knowledge, people look for signals to ascertain quality (Tversky and Kahneman, 1974). One of the common heuristics relied upon by managers as an indicator of quality is the centrality of actors (Nerkar and Paruchuri, 2005). In making decisions to enter new technological niche, for instance, firms rely on the status of other firms to make inferences about quality (Podolny and Stuart., 1995). Similarly, in making inferences about the viability of novel ideas, people are likely to rely on a manager's centrality in advice network as a signal of credibility of the ideas.

Conversely, although the position of influence of central actors suggests that they are better able at cultivating support for new initiatives to be adopted in organizations, these initiatives have a higher likelihood of success if they are formulated after considering the perspectives of diverse constituents across the firm. Individuals successful at mobilizing support for initiatives are more effective at developing new initiatives that resonate with the local conditions of different stakeholders (e.g., Howell and Shea, 2001). A central actor may have extensive social links but these links may not be distributed across different social circles. Information availability is not the same as information diversity (Anderson and Nichols, 2007). In this light, centrally positioned individuals who also have access to timely and diverse information, afforded by sparse advice networks, can be more successful at adapting their initiatives to the local situation of different constituents across the firm.

Because of inherent uncertainty around stakeholders' needs and potential changes brought about by new ideas, we expect network sparseness and network centrality to complement one another in enhancing managerial innovativeness. Therefore, we hypothesize that:

Hypothesis 3: Advice network sparseness and advice network in-degree centrality positively interact with each other, such that managerial innovativeness is highest when both network sparseness and network in-degree centrality are high.

METHODS

Data to examine our hypotheses were collected from a large emergency response services organization in Asia as part of a larger study on managerial effectiveness. The firm employed approximately 20,000 employees and is organized into six entities. These six entities are located in the same city, and comprise of a central headquarters and five subsidiaries. Within each entity, the work is primarily organized by functional areas such as operations, logistics, planning, human resources, technology, and so on. Although each subsidiary offers a distinct group of emergency response services which targets different emergency threats, the firm as a whole is organized into a cooperative divisional structure. The high service orientation of the firm encourages employees to engage in high levels of information sharing, and transfer of best organizational and customer practices. Additionally, employees across the whole firm cooperate in certain emergency threats and often participate in joint training programs; hence senior managers from different entities meet regularly to discuss changes or improvements in policies or procedures.

Because the mission of the firm is to provide emergency response services such as disaster recovery services, the firm is not a technically-oriented research and development organization. Innovations that are initiated and implemented by top-ranked managers in our sample pertained largely to administrative innovations such as changes in structures, and administrative processes and practices (Ibarra, 1993). Examples of administrative innovations that were implemented include changes to operational protocols to improve customer service, creation of new administrative structures to improve emergency response, and implementing new technologies to streamline the flow of information. The tendency for

top management to lead administrative innovations is consistent with evidence from prior literature, which found administrative innovations to be in the domain of senior managers who initiate and implement such innovations in a top-down manner (Bantel and Jackson, 1989; Daft, 1978). Preliminary interviews with senior managers reveal that new ideas are rarely imposed without first consulting the opinions of executives affected by the new idea. As senior management believes in consistency in service delivery, new ideas are collectively evaluated by those concerned and then implemented across the firm.

As our study focuses on senior managers' innovativeness, we collected our data from all the directors in the firm, who are the highest ranked executive in each work-unit. The firm has a total of 88 work-units, where the number of work-units in each entity ranged from 8 to 27, averaging 15 work-units per entity in the firm. We sent the director of each department a paper questionnaire and a self-addressed envelope to return the completed questionnaire to the researchers. Due to non-response, we achieved an overall response rate of 87.5% ($n = 77$). Of the respondents, 82% of them are male. On average, the respondents have worked in the firm for 15 years.

Measures

Managerial Innovativeness. Following Van de Ven's (1986, p. 590) definition of innovation, we measured managerial innovativeness by asking managers to nominate other managers whom they perceive "can formulate creative ideas and are able to launch or implement these new initiatives." Using a roster method, managers were provided with a list of equivalently ranked managers, and asked to place checks next to names of other managers whom they consider to be innovative. We relied on managerial nominations to evaluate the innovativeness of each manager for two reasons. First, the focus of our study on the top ranking executives precludes the use of superiors as a separate source to rate individual innovativeness. The hierarchical rank above the directors sampled in our study is the chief

executive officers of different entities who were not available to participate in our study. Second, peer managers can provide a reliable indication of one's innovativeness (Howell and Higgins, 1990) because they are likely to have witnessed or experienced how their peers have performed in initiating and pushing through new ideas. We chose to use the nomination approach, as opposed to asking managers to evaluate each of their peers, so as to reduce survey fatigue and increase the response rate. We computed managerial innovativeness (*Innovativeness*) by the number of innovation nominations received by a manager.

Network sparseness and network in-degree centrality. Network sparseness is defined as the extent to which contacts of a manager are connected to one another and network in-degree centrality is defined as the extent to which managers are the targets of other managers' ties. We used the sociometric question from Rodan and Galunic's (2004) study to operationalize managerial advice network because their question was adapted for the work of managers. Managers were given a list of names of their peers in the firm, and asked, "Getting your job done on a daily basis as a manager often requires advice and information from others. Who are the key people whom you regularly turn to for information and work-related advice to enhance your ability to do your daily job in the last 12 months?" Managers were asked to indicate – for each individual whom they go to for advice – the extent to which they go to that individual for advice on a 5-point Likert scale. An advice tie is deemed to exist from manager *i* to manager *j* if the former indicates that he/she goes to *j* for advice on a rating of at least 3 (the midpoint of the scale). Managers can nominate as many peers as they deem appropriate.

Using the same approach as Rodan and Galunic (2004), *Network Sparseness* is measured as $(100 - \text{density})$. Density is computed as the ratio of the number of ties among a manager's contacts to the maximum number of possible ties among those contacts (Wasserman and Faust, 1994). We used both incoming ties and outgoing ties to compute

Network Sparseness as both types of ties are potential sources of information. *Network In-degree Centrality* is measured by the ratio of incoming advice ties to the manager to the maximum possible number of incoming advice ties in the network (Lam and Schaubroeck, 2000). This is because prior research has established that it is incoming rather than outgoing advice ties that are conduits of one's influence. Both measures are computed using UCINET VI (Borgatti, Everett and Freeman, 2002).

Boundary-spanning variables. We adapted Ancona and Caldwell's (1992a) measures of scout and ambassador activities. *Scout* activities were measured by asking managers to rate the extent to which the manager performs the following activities for their work-unit: (1) "I find out what other units in the <FIRM> are doing on similar projects."; (2) "I scan the environment inside of the <FIRM> for expertise/ideas related to my unit's work"; and (3) "I collect technical or operational information/ideas from individuals outside of my unit." *Ambassador* activities were measured by asking managers to rate the extent to which the manager performs the following activities for their work-unit: (1) "I promote or "talk up" the unit to people outside of my unit"; (2) "I persuade others to support the unit's decisions" and (3) "I acquire resources (e.g. money, new members, equipment) for the unit". A 5-point Likert scale was used (1=not at all; 3=to some extent; 5=to a very great extent). The Cronbach alphas for *Scout* and *Ambassador* are .81 and .71 respectively, which are above Nunnally's (1967) recommended threshold of .70.

Control variables. We included demographic variables such as *Gender* (male = 1, female = 0) and *Age* (1=less than 20 years old, 2 =20–29 years old, 3=30–39 years old, 4=40–49 years old, 5=50–59 years old, 6=more than 60 years old) because they have been shown to be associated with innovation adoption (Kimberly and Evanisko, 1981; Sharma and Rai, 2003; Young, Charns and Shortell, 2001).

Technical knowledge can influence individual innovativeness by affecting one's depth of technical understanding, which is important for generating insightful ideas. Political knowledge, on the other hand, affects one's innovativeness by increasing one's familiarity with the organizational culture and goals of different departments, which is important for strategizing about how to galvanize support (Obstfeld, 2005). Thus, we measured each manager's *Education* (coded as a seven-level variable, ranging from 1 = high school level degree to 7 = doctorate level degree) and *Unit Tenure* (measured by the number of years managers have worked in their unit) to capture each manager's accumulated technical knowledge. In addition, managerial organizational tenure (*Org Tenure*), measured by the number of years a manager has worked in the organization, is included as a control to capture managers' political knowledge of the organization.

Managers who have greater formal authority or power in the organization can be more innovative when they exert their influence to obtain more resources or persuade others to support their new initiatives (Ibarra, 1993). Given that managers in our sample are of equivalent hierarchical rank in the organization, we operationalized managerial formal source of power through managers' span of control in their work-unit. This is measured by *Direct Reports* of managers (coded as an eight-level variable where 1 = "0 to 5" and 8 = "more than 200") which indicates the number of individuals who report directly to a manager.

Managers from different entities may also have different opportunities and need for innovation. Hence, we tested for differences in managerial innovativeness for managers across different entities. Using a one-way ANOVA test, we found that affiliation to different entities did not significantly impact their innovativeness ($F = .64, p = .67$), thus we did not include entity dummies in our analyses.

Analytical Tests

As our dependent variable is a count variable, ordinary least squares regression is not an appropriate statistical analytic method since the use of a count variable can lead to biased standard errors (Coxe, West and Aiken, 2009). Assumptions of homoscedasticity and normally distributed errors are violated when a count variable is the dependent variable in the linear regression model. The Poisson distribution is usually appropriate to model count variables, unless there is overdispersion in the data, that is, when the variance in the observed count data is greater than its mean. When there is overdispersion in count data, the Negative Binomial regression is superior to the Poisson regression in predicting count variables (Cameron and Trivedi, 1998). The result of the Lagrange Multiplier test ($Z = 4.21, p < .001$), which assesses whether the over-dispersion parameter in the negative binomial model is significantly greater than zero (Cook and Weisberg, 1983), demonstrates that the negative binomial model will provide a significantly better fit than the standard Poisson model. Interaction terms are tested using the procedures recommended by Aiken and West (1991), with the component variables standardized prior to computing the interaction terms.

RESULTS

Table I reports means, standard deviations, and intercorrelations among the variables. In Table II, we report descriptive statistics of managerial innovativeness and key independent variables by the different entities in the firm.

 Insert Tables I and II about here

Table III displays the negative binomial regression results of our hypothesized model. As reported in Model 1 of Table III, gender ($\beta = -.74, p < .05$) and age ($\beta = -.58, p < .001$) are control variables that are significantly associated with managerial innovativeness. Males and younger managers are significantly more innovative in the organization. In Model 2, we added the social network attributes. Managers who have sparser advice networks ($\beta = .27, p$

< .01) and are more central in the advice network ($\beta = .39, p < .01$) are significantly more innovative. In Models 3 and 4, we tested the interaction terms of social network variables with the boundary spanning variables in the regression models. Contrary to expectation, scout activities did not moderate the relationship between network sparseness and innovativeness (Model 3, $\beta = -.04, p > .05$). Hypothesis 1 is not supported.

The interaction term of network in-degree centrality and ambassador activities is positive and significantly associated with managerial innovativeness (Model 4, $\beta = .27, p < .05$). This interaction term remained significantly related to managerial innovativeness when all interaction terms are added (Model 6: $\beta = .33, p < .05$). We probed the interaction effects based on the recommendations of Aiken and West (1991). Figure 1 plots the relationships between network in-degree centrality and managerial innovativeness when ambassador activities are low (one standard deviation below mean) and high (one standard deviation above mean). Our test of simple slope reveals that when ambassador activities are high, the positive relationship between network in-degree centrality and managerial innovativeness is significant ($t = 3.83, p < .001$); but when ambassador activities are low, network in-degree centrality is not significantly related to managerial innovativeness ($t = .65, p > .05$). This pattern of findings supports Hypothesis 2, since the positive relationship between network in-degree centrality and managerial innovativeness is stronger when ambassador activities are higher.

Model 5 reports the test of interaction of network sparseness and network in-degree centrality on managerial innovativeness. Hypothesis 3 is not supported since the interaction term is not significant (Model 5: $\beta = -.17, p > .05$). The pattern of findings remains the same when all the interaction terms are entered in Model 6.

 Insert Table III and Figure 1 about here

DISCUSSION

Theoretically, network sparseness and network centrality emphasize different causal mechanisms on individual innovativeness, with diverse information access and influence as the key mechanisms accounting for the advantages of sparse social network and central social network on innovation respectively. We advance this perspective by exploring the extent to which behavioral actions are needed to mobilize information and influence accessed through social networks, and the extent to which such information and influence would mutually reinforce to enhance managerial innovativeness. By exploring the contingent relationships of network sparseness and centrality, our study makes two main contributions to the social network perspective on managerial innovativeness.

First, our study joins a growing body of research which demonstrates that the realization of social network advantages is contingent on individual characteristics (e.g., Adler and Kwon, 2002; Anderson, 2008; Baer, 2010; Baer, 2012; Reinholt et al., 2011; Zhou, Shin, Brass, Choi and Zhang, 2009). Distinct in our approach is our focus on behavioral strategies to appropriate resources, as opposed to prior research that focuses on motivation to act or ability to act. This is in line with Stevenson and Greenberg (2000, p. 653), who noted that “position reveals the potential for action, but potential can be used or not used in a variety of ways”. Our findings suggest that actions matter in realizing potential resources in social networks for innovation. However managerial actions to realize social network resources matter more in some circumstances than others. A high level of ambassador activities is necessary for social network centrality to positively impact managerial innovativeness, but scouting activities did not accentuate the effect of sparse networks on managerial innovativeness. The evidence therefore suggests a more nuanced conceptualization of the role of individual agency on actualizing potential network advantages, shifting the theoretical lens from *does* agency matter to *when* agency matters.

A plausible interpretation is that action to use information is endogenous to managers who cultivate a sparse advice network, but action to use influence is not endogenous to managers in central advice network positions. Individuals in sparse advice networks might already be motivated to exploit network advantages inherent in these networks such that the occupation of such a network is an indicator of motivated attention towards opportunities. Considering the pressure toward clustering of positive relations and tendency for bridge relations to decay (Burt, 2002), there is suggestive evidence that proactive effort is needed to maintain sparse networks. Hence, we may expect the maintenance of sparse advice networks to be the intentional efforts of managers to obtain new and diverse information. In this regard, occupation of a sparse advice network already suggests heightened attention toward opportunities and thus action to leverage the information for innovative purposes. Relative to sparse advice network, positions of in-degree centrality in the advice network are less subject to managerial strategic maneuvering since they are achieved as a result of others' advice-seeking activities. Further, they are also affected by the formal division of labor within the organization (Ibarra, 1993). To the extent that central advice positions can be inherited, potential influence advantage can come to a passive manager unwilling to act on it. As such only proactive managers who engage in ambassador activities are able to activate the potential influence in central positions for sociopolitical support. Overall, our research draws attention to the role of actions in realizing social network advantages for innovation, and points to the need for future research to explore when behavioral strategies would condition the effect of social network advantages.

Second, by exploring the complementary relationship of network sparseness and centrality, we also extend the social network perspective by clarifying the inter-relationships between these two social network attributes on innovativeness. While direct relationships of these two network attributes on innovation are well-established, few studies (see Nerkar and

Paruchuri, 2005, for exception) have explored their joint effect. Because both network attributes emphasize different resource pathways to enabling individual innovativeness, it is theoretically valuable to explore the extent to which diverse information and influence accessed from social networks will mutually reinforce to optimize managerial innovativeness. Our findings reveal that while advice network sparseness and network centrality have independent positive associations with managerial innovativeness, they do not jointly interact to enhance managerial innovativeness. In this light, both social network advantages appear to offer distinct, alternative social network routes to achieving managerial innovativeness. Diverse information and signals of influence from network positions do not mutually amplify to enhance managerial innovativeness.

This seems to contradict Nerkar and Paruchuri's (2005) study, which found that centrally positioned inventors' knowledge are more likely to be used by other inventors when they also cultivate non-redundant collaborative ties. However, it is important to note that the inventors in Nerkar and Paruchuri's study are involved in technological innovations whereas the context of our study is managers involved in administrative innovations. Difference in the type of innovations examined may account for the variation in findings, a point noted by others in prior research (Ibarra, 1993; Kimberly and Evanisko, 1981). Specifically, we suspect that the greater uncertainty surrounding technological ideas, given that they implicate not only internal procedural uncertainty but also external market uncertainty, accentuates the need for not only ideas that signal quality but also ideas that have been enriched by diverse sources of information. To the extent that administrative innovations involve less uncertainty, there is less need for diverse information and influence to amplify their independent effects in order for managers to be successful in their innovation attempts.

In the case of technological innovations, or in the R&D setting, scientists and inventors are competing in the external market for successful innovations. Relative to

administrative innovations, the sample of potentially relevant information that can impact the success of new initiatives is greatly expanded. In addition to considering potential internal operational requirements, development and implementation of technological ideas also involve contemplating about external customer needs, competitors' strategies as well as marketing channels in order for them to be successful in the external marketplace. Given these additional considerations, we can imagine that the level of uncertainty surrounding technological innovations is multiplied compared to that of administrative innovations; increasing the likelihood of negative evaluations by stakeholders (Mueller et al., 2012). Hence, inventors involved in product innovations need to not only broker unconnected groups to have unique access to a variety of information (Hargadon and Sutton, 1997) but also occupy a central position to signal the credibility of the uncertain idea (Nerkar and Paruchuri, 2005). Uncertainty that surrounds administrative innovations, on the other hand, is comparatively lower since development and implementation of new procedures or systems are limited to internal organizational constraints. This can lower the threshold of "acceptability" in that good ideas – born out of diverse information via sparse networks – need not be bolstered by the inventor's status in the firm for them to be adopted. Similarly, ideas which are perceived to be of high quality due to the inventor's central network position can be sufficient to overcome stakeholders' feelings of doubt or skepticism. This pattern of findings alerts us to pay more careful attention to how the types of innovation and the nature of uncertainty that they implicate may affect the effects of social network attributes on innovativeness.

Limitations

Several limitations of this study need to be acknowledged. First, we relied on evaluations by managers' peers as our measure of overall managerial innovativeness, as opposed to examining the performance of managers in specific innovation projects. Our

measurement choice was guided by two main considerations. First, the context of our study was not a technically-oriented research and development firm. Although senior executives in our study introduced new initiatives (e.g., new information systems, new services, new work processes), their day-to-day work was not to oversee innovation projects. Hence, a measure focused on the specific innovation projects of senior executives was neither relevant nor practical. Second, as highlighted by Howell and Higgins (1990), we believe that the peers of senior executives in our study were an accurate source to evaluate their innovativeness because they are involved in the collective discussion and approval of new initiatives for the firm. Notwithstanding, we recommend that future studies in this area consider both measures of managerial innovativeness so that cross-validation can be performed.

Second, our findings are also limited by the cross-sectional nature of our data. There is a possibility that managers who are evaluated as more innovative will be more sought after by their peers, such that the former becomes more central in the managerial advice network. Our lack of longitudinal data certainly precludes the testing of this causal relation. As a supplementary test to examine whether the data is better explained by a relation from network in-degree centrality to innovativeness or from innovativeness to network in-degree centrality, we used a variable which temporally precedes both network in-degree centrality and innovativeness to establish whether network in-degree centrality or innovativeness is the more plausible intervening variable. The more plausible intervening variable is then more likely to causally precede the other variable. We used managerial education as the variable that causally precedes both network in-degree centrality and innovativeness since the knowledge that manager accumulates through their education is likely to influence the degree to which others go to them for advice and their ability to create new ideas in the firm.

We ran two mediation negative binomial models where both dependent variables are count data. In the first model, network in-degree centrality is hypothesized to mediate the

relation between education and innovativeness, and in the second model, innovativeness is hypothesized to mediate the relation between education and the number of individuals who go to the manager for advice. Findings from the first model indicate that education was marginally significantly associated with innovativeness ($\beta = .25, p < .10$) and became non-significant when network in-degree centrality was included in the model ($\beta = .19, p > .10$). Network in-degree centrality was positively and significantly associated with innovativeness ($\beta = .08, p < .001$). In the second model, education was marginally significantly associated with the number of people who go to a manager for advice ($\beta = .10, p < .10$) and became non-significant when innovativeness was included in the model ($\beta = .06, p > .10$). Innovativeness was positively and significantly associated with the number of people who go to a manager for advice ($\beta = .03, p < .001$). Although both models indicate the plausibility of both network in-degree centrality and innovativeness as intervening variables, the first model provides a better fit than the second model (AIC for first model = 416.17; AIC for the second model = 429.30)². As such, the more plausible intervening variable is network in-degree centrality, providing some support to our theorized relation from network in-degree centrality to innovativeness.

Finally, our focus on a single firm may limit the generalizability of our study. The type of innovations in our sample is administrative in nature such as the creation or adaptation of organizational routines and policies. As we have pointed out, there can be significant differences between technological and administrative innovations such as complexity of the knowledge transferred as well as the extent of uncertainty surrounding the two types of innovation that influence how social network attributes might impact their success. Sparse advice networks may matter more than dense social networks for administrative innovations since knowledge flows that inspire innovation tend to be less complex in content. Relatedly, we did not find a significant interaction effect between

network sparseness and network centrality, which diverge from Nerkar and Paruchuri's (2005) study of inventors involved in technological innovations. As such, our findings need to be interpreted in the context of administrative innovations, and also suggest more careful distinction of the two types of innovation in interpreting social network effects on innovativeness.

Practical Implications

Our study highlights that managers may employ alternative social structural routes to create and promote new practices within their organizations. A sparse advice network and central position in the advice network among peers are both important social network attributes that can be utilized for administrative innovations. This opens the possibility for more managers to be involved in administering new routines since managers privileged in either sparse advice networks or central advice positions can be encouraged to participate. More broadly, the importance of social connectedness among peer managers – albeit in different ways for advice network sparseness and network centrality – in enhancing managerial innovativeness highlight the value of deep involvement in boundary-crossing advice networks within the firm. Both seeking for and responding to information from colleagues outside of one's work unit require time and effort, but to the extent that a key role of managers is about improving and innovating on the way things are accomplished within the firm, our study reveals that such investment in advice exchange across unit boundaries is valuable. Further, we found that managers who are more active in promoting their initiatives and lobbying for resources are more effective at harnessing the latent influence in their central positions. This highlights to managers the value of proactive influence strategies in materializing the power that comes with their central position in the advice network.

CONCLUSION

Our study draws attention to the contingent effects of social network sparseness and centrality on managerial innovativeness. In so doing, our research clarifies the relationships of two important social network attributes on managerial innovativeness and, also sheds new light on how managerial action matters in realizing social network advantages for innovative ends. We found that advice network sparseness and advice network centrality had independent relationships with managerial innovativeness suggesting diverse information and influence offers alternative resource pathways toward enabling successful administrative innovations. By joining social network theory of innovativeness with the boundary spanning perspective, our study also highlights the importance of identifying when behavioral strategies matter in utilizing resources afforded by advantaged social network positions.

NOTES

1. In-degree centrality is one of three forms of network centrality proposed by Freeman (1979), the other two being betweenness and closeness centrality. Individuals high in betweenness centrality are expected to enjoy control over resource flow since they sit on pathways through which information flows among others in the network. Individuals high in closeness centrality are best positioned to quickly access everyone in the network as they have the shortest paths to others in the network. We focus on in-degree centrality as it was found to be the strongest predictor of others' perceptions of power (Brass and Burkhardt, 1993).
2. As the two models are not nested, model fit is assessed using Akaike's information criterion (AIC) (Coxe, West and Aiken, 2009). The smaller the AIC, the better the model fit.

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Table I - Descriptive Statistics of Variables

	Mean	s.d.	1	2	3	4	5	6	7	8	9	10
1. Gender	.82	.39										
2. Age	4.03	.73	.06									
3. Education	5.22	1.06	.10	-.30**								
4. Org Tenure	17.05	9	-.12	.33**	-.35**							
5. Unit Tenure	3.72	3.89	-.19	.21	-.03	.05						
6. Direct Reports	3.79	2.47	.10	-.04	.01	-.08	-.12					
7. Network in-degree centrality	10.29	5.87	-.01	-.24*	.18	-.20	.07	.03				
8. Network Sparseness	58.21	17	-.17	-.07	.16	-.03	-.13	-.02	.18			
9. Scout	3.36	.73	-.15	-.04	-.18	.05	-.05	-.04	.16	.41***	(.81)	
10. Ambassador	3.71	.68	-.11	.01	-.26*	.20	.07	.04	-.02	.18	.53***	(.71)
11. Innovativeness	5.35	6.38	.18	-.31**	.21	-.12	-.08	.10	.42***	.21	.14	.10

*** $p < .001$, ** $p < .01$, * $p < .05$

Reliability scores (Cronbach alphas) are in parentheses.

Table II – Descriptive Statistics of Managerial Innovativeness and Key Independent Variables by Different Entities in the Firm

	Entity 1	Entity 2	Entity 3	Entity 4	Entity 5	Entity 6
Innovativeness	2.71 (3.73)	4.21 (2.39)	5.13 (5.94)	5.25 (5.90)	5.28 (8.33)	7.09 (7.34)
Network in-degree Centrality	3.76 (.50)	8.74 (3.12)	12.01 (5.24)	7.57 (2.79)	15.13 (5.07)	9.75 (6.77)
Network Sparseness	6.93 (11.74)	57.7 (15.25)	73.81 (9.89)	48.10 (14.37)	45.78 (12.92)	65.83 (17.23)
Scout	3.17 (.68)	3.39 (.80)	3.80 (.79)	2.95 (.78)	3.30 (.74)	3.45 (.60)
Ambassador	3.57 (.25)	3.71 (.77)	3.50 (1.14)	3.88 (.62)	3.59 (.62)	3.85 (.61)

Table III - Negative Binomial Regression Models

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Network Variables						
Network in-degree Centrality		.39** (.14)	.39** (.14)	.39** (.15)	.42** (.15)	.45* (.17)
Network Sparseness		.27** (.10)	.22 (.12)	.18 (.13)	.24* (.12)	.22 (.13)
Moderating Variables						
Scout			-.01 (.13)	.01 (.14)	-.02 (.13)	-.04 (.14)
Ambassador			.22 (.12)	.19 (.11)	.23* (.11)	.24* (.10)
Interaction Variables						
Network Sparseness * Scout			-.04 (.09)			-.05 (.11)
Network in-degree Centrality * Ambassador				.27* (.11)		.33** (.11)
Network Sparseness * Network in-degree Centrality					-.17 (.12)	-.24 (.14)
Control Variables						
Gender	-.74* (.33)	-.80** (.27)	-.81** (.27)	-.79** (.25)	-.88** (.28)	-.88** (.27)
Age	-.58*** (.14)	-.41** (.13)	-.39** (.13)	-.39** (.13)	-.42** (.13)	-.42** (.13)
Education	.10 (.10)	.04 (.09)	.09 (.09)	.08 (.09)	.07 (.10)	.05 (.10)
Org Tenure	.01 (.01)	.00 (.01)	.00 (.01)	.00 (.01)	-.00 (.01)	-.01 (.01)
Unit Tenure	-.00 (.05)	-.03 (.04)	-.04 (.04)	-.07* (.03)	-.03 (.04)	-.07 (.04)
Direct Reports	.05 (.04)	.03 (.05)	.02 (.04)	.02 (.04)	.03 (.05)	.01 (.04)
Log Pseudo-Likelihood	-204.94	-197.42	-196.18	-194.58	-195.44	-192.91

*** $p < .001$, ** $p < .01$, * $p < .05$

Figure 1
Relationship between Network in-degree Centrality and Managerial Innovativeness
at Different Levels of Ambassador Activity

