SOCIAL YET CREATIVE: THE ROLE OF SOCIAL RELATIONSHIPS IN FACILITATING INDIVIDUAL CREATIVITY

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Integrating creativity and social network theories, I explore the direct and interactive effects of relationship strength, network position, and external ties on individual creative contributions. Results from a study of research scientists suggest that weaker ties are generally beneficial for creativity, whereas stronger ties have neutral effects. I also found that centrality is more positively associated with creativity when individuals have few ties outside of their organization and that the combination of centrality and many outside ties is not optimal. I discuss the implications of these findings for creativity and social network research.

Although often desirable, individual creativity within organizations can arguably be difficult. Organizations, with their structures and rewards, may often stifle the creativity that has become increasingly valuable for firms, particularly in turbulent and uncertain times (Amabile, 1998). In keeping with creativity's practical importance, there has been a burgeoning interest by management scholars in understanding the factors in work contexts that constrain or facilitate individual creative contributions. This research complements the initial focus of creativity research on individual traits (see Barron and Harrington [1981] for a review) by focusing on facets of organizations and jobs. These facets have included the receipt of rewards (Eisenberger & Armeli, 1997), the evaluative context (Shalley & Perry-Smith, 2001), the complexity of jobs (Oldham & Cummings, 1996), and the use of goals (Shalley, 1995). Although critical motivational levers for organizations, these factors tend to emanate primarily from formal organizational systems and are less social in nature.

More social facets of the work environment have been given much less attention, but scholars have not totally ignored them. Two seminal theories of creativity propose that creativity is in part a social process (Amabile, 1983; Woodman, Sawyer, & Griffin, 1993). More specifically, factors in the work environment, such as supervisory support and social influences resulting from group interaction, are proposed to be important antecedents to creativity. In addition, research evidence suggests that accolades for creativity tend to be bestowed on those who study under highly creative types or who have been exposed to creative role models (Simonton, 1984). It also has been proposed that communication and interactions with diverse others should enhance creativity (e.g., Amabile, 1996; Ford, 1996; Woodman et al., 1993).

Although these ideas provide an important start to understanding the social context, they fall short of reflecting the complex social environment that workers experience. Within an organization, the current increased emphasis on teamwork and various forms of job sharing ensures that knowledge workers must interact with others to get their jobs done. Outside the organization, these individuals are likely to have broader bases of relationships in part because of the trend of changing employment. In terms of creativity, little is known about the roles of different types of work relationships, the pattern of relationships beyond direct ties, and the influence of relationships outside of the work context. If creativity is truly a social process, then focusing more explicitly on the social context should enhance understanding of what it takes to be creative in the highly interactive work environments that most workers experience. As Simonton asserted, "A successful 'social psychology of creativity' demands that the creative individual be placed within a network of interpersonal relationships" (1984: 1273). Prior to the recent conceptualization by Perry-Smith and Shalley (2003), the creativity

literature generally ignored relationship parameters addressed in social network theories (cf. Brass, 1995). The purpose of the present research was to address these gaps. More specifically, I used a social network lens to attempt to understand how social context relates to the creative contributions of individuals.

CREATIVITY FROM A SOCIAL PERSPECTIVE

Creativity, an individual-level construct, is the generation of novel and appropriate ideas, products, processes, or solutions (Amabile, 1983; Shalley, 1995). This set can encompass creative solutions to business problems, creative changes to job processes, and new technologies. The study of creativity, historically rooted in the traditions of psychology (Guilford, 1950; Taylor, 1964), is typically an effort to understand why some individuals are more creative than others and focuses on the cognitive and motivational processes that might help explain this discrepancy. In contrast, innovation research, particularly that which incorporates a social network frame, has been conducted at the organization level (e.g., Coleman, Katz, & Menzel, 1977; Rogers, 1983), with a focus on understanding the adoption or diffusion of certain innovations (cf. Burkhardt, 1994).

In this research, I specifically sought to understand the creative contributions of individuals versus the collective creativity of a group, project, or organization. Innovation-related research at the firm and group levels provides some suggestion that social relationships are important for creativity (e.g., Monge, Cozzens, & Contractor, 1992; Pelz & Andrews, 1966; Tushman, 1977); however, the assumption that creative drivers are the same at all levels may be simplistic and may incorrectly imply a compositional model of the creative process (Drazin, Glynn, & Kazanjian, 1999). Thus, researchers know little about how the social context affects individual thinking when it comes to the generation of creative ideas or solutions as evidenced by the relative creativity of work outputs.

According to Perry-Smith and Shalley's (2003) social perspective on creativity, the process through which social network parameters influence creativity can be linked with creativity-relevant cognitive processes and domain-relevant knowledge. A creativity-relevant cognitive process is any problem-solving approach that helps one come up with different alternatives, and it has been described as an individual's searching his or her mind and surroundings to generate potential responses (Amabile, 1983). Cognitive processes relevant to creativity involve remote association,

which is the ability to see connections between seemingly different concepts; divergent thinking, which is the tendency to present solutions that move away from established ways of doing things (Guilford, 1950; Mumford & Gustafson, 1988); and flexible thinking, which is the capacity to come up with different categories of responses to a single problem (Torrance, 1974). Although some people may have innately high levels of creativity-relevant skills, external factors, such as teaching and training, can also alter this dimension of the creative process (Basadur, Graen, & Green, 1982), as can instructions or goals to be creative (Shalley, 1995).

Similarly, contextual factors can affect domain-relevant knowledge. Domain-relevant knowledge is an individual's knowledge of facts, circumstances, and issues surrounding a given problem or area (Amabile, 1983). It involves technical expertise and the experience necessary to be able to come up with feasible solutions to a given problem. When individuals have more domain-relevant knowledge, the incidence of creative performance is enhanced (Mumford & Gustafson, 1988; Simonton, 1999) by an increased ability to generate potential solutions and to validate them to determine their appropriateness. For example, research in the marketing literature shows that product managers with more knowledge of a marketing environment produce more creative marketing programs (Andrews & Smith, 1996). Social interactions with others in a domain should enhance one's understanding of the area and facilitate the generation of approaches that are feasible and unique.

Weak and Strong Ties

Although there are a variety of ways to assess the different types of social interactions an individual may have, the concept of tie strength has been considered a basic characterization of social relationships (Granovetter, 1973). Given an individual's set of direct interactions, stronger relationships involve a high level of emotional closeness and relatively frequent interaction and reciprocity (Granovetter, 1973). These relationships have a variety of intuitive benefits, such as social support and trust (Krackhardt, 1992). However, weaker relationships, those involving comparatively low levels of closeness and interaction, may be particularly beneficial for creativity despite the intuitive "strength" of strong ties (Perry-Smith & Shalley, 2003).

In his seminal weak tie theory, Granovetter (1973) proposed that weak ties are more likely than strong ties to be nonredundant connections between two disparate social circles. For individuals,

this idea means that each weak tie may represent his or her sole connection to a particular social circle. Instead of being connected to multiple individuals in a clique, a person is likely to be connected with just one individual in this clique by the weak tie. In contrast, the strong tie is likely to be associated with a dense collection of redundant ties (Granovetter, 1973). In strongly tied networks, an actor will tend to receive the same information from different contacts, because this information will tend to travel over circular and redundant paths. In contrast, information traveling via a weak tie is more likely to originate from outside of one's immediate social circle. As a result, weaker connections may be associated with nonredundant information. This information may not necessarily be creative in nature, but is less likely to be repetitive.

Particularly relevant to creativity, this access to more nonredundant information should enhance domain-relevant knowledge (Glynn, 1996; Simonton, 1999). Domain-relevant knowledge is not necessarily premised on creative or novel information but reflects how much a person knows about a given area; it also is not necessarily detailed or highly complex but can be broad (Amabile, 1996; Mascitelli, 2000). The more nonredundant information a person receives, the greater his or her base of knowledge. Thus, weak connections with individuals in highly related domains should be associated with an enhanced knowledge base (Perry-Smith & Shalley, 2003). Given a problem or task, the individual with more weak ties can validate potential responses against implemented solutions used by his or her contacts. This exposure to nonredundant information provides a greater foundation for understanding the nuances of potential solutions, which may enhance creativity by facilitating cognitive recombinations and unusual connections (Mumford & Gustafson, 1988; Simonton, 1999).

Another way that weak ties may specifically facilitate creativity is that they are more likely to provide access to diverse perspectives. Strong ties are more likely to be between individuals who are similar on some dimension. Communication is easier with similar others, and their behavior is more predictable (Byrne, 1971). Weak ties, which involve lower levels of affect and interaction, are less contingent on similarities (Coser, 1975; Granovetter, 1982). Individuals with whom a focal individual has weaker contacts are likely to be different not only from the focal individual, but also from one another, since each weak tie is likely to represent a unique connection to a particular social circle. Taken as a whole, a person's collection of weak contacts should represent a heterogeneous collection of people with different backgrounds and ways

of doing things, and as a result, should provide access to a breadth of perspectives (Perry-Smith & Shalley, 2003). Background characteristics may be particularly meaningful indicators of divergent perspectives within organizations (Harrison, Price, & Bell, 1998), since selection criteria may minimize meaningful differences based on demographic characteristics.

The access to heterogeneous social circles weak ties provide should facilitate a variety of processes helpful for creativity (Perry-Smith & Shalley, 2003). The exposure to different approaches and perspectives should enhance important creativity-related cognitive processes such as divergent and flexible thinking (Coser, 1975; Granovetter, 1982). Exposure from weak ties may serve as a seed that causes a person to pursue previously unexplored directions or provides a spark that propels a person to integrate new ideas. In addition, an individual with many weak ties cannot easily, without reflection, make decisions that are consistent with the approaches and perspectives of all of his or her contacts. In this case, the individual is forced to think in broader terms and must combine these differing approaches in a unique way. Furthermore, weak ties facilitate autonomy, because an actor is less likely to strongly identify with one group but is instead more likely to define him- or herself apart from the diverse connections (Coser, 1975). Thus, the heterogeneity and nonredundancy expected of weak ties are two intervening variables that help explain why weak ties are associated with enhanced creativity.

Hypothesis 1a. The number of weak ties is positively associated with individual creativity.

Hypothesis 1b. Nonredundancy partially mediates the relationship between the number of weak ties and creativity.

Hypothesis 1c. Background heterogeneity partially mediates the relationship between the number of weak ties and creativity.

Although weak ties should facilitate creativity, because they are likely to be nonredundant connections and to provide access to heterogeneous perspectives, stronger ties, in contrast, may constrain creativity. Because strong ties are likely to be associated with dense networks of similar individuals (Granovetter, 1973), the relatively quick flow of redundant information through strong ties may further encourage the development of shared attitudes, opinions, and beliefs. In addition, the time required to reciprocate advice from stronger ties may detract from creative pursuits, which may undermine the focus needed for creativity (Csikszent-

mihalyi, 1996), and the ease and comfort level associated with the stronger relationship may limit the need to go to other sources (Hansen, 1999).

Furthermore, the closeness and affect of strong ties facilitates social influence pressures leading to conformity (Granovetter, 1973; Krackhardt, 1992), which is generally considered to hinder creativity by leaving little room for autonomy (Amabile, 1996). Although some research suggests that positive affect facilitates creativity (e.g., Isen, Daubman, & Nowicki, 1987; Madjar, Oldham, & Pratt, 2002), when positive affect is a result of interconnected and overlapping social interactions, the cognitive constraint and pressure for conformity may undermine any advantages of positive affect in isolation. This rationale is consistent with research suggesting that under some conditions, positive affect may not be best for creativity. In a field setting, George and Zhou (2002) found that positive mood was positively related to creativity, but only given certain conditions, and was negatively related to creativity given others.

Finally, the social support expected from strong ties is not generally expected to facilitate the initial development of creative ideas. A related line of research on creativity suggests that support for creativity in particular, whether coming from supervisors (Tierney & Farmer, 2002; Oldham & Cummings, 1996) or coworkers (Madjar, Oldham, & Pratt, 2002), may be helpful for creativity. Results of this work suggest that when supervisors encourage subordinates to come up with new ideas or serve as creative models, their subordinates will be more creative. However, this type of support is specific to being creative rather than providing more general social support and can come through weak or strong ties. In some settings, supervisors may desire and encourage creativity among their subordinates but may not have strong relationships with each. In other words, one could have a weak tie with someone who via his or her behavior encourages creativity but with whom a particularly close bond does not exist. Therefore, owing to the potential for conformity, the lack of exposure to heterogeneous perspectives, and the time constraints associated with strong ties, these ties are not expected to normally facilitate creativity.

Hypothesis 2. The number of weak ties is more strongly and positively associated with creativity than is the number of strong ties.

Network Centrality

The number and type of relationships do not explicitly capture a person's position within a greater social structure. Not only does each individual have direct relationships, but also, the individual and his or her relationships are embedded in a network of relationships. The social network literature suggests that position within an overall pattern of relationships, beyond direct ties, is also important (e.g., Brass, 1984; Ibarra, 1992). A network can be bounded so that it includes a group that is socially defined from an actor's perspective, such as an organization or division, or so that it includes actors with similar attributes (Laumann, Marsden, & Prensky, 1983). Within a given network, "closeness centrality" reflects the distance between an actor and all other actors in the network. An actor with high closeness centrality can access other members of the network via the lowest possible number of links. Thus, the actor is not too far removed from the majority of the other actors in the network, as is consistent with the intuitive notion of being in the center. It is important to note that centrality is not synonymous with having many strong ties. A central individual can have access to the rest of the network without the redundancy expected with strong ties.

Perry-Smith and Shalley (2003) proposed that actors with high closeness centrality are likely to feel more comfortable taking informed risks, assuming that their centrality is not so high that it becomes constraining. Compared to less central people, central individuals are more likely to be aware of whatever is going on in the network, through their access. In addition, they are more likely to be perceived as having high status (Ibarra, 1992). The access and status of central individuals should be commensurate with favorable perspectives and outlooks (Ibarra & Andrews, 1993) and perceptions of freedom and power (Brass, 1984). These perspectives should provide the confidence and personal discretion needed for calculated risk taking. Creativity involves risk, for example either in doing something unlike what has been done before or in presenting an approach that is unusual for the context.

In addition, the access closeness centrality facilitates also means a higher likelihood of being exposed to the various disparate social circles within the network. This exposure may facilitate thinking broadly and connecting unrelated areas. Central individuals may be less judgmental and more open-minded in considering and processing different approaches or ways of thinking. Individuals with high rank or tenure in an organization may also experience this freedom, but individuals can, by virtue of their centrality alone, experience the same comfort level with risk. Thus, I am proposing that

centrality has effects that go over and above those of rank or tenure.

Hypothesis 3. Closeness centrality is positively related to individual creativity.

Network Centrality and Outside Ties

Although a person may be on the periphery of an organization's network, he or she may have connections outside of the organization that stimulate creative thought. Outside connections can provide opportunities to be connected with people in related but different areas. These outside ties may equip a person with a wide range of response possibilities to draw on when developing solutions, enhancing creativity-related processes, and may stimulate divergent and autonomous thought processes. For example, in a qualitative study, product designers were considered to be on the periphery of a firm, but their peripheral position was argued to coincide with centrality in many networks outside of the organization that facilitated creativity (Sutton & Hargadon, 1996). A person with outside connections will not just apply known ideas from other areas to new areas, but these ideas will also expand the way he or she thinks about problems.

When outside ties are considered, a less central (peripheral) position in a network may not be the least desirable for creativity (Perry-Smith & Shalley, 2003). Since a peripheral actor is not firmly embedded in the network, he or she should be more able to recognize and attend to new, divergent ideas sparked by outside connections to different networks. These ideas can emerge without the constraints of worrying what key others will say or experiencing personal stress from potentially going against some accepted tenets of the network. Essentially, pressure from outside connections to conform may outweigh pressure from within the network, while the limited connection within the network should provide enough exposure within the domain for work to reflect the required degree of appropriateness. This reasoning suggests that when there is a large number of outside ties, centrality is expected to be less important for creativity. Thus, when individuals are on the periphery, it is desirable to also have many outside connections.

For the highly central individual, however, outside ties may be more detrimental to creativity than they are helpful. One risk of outside ties is that they can be inefficient and prone to distortion (Roberts, O'Reilly, Bretton, & Porter, 1974; Tushman, 1977). Individuals outside of a firm may reflect differing cultural norms and constraints, in addition to differing perspectives. Some level of this type of diverse orientation may facilitate creativity, but in the case of a highly central actor, he or she is receiving cognitive stimulation internally and is comfortable taking risks. In this case, external ties may create unnecessary noise and may distract from appropriate and valued novel contributions. Furthermore, this scenario could lead to stress from being pulled in too many directions—pulled both internally and externally—leaving a person less able to engage in creative thinking. It is possible that this person will be more of a catalyst for the creative ideas of others (Tushman, 1977), rather than a creator of new ideas. Thus, network centrality and outside ties will interact in such a way that outside connections will facilitate creativity for peripheral positions but will constrain creativity for central positions.

Hypothesis 4a. Closeness centrality with few outside ties is more positively associated with higher creativity than closeness centrality with many outside ties.

Hypothesis 4b. Low closeness centrality (peripheral position) with many outside ties is associated with higher creativity than low closeness centrality with few outside ties.

Hypothesis 4c. High closeness centrality with many outside ties is associated with lower creativity than high closeness centrality with few outside ties.

METHODS

I tested the hypotheses by studying researchers in two laboratories of an applied research institute, which I call "Labco," affiliated with a major university in the southeastern United States. Prior to data collection, I worked extensively with personnel in each lab to understand the research setting, the value placed on creativity, and the level of interaction, and to determine the appropriate individuals to be included in the survey. For example, after a variety of interviews and observations, I excluded both administrative staff and temporary personnel such as student assistants.

Labco was a multidisciplinary research center focusing on various technology areas ranging from information technology to aerospace engineering. In general, Labco's work had an applied bent with a focus on either discovery or invention, as well as a focus on addressing a predetermined need by solving a difficult problem. As one employee stated, "We are hired to make someone else's dream come true. We work on hard problems where miracles can happen. Our customers are looking for

things that haven't been done to solve the difficult problems." Given its character, this setting provided an interesting array of creativity.

In addition to valuing creativity, Labco had a very flat organizational structure with a fluid work structure. For example, one laboratory had only three formal levels, and a researcher could be the director on one project while at the same time working on another project for a different project director. In this setting, project clusters were overlapping and constantly changing and endured only as long as each particular project. The setting gave each individual an opportunity to work with a variety of others in the lab, across levels and divisions.

Furthermore, each lab within Labco had its own identity and could be considered an autonomous unit; very little interaction occurred *across* labs, and people typically remained within one lab for the duration of their careers. One researcher described the laboratories as "a confederation of independent states." Thus, I studied each lab as a closed network, considering within-network ties to be ties within one lab. Although only two labs were studied out of five, information about within-network ties was not excluded since each lab was a separate entity. Labs were excluded from this research primarily because their work was highly classified. In the two labs studied, employment was relatively stable, so the employees current at the time of the study should have reasonably approximated all potential actors.

I collected the data using a combination of a Web-based survey, third-party ratings, and archival records. A modified four-contact strategy was used as a means to distribute the survey and increase response rates (Dillman, 2000). Two days following an introductory note from the lab director, I distributed the survey via e-mail; two weeks later, I either sent a reminder note or telephoned. Finally, one month later, the lab directors sent a general note to thank those who had completed the survey and to ask those who had not completed it for their assistance. Individuals were also given the option of requesting a map of their network (87 percent requested this report).

The response rate for the survey was 82 percent for lab 1 (58 of 71) and 80 percent for lab 2 (51 of 64), for a total of 81 percent (109 of 135). This rate is consistent with the response rates of between 65 and 90 percent typically reported in the social network literature (Stork & Richards, 1992) and compares very favorably with response rates in the creativity literature of 55–75 percent (e.g., Gilson, Mathieu, Shalley, & Ruddy, 2005; Zhou & George,

2001). Partial information was available for pairs in which at least one member responded (96%).

The final number of cases used for analyses was 97 (72 percent of the sample) because of missing data. The Web survey was designed so that respondents could skip questions to protect their human rights as participants. Characteristics of nonrespondents and respondents were generally similar. There were no significant differences in the distribution of education level ($\chi^2[2] = 4.98$, $p > .05$), creativity ($\chi^2[4] = 6.58$, $p > .05$), or the number of times a person was selected as a contact by others ($\chi^2[2] = 4.24$, $p > .05$). Differences involved tenure ($\chi^2 = 17.73$, $p < .01$): individuals with less than five years of tenure were overrepresented.

Measures

To capture each individual's set of contacts, I asked respondents, "Thinking back over the past two years, with whom do you communicate about work-related topics," an item that was modified from the work of Brass (1985) and Burkhardt (1994). This question was chosen because it is during general conversations that an individual may be exposed to concepts that may spark new ideas. This exposure may not necessarily be purposeful, as would be the case if one sought advice on a specific problem, but may occur during the course of a variety of types of conversations. I also wanted to capture informal ties that might be outside of people's formal work duties. For example, more formal ties that reflect the flow of work may be more consistent with differences in job characteristics that may require different types of interactions.

To aid responses, I provided a list of researchers working in the same lab to enhance recall and improve accuracy and reliability (Labianca, Brass, & Gray, 1998; Marsden, 1990). In addition, I did not restrict the number of names an individual could select. Free choice approaches such as this have been used to reduce measurement errors and enhance reliability (Marsden, 1990). After they had selected names in response to the first network question, respondents were asked to "please refer to the list of associates and add to your list anyone else that you communicate with about work-related topics, even those you interact with less frequently, more informally, or less extensively." I added this step to prime the respondents to include their weaker contacts, since pretesting revealed that respondents tended to stop adding names before including weaker contacts in responses to the first relationship question.

Weak and strong ties. Given the set of relevant contacts, I next wanted to assess the strength of

each relationship. A number of scholars (e.g., Hansen, 1999; Seibert, Kraimer, & Liden, 2001) have used this two-stage approach of first obtaining the relevant contacts and then obtaining measures of tie strength for these contacts. Tie strength was measured by assessing the closeness, duration, and frequency of each relationship (Granovetter, 1973). Respondents were asked, "How close are you with each person?" (1 = "acquaintance," 2 = "distant colleague," 3 = "friendly colleague," 4 = "good friend," 5 = "very close friend"). These anchors were modified from prior research (see Marsden & Campbell, 1984) on the baisis of pretesting. To assess duration, respondents were asked, "How many years has each relationship been in existence?" (1 = "less than 2 years," 2 = "2 to 5 years," 3 = "5 to 10 years," 4 = "more than 10 years"). The frequency approach to tie strength was measured by asking respondents, "How frequently do you communicate with each person on average?" (6 = "daily," 5 = "several times a week," 4 = "several times a month," 3 = "once a month," 2 = "several times a year," 1 = "less often").

With a few exceptions (Hansen, 1999; Wegener, 1991), researchers have typically used a single measure of tie strength, such as closeness (e.g., Lin, Ensel, & Vaughn, 1981; Seibert et al., 2001) or frequency (Granovetter, 1973; Nelson, 1989). Although Granovetter (1973) suggested these components of tie strength, he conceded that each may operate somewhat independently, and Marsden and Campbell (1984) provided evidence suggesting that closeness, frequency, and duration were not unitary dimensions. Although their data were biased toward strong ties, closeness was the strongest indicator in some cases, and duration was in others. As a result, it was not clear whether closeness, duration, and frequency should be combined or analyzed as three different dimensions. In this study, the reliabilities were too low to warrant combining (α = .55 in lab 1 and .59 in lab 2), so I used three separate measures.

Ties were categorized as either weak or strong; the number of weak ties and the number of strong ties were then counted. For closeness, strong ties were considered to be very close friends and good friends and weak ties to be acquaintances, distant colleagues, and friendly colleagues, a categoriziation consistent with extant research (Marsden & Campbell, 1984). For the duration measure, I counted any tie with a duration greater than ten years as a strong tie. I used this cutoff as employment in this setting was relatively stable, and ties of five to ten years' duration were too short to be considered strong here. Although I report results using the ten-year cutoff, for completeness, and

given that duration may be confounded with tenure, I also used the cutoff of five years to define strong ties; the pattern of results was the same. For the frequency measure, interaction daily or several times a weak was considered to represent a strong tie, a defininition consistent with the work of Nelson (1989), who considered strong ties as involving six or more contacts in an average week. Social network researchers have frequently used tie counts (e.g., Seibert et al., 2001) and "cut points" (e.g., Nelson, 1989) to categorize ties.

Centrality. Prior to calculating centrality, I dichotomized the tie strength values so that 1 reflected a reported relationship and 0 reflected no relationship. In addition, I symmetrized the $N \times N$ matrix of relationships by assuming that a tie existed if one member of a pair of actors reported a relationship. Although disagreement has been used to indicate unreliability, lack of reciprocity may also characterize weak relationships (Granovetter, 1973). Among the pairs that did not agree about the existence of a relationship, only 13.8 percent in lab 1 (1.6 percent of all possible pairs) and 5.7 percent in lab 2 (0.8 percent of all possible pairs) involved the reporting actor indicating a strong relationship. This pattern suggests that most instances of disagreement involved weaker relationships. Given the importance of weak ties for creativity, retaining these types of relationships in the data was critical. The reported similarity between respondents and nonrespondents also suggested that the use of the one-person decision rule was warranted (Stork & Richards, 1992).

Closeness centrality was measured as a respondent's average distance to other members of the network (Brass, 1984; Freeman, 1979) and was calculated with the following equation:

$$C_j = 1/(n - 1) \left[\sum_{i=1}^{n} d(p_i, p_k) \right],$$

where $d(p_i, p_k)$ is the path distance between actors i and j, and n is the total number of people in the network. Actor i's centrality reflects the number of links needed to reach every other actor in the network. Thus, the measure is the average distance to each actor in the network.

Outside ties. Respondents were asked in the survey, "Thinking back over the past year, who are the people outside of your lab with whom you discuss any range of work-related matters?" This question allowed me to obtain data on each respondent's complete set of direct contacts, including those within and outside of his or her lab. The outside tie measure is a count of the number of people listed in response to this question.

Creativity. To measure creativity, knowledgeable observers rated the creativity of each respondent's work. This type of measure has been widely used in creativity research (e.g., Oldham & Cummings, 1996; Shalley & Perry-Smith, 2001; Tierney et al., 1999) and provides a broad assessment of creative contributions. In this case, supervisors rated the creativity of their group members' work over the past two years using a five-item scale. In two cases, the division chiefs (one level above the project supervisors) provided ratings in the absence of supervisors. In total, 22 supervisors and 2 division chiefs provided ratings (12 in each lab), yielding supervisor ratings for 86 percent of researchers in lab 1 (61 of 71) and 98 percent in lab 2 (63 of 64) for a total of 92 percent. The number of respondents rated by each person ranged from 3 to 19. All raters responded to the question, "How characteristic is each of the following items of employee's work over the last 2 years" (1 = "not at all characteristic" to 5 = "extremely characteristic"). The items were modified from Tierney, Farmer, and Graen (1999) and Zhou and George (2001) after extensive collaboration and discussion with lab directors and other employees.

The five creativity items included new ideas and approaches to customer problems, new applications for existing technology, risk taking, radical new ideas, and novel long-term vision or application. An exploratory principal component factor analysis with varimax rotation supported one dimension for creativity with an eigenvalue greater than 1 and explaining 74.4 percent of the variance. Thus, the five items were averaged (α = .91).[1,2]

In a check on the credibility of the creativity ratings, the lab director and the division chiefs for each lab nominated the top ten people in their labs in terms of "overall original and innovative contributions." In the lab where the division chiefs also rated creativity, the division chiefs were asked to nominate approximately one month later. A total of 30 individuals were nominated, reflecting the set of those whose work is highly creative. A *t*-test (*t*[97] = −4.20, $p \leq$ .01) confirmed that the nominated group had significantly higher supervisor ratings of creativity ($\bar{x}$ = 3.8, s.d. = 0.77) than those who were not nominated ($\bar{x}$ = 3.0, s.d. = 0.81).

Background heterogeneity. Background heterogeneity was comprised of measures of tenure and functional background, which are both widely used to measure background differences (Williams & O'Reilly, 1998), obtained from human resource records. Functional background was each person's highest academic degree. Six categories were represented: electrical engineering, computer science/engineering, other engineering, business, liberal arts, and physical sciences. Tenure was categorized into low (less than 5 years), medium (5 to 15 years), and high (more than 15 years).

To assess the extent to which a participant's group of direct contacts represented a variety of different backgrounds, I used Blau's (1977) index of heterogeneity, which is defined as follows:

$$Heterogeneity = \left(1 - \sum p_i^2\right),$$

where p is the proportion of direct contacts in a particular category and i is the number of different categories represented.

For each participant, the number of direct contacts in each category was counted. Then, a heterogeneity score was calculated for each individual for both tenure and functional background. Finally, I averaged the two scores to get an overall level of background heterogeneity, since I was interested in the overall heterogeneity reflected in an individual's collection of direct contacts rather than in any particular background variable.

Nonredundancy. I measured the extent to which an individual occupied a structural position in the network that was associated with connections to otherwise disconnected others with "betweenness centrality" (Freeman, 1979). Betweenness centrality measures the frequency with which an individual falls between pairs of individuals in a network. Betweenness is a more global measure of redundancy and structural bridges than other measures of redundancy, such as constraint (Burt, 1992), because it takes an entire network into account (Brass, 1992; Krackhardt, 1990). Since I had full network data available, I chose the betweenness approach rather than the more local approaches, such as constraint, used by others (Burt, 1992; Seibert et al.,

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[1] Factor loadings for creativity were as follows: new ideas and approaches to customer problems, .89; new applications for existing technologies, .83; risk taking, .84; novel long-term vision or application, .89; and radical new ideas, .86.

[2] I assessed the distinction between creativity and general performance using five performance appraisal items obtained from the company's human resources office for a subset of 65 respondents. I submitted the creativity and performance items to an exploratory principal component factor analysis with varimax rotation, and the analysis revealed that creativity and performance reflected two distinct dimensions with eigenvalues greater than 1 that together explained 65.9 percent of the variance. Example items for performance included: (1) success in funded programs, (2) recognized contributions to development of state, region, or nation, and (3) identification of sponsors and follow-through.

2001). For completeness, I also conducted the analysis substituting the local constraint measure for betweenness, and the results were largely unchanged.

Control variables. The control variables rank, tenure, and education were obtained from company records. I created the *rank* variable by assigning sequential numbers to each level ("research engineer/scientist I" = 0, "research engineer/scientist II" = 1, "senior research engineer/scientist" = 2, "principal research engineer/scientist" = 3). *Tenure* was the number of years a person had been employed by the lab, and *education* was coded 0, "no college degree"; 1, "bachelors degree"; 2, "master's degree"; and 3, "Ph.D." *Department,* measured with a set of dummy variables, was included as a means of accounting for differences in types of work that may influence creativity. Department also captured lab effects, since departments 1 and 2 reflected one lab and departments 3 and 4, the other.

Intrinsic motivation is widely theorized to facilitate creativity and was controlled for to rule out a plausible alternative explanation. Four items, modified from extant research (Amabile, Hill, Hennessey, & Tighe, 1994; Tierney et al., 1999), were averaged (α = .71). Example items included, "I enjoy coming up with new ideas for technologies or projects," and "I like my work to provide me with opportunities to increase my knowledge and skills."

Analysis

The hypotheses were tested via ordinary least squares (OLS) regression. First, the Durbin-Watson test revealed (using a .01 level of significance) that the level of autocorrelation was not substantial, and *d* ranged from 1.85 to 2.13. In addition, I performed an analysis of covariance to assess the effect of supervisor on creativity, since some individuals were rated by the same supervisor. After deleting groups smaller than five to obtain relatively consistently sized groups, I obtained results suggesting no significant differences among supervisors in how they rated creativity ($F[3,57]$ = 2.01, p > .05). Second, heteroscedasticity was examined by inspection of the partial scatter plots of residuals, which suggested that a serious violation of equal variances did not exist. However, the partial scatter plot involving the department dummy variables revealed an outlier. This case was traced to a participant who was not in a particular department and was at the same level as the division heads. There was only one individual in this "department." Removing this participant from the analyses did not change the results.

The two labs were pooled for all analyses. The results of Chow's *F*-test (Chow, 1960) suggested that the relationships between the independent variables and creativity were not significantly different between the two labs ($F[7,70]$ = 0.66, p > .05). I also performed the regression analyses with lab controlled for, in addition to the other control variables. However, lab could not be entered simultaneously with the department dummies, since the department dummies reflected a perfect linear combination of lab, and maximum tolerance limits were reached. Nevertheless, the results were the same when lab was controlled rather than department.

All of the control variables were entered (model 1) followed by the respective independent variables and product terms. The alternative measures of tie strength were tested in distinct models. For example, model 2 tested the effect of weak and strong ties, with 2a testing closeness, 2b testing duration, and 2c testing frequency. Models 3 (a, b, c) tested for mediation by adding background heterogeneity and nonredundancy, and models 4 and 5 tested the direct and interactive effects of centrality.

Since several of the variables were highly correlated, I reviewed variance inflation factors (VIFs) to assess the level of multicollinearity after first mean-centering the base variables prior to calculating the multiplicative interaction term (Aiken & West, 1991). Chatterjee and Price (1991) suggested that multicollinearity is not severe when the largest VIF is not greater than 10 and the mean of all VIFs is not considerably more than 1. Multicollinearity did not appear to be a substantial problem in models 1 through 3. For models 4 and 5, VIFs for centrality approached 10, and mean VIFs were 3.27 and 3.20, respectively. The primary drivers of the high VIFs were weak ties and nonredundancy, so I performed the analysis with and without these two variables, finding the effects of the independent variables on creativity were unchanged.

RESULTS

Table 1 reports the Pearson's correlations among all variables. Each of the weak tie measures was significantly correlated with overall creativity ($p \leq$ .01), whereas the number of strong ties was not. The correlation between closeness centrality and overall creativity was also positive and significant ($p \leq$ .01). Finally, the correlation between outside ties and overall creativity was not significant. Among the control variables, education, rank, and intrinsic motivation were significantly related to creativity ($p \leq$ .05).

TABLE 1

Means, Standard Deviations, and Correlations[a]

Variable	Mean	s.d.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1. Overall creativity	3.17	0.91																	
2. Weak ties (closeness)	13.78	9.44	.27**																
3. Strong ties (closeness)	3.67	3.93	.13	.22*															
4. Weak ties (duration)	15.03	9.65	.35**	.91**	.39**														
5. Strong ties (duration)	2.42	4.32	−.07	.35**	.51**	.11													
6. Weak ties (frequency)	11.96	8.92	.30**	.93**	.42**	.88**	.45**												
7. Strong ties (frequency)	5.42	3.77	.11	.54**	.60**	.61**	.36**	.43**											
8. Nonredundancy	44.98	79.03	.21*	.67***	.60***	.66***	.53***	.75***	.53**										
9. Background heterogeneity	0.56	0.14	.31**	.42**	.11	.42**	.06	.39**	.25*	.25*									
10. Centrality	54.70	6.91	.34***	.75***	.62***	.76***	.51***	.83***	.59***	.76***	.30**								
11. Outside ties	6.77	4.53	.10	.21	.02	.21	.02	.13	.24*	.06	.21	.17							
12. Intrinsic motivation	5.22	0.60	.20*	−.04	−.08	−.04	−.07	−.03	−.11	−.03	−.16	.02	.09						
13. Education	1.79	0.66	.21*	.01	.09	−.05	.23*	.09	−.09	−.02	.07	.18	.06	.06					
14. Rank	1.05	0.95	.21*	.16	.12	.03	.40**	.22*	−.01	.15	.13	.33**	−.01	.06	.71**				
15. Tenure	7.72	7.77	−.01	.23*	.32**	.05	.68**	.34**	.11	.38**	−.08	.43**	−.16	−.15	.19	.37**			
16. Department 1	0.35	0.48	.10	.30**	.02	.32**	−.05	.24*	.22*	.13	.17	.16	−.02	−.19	−.30**	−.29**	.05		
17. Department 2	0.12	0.33	−.21*	−.03	−.06	−.12	.15	−.03	−.05	.02	.19	−.11	.02	−.19	.12	.08	.13	−.28**	
18. Department 3	0.32	0.47	.21*	−.08	−.02	−.03	−.12	−.05	−.07	−.07	.14	.11	.07	.18	.32**	.34**	−.22*	−.50**	−.26*

[a] Correlations are based on n = 97, except for outside ties, where n = 83.

* p < .05

** p < .01

TABLE 2
Results of Regression Analysis for Creativity[a]

Variables	Model 1	Model 2a	Model 3a	Model 2b	Model 3b	Model 2c	Model 3c	Model 4	Model 5
Rank	0.11	0.06	0.02	0.11	0.08	0.06	0.03	0.00	0.04
Tenure	−0.01	−0.08	−0.03	0.10	0.14	−0.09	−0.05	−0.16	−0.24
Education	0.15	0.17	0.21	0.18	0.21	0.17	0.20	0.26	0.24
Department 1	0.32*	0.23	0.12	0.17	0.06	0.22	0.12	0.25	0.23
Department 2	−0.05	−0.06	−0.19	−0.06	−0.19	−0.07	−0.19	−0.14	−0.13
Department 3	0.23	0.20	0.07	0.15	0.02	0.19	0.07	0.07	0.12
Intrinsic motivation	0.19	0.18	0.20*	0.19	0.20*	0.17	0.19	0.16	0.14
Weak ties (closeness)		0.21*	0.06					−0.13	−0.03
Strong ties (closeness)		0.09	0.01					−0.03	0.06
Weak ties (duration)				0.32**	0.12				
Strong ties (duration)				−0.20	−0.32*				
Weak ties (frequency)						0.27*	0.11		
Strong ties (frequency)						0.00	−0.04		
Background heterogeneity			0.28*		0.28*		0.27*	0.24	0.22
Nonredundancy			0.10		0.18		0.10	0.11	0.08
Centrality								0.24	0.16
Outside ties								−0.02	0.11
Outside ties × centrality									−0.33**
ΔR^2		0.05	0.05	0.10**	0.05*	0.06*	0.05	0.01	0.07**
R^2	0.18	0.23	0.28	0.28	0.34	0.24	0.29	0.31	0.39
F	2.87*	2.94**	3.01**	3.81**	3.92**	3.05**	3.07**	2.43**	3.08**
n	97	97	97	97	97	97	97	83	83

[a] Standardized coefficients are reported.
  * $p < .05$
 ** $p < .01$

Table 2 summarizes the OLS regression results for overall creativity. Hypothesis 1a proposes that weak ties should be positively associated with creativity. As expected, and as shown in models 2a–2c, the effect of weak ties on creativity was positive and significant for each of the measures of weak ties ($p \leq .05$), and the effect of strong ties was not ($p > .05$). Thus, Hypothesis 1a was supported.

According to Hypothesis 1b, nonredundancy partially mediates the relationship between weak ties and creativity. To test mediation, I followed the procedure outlined by Baron and Kenny (1986). Weak ties were positively related to nonredundancy ($p \leq .01$) for closeness with the same level of significance as all other measures of weak ties.[3] However, as can be seen in models 3a–3c, between-

ness was not positively related to creativity ($p > .05$). Thus, Hypothesis 1b was not supported.

According to Hypothesis 1c, background heterogeneity will mediate the relationship between weak ties and creativity. As can be seen in Models 3a–3c, background heterogeneity was positively related to creativity ($p \leq .05$), and the effect of weak ties was no longer significant when heterogeneity was entered simultaneously. In addition, weak ties were positively related to heterogeneity ($p \leq .01$) beyond the relationship accounted for by the control variables.[4] Finally, I used Sobel's (1982) test to further assess the indirect effect of weak ties on creativity via heterogeneity; this test supported a positive indirect effect (closeness: $z = 2.09$, $p \leq .05$; duration: $z = 2.17$, $p \leq .05$; frequency: $z = 1.62$, $p \leq .10$). Thus, Hypothesis 1c was supported.

[3] The full equation is as follows: *Nonredundancy = −75.39 + 7.76 × intrinsic motivation − 19.95 × education + 4.12 × rank + 1.31 × tenure − 3.22 × department 1 + 19.97 × department 2 + 7.87 × department 3 + 4.57 × weak ties (closeness) + 9.37 × strong ties (closeness).*

[4] The full equation is as follows: *heterogeneity = .51 − .02 × intrinsic motivation − .01 × education + .02 × rank − .00 × tenure + .12 × department 1 + .18 × department 2 + .12 × department 3 + .01 × weak ties (closeness) + .00 × strong ties (closeness).*

To test Hypothesis 2, which proposes that weak ties will be more strongly, positively associated with creativity than strong ties, I tested the difference between the respective regression coefficients. The effect of weak ties was significantly different than that of strong ties for duration tie strength ($F[1,87] = 6.03$, $p \leq .05$), but the difference between weak and strong ties was not significantly different for closeness ($F[1,87] = 0.00$, $p > .05$) or frequency ($F[1,87] = 0.68$, $p > .05$).

To further understand the effects of weak versus strong ties, I created dummy variables representing three different cases: (1) weak and strong ties greater than their means, (2) weak ties greater than the mean and strong ties less than the mean, and (3) weak and strong ties less than their means. The case in which weak ties were less than the mean but strong ties were greater than the mean was used as the comparison group. Given the theorized benefits of weak ties versus strong ties, I expected group 2 to be associated with significantly higher creativity relative to the comparison group. The group 2 dummy variable was significantly related to creativity for duration ($b = .83$, $t = 2.40$, $p \leq .05$) and marginally related for frequency ($b = .54$, $t = 1.84$, $p \leq .10$), but it was not significantly related for closeness ($b = .27$, $t = 1.02$, $p > .05$). Thus, Hypothesis 2 was partially supported.

According to Hypothesis 3, centrality is positively associated with creativity. As can be seen in model 4, the relationship between centrality and creativity was not significant ($p > .05$). Thus, Hypothesis 3 was not supported.

Hypotheses 4a, 4b, and 4c propose that an interaction between centrality and the number of outside ties that is such that (1) closeness centrality with few outside ties will be more positively associated with creativity than centrality with many outside ties, (2) peripheral positions with many outside ties will be associated with higher creativity than peripheral positions with fewer outside ties, and (3) central positions with many outside ties will be associated with lower creativity than central positions with few outside ties. Model 5 shows that the interaction between closeness centrality and outside ties was negative and significantly related to creativity ($p \leq .01$). Figure 1 displays the form of the interaction.

I followed Aiken and West's (1991) interaction slope analysis to further assess the form of the interaction. This analysis revealed that the relationship between centrality and creativity was significantly positive when outside ties were low ($b = .53$, $t = 2.70$, $p \leq .01$) but neutral when outside ties were high ($b = -.16$, $t = -.81$, $p > .05$). Because of excessive multicollinearity (VIFs for centrality greater than 10), I ran these models without the variables for weak ties and nonredundancy. In addition, when peripheral positions existed, outside ties were positively related to creativity ($b = .41$, $t = 2.37$, $p \leq .05$), and when central positions existed, outside ties were negatively related to creativity ($b = -.23$, $t = -1.99$, $p \leq .05$). Hypotheses 4a, 4b, and 4c were supported.

DISCUSSION

This research was an effort to understand the more social side of creativity by hypothesizing and examining the role of several social network parameters. As hypothesized, the results suggest that weak ties facilitate creativity and that strong ties do not. In addition, connections to a more heterogeneous set of direct contacts mediated the relationship between weak ties and creativity. Exposure from this type of direct contact set may facilitate a variety of cognitive processes. In contrast, the social influence pressures leading to conformity and

FIGURE 1
Interaction of Outside Ties and Centrality
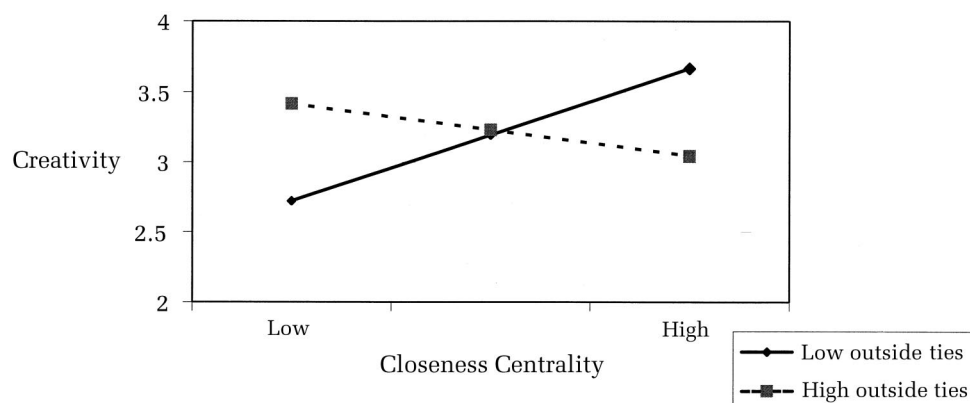
the cognitive constraint associated with strong ties may offset any potential benefits associated with social support. Also as expected, the relationship between centrality and creativity depended on the number of ties outside an organizational network. When the number of outside ties was high, centrality appeared to have little effect on creativity. It appears that peripheral individuals may feel freer to develop unusual ideas gleaned from connections outside. However, the combination of outside ties and high centrality was not preferred. In this case, outside ties may distract from creativity.

These findings make a contribution by providing a richer understanding of social relationships with regard to creativity, supporting the static portion of Perry-Smith and Shalley's (2003) social network perspective on creativity. As one of the first empirical tests of this perspective, the results highlight the importance of understanding tie strength for creativity, as well as the interactive effects of position within the broader social environment and outside ties. In addition, the findings provide conceptual support for the role of various cognitive processes, such as divergent, flexible, and autonomous thinking. Weak ties, in particular, may facilitate the generation of alternatives and encourage autonomous thinking. However, the role of domain-relevant knowledge remains unclear. The absence of support for mediation by nonredundancy in this research may suggest that domain-relevant knowledge plays a smaller role in explaining the association between weak ties and creativity. However, the effect of domain-relevant knowledge was not empirically verified. In general, the effects of contextual factors on creativity-relevant skills and domain-relevant knowledge have received limited attention in comparison to intrinsic motivation (Zhou & Shalley, 2003). This research may provide some additional insight into these two less-addressed processes, but more remains to be done conceptually and empirically to understand how they affect the relationship between social context and the generation of new ideas.

In addition to the contribution to understanding creativity, the results also have implications for understanding weak ties in general. Weak ties were positively correlated with nonredundancy, supporting Granovetter (1973). However, contrary to expectations, the results did not support the hypotheses that nonredundancy mediates the relationship between weak ties and creativity. Weak ties appear to have benefits for creativity over and above nonredundancy. In particular, the heterogeneous set of direct contacts provided by these ties did mediate. Thus, it appears that the strength of a tie is critical, not only its structural properties. This idea is consistent with findings for weak ties related to knowledge transfer and career outcomes, which have suggested that the effects of weak ties and structural redundancy may differ (Hansen, 1999; Seibert et al., 2001). Thus, researchers should continue to look at tie strength and structural redundancy separately, since their effects may differ.

The findings also indicate that it may be important to understand different aspects of tie strength. There were some differences in effects across the closeness-, duration-, and frequency-based measures. For example, the duration measure provided the most consistent support for the hypotheses. Frequency and closeness also supported the positive effect of weak ties, but differences between weak and strong ties were not as clear. This pattern of findings suggests that relationship duration may play an important role in shared experiences and conformity. Future research should do more to explore the dimensions of tie strength and how these dimensions relate to outcomes. Inconsistencies in how tie strength has been measured may explain the mixed results for weak ties in the literature (Brown & Konrad, 2001; Murray, Rankin, & Magill, 1981).

Contrary to expectations, centrality did not have a significant direct effect on creativity, although its interaction with outside ties was as expected. One possible explanation is that the relationship between centrality and creativity may not be linear. Perry-Smith and Shalley (2003) theorized that there is a point of diminishing returns and that centrality is positively associated with creativity only through some moderate level. However, in this particular research setting, the networks in both labs were fairly sparse, which was consistent with the overrepresentation of researchers with low tenure. For example, only seven individuals had centrality values of greater than 65 percent. Although it is difficult to identify what level of centrality is beyond moderate, this setting likely did not provide a range of centrality full enough to permit testing for curvilinearity. For the same reason, Perry-Smith and Shalley's (2003) curvilinear weak tie proposition could not be appropriately tested.

Another possibility for the insignificant result for centrality may be associated with the type of creativity studied. Recently, scholars have argued that creativity is not a unitary construct (Unsworth, 2001). To date, most of the creativity literature within the management sciences has focused on a unitary measure of creativity without specifying type (Unsworth, 2001), with few conceptualizations or empirical tests of multiple types of creativity in one study. In this research, I used a global measure of creativity, since a factor analysis sup-

ported one dimension; however, it is possible that network parameters may have different effects depending on creativity type. For example, perhaps centrality plays a particularly large role with responsive creativity, where a solution to a specified problem is required. Future research should theoretically and empirically explore the relationship between network parameters and types of creativity.

Although this research makes several important contributions, this learning must be considered in the context of the limitations. One limitation is the cross-sectional design, which foreclosed empirically determining directionality. More people in a network may seek out creative individuals than seek out uncreative ones, so creativity may lead to occupying more central network positions. Longitudinal designs should be used in the future to understand directionality and to test the dynamic portion of Perry-Smith and Shalley's (2003) theory.

Another limitation is that only one organization was tested, and these findings may be associated with the peculiarities of this particular sample. For example, creativity was encouraged and required as part of the job in this setting. Although perhaps not as explicit, creativity may be important in a wide variety of jobs and organizations (Shalley, Gilson, & Blum, 2000). I would expect the results to be similar in a variety of settings, since the theoretical ideas apply to creativity broadly, but differences in the extent to which creativity is required should be explored. In addition, the research setting represented an open and collaborate environment. In more hostile and competitive environments, the effect of weak ties may vary if individuals withhold and distort information with anyone other than their strongest ties. However, network research often involves one relatively small organization for practical reasons (e.g., Labianca et al., 1998; Mehra, Kilduff, & Brass, 1998), a type of setting that precludes testing the role of firm-level factors.

Despite these limitations, the results of this research have several possible practical implications. Employers should explore mixing up employees, not in dramatic ways, but enough to encourage the development of weaker relationships. This process may involve encouraging a variety of interactions outside of a person's immediate department, for example. Perhaps, as an anonymous reviewer suggested, one idea may involve rethinking traditional career trajectories by moving otherwise strong performers, who may be highly central, to the periphery, particularly if they have many outside connections. Employers could also encourage minisabbaticals that involve employees' spending time in other settings to facilitate the development of outside connections.

This type of activity could even be important for newer employees who are likely to be relatively peripheral. Firms could also encourage outside connections by bringing in visitors to fill complementary professional roles, for example. My results suggest that it may be best if these interactions are not strong (e.g., very frequent or intense); lower tie strength also may make changes along these lines easier to implement, given that people only have a limited amount of time at work and may experience intense pressures to focus on seemingly more instrumental tasks.

For researchers of creativity, this study suggests that the broader social context of social relationships should be considered and that measuring formal work context without incorporating informal aspects of organizational structure may result in unintended omission of important features. More specific avenues for research include looking at the flow of different information types, such as advice ties, support ties, and negative ties (Ibarra, 1992; Labianca et al., 1998). In addition, it would be helpful to study the influence of network ties on various stages of creativity, from idea generation to implementation, in the same study. For example, after creative ideas have been developed, strong ties may be more helpful for sharing ideas with others (Albrecht & Hall, 1991). Finally, future research also could do more to further understanding of the roles of different types of support—from general social support to support for creativity specifically—and the implications of differences for various types of relationships.

In summary, the findings extend the creativity literature by highlighting several facets of social relationships: relationship strength, network position, and outside ties. It seems that individuals interested in being creative should be mindful of being *too* connected via strong ties but should maintain and cultivate weaker relationships. In addition, position within the broader context of social relationships matters, and it interacts with connections outside of one's firm to explain creativity. By suggesting how individuals can be social in a way that facilitates creativity, this research provides a richer understanding of the role of social relationships, a relatively neglected topic within the creativity literature.

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