Team Leaders and Team Members in Interorganizational Networks: An Examination of Structural Holes and Performance

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Abstract

Through the examination of 11 intact interuniversity research project teams, this study examines the relationship between team leaders, team members, their communication networks (represented as structural holes), and performance. The study shows that in the conduct of their work, the team leaders bridged more structural holes than team members. Although team leaders demonstrated a higher level of out-of-alliance performance, they did not demonstrate higher levels of individual performance on their teams (compared with team members). Furthermore, we examined the relationship between structural holes and both individual team member performance and overall team performance. Contrary to our expectations, bridging structural holes were not significantly related to individual team member performance but were negatively and significantly related to overall team performance, the effect of which came mainly from team members' effective size.

Keywords: interorganizational networks, structural holes, team performance, team leaders

Work teams have become increasingly common in organizations for managing a variety of functions (Sundstrom, 1999), work products, and projects (Hackman & Johnson, 2009; Katzenbach & Smith, 1993; LaFasto & Larson, 2001). In particular, project teams integrate the knowledge and expertise of individuals in different functions to complete specific tasks within a predefined period of time (Cohen & Bailey, 1997; LaFasto & Larson, 2001; Sundstrom, 1999). Communication is integral to the leadership experience in teams (Hackman & Johnson, 2009). Whereas intraorganizational project teams normally include individuals from different functions within the organization, teams also commonly maintain high levels of external linkages (Sundstrom, 1999), thereby providing an opportunity for collaboration across organizational boundaries in the form of interorganizational teams.

As interorganizational teams require individuals to communicate across organizational boundaries, these relationships are critical in linking or connecting organizations in the environment (Oliver, 1990). As such, interorganizational teams might cross multiple boundaries including geographic, functional, time, identity, and organizational boundaries (Espinosa, Cummings, Wilson, & Pearce, 2003). The flexible arrangement of project teams, which might develop either formally (i.e., the organization appoints members to the group and defines the problems, group's authority, and project time frame for the group's functioning) or informally (i.e., the group emerges and self-organizes as problems occur; Galbraith, 1973) allow for a broad array of team compositions to occur within and across organizational boundaries. Given the vast amount of research collaboration that occurs in academic settings, interorganizational collaboration (i.e., teamwork) seems naturally present in the work activities of academicians. Although much of this collaboration is informal in nature, there are examples of team based collaborative efforts that are formal in nature. The present study examines interorganizational team-based interaction and activity using intact interuniversity research project teams formed through formal agency-sponsor linkages. In this case, sponsor ties provide access to vital resources and establish the power and influence structure, thus providing asymmetry in relation to the other organizations involved (Oliver, 1990). Consistent with resource dependence theory, organizations depend upon other organizations to regulate the flow of critical resources in an unstable or new environment (Mizruchi & Galaskiewicz, 1994).

Understanding the structure of relationships and communication patterns is important in interorganizational networks. In this study, we examine the influence of structural holes in interorganizational networks and their relationship to team structure (i.e., team leaders and members) and performance. Through the investigation of structural holes, we explore two primary research questions. First, does the team leader role provide the opportunity for leaders to span more structural holes and transcend team boundaries in interorganizational networks when compared with their team members? Second, does bridging structural holes for team members lead to advantages in the network that can be connected to improved performance? This study contributes to the literature by examining the influence of structural holes in two different contexts over the natural life of a set of interorganizational project teams.

We framed the literature review in two main ways: (a) teams, social networks, and structural hole theory and (b) structural hole theory and performance. Following the literature review, we discuss the hypotheses, the method, and design considerations that framed our study and we conclude the article with a discussion of the study's findings and implications.

Teams, Social Networks, and Structural Hole Theory

Teams

Team is defined as "a small number of people with complementary skills who are committed to a common purpose, performance goals, and approach for which they hold themselves mutually accountable," the team concept emphasizes its connection with performance (Katzenbach & Smith, 1993, p. 45), and the essential role of human communication (Hackman & Johnson, 2009). Fundamental to the idea of having individuals work together or collaborate in teamwork effectively is the ability to manage five core dynamics: team members, team relationships, team problem solving, team leadership, and the organizational environment (LaFasto & Larson, 2001). Effective team members, according to LaFasto and Larson (2001), have a working knowledge defined by their experience and problem-solving ability and demonstrate teamwork characteristics that reflect openness, supportiveness, an action orientation, and a positive personal style. Teamwork quality seems particularly significant for geographically dispersed teams as Hoegl, Ernst, and Proserpio (2007) found that teamwork quality is positively related to team effectiveness and team efficiency in innovation projects for more dispersed (i.e., low proximity) team members.

Previous research indicates a relationship between work-group characteristics and team effectiveness (Campion, Medsker, & Higgs, 1993; Campion, Papper, & Medsker, 1996). In particular, the ability to coordinate individual actions can influence team effectiveness (Zaccaro, Rittman, & Marks, 2001). Having better communication links among members allows for a greater degree of coordination. Reagans and Zuckerman (2001) observed that teams who averaged more frequent communication among team members achieve higher productivity. Understanding the level of disagreement that exists among team members is an important consideration as Kratzer, Leenders, and van Engelen (2006) found that team polarity can influence creative performance differently depending on the phase of the innovation process.

Team leaders who encourage members to participate in team problem solving enable collective information processing that facilitates team effectiveness (Zaccaro et al., 2001). Effective team leaders enable their teams to remain goal-focused, ensure a collaborative climate, build confidence by focusing on opportunities and accomplishments, demonstrate sufficient technical know-how, establish clear priorities, and manage performance expectations and reward results (LaFasto & Larson, 2001). Consistent with the functional leadership approach, team leaders who establish high performance goals, demonstrate appropriate performance strategies, and encourage members to achieve the goals will display higher team efficacy and cohesion than leaders who do not participate in such activities (Zaccaro et al., 2001). Effective teamwork requires an organizational environment that provides clear direction and management practices, the alignment of structure and processes to facilitate effective decision making and interaction, and systems to provide reliable information and relevant rewards to produce desired results (LaFasto & Larson, 2001).

Social Networks

Teams in organizations are likely to have both informal and formal communication network structures. Informal or emergent networks usually develop from individuals' daily interactions (Monge, 1987) and thus represent a dynamic process that organizational members actively create and enact via their patterns of relationships (Hartman & Johnson, 1990). By formalizing informal structures, organizations can ensure that informal processes occur, particularly in highly diverse and geographically distributed teams (Galbraith, 1973). Formal structures define a pattern of relationships among positions (Hartman & Johnson, 1990) based on the communication paths prescribed by individuals in authority positions (Monge, 1987). Despite different communication patterns, formal and emergent network structures provide a context that defines each other (Monge & Eisenberg, 1987) and thus, are interrelated (Krackhardt, 1990; Krackhardt & Stern, 1988; Monge & Eisenberg, 1987; Shrader, Lincoln, & Hoffman, 1989; Susskind, Behfar, & Borchgrevink, 2006). For example, individuals who have regular interactions with members of the same professional organization might meet informally to discuss recruiting and retention challenges and brainstorm potential strategies for increasing their organization's effectiveness in this area. If organizations benefit from these informal discussions, then organizational leaders might decide to formalize their structure as an interorganizational network. Whether the degree of similarity of the network structure for teams makes a difference is debatable. Research by Reagans and Zuckerman (2001) indicates that teams with more extensive links among members of different organizational tenure achieve a higher level of productivity than teams with highly homogeneous networks. Zaheer and Soda (2009), however, found that groups with a more homogeneous structure are more productive as a team.

Social networks can provide valuable resources or social capital (Baker, 1990; Belliveau, O'Reilly, & Wade, 1996; Bourdieu, 1986; Boxman, De Graaf, & Flap, 1991; Burt, 1992; Chen, Chang, & Hung, 2008; Coleman, 1990; Knoke, 1999; Lin, 2001; Nahapiet & Ghoshal, 1998; Odom-Reed, 2007;

Portes, 1998; Putnam, 2000; Woolcock & Narayan, 2000; Yuan, 2004). Networking seems particularly useful for project teams as Chen et al. (2008) found that social interaction and network ties relate positively with creativity in research and development project teams. Having access to social resources is a necessary although not sufficient condition on its own. In addition, awareness is critical as it is "only when the individual is aware of their presence, and of what resources they possess or can access (these ties have their networks as well), can the individual capitalize such ties and resources" (Lin, 2001, p. 25). As a theory of self-interest, social capital focuses on maximizing individual value (Monge & Contractor, 2003) by considering the manner in which individuals invest in social relations and use resources embedded in these relations to produce a return (Lin, 2001). In this sense, the social capital metaphor emphasizes advantage based on one's connections suggesting that individuals with better connections do better than those without such connections (Burt, 2001). The idea of having better connections represents the basis of Burt's structural hole perspective.

Structural Hole Theory

The structural hole theory suggests that bridge ties generate information benefits by providing better connections for individuals who have relationships that traverse and fill structural holes in the network (Burt, 1992). For example, in interuniversity team networks, professors might communicate with others who share a common connection within their respective university but also build network ties with professors at other universities, thereby placing these individuals in the position to fill structural holes for individuals who do not have access to these connections. Similar to Granovetter's (1973) strength of weak ties theory, Burt's structural hole theory emphasizes information benefits and predicts higher information benefits for nonredundant ties. These two theoretical perspectives, however, maintain different points of view as to the role of nonredundant ties in generating information benefits. Whereas the weak ties theory maintains it is the *weakness* of nonredundant bridge ties that generates information benefits, the structural hole theory posits that the *bridging* of nonredundant ties generates information benefits (Burt, 1992). The strategic task for individuals, according to Burt, is to concentrate resources on maintaining bridge ties by building networks that maximize the number of nonredundant contacts to increase network efficiency and preserve primary nonredundant contacts that provide access to separate and more diverse secondary contacts to enhance quality of benefits and network effectiveness. By understanding the roles of efficiency and effectiveness, the central player of the network is able to concentrate on maintaining relationships with primary contacts. The task of maintaining the network is delegated to the primary contacts allowing the central player to focus on primary relationships and the expansion of the network (Burt, 1992).

By maintaining the bridge between networks, an individual has the ability to use the network in their favor. Those individuals who focus on the expansion of the network, sometimes called network brokers, connectors, or entrepreneurs, have the foresight in detecting and developing productive opportunities. Empirical results (Burt, 2008) have indicated that players with access to structural holes have an advantage in detecting and developing productive opportunities. Burt observed that there is a strong association between performance and network constraint in populations of business managers and those managers with access to structural holes have an advantage in detecting and developing productive opportunities. Moreover, performance has also been shown to decrease as a network member's colleagues become more interconnected (Burt, 2008). With fewer structural holes in place in the individual's favor, poorer performance resulted.

The player's direct access to structural holes is a source of competitive advantage (Burt, 2008). On a macro scale, it has been observed that producers with direct access to structural holes among suppliers and customers have more opportunities to play competing organizations against one another. Burt (2008) observed that this leads to a negative association between producer performance and advantaged suppliers and customers who extract a disproportionate share of profit from business.

Managing nonredundant contacts seems particularly important for the team leader role. From a functional perspective of team leadership, the leader must manage information contacts via networking activities, make sense of information for the team, and represent the interests of team members (Zaccaro et al., 2001) as well as external constituencies (Sundstrom, 1999). Given these functions, team leaders must maintain a large number of intergroup linkages or bridge ties. As such, we predict that team leaders will have more relationships that traverse and fill structural holes in the network than team members. Specifically, we propose that team leaders will span more structural holes than team members in interorganizational networks.

Hypothesis 1a: Team leaders will have higher efficiency than their team members will.
Hypothesis 1b: Team leaders will have higher effective size than their team members will.
Hypothesis 1c: Team leaders will have lower constraint than their team members will.
Hypothesis 1d: Team leaders will have lower hierarchy than their team members will.

In addition to spanning more structural holes, we propose that team leaders will bring a greater overall skill set to the table than team members and hence, will demonstrate a higher level of individual performance and higher levels of competence outside of the network. In essence, out-of-network performance is a measure of talent going into the process. To test these propositions, we propose the following two hypotheses:

Hypothesis 2a: Team leaders will demonstrate a higher level of individual performance than their team members will.

Hypothesis 2b: Team leaders will demonstrate a higher level of out-of-alliance performance than their team members will.

Structural Hole Theory and Performance

Research indicates that networks rich in structural holes can enhance performance (Burt, 1992, 1997; Goyal & Vega-Redondo, 2007; Podolny & Baron, 1997). Maintaining network relations that bridge group and organizational boundaries provides access to a diverse source of ideas and influence (Burt, 1992) and relate positively to individual performance on complex and nonroutine tasks (Cross & Cummings, 2004). Furthermore, Goyal and Vega-Redondo (2007) found that individual agents create structural holes among members of a group in order to exploit positional advantages for their own benefit. These individuals will block profitable interactions between other members in order to create a situation in which they manipulate structural holes to improve their own performance.

Other research (Ahuja, 2000; Cho, Gay, Davidson, & Ingraffea, 2007; Cummings & Cross, 2003; Walker, Kogut, & Shan, 1997) suggests that structural holes do not offer much value in collaborative environments. For example, Walker et al. (1997) examined network formation in interorganizational relationships and found that startup firms tended to engage in more cooperative relationships than market transactions as they increased their social capital by forming more relationships that are new rather than taking advantage of structural holes. Ahuja (2000) in a longitudinal study of 97 interorganizational networks in the chemicals industry in Western Europe, Japan, and the United States, found that structural holes relate negatively to firm innovation output in that more structural holes result in less innovation output for firms.

Increasing indirect ties did not seem to offer an effective strategy for maximizing network benefits as this research showed that direct ties moderate the impact of indirect ties on firm innovation output. In addition, Cummings and Cross (2003) examined 182 project work groups at a *Fortune 500* telecommunications firm and found that teams perform better on nonroutine, complex tasks in a flatter hierarchy that encourages high member interdependence, contributions from all members, and more direct linkages. Leader structural holes showed a negative relationship with group performance after controlling for mean levels of group and leader communication. Cho et al. (2007) also found that structural holes did not provide a performance advantage for individuals interacting in a collaborative learning community, an environment that encourages collaboration rather than competition for information resources. Contrary to these findings, Odom-Reed (2007) examined structural holes as a source of bridging social capital in a partially distributed collaborative learning community, and found that structural holes relate positively with individual current performance after controlling for the effects of location. One significant difference between Odom-Reed's research and the other studies relates to the use of Burt's (1992) constraint measure for structural holes as opposed to the other studies which utilized efficiency (Ahuja, 2000), effective size (Cummings & Cross, 2003), or density based measures of structural equivalence (Walker et al., 1997) to measure structural holes.

The value of structural holes as social capital might differ based on the relational content associated with the network. For example, Podolny and Baron (1997) found that resource and information-based relationships produce positive social capital effects on performance whereas identity and expectation-based relations result in negative effects on performance. Similarly, Burt's (1997) research of early promotion among managers indicated that the social capital effect varies depending upon the kind of relationships. More specifically, Burt (1997) found a strong social capital effect for personal discussion relational networks as opposed to corporate authority relational networks that failed to produce the social capital effect. The strongest social capital effect, however, occurred with the combined network of personal discussion and corporate authority relations. Further, Odom-Reed (2007) found partial support for a positive relationship between structural holes and current individual performance in task rather than social relational networks.

Individuals' experience with structural holes over time can influence whether structural holes provide a source of social capital particularly during times of organizational change (Susskind, Miller, & Johnson, 1998) as the lack of this experience can create "'knowledge holes' in the social capital network" (Edelman, Bresnen, Newell, Scarbrough, & Swan, 2004, p. S65). Individuals' initial level of structural holes is important in shaping their experience over time as Susskind et al. (1998) found that individuals who experience increases in their structural holes over time perceive more organizational chaos and are less willing to accept an organizational change effort than others whose structural holes decline over time. In this sense, "a past network, with its accumulated relational experience, becomes a kind of 'network memory' that cannot be ignored as it may project a structural overhang over the present, much like a shadow of the past" (Soda, Usai, & Zaheer, 2004, p. 893). Current structural holes enhance project team members' performance more strongly than past structural holes (Odom-Reed, 2007; Soda et al., 2004), a finding that might relate to a "liability of newness" as bridge ties tend to decay at a faster rate, typically within the first 2 years of their formation and have higher maintenance costs than other kinds of relationships (Burt, 2002, p. 343).

Considering team leaders must manage information contacts via networking activities, make sense of information for the team, and represent the interests of team members (Zaccaro et al., 2001) and external constituencies (Sundstrom, 1999), and team leaders have a critical role in managing performance expectations and rewarding results (LaFasto & Farson, 2001), we expect that team leader will span more structural holes than team members in project teams, as predicted in the first set of hypotheses. Furthermore, research suggests that structural holes can produce positive social capital effects on performance depending on the relational content associated with the network (Burt, 1997; Odom-Reed, 2007; Podolny & Baron, 1997) and the time in which structural holes occur in network (Odom-Reed, 2007; Soda et al., 2004; Susskind et al., 1998). As such, we expect that structural holes will relate positively with performance as stated in the following two hypotheses: *Hypothesis 3a:* Structural holes will relate positively to team members' individual performance on the teams. *Hypothesis 3b:* Structural holes will relate positively to overall team performance.

Method

Project and Sponsor Background

The sponsoring organization initiated the formation project teams investigated here. In cooperation with six major hotel companies, the sponsor created a research alliance consisting of 11 leading hospitality management programs at American universities, composed of 49 professors at various ranks, and a coordinating project staff of four individuals from the sponsoring organization.

The research alliance was formed to conduct 11 integrated research projects based on current issues that hotel industry executives and academic leaders deemed important and "cutting edge" in terms of hotel operations and hospitality management. The alliance constituents identified employee turnover, government regulation, and technology as the three main areas of interest to develop research projects around.

At a preliminary meeting, each university participating in the research alliance selected a team leader and then each team leader selected his or her own team from faculty members within the 11 alliance universities. Team leaders either asked alliance members to join their team or were approached by alliance members to join a specific team. Teams were comprised of an average of five members, with one team ultimately possessing four members and two teams with six members. The structure of the teams was designed to allow collaboration within and between the 11 alliance universities, a network structure consistent with past research examining structural holes (cf. Cho et al., 2007; Cross & Cummings, 2004; Cummings & Cross, 2003; Odom-Reed, 2007).

The sponsoring organization provided compensation to each research alliance member for his or her participation in the project. The funds were distributed in increments to each participant's administrative head to be distributed according to each university's guidelines and procedures for grantrelated compensation. In addition, the sponsor provided each team with a research budget to cover nonsalary expenses associated with the project.

Each team was autonomous in that it was responsible for the conduct of their project. The project sponsor, however, established and organized project component deadlines, team leader meetings, standardized data collection across the 11 team projects, and the evaluation procedures to assess each team's performance in terms of team output, team leader performance, and individual contribution.

Each team was responsible for producing a comprehensive literature review, a theoretical foundation for their investigation, and the methodology to conduct the research project. The research alliance was in operation a total of 14 months before it was disbanded. The alliance completed the pilot studies for each of the 11 projects but did not conduct the final studies. Each team was given the option of completing the full version of their studies on their own. The research investigation presented here is based upon the interaction of the research alliance participants during the 14-month period the research alliance was in effect. Eighty-six percent of the alliance participants responded to the survey ($N = 44$). Thirty-nine percent of the respondents were female, ranging in age from 28 to 61 ($M = 44.92$).

Procedure

The measurement of team interaction and processes presents an interesting dilemma in the level of measurement. Teams are, by definition, an aggregate of individuals and their actions (Ilgen, Major, Hollenbeck, & Sego, 1993). As such this investigation attempted to carefully blend communication network data, with individual- and team-based constructs to address the issues presented herein. Specifically, communication network structure was measured to examine the broad-based foundation of team interaction, individuals' perceptions, attitudes, and performance were measured to gauge personal evaluations of and contribution to the team process, and performance was assessed at the individual- and team-level to objectively quantify each individual's and each team's performance independently.

The communication network relationships, attitudes, perceptions, and performance of the university researchers were measured once during the final stages of the research alliance using a communication relationship directory and surveys. Due to the nature of reporting communication network relationships, anonymity was not possible for the participants. However, participants were assured strict confidentiality in their responses, and guaranteed that their name or university affiliation would not be directly associated with their responses nor appear under any circumstances on any report generated from the data. Respondents were assigned an identification number that was used to refer to their responses following the data-collection process.

Communication Network Measurement

Network relationships. This study measured the distribution of each participant's communication relationships from a single network perspective, that is, formal alliance-specific contacts. Participants were provided with an alphabetized directory of all employees listed by research team and institution, based on information provided by the sponsoring organization. We recognized that describing the form and content of communication relationships presents a difficult problem in analyses of this type, as the respondents must identify themselves and their communication relationships. As previously stated, however, confidentiality was assured for all participants, and the high response rate of 86 % from a mail-based survey (N = 44, out of 51 possible respondents) indicates alliance members were willing to act as participants in this study.

Network properties. A linkage was defined as any reported connection between two network members. In these analyses, the prerequisite of reciprocity among relationships was not required. In network terms, a relationship does not have to be bidirectional to be recorded as a connection between two members and to provide a full range of perceived relationships for the network calculations. It should be noted however, that prior network research indicates that asymmetric relationships tend to be uneven in terms of member power, as the more powerful members often report having fewer relationships with less powerful network members rather than the inverse (cf. Johnson, 1993). In addition, in an investigation of friendship networks, Shah (1998) presented a two-point justification for maintaining asymmetry in networks: "first asymmetric ties indicate informal power or status differences and second, people's perceptions of a tie may vary" (p. 257). Using a network directory helped to minimize concerns of balance based on recall, as the respondents were presented with a complete team-by-team listing of all the project participants, to aid in their report of communication interaction, minimizing the possibility of erroneous reports of asymmetric relationships. Furthermore, given the relatively small size of the network (N = 44), and the corresponding familiarity of the researchers in the alliance, it was anticipated that very few relationships would emerge as asymmetric. Results concurred with this prediction indicating that only 4% of the reported relationships were asymmetrical.

Network data. The network relationships were recorded in a binary fashion and placed in a 51 × 51 matrix to account for all the asymmetric relationships reported, hence providing a complete set of network data including all individuals who were part of the alliance. A "1" indicated a relationship in the alliance between two members and a nonrelationship between two members was indicated by a "0." The data were analyzed using UCINET version 6.0 (Borgatti, Everett, & Freeman, 2002).

Individual and team performance. To assess individual-level performance, each team member rated his or her own performance, the performance of each team member, and his or her team leader. These ratings were completed at the same time as the third set of team project rankings. Individual performance scores for each participant were represented by the arithmetic mean of the combined ratings. The individual performance scores were shared exclusively with the individual rated. All performance scores were collected, tabulated, and stored by the project sponsor.

Each team's performance was assessed at three points in time through ratings provided by 12 raters. The raters were comprised of the 11 project team leaders and the director of the alliance. Each rater evaluated each team's output on 5-point rating scale (1 = *poor*, 2 = *fair*, 3 = *good*, 4 = *very good*, 5 = *excellent*) using a rating form similar to those used in the editorial review process in blind-refereed journals. Each team's manuscript was assessed for clarity, completeness, theoretical relevance, design, and methods. Each team leader, however, did not rate his or her own team's output. The rating process was single-blind, as it was possible for the raters to identify the team producing the output, but the raters remained anonymous. The 11 standardized sets of feedback were then returned to each team leader to share with his or her team in order to make improvements to the manuscript based upon the feedback provided. This process was repeated twice throughout the first 8 months of the project. Each team was provided with an aggregate rating score across all 11 raters and a ranking of their team's score in comparison to the other ten teams. The team output evaluations from both evaluation periods were averaged into a single-team performance score.

Out-of-alliance research performance. To provide an additional measure of each team member's performance as a researcher, this study recorded the number of double-blind-refereed articles that each network member had published in six top-rated journals in the field of hospitality management from a 4-year time frame beginning in 1996 through 2000, which represented 2 years prior to the formation of the alliance and 2 years following its completion. The journals were selected based on their reported publishing utility to academics as reported in the journal review study conducted by Schmidgall, Woods, and Rutherford (1996). The six journals used in this study include the *Journal of Hospitality and Tourism Research*, the *Cornell Hotel and Restaurant Administration Quarterly*, the *Journal of Travel Research*, the *Journal of Hospitality and Tourism Education*, the *International Journal of Hospitality Management*, and the *Florida International University Review*.

Analyses

To assess participants' structural holes, we used UCINET version 6.0 (Borgatti, Everett, & Freeman, 2002) to generate four indicators of structural holes (Burt, 1992): effective size, efficiency, constraint, and hierarchy. Effective size is the number of actors connected to an individual network. Some of these contacts are redundant, and some will be non-redundant (i.e., unique to that individual). Efficiency, is the number of non-redundant contacts (i.e., a portion of effect size) divided by the effect size held by the network member. Constraint is a measure that captures the extent to which a network member is connected to others in the network. This measure ranges from zero indicating the network member has many disconnected, easily replaced contacts, to one signifying the member has only one contact and hence is highly constrained. Last, hierarchy shows the extent to which network members are constrained to powerful others in their network. Hierarchy ranges from 0 when the members are equally constrained from each of their contacts to 1 when all constraint comes from one contact (Burt, 1992).

To examine the differences between the presence of team leaders' and team members' structural holes (Hypotheses 1a. 1b, 1c, 1d), individual performance on their team (Hypothesis 2a) assessed by perceptual measures, and out-of-alliance performance measured as articles published in top-rated journals in their field (Hypothesis 2b), *t* tests were performed. Regression was used to test the relationship between alliance members' structural holes and individual performance (Hypothesis 3a) and their team's performance (Hypothesis 3b).

Results

The means, standard deviations, and correlations among the study variables for the entire sample are reported in Table 1. The means, standard deviations, and range of the variables for the team leaders and the team members are presented in Table 2. The tests of the eight hypotheses are discussed in turn below.

Team Leaders, Team Members, and Structural Holes

The test of the first set of hypotheses (Hypotheses 1a through 1d) revealed that team leaders did bridge structural holes in the network, for three of the four structural hole indicators used in this study.

Hypothesis 1a is supported. Effect size was greater for team leaders relative to the team members, $t(42) = -3.51$, $p = .001$, $M = 12.05$, and $M = 4.62$, for team leaders and team members, respectively, indicating team leaders had a larger number of contacts than team members in the alliance.

Hypothesis 1b is supported. Contact efficiency was significantly higher for the team leaders compared with the team members, $t(42) = -3.21$, $p = .003$, $M = .50$ and $M = .37$, respectively, showing that team leaders had a higher proportion of non-redundant contacts in the alliance allowing them to bridge more structural holes.

Hypothesis 1c is supported. Constraint was significantly lower for team leaders compared with team members, $t(42) = 5.01$, $p < .001$, $M = .15$ and $M = .24$, respectively, indicating that team leaders had more redundancy from a greater number of easily replaced contacts in the alliance.

Hypothesis 1d is not supported. Contrary to our hypothesis, hierarchy was not significantly different for team leaders and team members, $t(42) = 5.01$, $p < .003$, $M = .06$ and $M = .07$, respectively. This relationship shows that team leaders and team members were equally constrained by prominent others in the network, indicating that no single alliance participant controlled or was dependent upon network interaction with a specific individual more than others.

Team Leaders, Team Members, and Performance

The test of the second set of hypotheses (Hypotheses 2a and 2b) revealed mixed support for our proposition that team leaders would show a higher level of performance compared with team members.

Hypothesis 2a is not supported. The individual performance of team leaders and team members was not significantly different, although it was slightly higher for team leaders, $t(42) = .91$, $p = .37$, $M = 4.53$ and $M = 4.31$, for team leaders and members, respectively. A look at the standard deviation in Table 1 from this item reveals that there was little variance in these items, $M = 4.37$, $SD = .67$. This finding suggests that individual performance was generally consistent within each individual team and across the teams in the alliance.

Hypothesis 2b was supported. Team leaders, compared with team members, had a higher level of out-of-alliance performance represented as refereed articles published during the 4-year time period examined, $t(42) = 2.39$, $p = .02$, $M = 3.55$ and $M = 1.52$, for team leaders and members, respectively. This result shows that the team leaders demonstrated a higher level of research productivity outside of the alliance.

Structural Holes and Performance

The test of the third set of hypotheses (Hypotheses 3a and 3b) revealed mixed support for our proposition that bridging structural holes would lead to a higher level of performance. The regression output, including, partial correlations and zero-order correlations appear in Table 3.

Hypothesis 3a was not supported. Structural holes were not significantly related to individual performance, $F(4, 39) = 1.12$, $p = .36$. This finding suggests that team members' access to structural holes in the alliance was not connected to a team member's individual performance on his or her team.

Hypothesis 3b was supported. Structural holes were significantly related to team performance, $F(4, 39) = 7.87$, $p < .001$. This finding demonstrates that structural holes in the alliance were connected to team performance. However, a closer look at the regression coefficients and the partial correlations revealed that the significant effect occurred from not bridging structural holes (the inverse of what we had hypothesized). The majority of the significant effect noted in the regression model came from effective size, partial $r = -.49$, $p < .001$.

In addition, efficiency and hierarchy were negatively, but not significantly, associated with team performance in the model.

Discussion

This study examined the communication interaction and performance of a set of researchers working in intact project teams on interuniversity projects, representing 11 universities nationwide. In doing so, this study analyzed network-, team-, and individual-based variables to examine how structural holes in the network relate to team leaders' and team members' interaction and performance in the alliance.

Team Leaders, Team Members, and Structural Holes

This study revealed that team leaders not team members benefited from structural holes in the alliance network. Team leaders in the alliance had a larger effect size, a larger proportion of non-redundant contacts in the network, and were less constrained, compared with the team members. In essence, these findings demonstrate that team leaders compared to team members had a (a) larger effect size, hence they spanned more structural holes; (b) higher proportion of non-redundant contacts in their networks, hence they had more access to unique and independent contacts in the alliance; and (c) lower level of constraint, which again shows that they spanned more structural holes, giving them more access throughout the alliance network.

The only structural hole indicator that did not significantly differ for team leaders and team members was hierarchy, indicating that constraint for team leaders and team members was not concentrated in a single relationship or set of relationships, which is consistent with Burt's (1992) findings. The structural holes clearly separated team leaders from team members. Team leaders had a wider range of contacts in the alliance network along with greater access to unique or non-redundant contacts overall. This finding could relate to the nature of their tasks as team leaders. However, each alliance participant, in theory, had access to one another through the alliance directory, thereby creating the potential for each individual to span structural holes in the network. It is clear that team leaders capitalized on bridging structural holes more consistently than team members.

Team Leaders, Team Members, and Performance

We examined the performance of team leaders compared with team members in two ways: team member's individual performance on his or her team and out-of-alliance performance represented as referred articles published in particular outlets.

Individual performance. Each team member was evaluated for their overall contributions to their team's performance over the project period. In the aggregate, this rating included the combination of a self-assessment and an assessment from every other team member. This study, however, showed that the individual performance for team leaders and team members did not differ significantly. As team leaders and team members received the same rating for their team's output, this study did not examine overall team performance scores in this set of analyses.

Out-of-alliance performance. While not directly connected to each team's project outcomes, higher levels of research and publication performance outside of the alliance were also significantly different for team leaders and team members, suggesting that the leaders were more productive in their research-related work outside the alliance. One would expect that the leader of a research team would be competent in conducting research. Consistent with this expectation, this study found that team leaders were certainly more productive in their research than team members were.

Structural Holes and Performance Outcomes

Structural holes and individual performance. As noted above, each team member was evaluated for their overall contributions to their team's performance during the project period. In this study, we did not find any significant association between an alliance member's level of structural holes and their performance as rated by their team. This result combined with the results from Hypothesis 2a (showing no significant difference in team leaders' and team members' individual performance) suggest that individual performance did not vary enough to capture the effect among this sample or—contrary to previous reports of the influence of structural holes and performance (cf. Burt, 1992, 2001, 2008; Cross & Cummings, 2004) bridging structural holes did not influence individual performance.

Structural holes and team performance. As noted above the team leaders and the project sponsor evaluated each team's research output at 3 points over the project period. Contrary to our proposed hypothesis that bridging structural holes would enhance team performance, the aggregated performance scores showed that bridging structural holes was significantly but inversely related to team performance. This finding is consistent with the findings of Cummings and Cross (2003) and suggests that team performance in this case was associated with a smaller effect size, a lower proportion of non-redundant ties, and loosely constrained relationships. In other words, teams whose members worked closely together within their groups performed better. Although this finding does not correspond with the structural hole argument that bridging structural holes creates an advantage or leads to higher performance for those bridging the gaps, it is, however, consistent with the findings from group literature that show cohesive teams generally perform better than teams that are loosely coupled (Campion et al., 1993, 1996; Hoegl et al., 2007). This finding is particularly interesting because these project teams were geographically dispersed and did not often meet face to face.

Another interesting outcome is the alliance team leaders bridged more structural holes than team members did. It may be that the team leaders brought the benefits they gained from bridging structural holes into their teams and hence were masked in the analyses when we combined the team leaders and team members to test the overall association of structural holes with team performance in Hypothesis 3b.

Study Limitations

In this field-based study, a relatively small sample was used and presents some concerns that should be identified. Although it may be methodologically desirable to garner a large sample of teams to investigate the issues presented in this study, the conduct of research in field settings is inherently limited by the entities under study. In this particular case, the research consortium was created by and bound to the project sponsor and its size and membership were planned specifically for a functional purpose, rather than the conduct of this study. As such, the unique properties captured through these intact, geographically dispersed groups are an example of a field sample offering practical insight, rather than strict methodical control. It may, therefore, be unwise to suggest that by default only "large" field samples be used. For the discovery and advancement of organizational-based knowledge, field studies are a necessary element, statistical and methodological limitations notwithstanding.

Conclusion

In this study, we wanted to test the extent to which teams and team leaders took advantage of the social capital in the alliance network during the 2-year period it was in existence. We suspected that there would be differences among team leaders' and team members' ability to bridge structural holes in the network and that bridging structural holes would be connected to alliance member's individual and team performance. The alliance was set up to operate over a 2-year time frame to create an exchange of information and ideas across the 11 universities that participated, although it was disbanded after 14 months. This time frame should have given the network relationships time to develop and hence give the network members and their teams time to take advantage of network relationships across the alliance. This context was very well suited to examine the influence of structural holes and is consistent with the contexts of other studies cited here (cf. Cho et al., 2007; Cross & Cummings, 2004; Cummings & Cross, 2003; Odom-Reed, 2007) and a priori, we had no reason to expect otherwise.

In sum, our study showed that team leaders did bridge more structural holes in the network than team members as shown in the tests of Hypotheses 1a, 1b, and 1c. Contrary to our hypotheses, team leaders and team members' individual performance in the network did not vary (Hypothesis 2a), but team leaders' performance outside the network was higher, measured as refereed articles published (Hypothesis 2b). Last, structural holes were not related to team member's individual performance on their teams (Hypothesis 3a), but performance was inversely and significantly related structural holes in the network (Hypothesis 3b). This suggests that following the initial team formation and the commencement of the pilot studies, team cohesion, not bridging was associated with higher levels of performance. Combined, these findings indicate that the team leaders built and managed their research teams, benefiting from their positions in the network and experience; consistent with structural hole theory, team leaders used those benefits to conduct and complete the work in their teams.

Two main advances in our knowledge of team-based interaction resulted from this study. First, a set of 11 intact teams across 12 organizational boundaries was studied. Much of the prior research on teams addresses intraorganizational efforts, which limits generalizability to settings outside the organization under study. In this instance, team members shared professional similarities, such as job type, education and training but differed in their geographic proximity, organizational affiliation, and organizational configuration. The consistencies in the patterns of team interaction uncovered here suggest that interorganizational collaboration can be effectively modeled and explained in a similar fashion to more traditional team-based structures.

Second, this investigation examined team-based interaction from three distinct, yet interrelated perspectives. By combining network structure, individual perceptions, and team outcomes, it was demonstrated that (a) team leaders spanned more structural holes than team members; (b) team leaders came to the alliance with a greater set of research skills; and (c) bridging structural holes was, significantly but inversely related to team performance among these intact, geographically dispersed teams over time.

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Authors’ Note

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Table 1. Means, Standard Deviations, and Correlations Among the Study Variable

	M	*SD*	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) Effect size	6.47	6.84	—						
(2) Efficiency	0.41	0.13	0.88**	—					
(3) Constraint	0.22	0.07	−0.74**	−0.71**	—				
(4) Hierarchy	0.06	0.04	0.28	0.44**	0.13	—			
(5) Individual performance	4.37	0.67	0.17	0.05	−0.21	−0.11	—		
(6) Team performance	3.25	1.09	−0.55**	−0.45**	0.16	−0.42**	0.18	—	
(7) Articles	2.02	2.57	0.02	0.04	−0.18	−0.16	0.24	0.25	—

**Correlations are significant at the .01 level (two-tailed).

Table 2. Descriptive Statistics for Team Leaders and Team Members

	M	*SD*	Min	Max
Effect size—TL	4.62	5.65	5.52	32.23
Effect size—TM	12.04	7.30	1.15	32.05
Efficiency—TL	0.50	0.12	0.35	0.75
Efficiency—TM	0.37	0.12	0.16	0.75
Constraint—TL	0.24	0.06	0.10	0.17
Constraint—TM	0.15	0.02	0.11	0.42
Hierarchy—TL	0.06	0.03	0.03	0.11
Hierarchy—TM	0.07	0.04	0.00	0.15
Individual performance—TL	4.53	0.72	3.00	5.00
Individual performance—TM	4.31	0.66	3.00	5.00
Outside performance—TL	3.55	3.59	0.00	12.00
Outside performance—TM	1.52	1.96	0.00	8.00

Note: TL = team leader, TM = team member. Team leader: $N = 11$; team member: $N = 33$.

Table 3. Regression Coefficients, Partial Correlations, and Zero-Order Correlations

	B	*SE*	Beta	*t*	*p* value	Zero-order *r*	Partial *r*
Dependent variable: Individual performance							
Effect size	0.045	0.03	.46	1.32	.19	.17	.21
Efficiency	−3.20	2.24	−.61	−1.45	.16	.05	−.22
Constraint	−3.01	3.04	−.31	−0.99	.33	−.21	−.16
Hierarchy	1.42	4.67	.07	0.30	.76	−.11	.05
Dependent variable: Team performance							
Effect size	−0.15	0.04	−.95	−3.52	.001	−.55	.49
Efficiency	1.97	2.86	.23	0.69	.50	−.45	.11
Constraint	−5.62	3.87	−.36	−1.45	.15	.16	−.22
Hierarchy	−6.59	5.95	−.21	−1.11	.27	−.42	−.18

References

Ahuja, G. (2000). Collaboration networks, structural holes, and innovation: A longitudinal study. *Administrative*

Science Quarterly, 45, 425-455.

Baker, W. (1990). Market networks and corporate behavior. *American Journal of Sociology, 96*, 589-625.

Belliveau, M. A., O'Reilly, C. A., III, & Wade, J. B. (1996). Social capital at the top: Effects of social similarity and status on CEO compensation. *Academy of Management Journal, 39,* 1568-1593.

Borgatti, S. P., Everett, M. G., & Freeman, L. C. (2002). Ucinet for Windows: Software for Social Network

Analysis [Computer software]. Harvard, MA: Analytic Technologies.

Bourdieu, P. (1986). The forms of social capital. In J. G. Richardson (Ed.), *Handbook of theory and research for the sociology of education* (pp. 241-258). New York: Greenwood.

Boxman, E. A. W., De Graaf, P. M., & Flap, H. D. (1991). The impact of social and human capital on the income attainment of Dutch managers. *Social Networks, 13*, 51-73.

Burt, R. S. (1992). *Structural holes: The social structure of competition*. Cambridge, MA: Harvard University Press.

Burt, R. S. (1997). A note on social capital and network content. *Social Networks, 19*, 355-373.

Burt, R. S. (2001). Structural holes versus network closure as social capital. In N. Lin, K. Cook, & R. S. Burt

(Eds.), *Social capital* (pp. 31-56). New York: Walter de Gruyter.

Burt, R. S. (2002). Bridge decay. *Social Networks, 24*, 333-363.

Burt, R. S. (2008). Industry performance and indirect access to structural holes. *Advances in Strategic Management, 25*, 315-360.

Campion, M. A., Medsker, G. J., & Higgs, A. C. (1993). Relations between work group characteristics and effectiveness: Implications for designing effective work groups. *Personnel Psychology, 46*, 823-850.

Campion, M. A., Papper, E. M., & Medsker, G. J. (1996). Relations between work team characteristics and effectiveness: A replication and extension. *Personnel Psychology, 49*, 429-452.

Chen, M.-H., Chang, Y.-C., & Hung, S.-C. (2008). Social capital and creativity in R&D project teams. *R&D Management, 38*, 21-34.

Cho, H., Gay, G., Davidson, B., & Ingraffea, A. (2007). Communication styles, social networks, and learning performance in a CSCL community. *Computers and Education, 49*, 309-329.

Cohen, S. G., & Bailey, D. E. (1997). What makes teams work: Group effectiveness research from the shop floor to the executive suite. *Journal of Management*, *23*, 239-290.

Coleman, J. S. (1990). *Foundations of social theory*. Cambridge, MA: Harvard University Press.

Cross, R., & Cummings, J. N. (2004). Tie and network correlates of individual performance in knowledge intensive work. *Academy of Management Journal*, *47*, 928-937.

Cummings, J. N., & Cross, R. (2003). Structural properties of work groups and their consequences for performance. *Social Networks*, *418*, 1-15.

Edelman, L. F., Bresnen, M., Newell, S., Scarbrough, H., & Swan, J. (2004). The benefits and pitfalls of social capital: Empirical evidence from two organizations in the United Kingdom. *British Journal of Management*, *15*, S59-S69.

Espinosa, J. A., Cummings, J. N., Wilson, J. M., & Pearce, B. M. (2003). Team boundary issues across multiple global firms. *Journal of Management Information Systems*, *19*, 157-190.

Galbraith, J. (1973). *Designing complex organizations.* Reading, MA: Addison-Wesley.

Goyal, S., & Vega-Redondo, F. (2007). Structural holes in social networks. *Journal of Economic Theory*, *137*, 460-492.

Granovetter, M. S. (1973). The strength of weak ties. *American Journal of Sociology*, *78*, 1360-1380.

Hackman, M. Z., & Johnson, C. E. (2009). *Leadership: A communication perspective* (5th ed.). Long Grove, IL: Waveland.

Hartman, R. L., & Johnson, J. D. (1990). Formal and informal group communication structures: An examination of their relationship to role ambiguity. *Social Networks*, *12*, 127-151.

Hoegl, M., Ernst, H., & Proserpio, L. (2007). How teamwork matters more as team member dispersion increases. *Journal of Product Innovation Management*, *24*, 156-165.

Ilgen, D. R., Major, D. A., Hollenbeck, J. R., & Sego, D. J. (1993). Team research in the 1990s. In M. M. Chemers & R. Aymon (Eds.), *Leadership and organizational effectiveness* (pp. 245-271). New York: Academic Press.

Johnson, J. D. (1993). *Organizational communication structure*. Norwood, NJ: Ablex.

Katzenbach, J. R., & Smith, D. K. (1993). *The wisdom of teams*. Boston: Harvard Business School.

Knoke, D. (1999). Organizational networks and corporate social capital. In R. Th. A. J. Leenders & S. M. Gabbay (Eds.), *Corporate social capital and liability* (pp. 17-42). Boston: Kluwer.

Krackhardt, D. (1990). Assessing the political landscape: Structure, cognition, and power in organizations. *Administrative Science Quarterly, 35*, 342-369.

Krackhardt, D., & Stern, R. N. (1988). Informal networks and organizational crises: An experimental simulation. *Social Psychology Quarterly, 51*, 123-140.

Kratzer, J., Leenders, R. Th. A. J., & van Engelen, J. M. L. (2006). Team polarity and creative performance in innovation teams. *Creativity and Innovation Management, 15*, 96-104.

LaFasto, F., & Larson, C. (2001). *When teams work best.* Thousand Oaks, CA: Sage.

Lin, N. (2001). *Social capital: A theory of social structure and action*. Cambridge, UK: Cambridge University Press.

Mizruchi, M. S., & Galaskiewicz, J. (1994). Networks of interorganizational relations. In S. Wasserman & J. Galaskiewicz (Eds.), *Advances in social network analysis* (pp. 230-253). Thousand Oaks, CA: Sage.

Monge, P. R. (1987). The network level of analysis. In C. R. Berger & S. Chaffee (Eds.), *Handbook of communication science* (pp. 239-270). Thousand Oaks, CA: Sage.

Monge, P. R., & Contractor, N. S. (2003). *Theories of communication networks*. New York: Oxford University Press.

Monge, P. R., & Eisenberg, E. M. (1987). Emergent communication networks. In F. M. Jablin, L. L. Putnam, K. H. Roberts, & L. W. Porter (Eds.), *Handbook of organizational communication* (pp. 304-342). Newbury Park, CA: Sage.

Nahapiet, J., & Ghoshal, S. (1998). Social capital, intellectual capital, and the organizational advantage. *Academy of Management Review, 23*, 242-266.

Odom-Reed, P. R. (2007). *Bonding and bridging social capital in collaborative learning networks.* Unpublished doctoral dissertation, Cornell University, Ithaca, NY.

Oliver, C. (1990). Determinants of inter-organizational relationships: Integration and future directions. *Academy of Management Review, 15*, 241-265.

Podolny, J. M., & Baron, J. N. (1997). Resources and relationships: Social networks and mobility in the workplace. *American Sociological Review, 62*, 673-693.

Portes, A. (1998). Social capital: Its origins and applications in modern sociology. *Annual Review of Sociology, 24*, 1-24.

Putnam, R. D. (2000). *Bowling alone: The collapse and revival of American community*. New York: Simon Schuster.

Reagans, R., & Zuckerman, E. W. (2001). Networks, diversity, and productivity: The social capital of corporate R&D teams. *Organization Science, 12*, 502-517.

Schmidgall, R., Woods, R. H., & Rutherford, D. G. (1996). Journal and periodical usefulness. *Cornell Hotel and Restaurant Administration Quarterly, 37*(2), 47-55.

Shah, P. P. (1998). Who are employees' social referents? Using a network perspective to determine referent others. *Academy of Management Journal, 41*, 249-268.

Shrader, C. B., Lincoln, J. R., & Hoffman, A. N. (1989). The network structures of organizations: Effects of task contingencies and distributional form. *Human Relations*, *42*, 43-66.

Soda, G., Usai, A., & Zaheer, A. (2004). Network memory: The influence of past and current networks on performance. *Academy of Management Journal*, *47*, 893-906.

Susskind, A. M., Behfar, K., & Borchgrevink, C. P. (2006). An exploration of the relationship between communication network structures, team-member exchange quality and teamwork. In G. B. Graen & J. A. Graen (Eds.), *Shared network leadership. LMX leadership: The series* (pp. 119-136). Charlotte, NC: Information Age.

Susskind, A. M., Miller, V. D., & Johnson, J. D. (1998). Downsizing and structural holes: Their impact on layoff survivors' perceptions of organizational chaos and openness to change. *Communication\ Research, 25*, 30-65.

Sundstrom, E. (Ed.). (1999). *Supporting work team effectiveness: Best management practices for fostering high performance.* San Francisco: Jossey-Bass.

Walker, G., Kogut, B., & Shan, W. (1997). Social capital, structural holes and the formation of an industry network. *Organization Science, 8*, 109-125.

Wasserman, S., & Faust, K. (1994). *Social network analysis: Methods and applications*. Cambridge, UK: Cambridge University Press.

Woolcock, M., & Narayan, D. (2000). Social capital: Implications for development theory, research, and policy. *World Bank Research Observer*, *15*, 225-249.

Yuan, Y. C. (2004). *The impact of social capital on the development of transactive memory systems*. Unpublished doctoral dissertation, University of Southern California, Los Angeles.

Zaccaro, S. J., Rittman, A. L., & Marks, M. A. (2001). Team leadership. *Leadership Quarterly, 12*, 451-483.

Zaheer, A., & Soda, G. (2009). Network evolution: The origins of structural holes. *Administrative Science Quarterly*, *54*, 1-31.