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BUILDING EFFECTIVE INTRA-ORGANIZATIONAL NETWORKS

THE ROLE OF TEAMS

Nancy Katz and David Lazer

This paper integrates the largely independent literatures on networks and teams. Our objective is twofold: (1) To understand what constitutes an effective organizational network when much of the work of the organization is done by teams; and (2) to examine the internal and external social capital needs of teams. We raise questions to guide future research, and point to potential managerial implications.

How does one build effective intra-organizational networks? An impressive body of research has accumulated on this question. Surprisingly, though, this literature has largely ignored one of the key relational building blocks of many organizations: Formal teams. The neglect of teams is particularly troubling because organizations are increasingly using teams to accomplish mission-critical tasks. Furthermore, the literature on team and small group dynamics offers a rich vein of findings that are potentially quite relevant to the topic of intra-organizational networks. This neglect of teams in the network literature is mirrored by a neglect of networks in the team literature. Our purpose in writing this paper is to provide a basis for the integration of these two bodies of literature.

Interestingly, in an earlier time, these literatures were intertwined. Bavelas and his colleagues used network methodology to study communication in small groups (Bavelas, 1950; Bavelas & Barrett, 1951; Christie, Luce & Macy, 1956; Leavitt, 1951; Shaw, 1964; Shaw, 1954). But this stream of research lost momentum, and, since that era, the literature on networks and the literature on teams have evolved quite independently (Friedkin, 1999).

This review is organized into six sections. First, we offer a brief characterization of each body of literature. Second, we provide a scheme for understanding the parallels between the network and team literatures. The scheme is designed to help identify which concepts from network theory can be imported sensibly into team theory, and vice versa. Third, we describe the core construct of "social capital" and its closest analog in the team literature. Fourth, we summarize what is already known about the inter-relationships between network and team effectiveness. Fifth, we identify questions to guide future research. Finally, we conclude with a discussion of the managerial prescriptions that this research vein might offer.

BRIEF OVERVIEW OF THE NETWORK AND TEAM LITERATURES

We begin by defining the two research traditions we wish to integrate: Social network analysis and team research. The paradigmatic focus of social network analysis is the configuration of relationships within a social system. Two principal questions drive the analysis: What factors underlie and explain a given configuration? And what are the effects of that configuration (Ibarra, 1993; Rowley, Behrens & Krackhardt, 2000; Tsai & Ghoshal, 1998)?

Social network analysis is a broad term that incorporates a variety of methods and applications, yielding a research tradition that is beyond the scope of this review to summarize fully. Important threads have included the development of methodologies to characterize networks, including mathematical tools such as graph theory (Wasserman & Faust, 1994; Watts & Strogatz, 1998); the development of statistical tools to deal with interdependencies peculiar to networks (Holland & Leinhardt, 1977; Krackhardt, 1987; Robins & Pattison, 2001); and the development of simulation methods to describe the evolution of networks (Banks & Carley, 1996; Zeggelink, 1995).

In assessing the impact of a given network structure, researchers have focused on a wide range of variables, including social influence (Erickson, 1988; Festinger, 1954); power (Daveni & Kesner, 1993; Padgett & Ansell, 1993); diffusion (Burt, 1992; Coleman, 1988; Rogers, 1995); social exchange (Cook & Emerson, 1984); economic exchange (Granovetter, 1985; Uzzi, 1997); social cohesion (Friedkin, 1993); and knowledge management (Carley, 1999; Contractor & Bishop, 2000; Hansen, 1999). There has been a recent surge of interest in "social capital," *i.e.*, how a set of relationships at the collective or individual level make that collective or individual more productive (Lin, 2001). The recent surge in interest can be attributed in

large part to Robert Putnam's (1993) work on associational affiliations and government effectiveness. Nahapiet & Ghoshal (1998) helped inaugurate the spread of "social capital" to the organizational literature.

One of the most robust findings in the literature on the factors underlying the structure of networks is that birds of a feather flock together (homophily, see McPherson, Smith-Lovin & Cook, 2001). This phenomenon has been demonstrated experimentally (Byrne, 1971), in small group settings (Newcomb, 1943, 1947), in work organizations (Ibarra, 1992; Kanter, 1977), and across society (Marsden, 1988).

> **" How does diversity affect team functioning along such dimensions as cooperation, creativity, cohesiveness, and decision making?"**

The team literature focuses on small work groups. Typically, the goal of a team study is to identify the variables that predict team effectiveness. Given the time- and labor-intensive nature of studying groups, most research relies on small N designs (small relative to network research) and on "snapshots" of group functioning (Weingart, 1997).

Historically, the team literature has focused on such variables as cohesiveness, size, leadership, motivation, and group goals (Guzzo & Dickson, 1996). In recent years, composition has become a central concern, particularly regarding diversity. The questions guiding this research include: How does diversity affect team functioning along such dimensions as cooperation, creativity, cohesiveness, and decision making (*e.g.*, Chatman & Flynn, 2001; Cox, Lobel & McLeod, 1991; Harrison, Price & Bell, 1998; Jackson, 1996; Jehn, Northcraft & Neale, 1999)? What types of diversity matter, and do different types of diversity (*e.g.*, demographic, functional, cultural, national, experiential) have different impacts on team functioning (*e.g.*, O'Connor, 1998; Watson, Kumar & Michaelsen, 1993)?

Another focus of considerable attention in recent years is the role of conflict among teammates (*e.g.*, Amason, 1996; De Dreu & Van Vianen, 2001; Jehn, 1995; Jehn & Mannix, 2001). What factors predict whether a team will experience low or high levels of conflict? What types of conflict have positive impacts on team performance? What types of conflict are harmful?

Another growing stream in the team literature focuses on the impact of technological innovations on teams (*e.g.*, Hollingshead & McGrath, 1995; McLeod, 1992). Researchers have focused on such questions as: Do computer mediated or "virtual" teams function in the same way as face-to-face teams? How do the needs of virtual teams differ from the needs of face-to-face teams? What types of tasks are best fulfilled by virtual teams, and what tasks require face-to-face contact?

In the 1950s, research on social networks and teams did overlap. Bavelas and his colleagues at the Massachusetts Institute of Technology conducted experimental analyses of how communication patterns among teammates influenced team effectiveness (Bavelas, 1950; Bavelas, *et al.*, 1951; Leavitt, 1951). This research highlighted the importance of the complexity of the information that needed to be transmitted across a network. When the information was simple, centralized communication was optimal. When the information was complex, centralized communication was dysfunctional.

Over the subsequent forty years, however, these two literatures diverged. To demonstrate the extent of the disjuncture, we conducted a survey of all network and team articles published between 2000-2001 in five top management journals (*Academy of Management Journal, Organization Science, Administrative Science Quarterly, Strategic Management Journal,* and *Organizational Behavior and Human Decision Processes*). We found 61 articles on networks and 105 articles on teams, but only four articles that involved both networks

and teams. While a small number, this is still a substantial increase from the entire decade of the 1990s, during which only two articles met these criteria. This increase suggests that researchers have recently begun to recognize the potential importance of the network-team nexus.[1]

A full explanation as to why these two literatures diverged is beyond the scope of this paper. We suspect it was largely due to a natural disciplinary coalescence around different paradigms in the 1950s and 1960s. In the small group and team literature, much of the theory development was based on laboratory experiments conducted by social psychologists (Moreland, Hogg & Hains, 1994). Social network theory, meanwhile, focused on broad concepts (*e.g.*, society, institutions) best understood by sociologists.

The result of this bifurcation was two largely independent literatures that examine many of the same or comparable phenomena. Given the recent surge of interest in social networks and in teams, we argue that the time is ripe to bring these two research streams back together.[2] We welcome evidence of the beginnings of such a trend. As this trend starts to gain momentum, we offer a kind of conceptual "Rosetta Stone" for integrating the two literatures, and define an ambitious agenda to guide research in this area.

MAPPING CONCEPTS

The key building block of network research is the tie.[3] A tie "establishes a linkage between a pair of actors" (Wasserman, *et al.*, 1994: 18). The literature on intra-organizational networks often examines ties based on communication, such as task-related communication ("To whom do you speak regularly about business matters?"), advice-related communication ("To whom do you go for advice when you have a work-related problem or a decision to make?"), and social communication ("Whom have you met with privately outside of work?"). Other types of ties include friendship, collaboration, affect, exchange, and spatial propinquity. Another important distinction in social network theory is made between strong and weak ties. This distinction often involves a whole set of issues around affect, mutual obligations, reciprocity, and intensity. The structure of strong tie networks tends to be densely intra-clique, and the structure of weak tie networks tends to be inter-clique (Granovetter, 1973). There has also been recent attention to "hindrance" ties—relationships that inhibit an individual's productivity (*e.g.*, Labianca, Brass & Gray, 1998; Sparrowe, Liden, Wayne & Kraimer, 2001).

In the team literature, there is no exact parallel to the tie. Many studies examine the overall amount of communication among teammates (*e.g.*, Shah & Jehn, 1993). Some studies look at how much each team member speaks (*e.g.*, Brown & Miller, 2000) and who says what (Larson, Christensen, Abbott & Franz, 1996). Communication is usually captured at the team or the individual level, *not the dyadic level* (*i.e.*, who speaks to whom). Furthermore, communication "has largely been viewed in terms of formal relationships rather than informal interaction patterns" (Guzzo & Shea, 1992). Studies categorize teams based on the prior history of their members, comparing teams comprised of strangers, acquaintances, or friends. Such studies typically compare the overall level of communication in these different types of teams (*e.g.*, Gruenfeld, Mannix, Williams & Neale, 1996).

The fact that the tie is *not* a core concept in the team literature underscores an essential question of this review: Can the pattern or distribution of ties help us understand team-level phenomena? For example, rather than focusing on the aggregate amount of communication, does it matter who communicates with whom? Given that the construct of ties has been shown to be important at the communal (Putnam, 2000) and organizational (Nahapiet, *et al.*, 1998) levels, we strongly suspect it is likely to matter at the team level

as well. Because social capital is defined as the way that the social network enhances the effectiveness of an individual or some set of individuals, we devote an extended discussion to social capital below.

Our objective in this paper is to help map the findings and methods of network theory onto the study of teams. In trying to assess which concepts from the network literature can be sensibly applied to the team literature (and vice versa), two primary issues must be considered. The first issue is the level of analysis at which a concept "lives." The second issue is the position of a concept in the causal chain.

Because it does not reify any particular level of analysis, network theory, can allow a researcher to cross levels of analysis with relative ease. One may examine the position of the team in an overarching network (*e.g.*, Ancona, 1990), describe a particular team's internal communication structure (*e.g.*, Sparrowe, *et al.*, 2001), or examine a particular individual's position within the team (*e.g.*, Bavelas, 1950). Many of the phenomena that we discuss below have manifestations at multiple levels. It is, therefore, possible to map network findings from one level to derive propositions at another level. We suggest that five extrapolations, summarized in Table One, are most sensible:

TABLE 1 MAPPING PARALLEL COMPARISONS

NETWORK	TEAM
Individual: organization	Individual: team
Organization: inter-organizational network	Team: intra-organizational network
Organizational network: organization	Team network: team
Organization: inter-organizational network	Individual: team
Individual: network	Team: intra-organizational network

The first line in Table One suggests that findings in the network literature about, for example, how an individual's position in the organizational network influences his or her effectiveness in the organization can be reasonably mapped onto the question of how an individual's position in a team influences his or her effectiveness on the team.

This conceptual mapping needs to be done with some caution, because, for example, a finding about what makes an organization effective in an inter-organizational network might not be usefully extrapolated to what makes an individual effective on a team. The key issue is whether a process or construct works at multiple levels (Brass, 2000). For instance, if the process is information diffusion, a network position that is advantageous to the individual (*e.g.*, centrality) might reasonably be argued to map to other levels of analysis such as the team (in an intra-organizational network of teams) or the organization (in an inter-organizational network of organizations). However, if the process or construct is distinctive to a particular level of analysis, it would be unwise to map to other levels. For example, an intrapsychic construct that "lives" at the individual level, such as "self monitoring," does not make sense at the organizational level.[4]

While network theory slides easily into the study of teams—since network theory is agnostic as to its level of analysis—the same cannot be said of team theory. Importing team and small group concepts into the analysis of networks is more challenging because of the natural reification of the team in the team literature. Indeed, a central concern in the team literature is establishing that a given construct lives on the team level (Klein & Kozlowski, 2000). Team-level phenomena are often emergent—the result of teammates' influence on one another—and models of team constructs must incorporate that interdependence.

> " Relationships that facilitate the productivity of individuals... are more likely to occur within an organization."

A second issue that researchers must grapple with when translating a concept from the network to the team literature (or vice versa) is the position of the concept in the causal chain. The two literatures are based, sometimes explicitly and sometimes implicitly, on two different causal models. The team literature is generally characterized by an "Input → Process → Output" model. Input includes such structure and design variables as team composition, the nature of the task, and the resources available in the team's environment. Process consists of the interactions among teammates—both task and social interactions—that are frequently described as the "black box" of team research (Weingart, 1997). Output involves the results of the team experience: The quality of the team's product, the impact of the experience on individual team members, and the viability of the team as a functioning unit (Hackman, 1987). This model (and refined versions thereof) is frequently adopted in reviews and integrations of the team literature (*e.g.*, Gist, Locke & Taylor, 1987; Guzzo & Shea, 1995; Pelled, Eisenhardt & Xin, 1999).

According to this model, the pattern of informal communication among teammates is generally treated as a process variable, mediating the relationship between inputs and outputs (*e.g.*, Brown, *et al.*, 2000). As discussed at greater length below, network factors may be relevant at any of these stages—input, process, or output. Consider the scenario of two teams and a researcher examining the impact of each team's network on its relative effectiveness. If the network of ties among members of Team A *before they were configured as a team* give it a performance advantage over Team B, it might be useful to consider the social network as an input. If the two teams have identical networks prior to configuration, but during the process one emerges with a network that makes it more effective, then it might be useful to view the network as part of the process. If, having configured the membership of the two teams in one way as compared to another affects the network of the organization after the team has completed its work, and this reconfiguring of the organizational network affects the productivity of the organization, then the network might be viewed as an output.

SOCIAL CAPITAL

While the concepts underlying the term "social capital" may be traced to Durkheim (1893) and beyond, the recent surge of interest in social capital can significantly be attributed to Putnam's (1993) work on associational affiliations and government effectiveness (for review see Adler & Kwon, 2002). Other recent landmark studies include Bourdieu (1985), Coleman (1988), Portes & Sensenbrenner (1993), and Woolcock (1998). While some of the literature has incorporated collective-level variables, such as trust (Putnam, 1995), social capital is best understood as how a particular network offers an actor access to resources that make it more productive. As Lin (2001: 26) argues, "Divorced from its roots in individual interactions and networking, social capital becomes merely another trendy term to employ or deploy in the broad context of improving or building social integration and solidarity."

The term "social capital" made the leap to the literature on organizations with Nahapiet & Ghoshal (1998). (Also see Zander & Kogut (1995) for many of the same themes, but without the term "social capital.") Nahapiet & Ghoshal argue that social capital offers a rationale for the existence of the firm, in contrast to Williamson's (1975) classic analysis regarding monitoring, small numbers, and opportunism. Relationships that facilitate the productivity of individuals, Nahapiet & Ghoshal asserted, are more likely to occur within an organization. Therefore, the clustering of individuals into firms will enhance overall production, independent of its effects on shirking.

At the individual level, social capital is defined as how an individual's configuration of ties affects his or her productivity. Similarly, at a collective level, social capital is how the configuration of ties of the collective (such as a team) affects the collective's productivity. While the construct of social capital has made the leap from the study of societies to the study of organizations, it has not yet made the leap into the literature on teams—with the noteworthy exceptions described below. The closest parallel in the team literature is the notion of process gains.[5]

Social Capital and Process Gains

Process gains are best understood in the context of process losses. Steiner (1972) describes process losses as the inefficiencies or dysfunctions that prevent a team from doing as well as it could. Steiner referred to a "coordination decrement" and a "motivation decrement." Process gains are the synergies that result from working as a team (over and above the gains from simply pooling the efforts of individual team members) (Hackman, 1987). A team's productivity will be a function of each teammate's individual contribution; process losses, or the costs of using a team (*e.g.*, wasted effort, free riding, coordination costs); and process gains (Hackman, 2002).

Process gains are, thus, *not* gains from, for example, specialization (which could occur even if two individuals were not on a team together). Rather, they are gains from a particular form of social organization—the team. Process gains include every benefit that arises from the interaction process among teammates, and which make a team's success on a task greater than the sum of the individual team members' contributions. Researchers have examined a variety of constructs that capture aspects of process gains, such as "transactive memory" (Wegner, 1986) and "team learning" (Edmondson, 1999).

Internal and External Social Capital

A key difference between the network and team literatures concerns boundaries. The paradigmatic focus of team research is on the task performance of a small group with a clear and well-defined boundary (Alderfer, 1977).[6] "Clear and well-defined" means that team members and outsiders know who is and is not on the team (Hackman, 1990). This is a critical element of the very definition of a team (Sundstrom, Demeuse & Futrell, 1990). While spanning the boundary between the team and its environment is important (Ancona & Caldwell, 1992), maintaining the integrity of that boundary is also recognized as essential to effective team functioning (Guzzo, *et al.*, 1996).

The paradigmatic focus of network research, in contrast, is on the impact of the structure of relationships within some population at *both* the unit level and the system level. Part of the beauty and value of network methods is that they are agnostic as to level and can model a world where boundaries are fluid, fuzzy, or even non-existent. Introducing teams to network theory, therefore, means introducing intra-organizational boundaries around team members. This requires us to formalize two new constructs:

internal and *external social capital*. Internal social capital arises from a team's internal network; external social capital arises from a team's external network.

Internal and external social capital have not been formalized as separate team-level constructs before, but we contend that sufficient evidence exists to support drawing this distinction. (Interestingly, Flap, Bulder & Volker (1998) have called for a similar conceptual separation between an *organization's* internal and external capital.) The findings of Reagans & Zuckerman (2001) and of Sparrowe, *et al.* (2001), summarized below, suggest making this distinction regarding a team's internal and external capital is both valid and useful; these two types of capital seem to function differently and serve different purposes. Henceforth in this article we refer not to a team's overall capital, but rather to its internal or external capital.

THE EXISTING INTERSECTION OF THE NETWORK AND TEAM LITERATURES

What do we know about how social networks affect the performance of teams? As noted above, our review of the literature in five top journals helped identify a small but intriguing body of empirical findings (Ancona, 1990; Baldwin, *et al.*, 1997; Brown & Miller, 2000; Haas, 2001; Hansen, 1999; Hinds, Carley, Krackhardt & Wholey, 2000; Reagans & Zuckerman, 2001; Sparrowe, *et al.*, 2001). In this section we briefly summarize those papers and we organize the findings into three categories: Internal connections, external connections, and team composition.

Internal Connectedness

The first question one might ask about internal connectedness is whether more is better, all other things being equal. Three studies have addressed this question, and found mixed results. Baldwin, *et al.* and Reagans & Zuckerman found support for the premise that more ties are associated with enhanced team performance, while Sparrow, *et al.* found none. We can identify no obvious mediating or moderating variable to explain the variance in findings.

Controlling for overall connectedness, the natural follow-up question is What *type* of internal connectedness is associated with enhanced team performance? Sparrowe, *et al.* examine the impact of centralization of communication on team performance when the information being conveyed was complex, finding modest support for the proposition that centralized communication was dysfunctional. Sparrowe, *et al.* collected their data in the field; Brown & Miller documented a comparable effect in a laboratory experiment. Brown & Miller found that teams working on low complexity tasks were more likely to form centralized communication networks than teams working on high complexity tasks.

Reagans & Zuckerman examined the interplay of diversity, network configuration, and team performance. They found that the density of boundary-spanning ties within the team (they examined subgroups defined by tenure with the organization) were positively related to team performance. Furthermore, the density of boundary-spanning ties was particularly valuable when the team was more densely tied together overall.

Sparrowe, *et al.* and Baldwin, *et al.* examined the internal density of "hindrance ties." Not surprisingly, both found that the greater the team's density of hindrance ties, the more poorly the team performed.

External Connectedness

Does the overall density of ties between a team and its environment affect team performance? Furthermore, does the particular configuration of external ties influence performance? The findings on the first question are mixed. While Ancona found a positive relationship, Baldwin, *et al.* found no rela-

tionship, and Sparrowe, *et al.* found a strong negative one. Baldwin, *et al.* explained their null findings as a reflection that teams in their study had little need for external communication; it was primarily the internal configuration of ties that mattered.

We cannot identify any obvious moderating variable that explains the inconsistency between the findings of Ancona and Sparrowe, *et al.*, but Hansen's and Haas's results offer a hint of explanation. Hansen found an interaction between tie strength and the complexity of information being transmitted. Weak ties worked best for conveying simple information; complex information required the "bandwidth" of strong ties. The inconsistency between the findings of Ancona and Sparrowe, *et al.* findings might be the result of not differentiating between strong and weak ties. Haas found that external connectedness may be positive or negative, depending upon a number of factors, including team autonomy and task overload. For teams with little autonomy or with overloaded team members, communication initiated by the external environment negatively affected team performance.

Composition

Hinds, *et al.* extended to the world of teams a result already well-established in the network literature: Homophily. Hinds, *et al.* found that even after controlling for pre-existing relationships, individuals prefer work group members who are the same race. Given the existence of homophilous prior ties, it is extremely likely that members of self-organized teams will select teammates who are similar to themselves.

The set of findings described above are promising. They suggest that the network-team nexus is a fruitful focus that deserves more attention from researchers. Of course, these findings are just a beginning. In the next section, we outline questions to guide future research.

RESEARCH AGENDA

The studies summarized above are the opening wedge of a potentially rich vein of research. In this section we outline questions that can guide that research. First, we contend with the issue of timing and how researchers might address questions of causality. Second, we turn to one of the biggest growth areas within network theory: Knowledge management. We suggest how propositions about knowledge management developed in the organizational context can be explored in the team context. Third, we examine one of the perennial issues in the study of teams: Individual effort and shirking. We propose ways in which network phenomena such as embeddedness might reduce shirking. Finally, we consider how teams may produce intergroup dynamics with network consequences.

Inferring Causality: Network and Team Sequence

There is a large body of literature on the consequences of networks. There is a small but growing literature on network evolution. Very little literature, however, wrestles simultaneously with the consequences of networks and the evolution of networks. (For exceptions, see Lazer, 2001; Newcomb, 1961; Zeggelink, 1995). To our knowledge, there are no such articles in the team setting. This is problematic because temporal dynamics must be taken into account before causality can be inferred.

In understanding the causal relationships between networks and teams, four stages must be considered. Figure One sketches those four stages: (1) The network that exists before the team is formed; (2) the role of the network in the team formation process; (3) the network while the team does its work; and (4) the network once the team has concluded functioning. Each stage in Figure One is analytically distinct. We pose questions that need to be addressed at each stage.

FIGURE 1 TEAM NETWORK STAGES
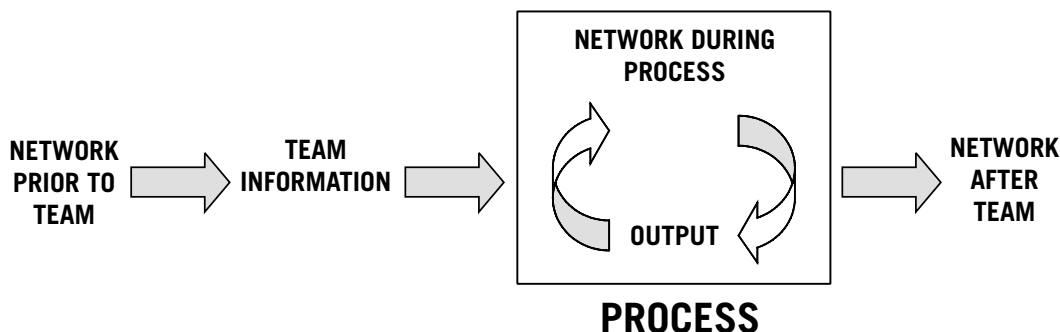
> **"We know that a team's success or failure can influence subsequent feelings of cohesiveness among teammates."**

Network pre-team: What is the network among team members *before* they are assigned to a team? Do team members know each other before the team exists? Jehn & Shah (1997) found differences in intra-team communication when they compared teams composed of friends to teams composed of acquaintances. What is the pattern of prior connections among team members, and between team members and non-team members? Does the network prior to the team have an impact on effectiveness independent of the network during the team process? In other words, do prior ties affect team functioning over and above the impact of communication during the team's life? What is the relationship between the network prior to the team and the network during the process? Networks tend to have some durability (Newcomb, 1961), and it seems likely that the pre-team network correlates to the network during the team process. This could have implications for task accomplishment; people might talk most with those they already know, even if the task demands that they talk mostly with teammates they do not already know.

Network during team formation: How are teams formed? Are they self-selected? As noted above, self-selected teams will likely be more homogeneous. Do self-selected teammates differ in other ways as well? Does the act of selecting someone as a teammate change the relationship, as compared to being assigned the same teammate?

Network during process and outcomes: Most of the research on the relationship between team network structure and outcomes looks at the network during the process. However, because networks are dynamic, there is a significant possibility of a feedback loop between outcomes and the team network. (See, for example, the feedback loop between team performance and cohesiveness, documented in Mullen & Copper's 1994 meta-analysis.) What might be the effects of a feedback process? We know that a team's success or failure can influence subsequent feelings of cohesiveness among teammates (Turner, Hogg & Smith, 1984). One possibility is that misery (lack of success) breeds company (connectedness). Another possibility is that successful collaborations result in increased communication. Lack of success may lead to a vicious cycle of failure, leading to disconnectedness, leading to more failure, and so on.

Network after team: What are the long-run effects of teams on the network? As Hinds, *et al.* (2000) note, having worked with someone increases the likelihood that one would choose to work again with him or her. Further, as noted above, success may have a positive effect on the duration of relationships.

Knowledge Management

One of the important resources that social capital offers access to is knowledge—*i.e.*, the expertise or wisdom possessed by other individuals. This might entail knowledge transfer (*e.g.*, "here's how you fix your computer") or knowledge access (*e.g.*, knowing whom to call to fix your computer). An effective *knowledge network* is built on a combination of individuals knowing (1) how to do things and (2) who knows how to do which things (Kogut & Zander, 1992; Carley, 1999; Monge & Contractor, 2002; Rogers, 1995). The transfer of knowledge is generally assumed to flow from individual to individual (*e.g.*, Cross, Parker, Prusak & Borgatti, 2001), from sub-unit to sub-unit within an organization (Hansen, 1999), or between organizations (*e.g.*, Dyer & Nobeoka, 2000).

While knowledge networks describe who knows what, each individual in the organization also has his or her own perception of who knows what—a "cognitive knowledge network" (Contractor, Zink & Chan, 1998). Cognitive knowledge networks are a combination of knowing who knows who and who knows what—*i.e.*, who knows who knows what. Cognitive knowledge networks vary in their accuracy and completeness (Contractor, *et al.*, 1998); higher levels of accuracy can be expected to result in greater access to the knowledge in the network.[7]

In the team literature, knowledge and learning have received substantial attention (*e.g.*, Hollingshead, 1998; Stasser, 1992; Stasser, Stewart & Wittenbaum, 1995), but the notion of knowledge *networks* within teams is only beginning to be explored (with a few noteworthy exceptions, *viz.*, Ancona, 1990; Hansen, 1999). Teams have the same needs to access knowledge as organizations do (although writ small), and findings about knowledge sharing among individuals in an organization and among subunits of an organization can map directly onto teams. This leads to several questions: Does internal connectedness promote the effective transfer and accessing of knowledge among team members?[8] Does external connectedness facilitate effective knowledge transfer between the team and the external environment? How do cognitive networks facilitate knowledge transfer?

Centrality in a network offers an individual actor greater access to a wider array of information and knowledge (Burkhardt & Brass, 1990; Ibarra & Andrews, 1993). The literature on interlocking directorates maps particularly well regarding a team's external ties (*e.g.*, Mizruchi, 1996). Interlocks provide useful knowledge from other boards (Davis, 1991; Haunschild, 1993). Therefore, it is reasonable to predict that teams that are centrally located in the intra-organizational network will outperform teams that are not centrally located—a consequence of the former's greater access to information and knowledge.

Having ties to diverse parts of the broader social system will yield non-redundant information to a given node (Granovetter, 1973). Burt (1992) highlights the value of "structural holes" to actors in a competitive system. A structural hole in a network exists when there are two or more sets of nodes within which there is ample communication, but between which there is little communication. Connecting otherwise disconnected sets of nodes maximizes the amount of non-redundant information a node receives. Therefore, it is reasonable to predict that teams which bridge structural holes will have an informational advantage over teams that do not.[9]

Effort and Free Riding

Free riding (or "social loafing") is a classic problem that can plague teams. One way to reduce free riding is to increase individual accountability (Harkins, 1987; Williams, Harkins & Latane, 1981). Network ties may foster that sense of accountability. If two individuals have many common ties, the outcome in that dyadic relationship will have reputational ramifications for each of those individuals far beyond the outcome of that particular exchange, creating individual-level accountability (Granovetter, 1985; Uzzi, 1997). Translating that logic to the team level, we can predict that a team is less likely to suffer from free riding if its members have a common array of *external* ties.[10]

Another mechanism social systems have that regulates individual tendencies toward non-cooperative behavior is the possibility of continued relationships, because the fruits of future collaboration are at stake (Axelrod, 1981). In other words, expected duration is another dimension of a relationship. One expects one's relationships with one's family to last a long time; one's relationships with one's neighbors somewhat less; and one's relationship with the individual from whom one purchased a camera considerably less still.

In fact, in experimental settings, merely having the subjects meet briefly before a prisoner's dilemma experiment yields higher levels of cooperation (Bohnet & Frey, 1999)—perhaps because meeting changes the probability of a future relationship and potential retaliation, which, in the absence of meeting, is zero.

This expectation of duration is particularly relevant in a team setting because the institutional setting affects the expectation of future relationships with other team members after the work of the team is done. If a team is drawn from different divisions of an organization, with different physical locations where the organization is not expected to pull together this set of individuals again, the expected duration of the relationships of team members is probably short. However, if individuals are drawn from the same part of the organization and from the same physical location, or if subsets of the team will be pulled together again for other projects, the expected duration of the relationship can be substantially longer. We would expect teams composed of relationships with a greater expected duration will suffer from less free riding.

Intergroup Dynamics, Cohesiveness, and Conflict Within Networks

The preceding discussion examined the impact of pre-existing networks on the effectiveness of teams. Here we examine the converse: What is the impact of introducing teams on the effectiveness of the network? As noted earlier, introducing teams into the network landscape means introducing formal boundaries. These boundaries are likely to foster ingroup/outgroup distinctions, which will in turn affect the network of the organization both positively and negatively.

In the landmark works on social capital in communities (*e.g.*, Bourdieu, 1985; Coleman, 1990; Putnam, 1993), boundaries (*e.g.*, class) within society played a key role in creating denser subsidiary networks, which in turn fostered cohesion, trust, sanctions, etc. Arguably, this logic should map onto teams within an organizational context, where the creation of teams will create pockets of densely connected individuals.

On the negative side, introducing teams into a network is likely to initiate classic intergroup processes, such as ingroup favoritism, hostility towards the outgroup, and intergroup competition (Alderfer, 1983; Kramer, 1991, 1993). The logic underlying these processes was established in a stream of research on social identity theory by Henry Tajfel and his colleagues (Tajfel, 1970; Tajfel, *et al.*, 1971; Tajfel & Turner 1979; Tajfel, 1982). According to Tajfel, *et al.*, people generally strive to enhance their self-image. A per-
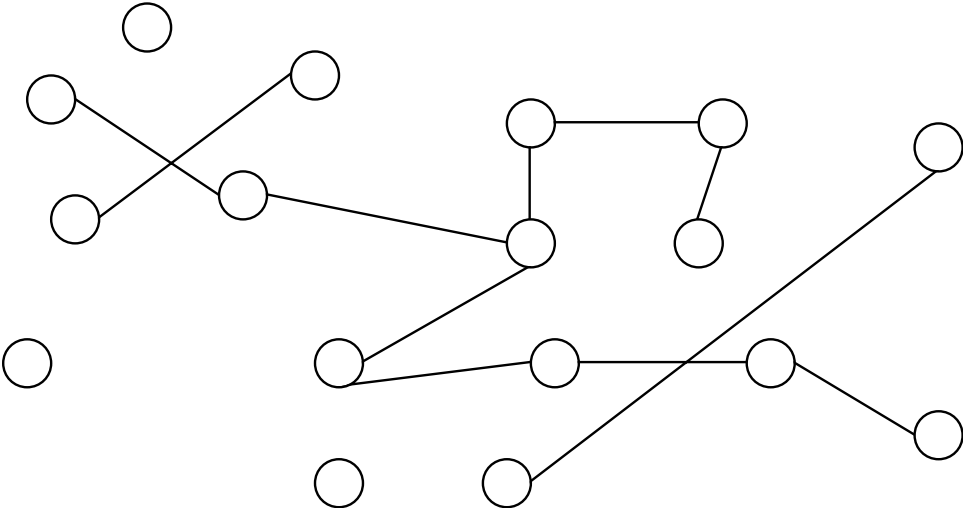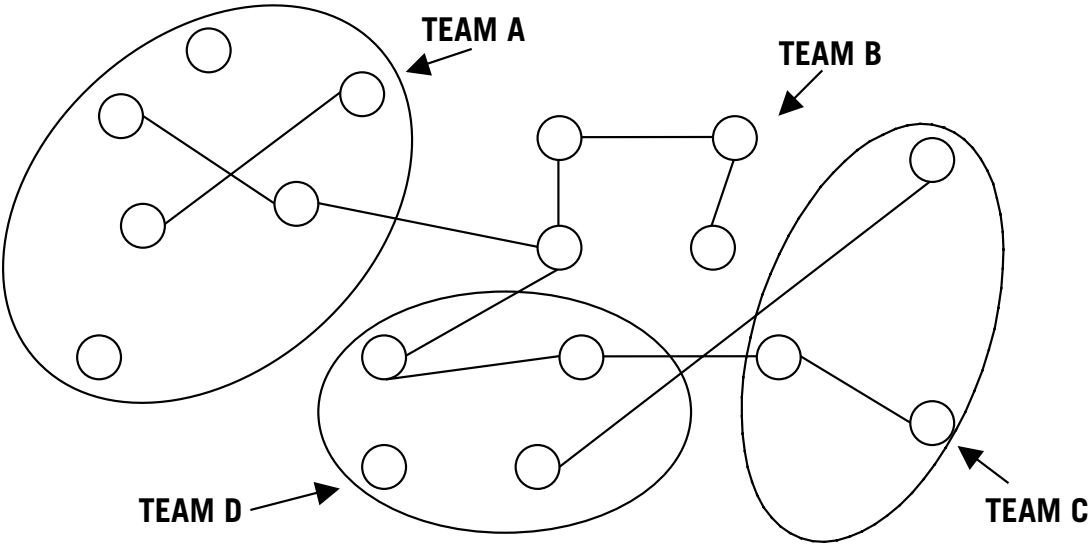
F I G U R E   2 A   NETWORKED ORGANIZATION WITHOUT TEAMS

F I G U R E   2 B   NETWORKED ORGANIZATION WITH TEAMS

TEAM A

TEAM B

TEAM D

TEAM C

son's self-image is comprised of two components: A personal identity and a social identity. When a person is assigned to a group, his or her social identity will be influenced by that group membership. In order to maintain a positive self-image, he or she is likely to overestimate the desirable characteristics of his or her own group, and the negative characteristics of the outgroup.

Compare two hypothetical networks in the same organization. The two networks are identical in all respects, except in the second network where individuals have just been assigned to four teams—A, B, C, and D (see Figures Two A and Two B). What impact will this have on the organizational network? Based on the research on intergroup processes, we can predict several important differences in how these two networks will evolve. First, we can expect ingroup favoritism to result in resource and information exchanges being redirected internally (Kramer & Brewer, 1984). An individual given the choice between an exchange that would benefit someone within his or her and an exchange that would benefit someone outside of it would likely choose the fellow group member. Second, even in the absence of such a choice, competitive processes and outgroup hostility would discourage exchanges that would benefit other groups.

It follows that the impact of superimposing these teams as a social organizing principle onto the organization may have contradictory effects on the organization. On the one hand, the presence of teams will increase many of the social regulators (*e.g.*, cohesion and embeddedness) that network theory highlights as being important to maintain collective action (*e.g.*, by limiting free riding). However, it also creates a potentially destructive competitive dynamic between groups. This negative impact could grow over time and lead to goal displacement, as people identify more with the goals of their own team than with the goals of the organization as a whole.

STUDYING EFFECTIVE NET(TEAM)WORKS: A METHODOLOGICAL DICTUM

Network and team research confront the same challenge: There is a tradeoff between internal and external validity. Some degree of control is necessary for drawing causal inferences. But can one distill the essentials of a relationship into an artificial laboratory setting? Clearly, the structure of payoffs, the distribution of information, and communication patterns can be reasonably manipulated, and thus the value of the Bavelas and subsequent research. However, many of the things we consider to be essential about relationships—history, probability of long run interaction, configuration of external ties/context—are difficult to manipulate.[11]

There is a long tradition of field research in both teams and networks. The challenge of such research is discerning what is causing what. This is a particular challenge in studying the impact of relationships on outcomes because many of the processes and outcomes one is interested in may have reciprocal effects.[12] Consider the critical question of whether the structure of network ties affects team success. Do ties lead to team success, or does team success lead to ties (*cf.*, Mullen & Copper's meta-analysis establishing the bidirectional links between cohesiveness and team performance, 1994)? Of course, both are true.

A challenge in combining network and teamwork approaches, then, is that a team's success or failure may affect the structure of the team's network (both internal and external). Would it be surprising to find that successful teams are more cohesive, have more informal ties, and fewer cliques and structural holes, even if there were no effects of connectedness on effectiveness? It is, therefore, necessary to collect network data that are causally antecedent to the outcome that is hypothesized to have been determined by

them.[13] Thus far, the studies that have examined teams and networks have not done that. Network data in all of the studies we found were collected *after* teams and individuals had produced outputs (and received feedback). So it is impossible to say whether these patterns are the result of (1) connectedness leading to success or (2) success leading to connectedness, as the feedback process summarized in Figure One indicates.[14] (Or lack of success leading to connectedness in hindrance networks.)

The findings of the few studies that have examined the nexus of effective teams and effective networks have provided a critical first step: Correlational results suggestive that social networks really matter to the effectiveness of teams. However, if one is going to make causal (and thus prescriptive) conclusions as to how networks affect the effectiveness of teams, it is necessary to study (or at least control for) the converse—*viz.*, what impact does effectiveness have on networks?

MANAGERIAL IMPLICATIONS

The above propositions are, of course, too preliminary to inspire any definitive advice for managers. But they are suggestive of a variety of ways managers could use teams to foster the creation of effective networks as well as use existing networks to foster effective teams. We divide our discussion into two parts: (1) The network needs of teams and (2) the teamwork needs of a networked organization.

The Network Needs of Teams

The network needs of a team are shaped by a variety of moderating variables. Task type is an especially important moderator. If the task involves the transmission of complex knowledge, we know that strong ties and accurate cognitive networks will prove helpful. If the task involves the transmission of simple knowledge, then investing in expensive strong ties would be overkill. Instead, a multitude of weak ties could prove effective.

When the task requires simple coordination among teammates, a centralized network will be optimal. If the task requires complex coordination, then a decentralized network will be more useful.

TABLE 2 TASK AND NETWORK NEED

| FUNCTIONAL NEED	NETWORK "NEED"
Complex knowledge transfer	Strong ties Accurate cognitive networks
Simple knowledge transfer	Weak ties
Coordination—simple	Centralized network
Coordination—complex	Dense, decentralized network
Public good/social loafing issues	Strong ties External embeddedness Iteration
External informational needs	Diverse external ties

When one free riding team member can "crash" the entire team—and free riding is thus a dangerous risk—a desirable network will feature high levels of embeddedness, strong ties within the team, and expectations for future interaction.

When task accomplishment requires that the team draw heavily on information from the external environment, diverse external ties to otherwise unconnected actors will maximize the informational yield of a team. Table Two summarizes these points.

Table Two offers managers a kind of roadmap for setting up teams with propitious network ties. However, it also alerts managers to tradeoffs they may face. It is impossible, of course, to construct a team with a centralized but distributed internal network—commonly embedded but with diverse ties to disconnected outside parties.[15] Managers must make choices. Consider Figure Three, which presents two alternative strategies for fostering social capital. Figure Three represents the network of a hypothetical organization which is divided into two functional areas. Team A features a more diverse set of external ties, but at the cost of internal connectedness and external embeddedness. Team B offers the opposite balance of advantages and disadvantages. A manager faces a choice between creating a team that is internally well-connected and cohesive but externally poorly connected, and a team that is externally well-connected but internally poorly connected and less cohesive.

F I G U R E 3   CROSS-DIVISIONAL *VS.* INTRA-DIVISIONAL TEAMS
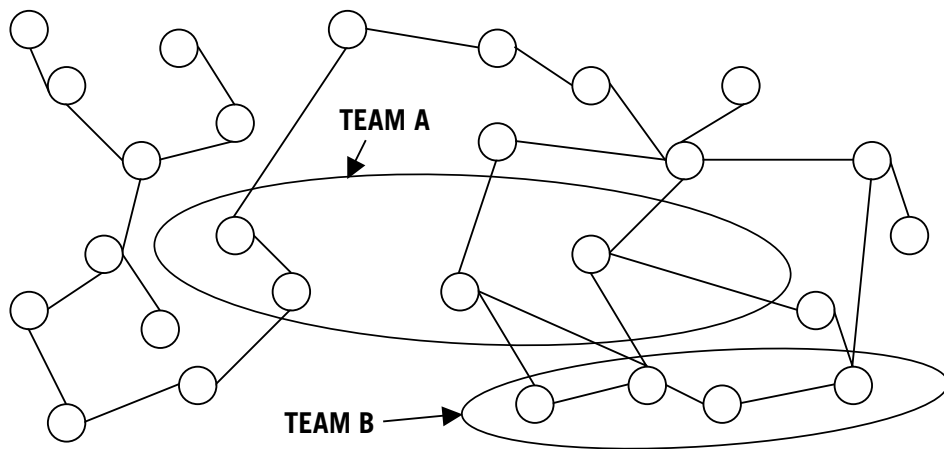
The Teamwork Needs of Networks

Earlier we addressed the question: How can networks foster effective teams? Now we pose the complementary question: How might teams foster effective networks? When a manager assigns people to teams, he or she is molding the social capital of the organization. Reconsider Figure Three. Imagine now that the organization suffers from inadequate information flow and rivalry between the two divisions (as reflected by the fact that there are no ties between the divisions). How might the manager foster information flow? Teams could provide a tool. The manager might create a cross-functional team like Team A.[16]

Consider an alternate scenario. Assume the manager needs to foster cohesiveness within divisions. In the short run, Team A might not be a more cohesive team, though in the long run it will foster cross-functional ties. In this scenario Team B will promote more of the desired cohesiveness; but in the long run it will do little to foster interfunctional coordination.

There are two overarching points here: (1) When assigning people to teams, managers should consider the impact of a team on the organization's long term social capital; and (2) managers should consider viewing social capital the same way they view other types of capital—it may need to be amortized over time. Under certain conditions, it may even be worth sacrificing some short-run team performance for the sake of fostering long-run organizational performance.

CONCLUSION

This paper has examined the theoretical implications of integrating the network and team literatures. Oddly enough, for two literatures focused on relationships, very few connections have been fostered between these two areas of study. Recently, however, a small stream of research has started to grow. Building on those initial findings, we define an agenda to guide future research. We also encourage appropriate caution on the part of researchers who seek to cross paradigms and levels of analysis. More research in this area is especially valuable because team composition is a "lever" that managers can control. This research can generate useful practical advice for managers.

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ENDNOTES

1 These numbers were derived by a search for articles whose abstracts contained "team" or "network" or "group," and by selecting only "network" articles in which ties or configurations of ties were an important variable for the network count and "team" articles which examined small work groups. We excluded articles on corporate boards and top management teams because these are analytically some distance from the paradigm of a "typical" team in an organization. Corporate boards and top management teams are very different from "typical" teams in terms of their task, their composition, and their resources.

2 The increase in research in teams and (especially) networks is striking. In 1990-91, there were only 27 articles in the five journals we examined that included "team" in their abstract, and 10 articles that included "network" in their abstract. In 2000-01, the equivalent figures were 105 and 61.

3 Similarly, Brass (2000) identifies the relationship as the key building block of network research.

4 It should be noted, however, that constructs traditionally thought of as individual-level, such as affect, have recently been argued to "live" at the team level as well (Barsade & Gibson, 1991). Our understanding of where a construct "lives" can change over time.

5   In this paper we focus on empirical articles that bridge the network and team literatures. It is important to note that there are also several interesting non-empirical papers that bring together network and team concepts (*e.g.,* Thomas-Hunt & Gruenfeld, 1998; Owens, Mannix & Neale, 1998).

6   Alderfer's oft-cited definition of a team includes several additional key elements, most notably that members are mutually interdependent to accomplish a shared goal and operate in the context of a larger organization.

7   That is, for example, if Joe knows Mark, and Joe knows Mark knows Anne, and Joe knows Anne knows how to fix Joe's problem, then Joe can ask Mark to introduce him to Anne, so that Anne can fix Joe's problem.

8   Except where we note otherwise, we are referring to ties during process.

9   Note that there is a tradeoff between embeddedness and structural holes. Embeddedness is simply how redundant team members' external networks are. A team would generally have structural holes in its external network because its members have very different (and unconnected) sets of ties; *i.e.,* they are embedded in different parts of the social system.

10   The reason why we specify external ties as the driver is that we are assuming that usually team members know whether particular individuals on the team free rode whether or not they are commonly embedded within the team social structure.

11   Not impossible, though—*e.g.*, consider Festinger's (1954) classic work on social influence, where some individuals were randomly placed in corners of the housing complex and thus had a greater array of social choices.

12   These reciprocal effects, of course, are not limited to questions about effectiveness, but are endemic in the study of social networks. For example, consider the social influence and homophily literatures as opposite sides of the same coin: Does similarity of attitude cause interaction or interaction cause similarity of attitude (Lazer, 2001)? In fact, these reciprocal effects are rarely controlled for.

13   There are two obvious ways to do this: to collect temporally antecedent data, or to use some instrument for the network (*e.g.*, spatial propinquity) for which it was impossible for there to be reciprocal effects.

14   There is a similar problem with their individual-level finding that communication centrality was very strongly related to performance: It may be that high-performing individuals were sought after as sources of information, and thus emerged as central actors because of their success. This problem was exacerbated by their decision to treat communications as symmetric; presumably, if high performers were sought after for information, then communication flowed from high performers to others.

15   Of course, this analysis also points to likely weaknesses to teams that are constructed, which, in turn, might point to interventions to address those weaknesses. For example, if cohesion is likely a challenge, more time might be devoted to building up relationships through team-building exercises, informal events, etc.

16   If the task puts a higher premium on cohesiveness than external information, Team A will not be as effective as Team B, which is drawn from a set of people with far more pre-existing ties. Still, it could make sense for the manager to create Team A rather than Team B. Why? Because Team A will foster the creation of cross-functional ties.

NANCY KATZ is Associate Professor of Public Policy at the John F. Kennedy School of Government at Harvard University, where she teaches courses on social psychology, organizational behavior, and human resource management. Her special interest is group dynamics, focusing specifically on how to promote an optimal balance between cooperation and competition among members of a team. Katz's research has been published in the *Harvard Business Review*, *Academy of Management Executive*, and *Social Justice Research*. She graduated from Harvard/Radcliffe *summa cum laude* with a degree in psychology and earned a Ph.D. in organizational behavior from the joint program of the Harvard Business School and the Department of Psychology.

DAVID LAZER is Assistant Professor of Public Policy at the John F. Kennedy School of Government at Harvard University, where he teaches courses on management and executive branch politics. He is also Associate Director of the National Center for Digital Government Research and Practice, and Co-chair of the Cambridge Colloquium on Complexity and Social Networks. Currently, he is completing an edited volume entitled *The Technology of Justice: DNA and the Criminal Justice System* and is launching an National Science Foundation-funded project to study how a web-based system might facilitate the sharing of information about this policy area ("www.dnapolicy.net"). Lazer has extensive interests in how connectedness affects political and social phenomena, including teamwork, interest groups, international governance, and presidential power. He holds a Ph.D. in political science from the University of Michigan.