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The Network Perspective on Small Groups

Theory and Research

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Abstract

This chapter provides a review of theory and research on small groups from the network perspective. First, a general summary of the social network perspective is provided. The primary theories that provide the intellectual underpinning of the network approach are identified, including theories of self-interest, theories of social exchange or dependency, theories of mutual or collective interest, cognitive theories, and theories of homophily. The dominant methods for conducting social network research are described. Then, empirical work focused on group-level network phenomena is reviewed. We articulate the primary substantive questions that still need to be addressed, as well as methodological refinements necessary to address them. Finally, we describe the benefits that can accrue to small group researchers who adopt a network perspective.

This chapter provides a broad review of the network perspective on small groups, with substantial attention to both theory and empirical findings. We trace the development of the network perspective from its early roots to its recent resurgence. The intended audience is small group researchers who are interested in how network ideas and methods can enhance their understanding of and traction on phenomena of interest. We hope to draw attention to the potential benefits of adopting a network perspective on small groups and to shape the direction in which this research stream evolves.

The chapter is organized into five sections. The first section is an introduction to the network perspective. Basic questions are addressed: What is a network? What are the essential dimensions along which networks meaningfully vary? How are networks measured? And what is the definition of a small group, from the network perspective? The second section is an overview of the core principles and the conceptual underpinnings of the network perspective, including theories of self-interest, theories of social exchange or dependency, theories of mutual or collective interest, cognitive theories, and theories of homophily. The third section is a chronological review of empirical research on networks and small groups. We include a number of studies that are not generally recognized as network research but have a significant (although typically overlooked) network component. We describe the relevant studies in some detail and provide an overview of the trajectory of the research. The fourth section is devoted to future directions. Here we define the substantive questions that need to be addressed, as well as methodological refinements necessary to sharpen our understanding of small group networks. Finally, in the conclusion, we specify the benefits that can accrue to small group researchers who adopt a network perspective. In Table 8.1 we summarize the main points of the chapter.

Introduction to the Network Perspective

What Is a Network?

A social network consists of a set of actors (*nodes*) and the relations (*ties* or *edges*) among these actors (Wasserman & Faust, 1994). The nodes may be individuals, groups, organizations, or societies. The ties may fall within a level of analysis (e.g., individual-to-individual ties) or may cross levels of analysis (e.g., individual-to-group ties). The defining feature of the network perspective is the conceptual building block of the tie—of individuals to individuals, groups to groups, or individuals to groups.

Table 8.1 The Network Perspective

Definition of perspective	The defining feature of the network perspective is the conceptual building block of the tie — of individuals to individuals, groups to groups, or individuals to groups
Key assumptions	The pattern of relationships has individual- and collective-level effects
Types of groups	There are two views of groups: (1) as emergent, within the network (e.g., clique analysis); and (2) as externally prescribed
Key theories	Theories of self-interest, theories of social exchange or dependency, theories of mutual or collective interest, cognitive theories, and theories of homophily
Dominant research methodologies	• Empirical work has focused on data collected from whole networks—that is, on every dyad within a bounded population, where advanced statistical approaches have been developed to deal with the interdependencies endemic in network data • Substantial research on egocentric data—the ties of particular individuals rather than the entire network • A long tradition of graph theory to describe the structure of networks • A tradition of experimental work, as well as emerging approaches using simulation modeling
Strengths	• Offers a tool for disaggregating many phenomena that have been studied at the group-level • Provides a coherent basis for measuring and understanding the group's context • Can help researchers integrate the internal workings of the group and the group's external environment • Allows a researcher to cross levels of analysis with relative ease • Provides tools for refined measurement of group interaction
Weaknesses	• Relative lack of longitudinal (dynamic) approaches to change in networks, although there has been increased attention to this issue in the last 5 years • Often difficult to distinguish the causal arrow between networks and the asserted effects of networks • Serious concerns about the reliability of (typically self-reported) relational data

What Are the Essential Dimensions Along Which Networks Vary?

Network researchers have examined a broad range of types of ties. These include: *communication ties* (such as who talks to whom, or who gives information or advice to whom); *formal ties* (such as who reports to whom); *affective ties* (such as who likes whom, or who trusts whom); *material* or *work flow ties* (such as who gives money or other resources to whom), *proximity ties* (who is spatially or electronically close to whom); and *cognitive ties* (such as who knows whom). Networks are typically *multiplex;* that is, actors share more than one type of tie. For example, two academic colleagues might have a formal tie (one is an assistant professor and reports to the other, who is the department chairperson), an affective tie (they are friends), and a proximity tie (their offices are two doors apart).

Network researchers have distinguished between *strong ties* (such as family and friends) and *weak ties* (such as acquaintances) (Granovetter, 1973, 1982). This distinction can involve a multitude of features, including affect, mutual obligations, reciprocity, and intensity. Strong ties are particularly valuable when an individual seeks socioemotional support, and they often entail a high level of trust. On the other hand, weak ties are more valuable when individuals are seeking diverse or unique information from someone outside their regular frequent contacts. This information could include new job or market opportunities.

Ties may be *nondirectional* (Joe attends a meeting with Jane) or vary in *direction* (Joe gives advice to Jane versus Joe gets advice from Jane). They may also vary in *content* (Joe talks to Jack about the weather and to Jane about sports), *frequency* (daily, weekly, monthly, etc), and *medium* (face-to-face conversation, written memos, e-mail, instant messaging, etc.). Finally, ties may vary in *sign,* ranging from positive (Joe likes Jane) to negative (Joe dislikes Jane).

How Are Networks Measured?

In a typical network study, every member of an organization is presented with a list of every other member of the organization.[1] Respondents are asked to put a checkmark next to every person on the list with whom they have contact. Respondents might also be asked to indicate how often they have contact, or the substance of those interactions. These self-report data are translated into a *sociogram,* using visualization software such as NetDraw (Borgatti, 2003), NetVis (Cummings, 2004), and Pajek (Batagelj & Mrvar, 2003). A sociogram is a visual display of all of the nodes and ties in a network. A sociogram can use a variety of algorithms to organize the layout of the nodes on the network visualization. Common layouts include random assignments, placing the nodes in a circle, arranging them based on certain attributes of the nodes (putting all females or all managers close to one another), or "annealing" the network, in which nodes that are tied (or more strongly tied) to one another are in closer proximity to each other than nodes that are not tied (or are more weakly tied) to them. The sociogram highlights whether there are many or few ties among organization members, the overall pattern of those ties, and where every individual respondent is situated in the network.

While the sociogram can provide a general sense of the network at a glance, researchers have developed a variety of metrics for quantifying important differences in network structure. Frequently used metrics include actor degree centrality (the extent to which actors send or receive direct ties), betweenness centrality (the extent to which actors have ties with others who are not directly connected), closeness centrality (the extent to which actors are directly or indirectly connected to the rest of the actors in the network), reciprocity (the extent to which there are mutual ties between actors), and transitivity (the extent to which actors who are connected to one another are also connected to the same other actors).

How Is a Group Defined From the Network Perspective?

The construct of a *group,* when used in the social network literature, has had two primary meanings: (1) a group as a structural feature of a network or (2) a group as an exogenously determined or imposed category. According to the first meaning, groups (cliques) are subsets of fully connected or almost fully connected nodes within some population. That is, a group is an *emergent* phenomenon. An example would be the numerous social cliques identified in the classic anthropological study of a small city in the Deep South in the 1930s (Davis, Gardner, & Gardner, 1941). Membership in the cliques was inferred from the pattern of people's joint attendance at events like church suppers, card parties, and PTA meetings.

Methodologically, the study of group or subgroup formation requires a set of criteria for classifying a given set of relations as a group. Whereas the definition of a clique (a fully connected set of relations) is unproblematic in the case of binary choices (Wasserman & Faust, 1994), the issue of choosing cutoff values becomes more complex for rankings (e.g., Newcomb, 1961) or other valued measures and when one wishes to relax the balance-theory-inspired requirement of complete transitivity among all within-group relations. Freeman (1992) has tackled this problem by applying the distinction

between strong and weak ties to distinguish subgroups within a larger network of ties in which they are embedded.

The second definition of a group is an exogenously determined category or boundary around a set of people (e.g., a corporation, a political party, or the residents of a city). In this context, network analysis is typically used to compare patterns of intra- versus intercategory communication. For example, in landmark works on social capital in communities (Bourdieu, 1985; Coleman, 1990; Putnam, 2000), group boundaries such as social class played a key role in creating denser subsidiary networks within classes. These dense networks facilitated both the diffusion of norms and the enforcement of those norms through the diffusion of reputations, iterated relationships, and threat of sanctions. The analogue in the small group arena would be groups with clearly defined boundaries and membership, such as the 14 men who worked together in the Bank Wiring observation room in one of the Hawthorne studies at the Western Electric plant (Homans, 1950). Members are viewed as belonging to one particular group (just as people are thought of as belonging to a particular social class or category), not as belonging to multiple overlapping groups.

Principles and Roots of the Network Perspective

Core Principles

The network approach spans a broad range of disciplines, including sociology, social psychology, mathematics, political science, anthropology, economics, and epidemiology. There is no single formal statement of the network perspective. Yet, there are certain core ideas that all or nearly all network scholars would likely endorse. Wellman (1988) has identified five fundamental principles that provide some "underlying intellectual unity" to the network approach.

First, people's behavior is best predicted by examining not their drives, attitudes, or demographic characteristics but rather the web of relationships in which they are embedded. That web of relationships presents opportunities and imposes constraints on people's behavior. If two people behave in a similar fashion, it is likely because they are situated in comparable locations in their social networks, rather than because they both belong to the same category (e.g., both are white women).

Second, the focus of analysis should be the relationships among units, rather than the units themselves or their intrinsic characteristics. Nothing can be properly understood in isolation or in a segmented fashion.

Third, analytic methods must not hinge on the conventional assumption of independence. A population or sample is defined relationally rather than categorically. Therefore, *inter*dependence among units is assumed.

Fourth, understanding a social system requires more than merely aggregating the dyadic ties. The flow of information and resources between two people depends not simply on their relationship to each other but on their relationships to everybody else. For example, it matters whether two people who communicate with each other are embedded within a cluster of individuals who also talk to one another or are embedded within two separate clusters that otherwise do not communicate at all (Burt, 1992).

Fifth, groups sometimes have fuzzy rather than firm boundaries. The building blocks of organizations are not discrete groups but rather overlapping networks. Individuals generally have cross-cutting relationships to a multitude of groups. Applying these five principles to small groups, a network study focuses on *relationships* among components in the group system—individual-to-individual ties within a group, individual-to-group ties, or group-to-environment ties—rather than on *features* of these components.

Theoretical Roots

How do network scholars explain why people create, maintain, dissolve, and possibly reconstitute network ties, and who is likely to form ties with whom? There are multiple schools of thought or "families of theories" (Monge & Contractor, 2003) within the network perspective, which approach this question from different vantage points. These include theories of self-interest, theories of social exchange or dependency, theories of mutual or collective interest, cognitive theories, and theories of homophily. We briefly describe each school, highlighting its intellectual forebears and its central theoretical mechanisms.

A large school of network researchers base their work on a rational *self-interest* paradigm. These scholars assume that people form dyadic and group ties in order to maximize their personal preferences and desires. The rational self-interest school within network research can be traced back to the work of sociologist James Coleman (1988). Coleman showed how—from two-actor interactions, with each actor operating out of self-interest—the basis for a social system (such as a small group) emerges. While each actor is trying to maximize his or her individual interests, at the same time, each is constrained because he or she is embedded in an interdependent relationship with the other. That relationship imposes limits on both actors' behavior and regulates the extent of self-seeking. These limits are counterbalanced by the increased access to resources each actor gets via the other.

Individuals consider the creation of ties as an investment in the accumulation of social resources or *social capital.* Social capital "is the sum of the resources, actual or virtual, that accrue to an individual or group by virtue of possessing a durable network of more or less institutionalized relationships of mutual acquaintance and recognition" (Bourdieu & Wacquant, 1992, p. 119). From a self-interest perspective, individuals expect to deploy this social capital (Coleman, 1988, 1990; Lin, 2001) and reap returns on their investment in the form of opportunities from which they can profit. For instance, Burt (1992, 1997, 1998, 2001) argues that *structural holes* in a network provide an opportunity for individuals to invest their social capital. Individuals fill a structural hole when they invest efforts to connect two or more others who are not directly connected. The return on their investment accrues from their ability to broker the flow of knowledge and information among those who are not directly connected.

A second school of network researchers draw on theories of *social exchange and dependency.* George Homans (1950) was a forebear of the social exchange school. Homans asserted that people establish ties to others with whom they can exchange valued resources. Whether a relationship will be sustained over time will depend on the payoffs to each of the two parties. With exchange theory, Homans sought to link the micro- to the macrolevel of analysis and show how the social structure arises from these one-on-one interactions. Richard Emerson (1972a, 1972b) enlarged the focus of exchange theory to look beyond the dyad at the network of relationships in which the dyad is embedded. Emerson examined exchanges and power dependences at both the interindividual and intergroup levels. He argued that when individuals or groups exchange valued resources, this is made possible due to a large-scale network of relationships.

Unlike theories of self-interest, an individual's motivation to create ties with others is not based on maximizing his or her personal investments. Instead, people are motivated to create ties based on their ability to minimize their dependence on others from whom they need resources and maximize the dependence of others who need resources they can offer. A social exchange calculus is often an optimal strategy to manage these dependencies. And these dependencies, social exchange theorists argue, constitute the glue that binds a group together. Several scholars have developed this perspective on dyads and groups into what is now commonly referred to as *network exchange theory* (Bienenstock & Bonacich, 1992, 1997; Cook, 1977, 1982; Cook & Whitmeyer, 1992; Willer & Skvoretz, 1997).

A third influential network perspective draws on theories of *mutual interest and collective action.* Its main premise is that "mutual interests and the possibility of benefits from coordinated action" (Marwell & Oliver, 1993, p. 2) often outweigh individual self-interest. Public goods theory, first articulated by Samuelson (1954), is one of the best developed theories of collective action. It was developed to explain the economics of collective versus private ownership of material infrastructure such as parks, bridges, and tunnels. More recently, it has been extended to explain the collective production and ownership of intellectual property (e.g., ideas, documents, decisions) such as those developed by small groups (Fulk, Flanagin, Kalman, Monge, & Ryan, 1996; Lessig, 2001; Monge et al., 1998).

Public goods theory seeks to explain the conditions under which group members contribute to the creation or maintenance of public goods so that everyone in the collective will be able to benefit from them. An important focus has been the role of communication networks in creating and maintaining these public goods. The calculus of mutual interest or collective action suggests that individuals do not create ties and coalesce into groups because it maximizes the self-interest of any individual within the group or even the exchange value between individuals in the group. Instead, the motivation to forge ties and form a group is to maximize their collective ability to leverage resources and mobilize for collective action in their environment. One of the defining features of a public good is the impossibility of exclusion (Hardin, 1982; Olson, 1965; Samuelson, 1954). That is, every member of the group has a right to benefit from the public good, irrespective of their contribution to its creation or maintenance. We know this phenomenon in the literature on group research as the "free rider" problem. Studying groups from a network perspective has the potential to enhance our understanding and management of free rider problems. For example, the literature on social capital (Bourdieu, 1985; Coleman, 1988) highlights the capacity of dense networks to reduce opportunistic behavior. If we view free riding as a kind of opportunistic behavior, this leads to testable hypotheses about how a group's network structure influences the effort level exerted by group members (Lazer & Katz, 2004).

A fourth network perspective on group research draws on a family of *cognitive theories.* Two of these theories are particularly relevant for the study of small groups: the theory of transactive memory systems and the theory of cognitive consistency. Although both theories focus on group members' cognitions, they differ in their explanation for why group members create and maintain their network ties. The theory of transactive memory explains that group members—each with his or her own set of skills and expertise—develop communication networks that help them identify and leverage the skills and expertise of others in the group (Hollingshead, 1998; Moreland, 1999; Wegner, 1987, 1995). These network ties facilitate the flows of knowledge within the group, thereby reducing the need for each

group member to possess skills or expertise available elsewhere in the group. Hollingshead, Fulk, and Monge (2002) offer an intriguing argument for combining the explanatory mechanisms offered by transactive memory theory and public goods theory (previously described) to study the use of intranets or other knowledge repositories by groups.

Whereas the theory of transactive memory focuses on *what* members think other group members *know,* cognitive consistency theory focuses on *who* members think other group members *like.* Heider's (1958) balance theory posited that if two individuals were friends, they should have similar evaluations of an object. This model was extended and mathematically formulated by Harary, Norman, and Cartwright (1965). Holland and Leinhardt (1977) argued that the object could be a third person in a communication network. If the two individuals did not consistently evaluate the third person, they would experience a state of discomfort and would strive to reduce this cognitive inconsistency by altering their evaluations of either the third person or their own friendship. In common parlance, this argument is captured by the aphorism that "we like to be friends with friends of our friends" and that we experience tension when our friends are not friends with one another. In small groups, these affect ties (who likes whom) are an important explanation of the creation of communication ties within a group and the development of coalition within groups. Researchers have examined the effects of cognitive consistency on individuals' attitudes. For instance, Krackhardt and Kilduff (1990) report that members whose friends are friends with one another (they call this *schema consistent*) tend to be more satisfied than those whose friends did not get along with one another.

Fifth, a network perspective can help explain group communication on the basis of *homophily.* That is, members are more likely to create communication ties with other group members who they deem to be similar. In colloquial terms, we know this explanation by the phrase "birds of a feather flock together." Brass (1995b) observes that "similarity is thought to ease communication, increase predictability of behavior, and foster trust and reciprocity" (p. 51). Indeed the similarity attraction hypothesis (Byrne, 1971) is exemplified in the work of Sherif (1958), who suggested that individuals were more likely to select similar others because by doing so, they reduce the potential areas of conflict in the relationship.

A key issue for theories of homophily is determining the criteria used to evaluate similarity. Homophily has been studied on the basis of similarity in age, gender, education, prestige, social class, tenure, and occupation (Carley, 1991; Coleman, 1957; Ibarra, 1995; Laumann, 1966; Marsden, 1988; McPherson & Smith-Lovin, 1987). The theory of self-categorization (Turner & Oakes, 1986, 1989) offers important insights into which criteria are likely

to be salient in judging similarity with other group members. Turner and Oakes argue that group members define their social identity through a process of self-categorization during which they classify themselves and others using categories such as age, race, and gender. The manner in which individuals categorize themselves influences the extent to which they associate with others who are seen as falling into the same category.

In today's increasingly virtual environments, group members often do not have access to visual cues, and hence, categories such as age and gender might become less salient than more abstract categories such as professional identity. As a result, groups where members perceive others as being similar are likely to have less conflict and more satisfaction. However, depending on the criteria used for judging similarity, these groups might also attenuate their exposure to diverse perspectives and hence impact their creativity (Brass, 1995a). A communication network perspective has the ability to explain (1) what criteria are used by group members to identify similar others and (2) how these criteria are invoked to create communication ties with similar others.

Empirical Research in the Network Perspective

In this section, we provide a chronological review of small group research that incorporates a network perspective. We draw from multiple disciplines, including social psychology, organizational behavior, administrative science, communication, anthropology, and sociology. (Table 8.2 provides a summary of the empirical findings that are reorganized based on the seven perspective questions that are serving as a guide for this volume.)

We distinguish between two general eras in the research: the 1930s to 1960s (the "early era") and the 1990s to 2000s (the "current era"). Some of the studies—largely those from the current era—are self-consciously network studies. In other words, the authors explicitly frame the research as "network research." Some of the studies—largely those from the early era—are not generally thought of as network research but in fact have a meaningful network component. It is our hope to raise awareness of the usually overlooked network features of several classic studies of small groups.

In understanding this research stream, it is important to be clear about what role network variables play in each study. In some studies, network ties constitute an input. In other studies, network ties constitute an output. Network ties can also mediate between inputs and outputs. Within each era, we organize the research into these three categories. Later, in our discussion of future research directions, we explore the implications of these analytic distinctions.

Table 8.2 Key Findings of Network Perspective Research

Group composition	• The greater the diversity of the group, the lower the interaction level • People choose to work in groups with people with whom they have prior ties and who are similar to themselves • The more prior relationships in a group, the greater the level of transactive memory within the group and the easier it is for members of the group to express disagreement
Group projects	• The greater the complexity of the task, the more likely a decentralized communication pattern will emerge within the group • Tasks interact with group structure in a variety of ways to affect performance (more below)
Group structure	• Group structure is conceived as the pattern of intragroup relationships • Technologies and resources may be conceived as nodes in the network • Norms are in part disseminated and enforced through social networks • When a group's task is relatively simple, a centralized pattern of ties among group members is more effective; when the task is complex, a decentralized pattern is more effective • Groups with centralized networks are more likely to produce a leader; the individual in the most central position is likely to emerge as the leader • When the information being conveyed among group members is relatively complex, strong ties are more effective than weak ties at conveying that information
Group interaction	The network perspective encompasses all dyadic-level interactions
Group action/outcomes	Results may be conceived at the nodal, group, or relational levels. For example: • At the nodal level: satisfaction, attitudes, effort • At the group level: performance • At the relational level: greater or lesser amount of ties inside and outside of groups
Change over time	• The role/impact of network ties depends on the point in the group's life; it is important to distinguish among ties that exist before the group is created; ties that exist during the group's work; and ties that remain after the group has completed its task • For self-formed groups (e.g., cliques), individuals who are similar will tend to be attracted to each other; • furthermore, mutual ties to third parties will predict the creation and the maintenance of ties between individuals • For exogenously formed groups, within-group ties will initially increase, and between-group ties will decrease—especially in a competitive environment • For groups with a novel task, the group's network will evolve from being low density, which enables exploratory group thinking, to high density, which enables execution
Ecology	• One can distinguish between individuals' ties to people outside the group and group-level ties to the outside • The density of a group's external ties can have either a positive or negative impact on group performance, depending on group autonomy and task overload • Ties to the larger organization can enhance a group's search capabilities and access to resources • Physical proximity is associated with a greater density of ties • Shared ties to individuals outside the group (embeddedness) regulates the effort level of group members

Early Era

Network as Input

In the 1950s and 1960s, Alex Bavelas and his colleagues at the MIT Group Networks Laboratory conducted a series of experiments on how networks shape group process. Bavelas and his colleagues manipulated the pattern of communication in small groups and measured the impact on individual and group functioning. The communication structure was determined by assigning participants (strangers to one another) to seats at adjoining cubicles and constraining who could pass messages to whom. Participants could not see one another but could slip written messages to certain other group members through slots in the walls. Figure 8.1 illustrates the types of network configurations studied for five-person groups. The researchers

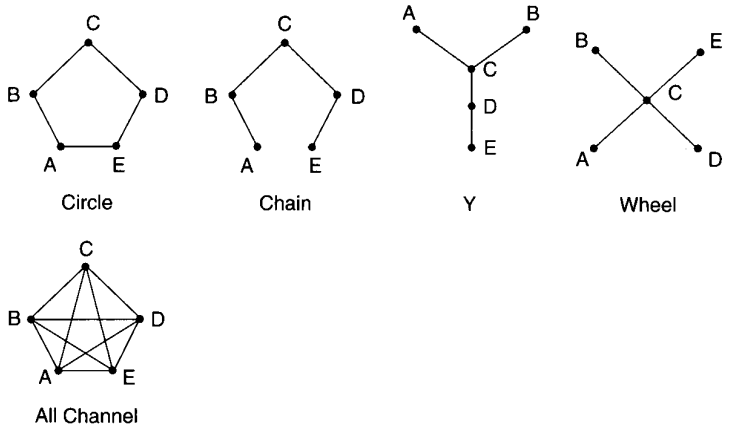

Figure 8.1 Sample of Five-Person Network Patterns

hoped to answer the question: What is the optimal network for group performance?

The MIT researchers found consistent differences in group outcomes based on how centralized the communication network was. Members of decentralized networks sent more messages, enjoyed the task more, made more errors, and were better at detecting and correcting errors. Members of centralized networks developed more differentiated role structures, with those in more central positions sending more messages, making fewer errors, and being designated leaders more often than those in peripheral positions (Bavelas, 1950; Bavelas & Barrett, 1951; Leavitt, 1951; Shaw, 1964).

The impact of centralization on task performance varied across studies based on task complexity, information distribution patterns, and the signal–to-noise ratio in the information. In simple information-gathering tasks, centralized networks were fastest. When the task required more complex processing, when information was distributed unevenly among members, or when the information was "noisy," groups with decentralized networks solved problems faster, showed more learning over time, and were better at detecting and correcting errors than groups with centralized networks (Shaw, 1964, 1971). Overall member satisfaction was higher in decentralized networks, regardless of variations in task features (Shaw, 1971).

The researchers also looked at the impact of changes over time in a group's communication network when the group's network was shifted from one pattern to another. The basic finding was that problem-solving

patterns that developed under centralized structures were continued after a change to decentralized structure, although satisfaction improved. In what apparently was a contrast effect, this change increased satisfaction above the levels of groups that had a decentralized network throughout the experiment, while a change in the other direction (to greater centralization) resulted in the lowest measured levels of satisfaction, below groups that had a centralized network throughout the experiment (Cohen, 1962; Shaw, 1954, 1964, 1971).

Guetzkow and Simon (1955) extended these results by demonstrating that a critical mediating variable in the relationship between network structure and group performance was how the group chose to organize itself. Guetzkow and Simon replicated Leavitt's (1951) experiments, in which groups performing a simple task performed better in the wheel network than the circle or the all-channel networks. Guetzkow and Simon categorized groups based on the actual patterns of signal sending. That is, for any given communication network configuration that Bavelas and colleagues studied, there were a number of potential patterns that the groups could actually realize. The more channels in the assigned configuration, the more potential patterns. Some of those patterns might be inefficient, and some very efficient. Thus, for example, in the all-channel network, there was nothing to stop the group from performing the same way—and as well as—in the wheel network. The only reason the group did not, Guetzkow and Simon argued, is that in general all-channel groups tended to organize themselves inefficiently.

In groups that were structured as a wheel, the communication pattern that quickly emerged was a two-level hierarchy, with all information going to and from the hub. In the circle network, a variety of actual communication patterns emerged, but the ones that performed best—the three-level hierarchy (where, for example, the information flows between A and B, B and C, C and D, and D and E)—performed about as well as the wheel. In the all-channel network, there was an even greater variation of patterns, but the two- and three-level hierarchies in the all-channel networks performed as well as the wheel networks. In short, Guetzkow and Simon (1955) found that the performance advantage of the wheel was entirely due to the choices group members made about which communication channels to use. In the wheel, communication patterns were constrained so that group members had essentially no choice but the optimal pattern. For the circle and the all-channel networks, there were many suboptimal patterns, and many groups chose those suboptimal patterns.

At the same time that Bavelas and his colleagues were conducting experimental work, researchers at the Tavistock Institute in London were conducting field research that led to the development of the sociotechnical

approach. The Tavistock researchers applied an implicit network perspective to the study of people, tasks, and technology. Studying groups in their natural settings, the researchers illustrated how the impact of a change in technology can be understood by considering how it affects the existing group structure, which they viewed as including the differentiated connections of workers to each other, their tools, and their tasks.

For example, Trist and Bamforth (1951) studied the introduction of new techniques for mining and their impact on the network of people, tools, and tasks. In contrast to earlier, nonmechanized "hand-got" mining methods, in which links among tasks, tools, and workers were coordinated into coherent and adaptive sociotechnical systems consisting of three to four men, the introduction of mechanization broke coordinating links among workers so that the production process and effective social organization were no longer compatible. Whereas the former cohesive structure allowed groups to adapt effectively to the changing demands of an extreme environment, the new system was brittle, greatly increasing the stress on the miners because of the constant threat of breakdown in the face of environmental challenges. Although the miners attempted to develop informal groups to counteract these problems, these network structures were strongly constrained by the physical and organizational context. The links and interdependencies among tasks and tools interacted with a severely constrained social structure to hamper productivity and produce widespread social and mental health problems among the miners.

Network as Output

How do groups and networks emerge in the first place? Several early studies shed light on this question. First was the classic Deep South study. In the 1930s, four researchers spent 18 months conducting a comprehensive study of the social structure in a small city in Mississippi (Davis et al., 1941; the fourth researcher was Davis's wife). The project, which was an early application of the methods of social anthropology to the study of modern society, explored the ways in which the social organization of the society governed behavior within and across caste (black/white) and class lines. These lines, in addition to gender boundaries and roles, formed the context in which smaller social groups (cliques) formed. These groups were homogeneous on caste and class dimensions and often on age, gender, and religious affiliation as well, a strong demonstration of the homophily principle.

One famous data set drawn from the Deep South study tracked the participation of 18 women in one or more of 14 events (e.g., church suppers, card parties, PTA meetings). Interviews indicated that the women belonged to one of two distinct cliques that partially overlapped in their social activities, and Davis et al. (1941) used the person-by-event matrix to classify each woman as a core, primary, or secondary member of one of the two cliques. Since that time, a series of researchers (e.g., Breiger, 1974; Freeman, 1992; Homans, 1950) have returned to this data set to test the usefulness of different ways of formalizing the concept of a social group. Theoretical conceptions of natural groups that require transitivity among all triads (if A has a tie to B and to C, then B must have a tie to C; Winship, 1977) do not fit the data set. Freeman (1992) demonstrated, however, that a sociological conception of the group based on Granovetter's distinction between strong and weak ties does allow for reliable detection of nonoverlapping groups without violating transitivity. Breiger (1974) viewed the data as an example of the "duality of persons and groups" because many of the events were meetings of distinguishably different groups. Thus, the same data set has been used to detect bounded "standing" groups with nonoverlapping membership (two distinct cliques), which nevertheless overlap strongly in their participation with "acting" groups of different types.

Two other early studies also focused on how networks of interaction arise among people who live in close proximity. The emergence of friendship groups from networks of interaction was studied by Newcomb and colleagues in a residence for university students (Newcomb, 1961) and in housing complexes by Festinger, Schacter, and Back (1950). The Newcomb study, which followed two sets of 17 men who were initially strangers, documented the chaining together over the course of 15 weeks of high-attraction dyads into triads, tetrads, and pentads, as the pattern of interpersonal attraction become increasingly ordered and complex. It documents how the evolution of both network and group structure was itself influenced by spatial proximity (roommates and those living on the same floor), similarity in values, and (in one set) the emergence of subgroup stereotypes based on demographic characteristics such as academic major and rural versus urban background. The hypotheses of the study were based on balance theory (Cartwright & Harary, 1956; Heider, 1946; Newcomb, 1953, 1981).

Work by Sherif and colleagues (Sherif, 1966; Sherif, Harvey, White, Hood, & Sherif, 1961) is another example of small group research that investigated network ties, although it is not conventionally recognized as network research. Most social psychologists think of the classic Robbers Cave study (Sherif et al., 1961) as documenting the emergence of intergroup hostility among two demographically identical groups of boys. That hostility was exacerbated by contact in competitive contexts, and it was eventually reversed through the need to work closely together to achieve superordinate goals. But the Robbers Cave study was in fact the third in a series of studies

of how changes in group boundaries influenced networks of interpersonal attraction.

The first studies, conducted in 1949 and 1953 (summarized in Sherif, 1966), brought together two dozen boys age 11 to 12 from white, middle-class, Protestant families for a 3-week summer camp. At first, all boys were together in one bunkhouse. Once stable friendship clusters emerged, the boys were asked informally who their best friends were. The boys were then reassigned to two cabins, so that about two thirds of their best friends were in the other cabin. After the boys had adjusted to the change, they were asked again about who their best friends were in the entire camp (including both cabins). Although only one third of their cabin mates had been among their original choices, 95% of their subsequent choices were from within their cabin groups.

In the third (Robbers Cave) study (Sherif et al., 1961), the boys were divided into two cabins from the start (skipping the full group initial stage), and a stage of reintegration through superordinate goals and cooperative activities was added. After these cooperative activities, what had been an overwhelming percentage (more than 90%) of friendship choices within the separate groups of Eagles and Rattlers shifted back to a greater balance between groups, with intergroup choices accounting for a quarter to a third of all choices.

Network as Mediator Between Inputs and Outputs

Perhaps the earliest example of a network perspective on work groups can be found in the Hawthorne studies—a series of investigations of factors affecting work performance that took place in the late 1920s and early 1930s at the Western Electric Company in the Hawthorne Works in Chicago. Although the original studies were designed to look at the impact of lighting on worker productivity, the puzzling results directed the researchers' attention to the impact of the developing social network within groups of workers who were segregated for the purposes of the study. The researchers documented two effects that on the surface seemed contradictory.

The 14 men in the Bank Wiring Observation Room (Roethlisberger & Dickson; Homans, 1950) maintained a steady level of output despite management incentives designed to increase production. Networks of helping, job trading, friendship, and antagonism were documented, and analysis of these multiple networks revealed the existence of two cliques and several isolates. The helping and job-trading networks were part of a self-regulatory system that regulated output through the social sanctioning of men who violated group norms.

The five women in the Relay Assembly Room, however (Mayo, 1933), showed a consistent improvement in output over the course of 5 years. The development of network ties connecting the women was evidenced by, among other indicators, "the entertainment of each other in their respective homes, especially operatives one, two, three, and four" (p. 68). The results are consistent, however, when looked at from the perspective of how social structure can mediate between incentives and performance. The trajectory of improvement for the Relay Assembly women was only trivially affected by interventions such as the addition of a rest period and snacks, and later the removal of same.

Interestingly, research on small group networks was a fallow area in the 1970s and 1980s. What accounts for this lull? We cannot be sure, but we suspect two phenomena may have been operating. Social psychologists, who dominated the early era in research on small group networks, became increasingly focused on social cognition, a primarily individual-level phenomenon, and interest in groups waned in social psychology (Arrow, McGrath, & Berdahl, 2000; Moreland, Hogg, & Hains, 1994). Meanwhile, research on networks migrated to the field of sociology, where the focus was on macrolevels of analysis, such as the organization and the society, rather than on the small group.

Current Era

The last 15 years have seen a virtual tidal wave of network research. In particular, the social network construct of social capital has received tremendous attention since Putnam (1993). The popularity of network notions is now filtering down to the group level of analysis. Network researchers, traditionally focused on individual- and organizational-level networks (Cummings & Cross, 2003), are expanding their focus to include the networks within and among small groups. Small group researchers are curious to learn whether network methods might add to their understanding of and traction on small group phenomena. Thus, the two bifurcated streams of research—networks and small groups—are coming together again. In this section, we review recent research on small group networks. Again, we organize the research into three general categories: network as input, network as output, and network as mediator between input and output. Whenever possible, we highlight conceptual links between the early and the current eras.

Network as Input

Several researchers have returned to the question that Bavelas and his colleagues raised—What is the optimal network for group performance?—but

broadened the scope of the investigation from laboratory experiments to field research. Sparrowe, Liden, Wayne, and Kraimer (2001) conducted a field study of 38 work groups in five organizations, where the groups were performing relatively complex tasks. The members of each group were asked how often they sought help or advice from one another on work-related matters. Supervisors provided assessments of each group's performance, including the quality, quantity, and timeliness of the work product and the levels of initiative and cooperation demonstrated by the group. Consistent with the early research at MIT, Sparrowe et al. found that groups with decentralized patterns of communication performed better than groups with centralized communication patterns.

Cummings and Cross (2003) found similar effects in their study of 182 project groups in a global telecommunications company. The groups had been nominated, based on outstanding performance, to participate in a company-wide reward program. The groups varied in size from 4 to 12 members and carried out complex, nonroutine work, such as new product development and internal improvement initiatives. Group members were asked to recall how often they communicated with one another over the course of the project. Controlling for the mean number of ties, Cummings and Cross found that a more hierarchical (as opposed to "flat") pattern of communication was associated with stronger group performance. On a more applied level, Lipman-Blumen and Leavitt (2001) have drawn on this type of centralization research to support their theory of high-performing "hot groups," whose success they attribute in part to their fluid, decentralized communication structures.

Other researchers have focused on the number rather than the pattern of communication links among group members. Baldwin, Bedell, and Johnson (1997) examined network ties within and among 62 MBA student groups of three to five members. Students were asked to identify who are "good friends, people you see socially outside of school" and who are "important sources of school-related advice." Baldwin et al. found that the friendship and advice ties within a group were positively associated with perceptions of group effectiveness, which in turn were positively associated with group grade. Reagans and Zuckerman (2001) drew on survey data collected from 224 corporate R&D groups in the mid-1980s. The groups came from 29 corporations, across seven industries. Reagans and Zuckerman analyzed the relationship between how often group members reported communicating with one another and group productivity as assessed by the group leader or manager. The researchers found the most productive groups were those with the most ties that cut across demographic boundaries, linking group members with different outlooks.

On a more theoretical level, Markovsky and colleagues have examined the conditions under which internal ties among group members could impair group performance. Markovsky et al. have considered subgroup formation as a source of friction that could degrade the overall solidarity of a larger unit. When people become involved in exclusive friendship cliques within a larger group, the unity of structure is disrupted (Markovsky & Chaffee, 1995; Markovsky & Lawler, 1994), and internal divisions between subgroups can weaken the group structure.

Gruenfeld, Mannix, Williams, and Neale (1996) examined related questions in an experimental study in which 71 three-person groups performed a decision task (solving a murder mystery). Groups were composed of either three familiars, two familiars and one stranger, or three strangers. A familiar was someone the participant defined as feeling "close to" or knowing "very well." In half of the groups, important clues were distributed evenly among the group members, and in half of the groups, information was distributed unevenly. Familiarity had a main effect on participants' perceptions of group process; familiar groups felt more comfortable working together and expressing disagreement. Familiarity also affected the groups' task strategy. Groups of familiars and mixed groups were more likely to pool their unique information, whereas groups of strangers were more likely to aggregate their individual choices and adopt the majority position. This difference in task strategy meant that groups of familiars and mixed groups performed best (identified the correct suspect) when information was distributed unevenly, and groups of strangers performed best when information was distributed evenly.

Network thinking has also influenced new conceptual models of groups. Building on the sociotechnical perspective, some researchers are reconceptualizing groups as a set of dynamic relations among people, tools, and tasks that form a complex system. Tschan and von Cranach (1996), for example, consider how tasks are connected to one another within the larger frameworks of group projects. Krackhardt and Carley (2003), in their PCANS (Precedence, Commitment, Assignment, Network, and Skill) model of organizational structure, develop a formalization of how people, tasks, and resources can be represented. Arrow et al. (2000) demonstrate how the full coordination network that constitutes the group structure can be decomposed into the networks that connect elements of a single type (people, tasks, or tools) and those that connect different types of nodes, providing network definitions of concepts such as the division of labor (the set of links that connect people to tasks) and roles (the set of links that connect people to tools and resources) and generating new constructs such as the *job network*, which specifies which tools and procedures are to be used to complete which

tasks. The differential importance of the component networks within groups provides the basis for distinguishing among types of groups, such as task forces (in which the task and labor networks are primary), crews (in which the tool and job networks are primary), and teams (in which the member and role networks are primary).

The aforementioned studies focus on a group's internal network, that is, the pattern and number of ties among group members. Other studies, described later, focus on a group's external network, that is, the group's ties to individuals, groups, and organizations outside the group.

Ancona and Caldwell (1992) drew attention to the importance of a group's ties to its environment. Ancona and Caldwell developed a typology of 15 boundary-spanning behaviors, many of which involve the transfer of information and resources from outside the group. Research on interlocking boards of directors supports the notion that external group ties can play an important role in group success (e.g., Mizruchi, 1996) by providing useful knowledge from other boards (Davis, 1991; Haunschild, 1993). Some researchers, however, have reported mixed findings regarding the importance of boundary-crossing ties. Baldwin et al. (1997) found no relationship between a team's external ties and its performance. Sparrowe et al. (2001) found a strong *negative* relationship between a team's external ties and performance. Baldwin et al. suggest that their null findings simply reflect the fact that groups in their study had little need for external communication; due to the nature of the task, the configuration of internal ties was more important than external ties. In other words, a group's "need for external resources," as defined by the nature of the task, moderated the impact of external ties.

We believe work by Hansen (1999) and Haas (2002) may help resolve the discrepancy between Sparrowe et al.'s (2001) results (external ties can hurt a team's performance) and the other research suggesting external ties can be a valuable source of information and resources. Hansen found an interaction between tie strength and the complexity of information being transmitted. Weak ties worked best for bringing simple information from the external environment into the team. Complex information required the "bandwidth" of strong ties. Sparrowe et al.'s findings might be the result of not differentiating between strong and weak ties. Furthermore, Haas found that having many external ties may be either beneficial or harmful for a team depending on a number of factors, including autonomy and task overload. For teams with little autonomy or with overloaded members, communication initiated by the external environment negatively affected group performance.

External ties can influence group performance through other mechanisms in addition to information flow. Several researchers have examined the impact of intergroup ties on conflict. Nelson (1989) studied three to seven

groups within each of 20 organizations. Nelson measured the number of strong and weak ties within and between the groups in each organization, based on frequency of contact. Nelson categorized each organization as either "high conflict" or "low conflict." High conflict was scored when one or more of the following conditions were present: There was recent turnover, pessimism about the organization's future due to infighting, inability to reach consensus on strategic or operational change, recent intervention by outsiders due to internal inability to make changes, or "easily identifiable opposing internal factions." Nelson found that low-conflict organizations had significantly more strong ties within and among groups.

One recent study looked at the impact of network ties on effort. Lazer and Katz (2004) found that when group members shared many overlapping external ties, they were less likely to free-ride on one another's efforts. In other words, structural embeddedness (Granovetter, 1985; Uzzi, 1996) regulated the effort level of group members. This finding highlights the broader trade-off groups face in having redundant external ties, which would limit opportunistic behavior, as compared to having nonredundant external ties, which would offer greater access to information and resources (Burt, 1992).

Network as Output

Several researchers have focused on the question: What conditions influence the emergence of a centralized pattern of ties? Building on work such as Tushman (1978) and Hirokawa, Ebert, and Hurst (1996) suggesting that people working on complex tasks are likely to use decentralized, consultative decision-making structures, Brown and Miller (2000) conducted an experiment to examine the impact of task complexity on network centralization. Forty-eight groups of four to five people were given the task of proposing policies for an early education program. All groups were given the same information, but groups differed in how they needed to process that information. Half of the groups were required to decide on six goals and two interventions for each goal. The other half were required to decide on two goals and one intervention for each goal. Brown and Miller videotaped the group discussions and coded the number of messages sent and received by each group member. The researchers found that groups assigned to the high-complexity version of the task developed less centralized communication patterns than groups assigned to the low-complexity version of the task.

Argote, Turner, and Fichman (1989) examined the impact of stress and tension on network centralization in 20 five-person groups. Argote et al. adopted a task first used by the MIT researchers, the common symbol task, where participants had to figure out which of five colors displayed on cards

were commonly held by everyone in the group. Group performance was defined as the proportion of group members who gave the correct answer. Argote et al. found that groups experiencing high stress and tension developed more centralized communication networks, consistent with earlier research into threat-rigidity effects (Staw, Sandelands, & Dutton, 1981).

In a study that looked at both the emerging network and the impact of that network (hence, network as both output and input), Friedkin (1999) applied social influence network theory to account for the phenomenon of group polarization, which is a shift in member opinions after group discussion of an issue. In these experiments (with 50 four-person groups, 32 three-person groups, and 36 two-person groups), Friedkin manipulated the communication structure by constraining communication to telephones. That is, rather than the typical paradigm of social influence research, where all communication occurs at a collective level (e.g., Asch, 1951), communication in Friedkin's experiments was predominantly dyadic. Friedkin found an uneven distribution of influence, where participants influenced (and were influenced by) some people more than others. This resulted in an overall shift in opinions toward an emergent group norm based on this uneven influence, rather than simple convergence to the mean of members' prediscussion opinions.[2]

Network as Mediator Between Inputs and Outputs

One recent experimental study is noteworthy for pinning down causal relationships and mediating variables. Jehn and Shah (1997) conducted an experiment using 53 three-person groups. The study was a 2 x 2 factorial design; groups were composed of either friends or acquaintances and performed either a decision-making or a motor task. On both types of tasks, groups composed of friends outperformed groups composed of acquaintances. Jehn and Shah measured a number of potential mediating processes: information sharing, morale building, planning, critical evaluation, commitment, monitoring, and cooperation. The researchers found that information sharing and morale building mediated the relationship between friendship and performance on the motor task.

This recent era of research on the internal networks of small groups opens new vistas for fruitful investigation. The early experimental research that divided tasks into simple versus complex, although an important first step, undervalued variables that might interact with network structure to produce outcomes. The currently emerging framework—reconceptualizing groups as consisting of multiple component networks—will help us understand how the value of a particular network structure is contingent on the distribution of knowledge and other resources, as well as task structure.

Future Directions

Having summarized the existing studies, we now focus on the future of this research stream. In this section, we define the outstanding substantive questions that need to be addressed, as well as methodological refinements necessary to address them.

Research Questions

Social network analysis typically focuses on a single snapshot of the network. As we discuss later, it is critical that the methodology expand its repertoire of tools to understand networks over time. The lack of longitudinal analysis leads to questions regarding which is causally antecedent, the network or the hypothesized effects of the network (Lazer, 2001). We would distinguish among three conceptually distinct stages of a group's network: the network pregroup formation, the network during the group's existence, and network postgroup. Within each stage, there are substantive questions that need to be answered.

Network Pregroup

What is the pattern of prior connections among group members, and between group members and nonmembers? Does the network prior to the group have an impact on effectiveness independent of the network during the group process? In other words, do prior ties affect group functioning over and above the impact of communication during the group's life? What is the relationship between the network prior to the group and the network during the process? Networks tend to have some durability (Newcomb, 1961), and it seems likely the pregroup network is correlated with the network during the group 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 group members they do not already know.

These pregroup issues then lead directly to questions around how groups are formed from the pregroup network (cf. Owens, Mannix, & Neale, 1998). Are group members self-selected? As noted previously in the discussion of homophily, self-selected groups will likely be more homogeneous. Do self-selected group members differ in other ways as well? How does selecting someone as a member of your group affect the evolving dyadic tie differently from simply finding yourself assigned together to the same group?

Network During Process and Outcomes

Most of the research on the relationship between outcomes and group network structure 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 group network. (See, e.g., 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? 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 Postgroup

What are the long-run effects of groups on the network? Arrow and Crosson (2003) found that once two people had been together in a group, the chances of their choosing to work together in a subsequent group increased. Similarly, Hinds, Carley, Krackhardt, and Wholey (2000) showed that people choose to work with people with whom they already have a strong working relationship. Furthermore, as noted previously, success may have a positive effect on the duration of relationships. How does the group outcome influence the future choices and options group members face in selecting groups to join?

Methodological Issues

There are three methodological issues that we feel need to be addressed to enhance the capacity of the network perspective. First, given the importance of taking the life cycle of a group into account when understanding its network, as previously discussed, tools must be developed that allow for the analysis of networks over time. The field has begun to wrestle with this issue, with the application of simulation analysis to study the dynamics of networks (Banks & Carley, 1996; Carley, 2003; Zeggelink, 1995) and the development of statistical methods, such as Monte Carlo maximum likelihood procedures, to examine longitudinal data (Huisman & Snijders, 2003; for a review, see Wasserman & Robins, in press). Although these new methodologies have yet to have a widespread impact on the field, they have the potential to be transformational.

Second, there are concerns with the reliability and validity of network data as they are currently collected. The vast majority of research on

social networks relies on self-report data. A series of studies comparing self-report and observational relational data have found surprisingly large divergences between the two (Bernard, Killworth, & Sailer, 1980, 1982; Bernard, Killworth, & Cronenfeld, 1984; Marsden, 1990). Some researchers, such as Freeman, Romney, and Freeman (1987) have downplayed this concern, suggesting that observational data capture only a snapshot of interaction whereas self-report data provide a truer picture of the long-term social structure. Richards (1985) has argued that self-reported data capture perceptions about the network, and those perceptions are themselves theoretically important—a notion captured by W. I. Thomas's observation that "perceptions are real in their consequences even if they do not map one-to-one onto observed behaviors" (Krackhardt, 1987, p. 128). Most of the studies we cited in this chapter assume that self-report network data measure some long-run behavioral features of the network, per Freeman et al. We are less sanguine about—and believe much more attention must be paid to—the validation of self-reported network data.

Third, as noted early in the chapter, one of the fundamental assumptions of network analysis is the nonindependence of observations—that is, of both the nodes and the relations. One of the critical areas that has moved forward over the last few years, and needs to move farther still, is the development of statistical methods that capture the types of interdependencies that we know occur in social networks. Network methodologists have begun to develop techniques for the statistical modeling of social networks using Markov random graph models and the p^* family of models (Robins, Elliott, & Pattison, 2001; Wasserman & Pattison, 1996). These statistical models can detect whether an observed network exhibits certain hypothesized structural tendencies. These are important developments, and we assert that more progress is needed to propel the study of small group networks from a primarily descriptive focus to one that can be used to statistically confirm hypotheses about the structural tendencies of ties within groups (Contractor, Wasserman, & Faust, in press).

Conclusion

The use of social network analysis to study groups has begun to emerge from the sideline where it was relegated for decades. We think that this trend has significant merit, because social network analysis offers tools that can help small group researchers deal with challenges they currently face. For example, an increasing number of scholars have criticized the relative paucity of

theory and research that attends to the group's external environment and how a group manages its relationship with strategic outsiders (e.g., Stohl & Putnam, 1994). The network perspective offers a coherent basis for measuring and understanding the group's context. The group's context is viewed as the larger social structure of connections among people, resources, and other collectives in which a group is embedded and to which it is connected. Network analysis offers an array of tools for investigating patterns of relations between a group and its external context.

More generally, a key benefit of the network approach is that it allows a researcher to cross levels of analysis with relative ease. Thus, one may examine the position of the team in an overarching network (e.g., Ancona, 1990), describe the internal structure of communication of a particular team (e.g., Sparrowe et al., 2001), or examine the position of a particular individual within the team (e.g., Bavelas, 1950).

On a related note, the network perspective can help researchers integrate the internal workings of the group and the group's external environment. Studies have generally focused on *either* the relationships among group members (e.g., cohesiveness, coordination, etc.) or on the group's relationship with outsiders, but relatively few studies link the internal and external perspectives (Ancona & Caldwell, 1992). Network methods can help researchers examine how a team's internal workings and its external environment interact. For example, Lazer and Katz (2004) found that group members' shared ties to friends outside the group influenced the extent of social loafing by group members.

Finally, network analysis offers techniques for identifying and exploring important features of small group interaction. While one such feature—centralization—has already received substantial attention, network techniques can help researchers assess other, potentially important features of small group interaction. For example, how do isolates (individuals without any ties) affect group functioning (e.g., Thomas-Hunt, Ogden, & Neale, 2003)? Do the capabilities of particular nodes (e.g., the central node) matter? As group membership changes over time, how do the addition and deletion of nodes—and the requisite reconfiguration of relationships—affect group dynamics?

Of course, like any conceptual framework, the network perspective has its limits. For example, the pattern of ties among group members is not always important; relationships among members of a tug-of-war team should matter far less than they do in a high-technology research and development team. However, we believe that as an approach to the study of small groups, social network analysis promises a particularly high yield to researchers.

Notes

1. There are also studies that examine *egocentric* networks, where a sample of individuals is selected and those individuals are asked about their relationships. This is particularly valuable in understanding certain features (e.g., interracial communication) of very large (e.g., societal) networks, where a complete census of the network is impossible (Marsden, 1988). Typically, in small group networks, a complete census of the group's network is possible and desirable.
2. This research raises an intriguing issue regarding the verisimilitude with "real world" small group phenomena—some of which occur through the types of dyadic interactions that Friedkin examined and some of which occur not on the dyadic but the group level.

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9

Traces, Trajectories, and Timing

The Temporal Perspective on Groups

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Abstract

This chapter reviews empirical and theoretical literature that takes a temporal perspective on groups. The temporal perspective is process focused, treating groups as systems in which change occurs across multiple time scales. The review is organized around six themes that have been especially generative: (1) Time is socially constructed, (2) time is a resource, (3) time is a fundamental issue for theory and research, (4) groups change systematically over time, (5) group processes have temporal patterns, and (6) groups are complex systems characterized by nonlinear dynamics. We close by calling for continued theory and methodological developments to better integrate the disparate theories and findings found in literature inspired by the temporal perspective, and by identifying some changes in infrastructure that would facilitate this integrative process.