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A Social Network Perspective On Industrial/Organizational Psychology

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Author Note

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Abstract

This paper applies a social network perspective to the study of industrial/organizational psychology. Complementing the traditional focus on individual attributes, the social network perspective focuses on the relationships among actors. The perspective assumes that actors (whether they be individuals, groups, or organizations) are embedded within a network of interrelationships with other actors. It is this intersection of relationships that defines an actor's position in the social structure, and provides opportunities and constraints on behavior. A brief introduction to social networks is provided, typical measures are described, and research focusing on the antecedents and consequences of networks is reviewed. The social network framework is applied to organizational behavior topics such as recruitment and selection, performance, power, justice, and leadership, with a focus on research results obtained and directions for future research.

Keywords: social networks, social network measures, organizational psychology, methodological issues, structural holes, social capital

Introduction

In the fall of 1932, the Hudson School for Girls in upstate New York experienced a flood of runaways in a two-week period of time. The staff, who thought they had a good idea of the type of girl who usually ran away, was baffled trying to explain the epidemic. Using a new technique that he called “sociometry,” Jacob Moreno graphically showed how the girls’ social relationships with each other, rather than the personalities or motivations, resulted in the contagious runaways (Moreno, 1934). More than 50 years later, Krackhardt and Porter (1986) showed how turnover occurred among clusters of friends working at fast-food restaurants.

During the 1920s, the researchers of the famous Hawthorne studies at the Western Electric Plant in Chicago diagrammed the observed interaction patterns of the workers in the bank wiring room. Their diagrams resembled electrical wiring plans and showed how the informal relationships were different from the formally prescribed organizational chart. Today, many studies have investigated employee interaction patterns in organizations (see Brass, Galaskiewicz, Greve, & Tsai, 2004, for a review).

What these studies have in common is a focus on the relationships among people in organizations, rather than attributes of the individuals. It is, of course, highly appropriate that the study of organizational behavior focuses on the attributes of individuals in organizations; and, it is to the credit of my industrial/organizational psychology friends that so much progress has occurred. However, to focus on the individual in isolation, to search in perpetuity for the elusive personality or demographic characteristic that defines the successful employee is, at best, failing to see the entire picture. At worst, it is misdirected effort continued by the overwhelming desire to develop the perfect measurement instrument. There is little doubt (at least in my mind) that the traditional study of industrial/organizational psychology (or organizational behavior) has been

dominated by a perspective that focuses on the individual or the organization in isolation. We are of course continually reminded of the need for an interactionist perspective: that the responses of actors are a function of both the attributes of the actors and their environments. Even with attempts to match the individual with the organization, the environment is little more than a context for individual interests, needs, values, motivation, and behavior.

I do not mean to suggest that individuals do not differ in their skills and abilities and their willingness to use them. I too revel in the tradition of American individualism. I will not suggest that individuals are merely the “actees” rather than the actors (Mayhew, 1980). Rather, I wish to suggest an alternative perspective, that of social networks, that does not focus on attributes of individuals (or of organizations). The social network perspective instead focuses on relationships rather than (or in addition to) actors—the links in addition to the nodes. It assumes that social actors (whether they be individuals, groups, or organizations) are embedded within a web (or network) of interrelationships with other actors. It is this intersection of relationships that defines an individual’s role, an organization’s niche in the market, or simply an actor’s position in the social structure. It is these networks of relationships that provide opportunities and constraints, that are as much or more, the causal forces, as the attributes of the actors.

Given the rapid rise of social network articles in the organizational journals, it may be unnecessary to familiarize readers with basics (Borgatti & Foster, 2003). However, the popularity often creates confusion and threatens the coherence of the approach (see Kilduff & Brass, 2010, for a discussion of core ideas and key debates). I begin with a brief, general primer on social networks, including tables that illustrate the various social network measures typically used in organizational behavior research. I will not begin at the beginning; excellent histories of social network analysis are available (see Freeman, 2004), nor will I attempt to reference every

social network article that has ever appeared in an organizational behavior journal. Reference to my own work is more a matter of familiarity than self-promotion. I will focus on the design of social network research with attention to findings regarding the antecedents and consequences of social networks from an interpersonal perspective (a micro approach) with only occasional references to inter-organizational research when appropriate. I attempt to note the research that has been done and suggest directions for future research, also noting the criticisms and challenges of this approach. My overall goal is to provide readers enough information to conduct social network research and enough ideas to encourage research on social networks in organizational behavior.

Social Networks

I define a network as a set of nodes and the set of ties representing some relationship or absence of relationship between the nodes. In this most abstract definition, networks can be used to represent many different things, resulting in the adoption of the perspective across a wide range of disciplines (see Borgatti, Mehra, Brass, & Labianca, 2009). Even researchers in the hard sciences of physics and biology have applied networks to their favorite theories. Thus, we find no universal theory of networks. Rather, we find a perspective that applies many of the network concepts and measures to a variety of theories.

In the case of social networks, the nodes represent actors (i.e., individuals, groups, organizations). Actors can be connected on the basis of (a) similarities (same location, membership in the same group, or similar attributes such as gender), (b) social relations (kinship, roles, affective relations such as friendship, or cognitive relations such as knows about), (c) interactions (talks with, gives advice to), or (d) flows (information; Borgatti et al., 2009). In organizational behavior research, the links typically involve some form of interaction, such as

communication, or represent a more abstract connection, such as trust, friendship, or influence. They may also be used to represent physical proximity or affiliations in groups, such as CEOs who sit on the same boards of directors (e.g., Mizruchi, 1996). Although the particular content of the relationships represented by the ties is limited only by the researcher's interest, typically studied are flows of information (communication, advice) and expressions of affect (friendship). I will refer to a focal actor in a network as "ego;" the other actors with whom ego has direct relationships are called "alters."

Although the dyadic relationship is the basic building block of networks, dyadic relationships have for many years been studied by social psychologists. The idea of a network (if not the technical graph-theoretic definition) implies more than one link. Indeed, the added value of the network perspective, the unique contribution, is that it goes beyond the dyad and provides a way of considering the structural arrangement of many nodes. The unit of analysis is not the dyad. As Wellman (1988) notes, "It is not assumed that network members engage only in multiple duets with separate alters." Indeed, it might be said that the triad is the basic building block of networks (Krackhardt, 1998; Simmel, 1950). The focus is on the relationships among the dyadic relationships (i.e., the network). Typically, a minimum of two links connecting three actors is implicitly assumed in order to have a network and establish such notions as indirect links and paths.

The importance of indirect ties and paths is illustrated in Travers and Milgram's (1969) experimental study of "the small world problem." They asked 296 volunteers in Nebraska to attempt to reach by mail a target person living in the Boston area. They were instructed, "If you do not know the target person on a personal basis, do not try to contact him directly. Instead, mail this folder to a personal acquaintance who is more likely than you to know the target

person, ” (Travers & Milgram, 1969, p. 420). Recipients of the mailings were asked to return a postcard to the researchers and to mail the folder on to the target (if known personally) or someone more likely to know the target. Of the folders that eventually reached the target, the average number of intermediaries (path length) was approximately six, leading to the notion of “six degrees of separation” and providing empirical evidence for the common expression, “It’s a small world” (see Watts, 2003, for a more refined and updated thesis on small worlds).

Closely connected to the assumption of the importance of indirect ties and paths, is the assumption that something (often information, influence, or affect) is transmitted or flows through the connections. Although other mechanisms for explaining the results of network connections have been provided (Borgatti et al., 2009), most organizational researchers explain the outcomes of social networks by reference to flows of resources. For example, a central actor in the network may benefit because of access to information. Podolny (2001) coined the term “pipes” to refer to the “flow” aspect of networks, but also noted that networks can serve as “prisms,” conveying mental images of status, for example, to observers.

The final assumption of most social network research is that the network provides the opportunities and constraints that affect the outcomes of individuals and groups. Often included is the assumption that these linkages as a whole may be used to interpret the social responses of the actors (Mitchell, 1969). While this assumption does not exclude the possible causal effects of human capital, it assigns primacy to network relationships and leads logically to the concept of social capital.

Social Capital

As differentiated from human capital (an individual’s skills, ability, intelligence, personality, etc.) or financial capital (money), the popularized concept of social capital refers to

benefits derived from relationships with others. The task of precisely defining and measuring social capital has received much attention and resulted in considerable disagreement (see Adler & Kwon, 2002, for a cogent discussion of the history of usage of the term). Definitions have generally followed two perspectives. One perspective focuses on individuals and how they might access and control resources exchanged through relationships with others in order to gain benefits or acquire social capital. This approach is exemplified by the studies that suggest that an actor's position in the network provides benefits to the actor. Burt's (1992) work on the advantages of "structural holes" in one's network (ego is connected to alters who are not themselves connected) is an example. The other perspective focuses on the collective and assesses how groups of actors collectively build relationships that provide benefits to the group (e.g., Oh, Labianca, & Chung, 2006). This approach is exemplified by Coleman's (1990) often cited reference to social capital as norms and sanctions, trust, and mutual obligations that result from "closed" networks (a high number of interconnections between members of a group; ego's alters are connected to each other). Putnam's (1995) "Bowling Alone" work on the demise of social capital in the US is another example of this collective approach. Putnam's (1995) statistics show a steady decline in membership in bowling leagues, bridge clubs, and community and church groups since the 1950s. The collective, group-level approach does not forgo the individual entirely, as it suggests how collective social capital may benefit the individual members of the group as well as the group. Indeed, both approaches suggest individual and group level benefits.

The difference in the focus is amplified by seemingly contradictory predictions concerning the acquisition of social capital. At the individual level, connecting to disconnected others results in social capital; at the collective level, connecting to others who are themselves

connected results in closure in the network and the social capital associated with trust, norms, and group sanctions. Such networks can provide social support and a sense of identity (Halgin, 2009). However, one can be “trapped in your own net” as closed networks can constrain action (Gargiulo & Benassi, 2000). Indeed, both approaches are based on the underlying network proposition that densely connected networks constrain attitudes and behavior. In one case (Coleman, 1990; Putnam, 1995), this constraint promotes good outcomes (trust, norms of reciprocity, monitoring and sanctioning of inappropriate behavior); in the other case (Burt, 1992) constraint produces bad outcomes (redundant information, a lack of novel ideas). When the network is extended outward (enlarged) it is typically the bridges (structural hole positions) that provide the closure for the larger network.

Attempts have been made both to test one approach versus the other as well as to reconcile both approaches (Burt, 2005). However, as Lin (2001, p. 8) points out, “Whether social capital is seen from the societal-group level or the relational (individual) level, all scholars remain committed to the view that it is the interacting members who make the maintenance and reproduction of this social asset possible.” Nahapiet & Ghoshal, (1998, p. 243) offer a comprehensive definition: “The sum of the actual and potential resources embedded within, available through, and derived from the network of relationships possessed by an individual or social unit.” One can view social capital, like other forms of capital, from an investment perspective with the expectation of future (often times uncertain) benefits (Adler & Kwon, 2002). We invest in relationships with the hoped-for return of benefits. These benefits may be in the form of human capital, financial capital, physical capital, or additional social capital.

Some network researchers have dismissed the definitional battles surrounding social capital as irrelevant to their research. They note that the definitions have become so broad as to

be meaningless. As Coleman (1990) notes, social capital is like a “chair”—it comes in many different shapes and sizes but is defined by its function. And it is important to note that much social network research focuses on how actors become similar (e.g., diffusion studies), rather than on how actors differentially benefit from networks. Nevertheless, the seemingly contradictory hypotheses of structural holes versus closure have generated a furious deluge of research. In addition, the concept of social capital has provided a legitimizing label that reinforces many of the underlying assumptions of social network analysis.

Social Network Approaches and Measures

Social network research can be categorized in many ways; I choose to organize around four approaches or research foci: (a) structure, (b) relationships, (c) resources, and (d) cognition. To these four, I add the traditional organizational behavior focus on the attributes of actors and note that these approaches can, and often are combined (e.g., Seibert, Kraimer, & Liden, 2001). Associated with each approach, I list network measures that have typically been used in organizational research.

Focus on structure. Consider the diagrams in Figure 1. Almost everyone would predict that the center node (position A) in Figure 1a is the most powerful position. Most people make this prediction without asking whether the nodes represent individuals or groups, or whether the lines represent communications, friendship, or buy-sell transactions. Nor does anyone ask if the lines are of differing strengths or intensities, or whether they represent directional or reciprocated interactions. Most people simply look at the diagram and predict that node A is the most powerful.

Insert Figure 1 about here

We make these judgments based simply on the pattern or structure of the nodes and ties; Figure 1 provides no information other than the structural arrangement of positions. We do not know the values, attitudes, personalities, or abilities of any of the nodes. From a purely structural perspective, a tie is a tie is a tie, and a node is a node is a node, (only differentiated on the basis of its structural position in the network). It is the *pattern* of relationships that provide the opportunities and constraints that affect outcomes.

The structural focus is at the heart of social network analysis, and the abstract nature of patterns of nodes and ties have led to the wide application of networks to a variety of different disciplines. It has also led to a search for universal patterns that may be applied to such diverse topics as atoms and molecules, transportation networks, and electrical grids. For example, researchers have noted small-world patterns (dense clusters connected by a few number of bridges) in nematodes, electrical power transmission systems, and Hollywood actors (Watts, 2003).

A purely structural explanation for the advantage of A over the other nodes in Figure 1a would simply note that A is the most central position in the network. Period. However, purely structural explanations are rarely acceptable to reviewers for organizational behavior journals (for the extreme structural perspective, see Mayhew, 1980). Rather, reviewers and authors exhibit a tendency toward reductionism and theoretical explanations based on human agency. These tendencies represent a metaphysical preference, masquerading as a debatable point (Mehra, 2009).

In explaining their choice in Figure 1a, most people could articulate an intuitive notion of centrality. They might suggest that position A is at the “center” of the group, that position A has access to all the other positions, or that the other positions are dependent on position A—they must “go through” position A in order to reach each other. They might conclude that position A controls the group; A is not dependent on any one other node, and all the other nodes are dependent on A. Thus, most people have an intuitive idea of what social networks are, what centrality is, and how both might relate to power. Consequently, few people would be surprised to learn that their intuitive prediction has been supported in a number of settings (see Brass, 1992).

Table 1 (adapted from Brass, 1995a) presents typical measures used to describe structural positions in the network (see also Kilduff & Brass, 2010, for a glossary of network terms). It is important to keep in mind that these measures are not attributes of isolated individual actors; rather, they represent the actor’s relationship within the network. If any aspect of the network changes, the actor’s relationship within the network also changes. For example, in Figure 1a, adding an additional tie and node to each of the four nodes B, C, D, and E will substantially decrease A’s power. In addition to describing positions within the network, several structural measures have been developed to describe the entire network. For example, network 1a could be described as more centralized than network 1b. Some typical structural measures used to describe entire networks are listed in Table 2 (adapted from Brass, 1995a).

Insert Tables 1 & 2 about here

Structural measures have also been developed for identifying groups or clusters of nodes (actors) within the network. For example, a network is sometimes described as having single or multiple components (all nodes in a component are connected by either direct or indirect links). Any actor in a component can reach all other actors in the component directly or through a path of indirect ties. One large component is typical of networks within organizations.

There are two typical methods of grouping actors within components, a relational method often called *cohesion*, and a structural method referred to as *structural equivalence*. The relational cohesion approach clusters actors based on their ties to each other. For example, a clique is a group of actors where every actor is connected to every other actor (network 1b represent a clique). Other measures have been developed to relax the clique criteria for grouping actors. For example, n-clique groups all actors who are connected by a maximum of n links. A k-plex is a group of actors in which each actor is directly connected to all except k of the other actors (Scott, 2000).

The structural equivalence approach is based on the notion that actors may occupy similar positions within the network structure, although they may not be directly connected to each other. For example, two organizations in the same industry may have similar patterns of links to suppliers and customers but may not have any direct connection between themselves. The two organizations are structurally equivalent as they occupy similar structural positions in the network. In a communication network, structurally equivalent actors may communicate with similar others but not necessarily communicate with each other. In network 1a, actors B, C, D, and E are structurally equivalent. A technique called blockmodeling is used to group actors on the basis of structural equivalence (DiMaggio, 1986).

Because actors in organizations are typically formally grouped via hierarchy and work function, it is difficult to find organizational behavior research that uses network measures to group people. For an extensive and detailed description of grouping measures, see Scott (2000, pp. 100-145) or Wasserman and Faust (1994, pp. 249-423).

Focus on relationships. Rather than assuming that all relationships are the same (a tie is a tie), social network researchers often attempt to differentiate the ties. Focusing on the content of the relationships (what type of tie the lines in the network diagram represent) is a boundary specification issue (see below). Rather than focus on the particular content, several other ways to characterize the ties have been measured by social network researchers. While the structural approach typically treats ties as binary (present or absent) and directional (ego seeks advice from alter), the focus on relationships typically assigns values to ties (such as frequency or intensity). Table 3 (adapted from Brass, 1995a) indicates typical measures of links, or ties. Although each of the measures in Table 3 can be used to describe a particular link between two actors, the measures can be aggregated and assigned to a particular actor or used to describe the entire network. For example, we might note that 70% of the ties in a network are reciprocated.

Insert Table 3 about here

The focus on relationships in social networks has been dominated by Granovetter's (1973) theory of the "the strength of weak ties." Granovetter (1973) argued that job search is embedded in social relations which he defined as strong or weak ties. Tie strength is a function of time, intimacy, emotional intensity (mutual confiding), and reciprocity (Granovetter, 1973, p. 348). Strong ties are often characterized as friends and family; weak ties are acquaintances.

Granovetter (1973) found that weak ties were more often the source of helpful job information than strong ties.

Although the research exemplified the relational approach, it was Granovetter's (1973) structural explanation for the "strength of weak ties" that generated research interest in networks. Focusing on the indirect ties in the network, Granovetter (1973) argued that strong ties tend to be themselves connected (part of the same social circle) and provide the job seeker with redundant information. Weak ties, on the other hand, tend to not be connected themselves; they represent ties to disconnected social circles (bridges) that provide useful, nonredundant information in finding jobs. Thus, "social structure can dominate motivation," (Granovetter, 2005, p. 34). While strong-tie friends may be more motivated to help than weak-tie acquaintances, it is likely to be acquaintances that provide information concerning new jobs. Although subsequent research refined and modified these results (cf., Bian, 1997; Lin, 1999; Wegener, 1991), Granovetter's (1973) notion that weak ties can be useful bridges connecting otherwise disconnected social circles is one of the most referenced ideas in the social sciences.

Strong ties have also received research attention as they are often thought to be more influential, more motivated to provide information, and of easier access than weak ties. For example, Krackhardt (1992) showed that strong ties were influential in determining the outcome of a union election. Hansen (1999) found that while weak ties were more useful in searching out information, strong ties were more useful for the effective transfer of information. Uzzi (1997) found that "embedded ties" were characterized by higher levels of trust, richer transfers of information and greater problem solving capabilities when compared to "arms-length" ties. On the downside, strong ties require more time and energy to maintain and come with stronger obligations to reciprocate.

In addition, negative ties have recently drawn research attention (Labianca & Brass, 2006). Defined as “dislike,” “prefer to avoid,” or “difficult to work with,” Labianca & Brass (2006, p. 597) propose that these “social liabilities” are a function of four characteristics: strength (mild distaste to intense hatred), reciprocity (one or both parties dislike the other), cognition (awareness by each party of dislike by the other), and social distance. Social distance refers to whether the negative relationship is direct or whether it involves being connected to someone who has a negative tie to a third party (or extended distance in the network). Being friends with someone who is disliked by others can be a social liability but disliking a person who is disliked by many others may mitigate social liabilities. Research on negative asymmetry suggests that negative relationships may be more powerful predictors of outcomes than positive relationships. For example, Labianca, Brass, and Gray (1998) found that positive relationships (friends in the other groups) were not related to perception of intergroup conflict, but negative relationships were (someone disliked in the other group).

Focus on resources. Rather than assume that all nodes (in particular, alters) are the same, some social network researchers have focused on the resources of alters. Lin (1999) has argued that tie strength and the disconnection among alters is of little importance if the alters do not possess resources useful to ego. In response to Granovetter’s (1973) findings, Lin, Ensel, and Vaughn (1981) found that weak ties reached higher status alters and that alters’ occupational prestige was the key to ego obtaining a high status job. Lin (1999) reviews research supporting this resource-based approach to status attainment across a variety of samples in different countries. While a more complete focus might address the complementarity of ego and alters’ resources, this approach has primarily relied on status indicators. For example, Brass (1984)

found that links to the dominant coalition of executives in a company were related to power and promotions for non-managerial employees.

Focus on attributes. As Kilduff and Tsai (2003, p. 68) note, the study of individual attributes “calls forth various degrees of scorn and dismissal from network researchers.” In carving out their structural niche, network researchers have largely ignored individual attributes with the exception of controlling for various demographic characteristics such as gender. Similarly, the effects of human agency in emerging networks and the ability or motivation of individuals to take advantage of structural positions is missing from most network research. From a structural perspective, individual characteristics such as personality are the result of an historical accumulation of positions in the network structure. Thus, there is ample opportunity for research that investigates how individual characteristics affect network structure (e.g., Mehra, Kilduff, & Brass, 2001) or how individual abilities and motivations might interact with the opportunities and constraints presented by network structures (e.g., Zhou, Shin, Brass, Choi, & Zhang, 2009). Rather than arguing about the relative importance of structure and agency, it may be more useful to determine which structures maximize individual agency. While the centralized structure in network 1a presents a strong situation and an easy structural prediction, it is difficult to predict the most powerful node in network 1b without reference to individual attributes.

Focus on cognition. Rather than viewing networks as “pipes” through which resources flow, the cognitive approach to social networks has focused on networks as “prisms.” As reported by Kilduff and Krackhardt (1994), when approached for a loan, the wealthy Baron de Rothschild replied, “I won’t give you a loan myself, but I will walk arm-in-arm with you across the floor of the Stock Exchange, and you will soon have willing lenders to spare,” (Cialdini, 1989, p. 45). As exemplified by this quote, the cognitive approach to networks focuses on

individuals' cognitive interpretations of the network. Kilduff and Krackhardt (1994) found that being perceived to have a prominent friend had more effect on one's reputation for high performance than actually having a prominent friend in the organization. Likewise, Podolny (2001) notes how the market relations between firms are not only affected by the transfer of resources, but also by how third parties perceive the quality of the relationship. You are known by the company you keep. But, cognitive interpretations are not only made by third party observers. Relationships hinge on the cognitive interpretations of actions by the parties involved. For example, we are not likely to form relationships with people whom we perceive as trying to use us. Calculated self-interest in building relationships, if perceived, is self defeating. Brokers may be perceived as less trustworthy than closely connected members of the groups they connect. I also include in this category studies that focus on individual's mental maps of networks (e.g., Krackhardt, 1990). The focus on cognition also poses the question of whether the enhanced awareness of social networks (through social networking sites such as Facebook and management consultants offering network workshops) may alter the way people form, maintain, and terminate ties. Such awareness also challenges self-reports as valid sources of network data. Kilduff and Tsai (2003) and Kilduff and Krackhardt (2008) provide more extended discussions of cognition and networks.

Methodological Issues

Social network data may be collected from archival records (inter-organizational alliances, e-mail, membership in groups), observations, informant perceptions (interviews or questionnaires), or a combination of these methods. While archival records provide accuracy, it is often difficult to determine what is being exchanged or how to interpret the ties. Observation is very time consuming and the chances of missing an important link or misinterpreting an

interaction are high. At the interpersonal level, most organizational behavior researchers have used questionnaires to obtain self-reports from actors. People are asked whom they talk with, trust, are friends with, etc. Although research has shown that people are not very accurate in reporting specific interactions (Bernard, Killworth, Kronenfeld, & Sailer, 1984), reports of typical, recurrent interactions are reliable and valid (Freeman, Romney, & Freeman, 1987).

People can be asked to *list* the names of alters in response to name generators or asked to select their alters from a *roster* of all names in the network of interest. While the list method relies on people remembering all important alters and having the time and motivation to list them all, the roster method assumes that the researcher can identify all possible alters prior to data collection. People are more likely to remember their strong ties so the roster method may be preferable when attempting to tap weak ties, and vice versa. The roster method will almost always result in larger reported networks.

Researchers can collect *ego network* data (typically used when sampling unrelated egos from a large population) or *whole network* data (typically used when collecting data from every ego within a specified network such as one particular organization). An ego network consists of ego, his direct-link alters, and ties among those alters (Borgatti, 2006). Ego is typically asked to list his direct-link alters and to indicate whether the alters are themselves connected. Such data is limited by ego's ability to accurately describe the connections among direct-tie alters, and many structural network measures cannot be applied to ego network data (i.e., centrality). No attempt is made to collect data on path lengths beyond direct-tie alters. Whole network data consists of archival, observational, or informant reports of all nodes and ties within a specified network (e.g., all organizational alliances within an industry, all friendship relations among employees within a group or an organization). All participants are asked to report their direct ties and all

reports are combined to form the whole network. While the whole network approach does not rely on a single informant and allows the researcher to calculate extended paths and additional structural measures, the danger arises from the possibility of mis-specifying the network (important nodes and links are not included).

Boundary specification. If it is indeed a small world, bounding the network for research purposes is an important, if seldom addressed, issue. Given the research question, what is the appropriate membership of the network? This involves specifying the number of different type networks to include as well as the number of links removed from ego (indirect links) that should be considered. Both decisions have conceptual as well as methodological implications.

In organizational research, formal boundaries exist: work groups, departments, organizations, industries. Seldom have researchers even addressed the issue of how many links (direct and indirect) to include as the network may extend well beyond ego's direct ties. The importance of this boundary specification is emphasized by Brass' (1984) finding that centrality within departments was positively related to power and promotions while centrality within the entire organization produced a negative finding. The appropriate number of links has recently garnered renewed attention with the publication of Burt's (2007) findings. He found that second-hand brokerage (structural holes beyond ego's local direct-tie network) did not significantly add to variance in outcomes in three samples from different organizations, justifying his use of data focusing on ego's local, direct-tie network (ego network data). Unlike sexually transmitted diseases, information in organizations tends to decay across paths and including ties three or four steps removed from ego may be unnecessary. As Burt (2007) notes, people may not have the ability or energy to think through the complexity of brokerage in an extended network. He also notes that his results are limited to the brokerage-performance relationship, as several examples

exist of the importance of third-party ties (two-steps removed from ego): Bian (1997) in finding jobs, Gargiulo (1993) in gaining two-step leverage; Labianca et al. (1998) in perceptions of conflict, and Bowler and Brass (2006) in organizational citizenship behavior.

Whole network measures of structural holes (accounting for longer paths) also have been shown to be significant in predicting power and promotions (Brass, 1984, 1985a) and performance (Mehra et al., 2001), although Burt (2007) suggests these results may hinge on a strong relationship between direct-tie brokerage and extended brokerage. Although experimental studies of exchange networks have shown that an actor's structural hole power to negotiate (play one alter off against the other) is significantly weakened if the two alters each have an additional link to an alternative negotiating partner (Cook, Emerson, Gilmore, & Yamagishi, 1983), Brass and Burkhardt (1992) found no evidence of this effect in a field study. In sum, there is considerable evidence for both a local and the more extended network approach, and it is likely that debate will ensue and continue. Including the appropriate number of links is likely a function of the research question and the mechanism involved in the flow, but assuredly, researchers will need to attend to and justify their boundaries more explicitly in the future.

The conceptual implications concern the issue of structural determinism and individual agency. Direct relationships are jointly controlled by both parties and motivation by one party may not be reciprocated. All dance invitations are not accepted. If important outcomes are affected by indirect links (over which ego has even less control), the effects of agency become inversely related to the path distance of alters whose relationships may affect ego. Structural determinism increases to the extent that distant relationships affect ego. For example, a highly publicized study by Fowler and Christakis (2008) found that ego's happiness was predicted by the happiness of people up to three links removed from ego.

Identifying the domain of possible types of relationships (network content) is equally troublesome (see Borgatti & Halgin, 2011, for an extended discussion of network content). Burt (1983) noted that people tend to organize their relationships around four categories: friendship, acquaintance, work, and kinship. Types of networks (the content of the relationships) are sometimes classified as informal versus formal, or instrumental versus expressive (Ibarra, 1992). For example, Grosser, Lopez-Kidwell, and Labianca (2010) found that negative gossip was primarily transmitted through expressive friendship ties, while positive gossip flowed through instrumental ties. However, interpersonal ties often tend to overlap and it is sometimes difficult to exclusively separate ties on the basis of content.

Conceptually, the issue is one of appropriability. Coleman (1990) included appropriability as a key concept in his notion of social capital. One type of tie may be appropriated for a different use. For example, friendship and workplace ties are often used to sell Girl Scout cookies. Indeed, Granovetter's (1985) critique of economics argued that economic transactions are embedded in, and affected by networks of interpersonal relationships (see also Uzzi, 1997). Although the concept of "embeddedness" has been confused in a number of ways, the idea that different types of relationships overlap and that one type of tie may be appropriated for another use casts doubt on the notion that different types of networks produce different outcomes. If different ties are appropriable, the danger of focusing on only one type of tie (e.g., advice) is that other important ties (e.g., friendship) may be missing from the data. Thus, researchers like Burt (1997) typically measure several different types of content and aggregate across content networks. On the other hand, Podolny and Baron (1997) findings suggest different outcomes from different types of networks, and there is evidence that people prefer their affective and instrumental ties to be embedded in different networks (Ingram & Zou, 2008) as

they represent contrasting norms of reciprocity (see also Casciaro & Lobo, 2008). Of course, it is unlikely that negative ties (Labianca & Brass, 2006) can be appropriated for positive use; centrality in a conflict network will certainly lead to different results than centrality in a friendship network.

Levels of analysis. Social networks are often touted for their ability to integrate micro and macro approaches (Wellman, 1988). They provide the opportunity to simultaneously investigate the whole as well as the parts (Ibarra, Kilduff, & Tsai, 2005). The dyadic relationships are used to compose the network; they are the parts that form the whole. Network measures assigned to individual actors (Table 1) are cross-level because they represent the relative position of a part within the whole. Actors also can be clustered into groups or cliques based on their relationships within the network. Thus, it is possible to study the effects of whole network characteristics (e.g., core-periphery structure) on group (e.g., clique formation) and individual (e.g., centrality) characteristics. Combining measures at different levels, researchers might ask how individual centrality within the group interacts with the centralization of the group to affect important outcomes such as power. Although possible, such analyses have rarely been undertaken (see Sasidharen, Santhanam, Brass, & Sambamurthy, 2011, for an exception).

Breiger (1974) notes that when two people interact, they not only represent themselves, but also any formal or informal group/organization of which they are a member. Thus, individual interaction is often assumed to also represent group interaction. For example, CEOs who sit on the same boards of directors are assumed to exchange information that is subsequently diffused through their respective organizations and affects organization outcomes (e.g., Galaskiewicz & Burt, 1991). While the assumptions are not directly tested (Zaheer & Soda, 2009), they provide a convenient compositional model for moving across levels of analysis.

Social Network Theory

Despite reference to an amorphous “social network theory” in the management literature, perhaps the most frequent criticism of the approach is that it represents a set of techniques and measures devoid of theory (but see Borgatti & Halgin, 2011 and Borgatti & Lopez-Kidwell, in press). Just as Tables 1, 2, and 3 illustrate, it is often easier to catalog the measures than to provide a theoretical explanation for the emergence and persistence of social networks. More often, the measures are used to operationalize constructs suggested by the researcher’s favorite theory. Rather than a weakness, the development of sophisticated measures of social structure is a distinctive strength of social network analysis that has allowed researchers from many different disciplines to mathematically represent concepts that were previously only loose metaphors (Wellman, 1988). In the chronology of networks, the first step was to develop mathematical measures to represent structural patterns. Such measures abound and new measures are consistently being developed. For example, the social network software program UCInet (Borgatti, Everett, & Freeman, 2002) includes nine different measures of the concept of positional centrality. With the measures in hand, it was then necessary to show that they relate to important outcomes. Without this step, it made little sense to investigate the emergence of networks (antecedents) or how networks develop and change over time.

Social networks are often equated with social structure (Wellman, 1988). Attitudes and behavior are interpreted in terms of social structure rather than the human capital of the actors. Similar structures produce similar outcomes. At the extreme, “the pattern of relationships is substantially the same as the content” (Wellman, 1988, p. 25). Rather than adopting this extreme position, I rely on structuration theory (Giddens, 1976).

As outlined in Brass (1995a), interaction and communication can be intended and purposeful or unintended, and more or less constrained by factors external to the actors. As Barley (1990) notes, "...while people's actions are undoubtedly constrained by forces beyond their control and outside their immediate present, it is difficult to see how any social structure can be produced or reproduced except through ongoing action and interaction" (pp. 64-65). Whether to satisfy social or instrumental needs, in a general sense, people interact in order to make sense of, and successfully operate on their environment. As Darwin noted, survival may have gradually nudged humans toward cooperative groups that benefit survival. When the interaction is helpful in this regard, the interaction continues and a relationship is formed. Although interactions may be initially coincidental, repeated interaction is not. Repeated interaction leads to social structure: relatively stable patterns of behavior, interaction, and interpretation. As these patterns emerge from recurrent interaction, they take on the status of predictable "taken-for-granted facts" (Barley, 1990, p. 67). Institutionalized patterns of interaction become external to individuals and constraint their behavior. The constrained behavior in turn further reinforces the socially shared social structure that facilitate future interaction, just as language facilitates communication. However, interactions which occur within the constraints of structure can gradually modify that structure. For example, those persons disadvantaged by the current structural constraints may actively seek to change them, or exogenous shocks may provide the occasion for major restructuring. In attempting to merge the individual and the social structure, I do not ignore individual agency nor the structural constraints which may at times render it useless. Structure and behavior are intertwined, each affecting the other. Thus, I proceed to explore the antecedents and outcomes of networks in relation to organizations. I underscore

the dynamic nature of structuration theory, noting that antecedents can at times be outcomes and vice-versa.

Social Networks: Antecedents

Spatial, Temporal, and Social Proximity

Although the advent of e-mail and social networking sites such as Facebook may moderate the effects of proximity on relationships, the same might have been said for telephones. However, being in the same place at the same time fosters relationships that are easier to maintain and more likely to be strong, stable links (Borgatti & Cross, 2003; Festinger, Schachter, & Back, 1950; Fulk & Steinfield, 1990; Monge & Eisenberg, 1987). In addition to spatial and temporal proximity, social proximity also fosters relationships. A person is more likely to form a relationship with an alter two links removed (e.g., acquaintance of a friend) than three or more links removed. To the extent that organizational workflow and hierarchy locate employees in physical and temporal space, we can expect additional effects on social networks. Because it would be difficult for a superior and subordinate directly linked by the formal hierarchy to avoid interacting, it would not be surprising for the “informal” social network to shadow the formal hierarchy of authority (or workflow). For example, Tichy and Fombrun (1979) found higher density and connectedness in the interpersonal interaction network in an organic organization than a mechanistic organization. Similarly, Shrader, Lincoln, and Hoffman (1989) found networks of high density, connectivity, multiplexity, and symmetry, and a low number of clusters in organic organizations. Confirming this intuition, Burkhardt and Brass (1990) and Barley (1990) found that communication patterns in an organization changed when the organization adopted a new technology.

Homophily

Spatial, temporal, and social proximity provide opportunities to form relationships, but we do not form relationships with everyone we meet. Social psychologists and sociologists are quite familiar with homophily: a preference for interaction with similar others. A good deal of research has supported this proposition, and it is a basic assumption in many theories (see McPherson, Smith-Lovin, & Cook, 2001, for a cogent review). Similarity has been operationalized on such dimensions as race and ethnicity, age, religion, education, occupation, and gender (roughly in order of importance). People can be similar on many different dimensions. Distinctiveness theory suggests that the salient dimension is the one most distinctive relative to others in the group (Leonard, Mehra, & Katerberg, 2008; Mehra, Kilduff, & Brass, 1998). As McPherson et al. (2001, p. 415) summarize, similarity breeds connections of every type: marriage, friendship, work, advice, support, information transfer, and comembership in groups. “The result is that people’s personal networks are homogeneous with regard to many socio-demographic, behavioral, and interpersonal characteristics.” Similarity is thought to ease communication, increase predictability of behavior, foster trust and reciprocity, and reinforce self-identity. Using electronic name-tags to trace interactions at a business mixer, Ingram and Morris (2007) found evidence of associative homophily: a tendency to join conversations when someone in the group was similar. We would expect the characteristics of the links between actors to be related to the degree of actor similarity. Interaction between two similar actors is likely to be more frequent, reciprocated, salient, symmetric, stable, multiplex, strong, and decay less quickly than interaction between dissimilar actors. Similarity of actors also may be positively related to the density or connectedness of the network. Homophily is not a perfect predictor of relationships as similarity can also lead to rivalry for scarce resources, and

differences may be complementary and combined for successful outcomes. Exceptions can also occur as people aspire to make connections with higher status alters. However, there is little incentive for the higher status person to reciprocate, absent homophily on other characteristics. For example, Brass and Burkhardt (1992) found that interaction patterns were correlated with similar levels of power.

Focusing on gender homophily, Brass (1985a) found two largely segregated networks (one predominately men, the other women) in an organization. Ibarra (1992) also found evidence for homophily in her study of men's and women's networks in an advertising agency. In distinguishing types of networks, she found that women had social support and friendship network ties with other women, but they had instrumental network ties (e.g., communication, advice, influence) with men. Men, on the other hand, had homophilous ties (with other men) across multiple networks, and these ties were stronger. Gibbons and Olk (2003) found that similar ethnic identification led to friendship and similar centrality. Perceived similarity (religion, age, ethnic and racial background, and professional affiliation) among executives has been shown to influence interorganizational linkages (Galaskiewicz, 1979). Although social network measures were not included, research on relational and organizational demography (e.g., Williams & O'Reilly, 1998) has employed the similarity/attraction assumptions. We also would expect similarity of personality and ability to be related to the interpersonal network patterns of interaction.

Due to culture, selection, socialization processes, and reward systems, an organization may exhibit a modal demographic or personality pattern. Kanter (1977) has referred to this process as "homosocial reproduction," consistent with attraction-selection-attrition research (Schneider, Goldstein, & Smith, 1995). Thus, an individual's similarity in relation to the modal

attributes of the organization (or the group) may determine the extent to which he or she is central or integrated in the interpersonal network. This suggests that minorities may be marginalized, and peripheral status and homophily may result in a large rather than small world networks for minorities in organizations (Mehra et al., 1998; Singh, Hansen, & Podolny, 2010).

The above discussion implies that interaction in organizations is emergent and unrestricted. However, organizations are by definition organized. Labor is divided. Positions are formally differentiated both horizontally (by technology, workflow, task design) and vertically (by administrative hierarchy), and means for coordinating among differentiated positions are specified. Similarity is a relational concept and organizational coordination requirements may provide opportunities or restrictions on the extent to which a person is similar or dissimilar to others.

Balance

Early studies (DeSoto, 1960) showed that transitive, reciprocal relationships were easier to learn, an indication of how people organize relationships in their minds with an apparent preference for balance. More recently, Krackhardt & Kilduff (1999) found similar perceptual notions of balance based on distance from ego. Indeed, cognitive balance (Heider, 1958) is often at the heart of network explanations (see Kilduff & Tsai, 2003, for a more complete exploration). A friend of a friend is my friend; a friend of an enemy is my enemy. Granovetter's theory of weak ties assumes a relationship between alters who are both strongly tied to ego. Structurally, balance is seen as transitivity and efforts have been made to extend the triadic notion of balance to larger networks (Hummon & Doreian, 2003). However, we know that balance is not the sole mechanism for explaining network structure. In a perfectly balanced world, everyone would be part of one giant positive cluster, or two opposing clusters linked by negative ties. The adage

“two’s company, three’s a crowd,” also suggests that strong ties to alters do not guarantee that the alters will become friends themselves; rather, they may become rivals for ego’s time and attention.

Human and Social Capital

As Lin’s (1999) theory of social resources suggests, actors who possess more human capital (skills, abilities, resources, expertise) are going to be more attractive partners than those with less human capital. Indeed, centrality in the advice network may provide a good proxy for expertise. However, affect plays an important role. Casciaro and Lobo (2008) found that when faced with the choice of “competent jerk” or a “lovable fool” as a work partner, people were more likely to choose positive affect over ability. Of course, relationships with persons with more human capital (e.g., status) are tempered by the high status person’s possible reluctance to form a relationship with lower status people. However, in general, it’s probably accurate to say that human capital creates social capital. In addition to human capital, those who possess more social capital may be more attractive than those who possess less. For example, forming a relationship with a person with many connections creates opportunities for indirect flows of information and other resources. While Coleman (1990) famously noted that social capital creates human capital, human capital can create social capital and social capital can create even more social capital.

Personality

Due to the structural aversion to individual attributes, until recently few studies had investigated the effects of personality on network patterns. Mehra et al. (2001) found that high self-monitors were more likely to occupy structural holes in the network (connect to alters who were not themselves connected), and Oh and Kilduff (2008) reinforced these findings in a

Korean sample. Self-monitoring refers to an individual's inherent tendency to monitor social cues and present the image suggested by the audience. Using a battery of personality traits, Kalish and Robins (2006) found that individualism, high locus of control, and neuroticism were related to structural holes and Klein, Lim, Saltz, and Mayer (2004) found a variety of personality factors related to in-degree centrality in advice, friendship, and adversarial networks. Yet, the results indicated relatively few correlates minimal, but significant variance explained. While many other network measures and personality traits might be correlated, the results suggest that strong theoretical rationale is needed.

Culture

Organizational and national culture also may be reflected in social network patterns. For example, French employees prefer weak links at work, whereas Japanese workers tend to form strong, multiplex ties (Monge & Eisenberg, 1987). Lincoln, Hanada, and Olson (1981) found that vertical differentiation was positively related to personal ties and work satisfaction for Japanese and Japanese Americans. Horizontal differentiation had negative effects on these workers. In addition, in Chinese cooperative high-tech firms Xiao and Tsui (2007) found that bridging structural holes could be likened to "standing in two boats." More research is needed to fully understand how culture may affect social networks. In particular, research suggests that cooperative versus competitive cultures may be an important moderator of network effects.

Clusters and Bridges

Proximity, homophily, and balance predict that the world will be organized into clusters of close friends with similar demographics and values. Indeed, it is nice to be surrounded by people with the same values whom you can trust and rely upon for social support. We add to this the tendency for friends to reinforce each other and become even more similar. As Feld (1981)

notes, activities are often organized around "social foci"—actors with similar demographics, attitudes, and behaviors will meet in similar settings, interact with each other, and enhance that similarity. In-group/out-group biases foster tightly knit cliques. Yet, it is the bridges—people who connect different clusters—that make it a “small world.” Figure 2 represents the clusters and bridges thought to portray the way the world’s relationships are organized.

 Insert Figure 2 about here

Whether these clusters represent the volunteers in Nebraska and lawyers in Boston, different departments in an organization, different ethnic groups, or, as is the case in this diagram from Rob Cross, an organization’s R&D departments in different countries (Cross, Parker, & Sasson, 2003), it is the bridges that make it possible for information or resources to flow from one cluster to another. As Travers and Milgram (1969) noted, letters that circulated among friends within the same cluster did not reach the lawyer in Boston. It was only when the letter was sent to a bridge that allowed it to reach its destination.

With the strong preferences for homophily and balance, what then motivates a person to connect with a different cluster? As Granovetter (1973) and Burt (1992) argue, there are advantages to connecting to those who are not themselves connected. Information circulates within a cluster and soon becomes redundant. Connecting to diverse clusters provides novel information and different perspectives that can lead to creativity and innovation (as well as finding a better job).

A variety of factors can affect social networks. Obviously the influences are complex and the effects cross levels of analysis. Additional influences remain to be explored. In addition, few

studies have examined more than one influence. Multivariate studies encompassing multiple theories and multiple levels of analysis are needed to begin to understand the complex interactions involved among the factors (Monge & Contractor, 2003).

Social Networks: Outcomes

Returning to structuration theory, network patterns emerge and become routinized and act as both constraints on, and facilitators of behavior. I now turn to the outcomes of these networks, noting that the antecedents are only of interest if the networks affect important outcomes. I focus on traditional I/O topics and outcomes. Network research has followed two classes of outcomes: how people are the same (e.g., contagion/diffusion studies) and how people are different (e.g., performance studies) based on their networks. I begin with attitude similarity.

Attitude Similarity: Contagion

Just as I noted the propensity for similar actors to interact, theory and research have also noted that those who interact become more similar (sometimes referred to as induced homophily). Asch's (1951) classic experiments on conformity demonstrate how individuals can be influenced by others. Erickson (1988) provides the theory and research concerning the "relational basis of attitudes." People are not born with their attitudes, nor do they develop them in isolation. Attitude formation occurs primarily through social interaction—people attempt to make sense of reality by comparing their own perceptions with those of others, in particular, similar others. Attitudes of dissimilar others have little effect, and may even be used to reinforce one's own attitudes.

Attitude similarity has received much research attention under the general heading of "contagion." Much writing has focused on the role of social networks in adoption and diffusion of innovations (cf. Burt, 1982; Rogers, 1971). These studies generally show that cosmopolitans

(i.e., actors with external ties which cross social boundaries) are more likely to introduce innovations than are locals (Rogers, 1971). Likewise, central actors, sometimes identified as “opinion leaders” are unlikely to be early adopters of innovations when the innovation is not consistent with the established norms of the group (Rogers, 1971). The network studies focus on the spread of diseases as well as new ideas.

The classic study of the diffusion of tetracycline among physicians (Coleman, Katz, & Menzel, 1957) showed the influence of networks on the prescriptions written for the new drug. However, reanalysis of the original data indicated that adoption was more a matter of occupying similar positions in the network (structural equivalence) than direct interaction. According to Burt (1987), actors cognitively compare their own attitudes and behaviors with those of others occupying similar roles, rather than being influenced by direct communications from others in dissimilar roles. Likewise, Galaskiewicz and Burt (1991) found similar evaluations of nonprofit organizations among structurally equivalent contributions officers, and structural equivalence explained these contagion effects better than the direct contact “cohesion” approach. Walker (1985) found that structurally equivalent individuals had similar cognitive judgments of means-ends relationships regarding product success.

However, supporting a direct connection, cohesion approach, Davis (1991) showed how the “poison pill” diffused through the network of inter-corporate ties. Likewise, Rice and Aydin (1991) found that attitudes about new technology were similar to those with whom employees communicated frequently and immediate supervisors. However, estimates of others’ attitudes were not correlated with others’ actual (reported) attitudes. In another study, Rentsch (1990) found that members of an accounting firm who interacted with each other had similar interpretations of organizational events, and that these meanings differed qualitatively across

different interaction groups. Krackhardt and Kilduff (1990) found that friends had similar perceptions of others in the organization, even when controlling for demographic and positional similarities. In a longitudinal study following a technological change, Burkhardt (1994) found attitude similarity among both structurally equivalent actors and those with direct links. While the debate about structural equivalence vs. direct interaction generated several studies, research interest decreased as it became apparent that both have an effect. In addition, the Coleman et al. (1957) data that generated the original debate has been reanalyzed several times with each reanalysis refuting the previous one (see Kilduff & Oh, 2006, for an in-depth history and summary of results). Recent similarity studies have been more concerned with the topics of leadership (Pastor, Meindl, & Mayo, 2002), perceptions of justice (Umphress, Labianca, Brass, Kass, & Scholten, 2003) and affect (Totterdell, Wall, Holman, Diamond, & Epitropaki, 2004) than with the previous structural equivalence/cohesion debate.

The small-world model of bridges to disconnected clusters provides the underlying theory for the far-reaching and rapid spread of information. While this model works well when considering contagious diseases, or information about job openings, where a single contact is all that is needed for diffusion, the adoption of social behavior (such as innovations) may be more complex than the spread of disease (Centola, 2010). A change in social behavior may require redundant exposure from multiple contacts providing the reinforcement necessary to promote adoption. In an internet experimental study, Centola (2010) found that adoption was more likely when participants received “redundant” encouragement from multiple ties. In addition to fostering behavioral change, redundant ties also provide credibility or verification of information and make one less dependent on single sources of such information or other resources (Brass & Halgin, 2011). While strong ties and the inverse of structural holes may provide good proxies for

redundant ties, friends may be sources of non-redundant information and disconnected contacts may provide the same redundant information. Brass and Halgin (2011) propose a focus on redundant *content* (what flows through the connections) in place of, or in addition to redundant *positions* in the network. While everyone needs to know a doctor or a car mechanic, having a redundant backup mechanic provides a second opinion that we often find useful. Rather than avoiding redundancy, redundant contacts may represent an additional source of social capital.

Job Satisfaction

Early laboratory studies (see Shaw, 1964, for review) found that central actors were more satisfied than peripheral actors in these small (typically five-person) groups and Roberts and O'Reilly (1979) found that relative isolates (zero or one link) in the communication network were less satisfied than participants (two or more links). However, Brass (1981) found no relationship between satisfaction and centrality (closeness) in the workflow of workgroups or departments and a negative relationship to centrality within the entire organization's workflow. Brass (1981) suggested that this latter finding may be due to the routine jobs associated with the core technology of the organization. Job characteristics mediated the relationship between workflow network measures and job satisfaction (Brass, 1981; Ibarra & Andrews, 1993).

Although more research is needed, these limited results suggest that there may be a curvilinear relationships such that isolation is probably negatively related to satisfaction, while a high degree of centrality may lead to conflicting expectations, communication overload, and stress. In addition, interaction is not always positive. When possible, we tend to avoid interaction with people we dislike, thereby producing a positive correlation between interaction and friendship. However, work requirements place constraints on the voluntary nature of social interaction in organizations. The possibility that such required interaction may involve negative

outcomes suggests the need for further research on the negative side of social interaction (Labianca & Brass, 2006).

Affect

Focusing on affect rather than job satisfaction, Totterdell et al. (2004) found that membership in a densely connected group was negatively related to negative affective states, and reductions in network density (due to a merger) were related to negative changes in affect. While interest in job satisfaction has waned, research on affect in organizations has dramatically increased (Barsade, Brief, & Spataro, 2003; George & Brief, 1992). Of particular interest to network researchers is emotional contagion: the transfer and diffusion of moods and emotions within workgroups to the point of suggesting constructs such as group emotion (Barsade, 2002).

Power

A variety of studies and settings have noted that central network positions are associated with power (Brass, 1984, 1985a; Brass & Burkhardt, 1993; Burkhardt & Brass, 1990; Fombrun, 1983; Krackhardt, 1990; Shaw, 1964; Sparrowe & Liden, 2005). Theoretically, actors in central network positions have greater access to relevant resources (decreasing their dependence on others), and potential control over such resources (increasing others' dependence on them). Thus, two measures of centrality, closeness (representing access), and betweenness (representing control) correspond to resource dependence notions (Brass, 1984; Brass, 2002). Both measures have been shown to contribute to the variance in reputational measures of power, and promotions in organizations (Brass, 1984, 1985a). In addition, simple degree centrality measures of the size of one's ego network (symmetric and asymmetric) have been associated with power (Brass & Burkhardt, 1992, 1993; Burkhardt & Brass, 1990) including degree centrality in the gossip network (Grosser, Lopez-Kidwell, Labianca, & Ellwardt (2011).

Studying nonsupervisory employees, Brass (1984) found that links beyond the workgroup and workflow requirements were related to influence. In particular, closeness to the dominant coalition in the organization was strongly related to power and promotions. The dominant coalition was identified by a clique analysis of the interaction patterns of the top executives in the company. In a follow-up study (Brass, 1985a), men were more closely linked to the dominant coalition (composed of four men) and were perceived as more influential than women even when controlling for performance. Assuming male domination of powerful executive positions in many organizations, women may be forced to forgo any preference for homophily in order to build connections with the dominant coalition. Thus, the organizational context places constraints on preferences for homophily, especially for women and minorities (Ibarra, 1993). Women in integrated workgroups (at least two men and two women) and who were closely connected to the men's network (only male employees considered) were perceived as more powerful than women who were not. However, there were also power benefits for men who had links (closeness centrality) to the women's network (only women employees considered; Brass, 1985a).

Sparrowe and Liden (2005) related betweenness centrality in the advice network to power and also found a three way interaction between leader-member exchange relationships (LMX), supervisor centrality, and overlap between supervisor and subordinate network. Subordinates benefited from trusting LMX relationships with central supervisors who shared their network connections (sponsorship). When leaders were low in centrality, sharing ties in their trust network was detrimental.

In integrating the structural perspective with the behavioral perspective, Brass and Burkhardt (1993) found that network position was related to behavioral tactics used, that both

network position and behavioral tactics were independently related to perceptions of power, and that each mediated the relationship between the other and power. While network position may represent potential power, behavioral tactics represent the strategic use of resources. Behavioral tactics increased in importance as network position decreased in strength.

One such tactic, building coalitions, has been investigated from a network perspective (Murnighan & Brass, 1991; Stevenson, Pearce, & Porter, 1985). Murnighan and Brass (1991) suggest that coalitions form around issues; actors are connected on the basis of common attitudes about, or mutual support, of an issue, and networks change as issues change. Although recurring interactions based on affect, advice, or workflow may provide a probable template for coalition activity, issue networks are more fleeting. Forming successful coalitions requires an accurate knowledge of the network. Adopting a cognitive approach, Krackhardt (1990) found that the accuracy of individual cognitive maps of the social network in an organization was related to perceptions of influence. In a case analysis, Krackhardt (1992) also demonstrated how a lack of knowledge of the social networks in a firm prevented a union from successfully organizing employees.

Recruitment and Selection

In the classic example of the strength of weak ties, people were able to find jobs more effectively through weak ties (acquaintances) than strong ties or formal listings (Granovetter, 1982). Subsequent studies reinforced and modified those results (Lin et al., 1981; Wegener, 1991). Weak ties used in finding jobs led to higher status jobs when the weak ties connected the job seekers to those of higher occupational status, forming the foundation for Lin's (1999) theory focusing on the resources of alters. For example, Halgin (2009) found effects for connections to high status others on hiring decisions, even when controlling for previous performance.

Focusing on the employer side of the labor market, Fernandez and colleagues (Fernandez, Castilla, & Moore, 2000; Fernandez & Weinberg, 1997) investigated the use of employee referral networks in recruitment and selection of bank employees. Organizations often provide monetary bonuses to employees who provide referrals who are eventually hired by the company and who remain for a specified period of time. Using employee networks for recruitment and selection is thought to provide a richer pool of applicants, a better match between referred applicants and job requirements, and social enrichment (referred applicants when hired have already established social connections to the referring employee). All three mechanisms suggest that referred hires are less likely to quit. Fernandez & Weinberg (1997) found that referred applicants had more appropriate resumes and timing, but these did not explain referrals' advantage in hiring. Fernandez et al. (2000) also found support for the richer pool explanation, but did not find that referred applicants were better informed of job requirements (better match argument). There was some evidence of the social enrichment mechanism at work (interdependence of turnover between referrers and referrals). In a cost analysis, they found that the \$250 monetary bonus resulted in a return of \$416 in reduced recruiting costs. They also found evidence of homophily in hiring referrals, suggesting the danger of homosocial reproduction in organizations (Kanter, 1977). However, a diverse pool of existing employees can lead to continued diversity in the workforce. Consistent with the referral hiring advantage, Seidel, Polzer, and Stewart (2000) found that hires with previous connections in the organization were able to negotiate higher salaries than those with no previous connections. Likewise, Williamson and Cable (2003) found that firms hired top management team members from sources with whom they shared network ties. They also noted social contagion effects among firms in their

hiring practices. Similarly, in a qualitative study, Leung (2003) found that entrepreneurial firms tended to rely on strong, direct ties in recruitment and selection of employees.

As in the case of recruiting via the use of networks, selection may also depend on network ties, particularly when the qualified applicant pool is large or when hiring standards are ambiguous. In such cases, similarity between applicant and recruiter may be an important basis of the selection choice. Because of the overlap between social networks and actor and attitude similarity, selection research might fruitfully pursue the effects of patterns of social relationships on hiring decisions.

In a case study, Burt and Ronchi (1990) analyzed hiring practices in an organization in which conflict had escalated to the point of shootings and bomb threats. Using archival data provided in the application forms of current employees, they matched the pattern of hiring with the warring factions in the company. The network analyses showed how a manager had virtually taken control of the company years earlier by hiring family, friends, and friends of friends, from a close geographical location surrounding his community. The conflicts arose between those people obligated to the manager and others hired from a rival community. The network structure was also used to identify employees with links to both groups who could serve as mediators of the conflict (Burt & Ronchi, 1990).

Socialization

Following selection, network involvement may play a key role in the socialization and commitment of new employees (Eisenberg, Monge, & Miller, 1984; Jablin & Krone, 1987; Sherman, Smith, & Mansfield, 1986). Similarly, Morrison (2002) found that network size, density, tie strength, and range were related to organizational knowledge, task mastery, and role clarity. Newcomers' friendship networks related to their social integration and organizational

commitment. However, because network integration and socialization and commitment may be reciprocally causal, it is impossible to know from these correlational studies whether integration into the network leads to commitment, or vice versa.

Training

Few studies address social networks or provide a structural perspective on training (Brass, 1995a). If training is viewed as acquiring new and innovative ideas and skills, once training is introduced or adopted, the diffusion of the training (or the spread of new ideas and skills) can be predicted by social network relationships. For example, Burkhardt and Brass (1990) investigated the introduction, training, and diffusion of a major technological change in an organization. The diffusion process closely followed the network patterns following the change, with structurally equivalent employees adopting at similar times.

In a similar study of the introduction of a new computer technology, Papa (1990) found that productivity following the change, as well as speed of learning the new technology was positively related to interaction frequency, network size, and network diversity (i.e., number of different departments and hierarchical levels contacted). While formal training programs can provide basic operating information, much of the learning about a new technology occurs in on-the-job exchange of information as employees attempt to apply the training (Sasidharen et al., 2011). Exchanging information with others had a positive effect on productivity, even when controlling for past performance (Papa, 1990).

Training may also be viewed as an opportunity to build social connections among participants. Deep and lasting relationships can be formed when cohorts proceed through intense training experiences (e.g., military training) or through life experiences in college (Brass, 1995a). Organizations may form cross-functional training groups that promote network connections

across diverse, heterogeneous groups, or may encourage “staff swaps” to integrate distinct subcultures in organizations (Krackhardt & Hanson, 1993). However, mandated interaction does not always lead to stable links and longitudinal research is needed to map network connections formed during training.

Career Development: Getting Ahead

Subsequent to Granovetter’s strength of weak ties, Burt’s 1992 book, “Structural Holes” was perhaps the most influential research in propelling studies of social networks. Burt (1992) argued that the size of one’s network is not as important as the pattern of relationships; in particular, the extent to which your contacts are not themselves connected (creating a “structural hole” in your network). Based on Simmel’s (1950) analysis of triads, Burt (1992) noted the advantages of the “tertius gaudens” (i.e., “the third who benefits”). Not only does the “tertius” gain nonredundant information from the contacts (i.e., the strength of weak ties argument), but the tertius is in a position to control the information flow between the two (i.e., broker the relationship), or play the two off against each other. The tertius profits from the disunion of others. However, in order to play one off against the other, the two alters need to be somewhat redundant, offsetting any advantage gained from nonredundant information. In addition, the irony of the structural hole strategy is that connecting to any alter creates brokerage opportunities for the alter as well as for ego (Brass, 2009). Without entirely ignoring the strength of ties, Burt (1992) argued that a direct, structural measure of disconnection among alters was preferable to the weak tie proxy. Contrasted with Coleman’s (1990) and Putnam’s (1995) conceptualization of social capital as trust generated by closed networks, Burt’s (1992) focus on the social capital of structural holes led to a tremendous number of research studies.

Using the criterion of rate of previous early promotions, Burt (1992) found the presence of structural holes to be more effective for a sample of 284 managers in a large, high-technology firm, except in the case of women and newly hired managers. For women and newcomers, a strong tie pattern of connecting to well-connected sponsors worked best. Burt, Hogarth, and Michaud (2000) replicated the benefits of structural holes for French managers using salary as the dependent variable. Often cited in support of Burt's (1992) structural hole hypothesis, Podolny and Baron (1997) found that an upward change in grade shift during the previous year (mobility) was related to large, sparse networks. Unlike Burt (1992) who aggregated across five different networks, Podolny and Baron (1997) found that in one of the five networks (the "buy-in" network) dense connections were advantageous, providing what Podolny and Baron (1997) suggested was an identity advantage of closed networks. They argue that the content of the network makes a difference. Because the network data in each of the above studies were not longitudinal, it is difficult to discern whether the networks were the result of promotions or the cause of promotions (although Podolny & Baron, 1997, eliminated ties formed following promotions). However, previous studies by Brass (1984, 1985a) support Burt's (1992) contention, finding that betweenness centrality (a whole network measure of structural holes within departments) led to promotions for both men and women three years following the network data collection. Supporting Lin's (1999) resource approach, Brass (1984) also found that connections to the dominant coalition (a highly connected group of top executives) were significantly related to promotions.

In a study of 1359 Dutch managers, Boxman, De Graaf, and Flap (1991) found that external work contacts and memberships related to income attainment and level of position (number of subordinates) for both men and women when controlling for human capital

(education and experience). The return on human capital decreased as social capital increased. In a study combining different network approaches (structural, relational, resource, and attribute) and measuring flows, Seibert et al. (2001) found that both weak ties and structural holes in career advice network were related to social resources which, in turn, were related to salary, promotions over one's career, and career satisfaction.

Individual Performance

As with promotions, Burt's (1992) structural hole theory has also been applied to individual performance in organizations. Supporting this approach, Mehra et al. (2001) found that betweenness centrality was related to supervisors' ratings of performance. Likewise, Mizruchi and Stearns (2001) found that density (few structural holes) and hierarchy (dominated by one or a few persons) in approval networks negatively related to closing bank deals. Network size was positively related, and strength of tie was negative. Also supporting structural holes, Cross & Cummings (2004) found that ties to diverse others related to performance in knowledge intensive work. Finally, Burt (2007) reports relationships between structural holes and performance for three samples: supply chain managers (salary and performance evaluations), investment bankers (annual compensation), and financial analysts (election to the Institutional Investor All-American Research Team). Sparrowe, Liden, Wayne, and Kraimer (2001) found that in-degree centrality in the advice network was positively related to supervisor ratings of performance, but they did not include measures of structural holes in their analysis. Different findings were reported in one study (Lazega, 2001) indicating that constraint (lack of structural holes) positively related to performance (billings) in a U.S. law firm. Lazega (2001) extensively describes the cooperative, sharing culture in the law firm, suggesting a cooperation/competition contingency. Supporting the notion of a cooperation contingency, Xiao and Tsui, (2007) found

that structural holes had a negative effect on salary and bonuses in high-commitment organizations in the collectivist culture of China. They liken the structural hole position to a Chinese cultural interpretation of “standing in two boats.” Noting the difference in being the object of directional relationships, rather than the source (Burt & Knez, 1995), Gargiulo, Ertug, and Galunic (2009) found that closed networks were beneficial (bonus) for information seekers, but not information providers. Although the data in the above studies are cross sectional, and some evidence suggests a cooperation/competition contingency, there seems to be solid support for the structural hole—performance relationship.

Adopting a cognitive focus on performance, Kilduff and Krackhardt (1994) found that being perceived as having a powerful friend in the organization related to one’s reputation for good performance, although actually having a powerful friend was not related to reputation. While being closely linked to a powerful other may result in “basking in the reflected glory,” it may also result in being perceived as “second fiddle” or “riding the coattails” of a powerful other. Strong connections to a mentor may be perceived as an indication of potential success early in one’s career, but as second fiddle late in one’s career. The reliance on a mentor’s network creates a dependency on the mentor to mediate the flow of resources; thus, a strong tie to the mentor (or high LMX with one’s supervisor) may be required (Sparrowe & Liden, 2005).

Group Performance

A variety of studies have investigated the effects of interpersonal network patterns on group performance. Uzzi (1997) described how embedded relationships characterized by trust, fine-grain information, and joint problem solving can have both positive and negative economic outcomes for small firms in the garment industry. Firms can become over-embedded and miss economic opportunities presented by “arms-length” transactions. Hansen (1999) found that weak

inter-unit ties speed up group project completion times when needed information is simple, but slows them down when knowledge to be transferred is complex. He concludes that weak ties help search activities; strong ties help knowledge transfer. Of course, employees must know who knows what in the organization (Borgatti & Cross, 2003). Tsai (2001) noted that in-degree centrality in knowledge transfer network (among units) interacted with absorptive capacity to predict business unit innovation and performance.

Much of the work on interpersonal networks and group performance has been done by Reagans, Zuckerman, and McEvily (2004) who conclude that internal density and external range in knowledge sharing networks related to group performance (as measured by project duration). Similarly, Oh, Chung, & Labianca (2004) found that internal density (inverted U relationship) and number of bridging relationships to external groups in an informal socializing network related to group performance (as rated by executives). A meta-analysis by Balkundi & Harrison, (2006) showed that density within teams, leader centrality in teams, and team centrality in intergroup networks related to various performance measures. These studies provide a solution to the debate about structural holes and cohesion. Teams benefit from internal cohesion and external links to other groups that are not themselves connected.

Leadership

Despite early laboratory studies showing that central actors in centralized group structures were overwhelmingly chosen as leaders (Leavitt, 1951; see Shaw, 1964, for a review), there have been few empirical studies of networks and leadership (see Balkundi & Kilduff, 2005, Brass & Krackhardt, 1999, and Sparrowe & Liden, 1997, for theoretical articles). An exception is Mehra, Dixon, Brass, and Robertson (2006) who found that leaders' centrality in external and

internal friendship networks was related to objective measures of group performance and to their personal reputations for leadership among different organizational constituencies.

Job Design

Although traditional research on job design (e.g., Hackman & Oldham, 1976) waned in the 1990s, an early study by Brass (1981) found that job characteristics (e.g., task variety and autonomy) mediated relationships between workflow centrality in the workgroup and employee satisfaction and performance. Centrality within the entire organization's workflow network (rather than the smaller workgroups) was negatively related to job characteristics (Brass, 1981). These latter jobs in the organization's technical core were routinized, while the jobs on the boundary of the organization were more complex. In a follow-up study, Brass (1985b) used network techniques to identify pooled, sequential, and reciprocal interdependencies within workgroups. Performance varied according to combinations of technological uncertainty, job characteristics, and network patterns. The results suggest that performance is best when the networks match the task and workflow requirements, possible contingency factors noted by Burt (2000). For example, laboratory studies (see Shaw, 1964 for a review) found that centralized communication networks (e.g., Figure 1a) resulted in more efficient performance when tasks were simple and routine. For complex, uncertain tasks, decentralized networks (e.g., Figure 1b) were better. For a summary of the recent resurgence in job design from a social perspective, see Grant and Parker (2009).

Turnover

While job satisfaction is often related to turnover, Mossholder, Settoon, and Henegan (2005) found that in-degree centrality (combined advice and communication networks) added significant variance to satisfaction in predicting turnover over a five-year study window. Krackhardt and Porter (1986) found that turnover in fast-food restaurants did not occur randomly, but in structurally equivalent clusters in the perceived interpersonal communication network. In a longitudinal study, Krackhardt and Porter (1985) also investigated the effects of turnover on the attitudes of those who remained in the organization. The closer the employee was to those who left, the more satisfied and committed the remaining employee became, suggesting that the remaining employees cognitively justified their decision to stay by increasing their satisfaction and commitment. Although Krackhardt & Porter (1985, 1986) used cognitive network data, they did not focus on the extent to which turnover in the network provides a signal (prism effect) that activates or justifies additional turnover or whether a threshold effect leads to massive exits detrimental to the organization's survival. Focusing on organizational performance, Shaw, Duffy, Johnson, and Lockhart (2005) investigated the effects of turnover of key network actors (above and beyond turnover rate and individual performance) on the organizational performance of 38 restaurants. They found support for a curvilinear relationship between the loss of employees who occupied structural holes in the network and organizational performance.

Justice

According to equity theory (Adams, 1965), employees compare their perceived input/outcome ratios with their perceptions of others' input/outcome ratios. The problem of testing equity predictions outside the laboratory has been the large number of possible "others" that

might be considered for possible comparison. Noting this problem, Shah (1998) found that people rely on structurally equivalent others in making task-related comparisons and friends when making social comparisons.

Although justice research has always been relational, few studies have progressed past the dyadic comparison. DeGoey (2000, p. 51) notes that the “often ambiguous and emotionally charged nature of justice-related events” compels actors to make sense of these events through social interaction. He provides an extensive review and hypotheses concerning “storytelling” and the social construction and maintenance of shared justice perceptions over time. Building on this work, Shapiro, Brass, and Labianca (2008) theorize about how network patterns might affect the diffusion and durability of perceptions of inequity.

Negotiations

Few topics have generated as much research over the past 40 years as negotiations (see Bazerman, Curhan, Moore, & Valley, 2000, for a review). Despite the many empirical studies, social relationships have been relatively neglected (Valley, Neale, & Mannix, 1995), and even fewer studies have gone beyond the negotiating dyad (Valley, White, & Iacobucci, 1992) to consider triadic relations or the entire network. Yet, it is likely that the social networks of negotiators will affect both the process and outcomes of negotiations. To the extent that negotiations involve the exercise of power, the network findings regarding centrality should provide some clues as to asymmetric advantages. Structural holes may provide useful, nonredundant information or tap into transaction alternatives that can be played off against each other, while overlaps in negotiators’ networks may provide the closure necessary for trust, reciprocity, and mutually beneficial outcomes. While Granovetter (1985) and Uzzi (1997) have demonstrated how economic transactions are embedded in social relations, McGinn and Keros

(2002) have shown how such social ties ease coordination within a negotiation and allow for an improvised shared logic of exchange that facilitates negotiation. Thus, the structural results of network analysis may add predictive power to negotiation research, while the more cognitive and behavioral insights from negotiation research may provide the understanding of the process mechanisms often missing from network analysis.

Conflict

Focusing on the overall pattern of ties in twenty organizations, Nelson (1989) found that low-conflict organizations were characterized by more strong ties between members of different groups than in high conflict organizations. However, when including negative ties, Labianca et al. (1998) found that friendship ties across groups were not related to perceptions of intergroup conflict, but negative relationships (measured as “prefer to avoid” a person) were related to higher perceived conflict. Third party relationships (having friends who reported negative relationships across groups) also related to perceptions of intergroup conflict. While psychologists have studied dyadic conflict, the third party results suggest that future research might investigate the contagion effects of conflict—how it escalates and moves (or is dampened or resolved) through social networks.

Citizenship Behavior

Despite a tremendous amount of research on organizational citizenship behavior (e.g., Bateman & Organ, 1983; Podsakoff, MacKenzie, Paine, & Bachrach, 2000) very few studies of this topic have adopted a social network perspective. Many of the studies focus on a perceived equity exchange between the employee and the organization. Rather than focus on the employee/organization exchange, Bowler and Brass (2006) investigated affective exchange between employees. Interpersonal citizenship behavior (as reported by recipients of the behavior)

was significantly related to friendship even when controlling for job satisfaction, commitment, procedural justice, hierarchical level, demographic similarity, and job similarity. People also performed helping behavior for more powerful others and friends of more powerful others. Settoon and Mossholder (2002) found that in-degree centrality related to supervisors' ratings of person- and task-focused interpersonal citizenship behavior. Reversing the causality, Bolino, Turnley, & Bloodgood (2002) argue that organizational citizenship behavior can result in the creation of social capital within an organization. They provide a theoretical model of how Van Dyne, Graham, and Dienesch's (1994) five OCB dimensions can foster ties that can be appropriated for other uses, can foster relationships characterized by liking, trust, and identification, and promote shared narratives and language.

Creativity/Innovation

Fueled by the notion that creativity often involves the synthesis or recombination of different ideas or perspectives, researchers have looked beyond individual cognitive processes for social sources of diverse knowledge (Amabile, 1996), such as an individual's network (Perry-Smith & Shalley, 2003). Following Granovetter (1973), Brass (1995b) proposed that weak ties should provide nonredundant information and thereby increase creativity. Burt (2004) found that ideas submitted by managers with structural holes were judged by top executives to be more creative than managers with few structural holes. Perry-Smith (2006) found effects for weak ties, but not structural holes (using the whole network measure of betweenness centrality) on supervisor ratings of employee creativity. Using a similar measure of employee creativity in a Chinese sample, Zhou et al. (2009) found a curvilinear relationship between weak ties and creativity, but no relationship for structural holes. They argue that weak ties not only capture nonredundant information between alters but also capture homophily effects between ego and

alters. This is also one of the few studies to investigate an interaction between individual attributes and networks. They found an interaction between conformity values and weak ties. People with low conformity values were able to take advantage of the opportunities presented by weak ties.

Viewing innovation as the implementation of creative ideas, Obstfeld (2005) focused on a *tertius iugens* orientation: the tendency to bring people together by closing structural holes. Ego network density (few structural holes) aggregated across several networks related to involvement in innovation. Density positively related to structural holes suggesting that closing holes may lead to reciprocation. Obstfeld's (2005) findings were consistent with an earlier study (Ibarra, 1993) that found centrality (asymmetric Bonacich measure) across five networks related to involvement in technical and administrative innovations. Obstfeld (2005) argued that structural holes may lead to creative ideas, but innovation requires the cooperation of closed networks. Focusing on utility patents, Fleming, Mingo, and Chen (2007) found that collaborative brokerage (structural holes) helped generate patents but hampered their diffusion and use by others.

Unethical Behavior

In his critique of economics, Granovetter (1985) noted how social relationships and structure affect trust and malfeasance. Economic transactions are embedded in social relationships and actors do not always pursue self interests to the detriment of social relationships. Brass, Butterfield, and Skaggs (1998) built on these ideas within the context of ethics research. They argue that the constraints of various types of relationships (strength, status, multiplexity, asymmetry) and the network structure of relationships (density, cliques, structural holes, centrality) on unethical behavior will increase as the constraints of characteristics of

individuals, organizations, and issues decrease, and vice versa. However, such predictions are extremely difficult to test in natural settings. One exceptional paper, Baker and Faulkner (1993) focused on price fixing conspiracies (illegal networks) in the heavy electrical equipment industry. In this network study, convictions, sentences, and fines related to personal centrality, network structure (decentralized) and management level (middle).

Conclusion: Challenges and Opportunities

Overall, I have attempted to demonstrate how a social network perspective might contribute to our understanding of industrial/organizational psychology. In the process, I have tried to note challenges and opportunities for future research. While the structural perspective has provided a useful niche for social network research, measuring the pattern of nodes and ties challenges the researcher to provide explanations of why these patterns of social relations lead to organizational outcomes. While the network provides a map of the highways, seldom is the traffic measured (Brass, 1984; Stevenson & Gilly, 1991). For example, various explanations are provided for the benefits of structural holes (Burt, 1992). Ego may play one alter off against another, ego may acquire nonredundant information or other helpful resources, ego may recognize a synergistic opportunity and act on it herself, or ego may refer one alter to the other and benefit from future reciprocation. Or, ego may simply be mediating a conflict between the two alters. Similarly, network closure is assumed to provide trust and norms of reciprocation but seldom are these explanatory mechanisms verified. Future network research will need to measure the processes and mechanisms to get a fuller understanding of the value of particular structural patterns.

In establishing the predictive value of a structural perspective, network researchers have emphasized the importance of relationships to the detriment of individual agency. Although few

organizational network scholars deny the importance of human capital and individual agency, few efforts have been made to tap the hallmark of industrial/organizational psychology: the ability and motivation of actors. While network researchers have begun to include personality variables, it was previously assumed that, other things being equal, actors would be capable and motivated to take advantage of network opportunities (or equally constrained by existing structures). Researchers will not only need to account for ability and motivation, but also identify strong structures that overwhelm individual agency (i.e., Figure 1a) and weak structures that maximize individual differences (i.e., Figure 1b). It is likely that individual attributes will interact with network structure to affect outcomes (e.g., Zhou et al., 2009).

The next logical growth in network research is the evolution of networks; how they change over time. Although there are few longitudinal studies of network change at the individual level (e.g., Barley, 1990; Burkhardt & Brass, 1990), interorganizational scholars are now leading the boom via the use of archival, longitudinal, alliance data (e.g., Gulati, 2007). In addition, network scholars have actively devised computer simulations of network change (e.g., Buskens & van de Rijt, 2008; Gilbert & Abbott, 2005). Several questions beg for research. How are ties maintained and what causes them to decay or be severed (Burt, 2002; Shah, 2000)? What are the effects of past ties, and can dormant, inactive, past ties be reactivated? Does the formation of new ties affect existing ties, and vice versa? Can external agents (i.e., managers) affect the network formation and change of others? How do endogenous factors contribute to network change? For example, it is likely that network centrality leads to success and that success in turn leads to greater network centrality. Many opportunities exist for research on the dynamics of networks.

It has become popular to apply network thinking to various established lines of research, much as I have done in this chapter. Equally profitable would a reverse process of applying findings from organizational behavior research to social network analysis. What can social network researchers learn from industrial/organizational psychology? It is a small world of industrial/organizational psychologists and social network researchers if bridges exist across these disciplinary clusters. Hopefully, this chapter will foster such bridges by energizing collaborative research.

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Table 1

Typical Structural Social Network Measures Assigned to Individual Actors

<i>Measure</i>	<i>Definition</i>
Degree	Number of direct links with other actors
In-degree	Number of directional links to the actor from other actors (in-coming links)
Out-degree	Number of directional links from the actor to other actors (out-going links)
Range (Diversity)	Number of links to different others (others are defined as different to the extent that they are not themselves linked to each other, or represent different groups or statuses)
Closeness	Extent to which an actor is close to, or can easily reach all the other actors in the network. Usually measured by averaging the path distances (direct and indirect links) to all others. A direct link is counted as 1, indirect links receive proportionately less weight.
Betweenness	Extent to which an actor mediates, or falls between any other two actors on the shortest path between those two actors. Usually averaged across all possible pairs in the network.
Centrality	Extent to which an actor is central to a network. Various measures (including degree, closeness, and betweenness) have been used as indicators of centrality. Some measures of centrality (eigenvector, Bonacich) weight an actor's links to others by the centrality of those others.
Prestige	Based on asymmetric relationships, prestigious actors are the object rather than the source of relations. Measures similar to centrality are calculated by accounting for the direction of the relationship (i.e., in-degree).
Structural	Extent to which an actor is connected to alters who are not themselves

Holes	connected. Various measures include ego-network density and constraint as well as betweenness centrality.
Ego-network density	Number of direct ties among other actors to whom ego is directly connected divided by the number of possible connections among these alters. Often used as a measure of structural holes when controlling for the size of ego's network.
Constraint	Extent to which an actor (ego) is invested in alters who are themselves invested in ego's other alters. Burt's (1992, p. 55) measure of structural holes; constraint is the inverse of structural holes.
Liaison	An actor who has links to two or more groups that would otherwise not be linked, but is not a member of either group.
Bridge	An actor who is a member of two or more groups.

Table 2

Typical Structural Social Network Measures Used to Describe Entire Networks

<u>Measure</u>	<u>Definition</u>
• Size	Number of actors in the network
• Inclusiveness	Total number of actors in a network minus the number of isolated actors (not connected to any other actors). Also measured as the ratio of connected actors to the total number of actors.
• Component	Largest connected subset of network nodes and links. All nodes in the component are connected (either direct or indirect links) and no nodes have links to nodes outside the component. Number of components or size of the largest component are measured.
• Connectivity (Reachability)	Minimum number of actors or ties that must be removed to disconnect the network. Reachability is 1 if two actors can reach each other, otherwise 0. Average reachability equals connectedness.
• Connectedness/ fragmentation	Ratio of pairs of nodes that are mutually reachable to total number of pairs of nodes
• Density	Ratio of the number of actual links to the number of possible links in the network.
• Centralization	Difference between the centrality scores of the most central actor and those of other actors in a network is calculated, and used to form ratio of the actual sum of the differences to the maximum sum of the differences
• Core-	Degree to which network is structured such that core members

- peripheriness connect to everyone while periphery members connect only to core members and not other members of the periphery.
- Transitivity Three actors(A, B, C) are transitive if whenever A is linked to B and B is linked to C, then C is linked to A. Transitivity is the number of transitive triples divided by the number of potential transitive triples (number of paths of length 2). Also known as the weighted clustering coefficient.
- Small-worldness Extent to which a network structure is both clumpy (actors are clustered into small clumps) yet having a short average distance between actors.
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Table 3

Typical Relational Social Network Measures of Ties

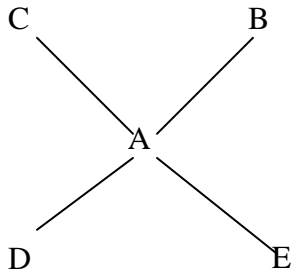
<u>Measure</u>	<u>Definition</u>	<u>Example</u>
indirect links	Path between two actors is mediated by one or more others	A is linked to B, B is linked to C, thus A is indirectly linked to C through B
frequency	How many times, or how often the link occurs	A talks to B 10 times per week
duration (stability)	Existence of link over time	A has been friends with B for 5 years
multiplexity	Extent to which two actors are linked together by more than one relationship	A and B are friends, they seek out each other for advice, and work together
strength	Amount of time, emotional intensity, intimacy, or reciprocal services (frequency or multiplexity sometimes used as measures of strength of tie)	A and B are close friends, or spend much time together
direction	Extent to which link is from one actor to another	Work flows from A to B, but not from B to A
symmetry (reciprocity)	Extent to which relationship is bi-directional	A asks for B for advice, and B asks A for advice

Figure Captions

Figure 1. Network Diagrams.

Figure 2. Cluster and Bridges.

(1a)



(1b)

