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New Developments in Social Network Analysis

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Abstract

This review of social network analysis focuses on identifying recent trends in interpersonal social networks research in organizations, and generating new research directions, with an emphasis on conceptual foundations. It is organized around two broad social network topics: structural holes and brokerage and the nature of ties. New research directions include adding affect, behavior, and cognition to the traditional structural analysis of social networks, adopting an alter-centric perspective including a relational approach to ego and alters, moving beyond the triad in structural hole and brokerage research to consider alters as brokers, expanding the nature of ties to include negative, multiplex/dissonant, and dormant ties, and exploring the value of redundant ties. The challenge is to answer the question "What's next in social network analysis?"

INTRODUCTION

It has been almost 100 years since the researchers at the Hawthorn plant diagramed the social networks of employees (Roethlisberger & Dixon 1939). Apropos to their subjects' tasks, they diagramed the relationships in the bank wiring room as electrical circuits. The more familiar network diagrams that we see today are often credited to Jacob Moreno, who showed that running away from the Hudson Valley Girls School was contagious (Moreno 1934). Although Granovetter's influential article on the strength of weak ties appeared in 1973, it was not until the late 1980s and early 1990s that social network research began to appear on a regular basis in management journals. This was fueled by the advances in personal computers and the advent of network software such as UCINet (Borgatti et al. 2002) coinciding with Burt's (1992) influential book on structural holes and Coleman's (1990) theory of social capital. The concept of social capital (benefits derived from relationships with others) provided a legitimizing umbrella label for social network research. Such research enjoyed an exponential rise in the journals from 1995 to 2010 and has now plateaued at a mainstream level. Social networks have consistently been shown to affect important individual, group, and organizational outcomes (Brass et al. 2004).

So, what is new? That is the challenge faced in this review. Where is social network theory and research headed? I attempt to predict those trends, noting that my predictions are undoubtably biased by my own network of network scholars. Phrases like, "in my opinion" and "I think" could be added to many of the following sentences. I focus on interpersonal networks (omitting interorganizational networks), given the limits of this review and assumptions about my audience of organizational psychologists. I neither attempt to include every social network article published in the past 15 years, nor do I attempt to apply social network analysis to an extensive variety of organizational behavior and human resource management topics; other reviews of this nature exist (Brass 2012, Brass & Borgatti 2020). For example, Soltis et al. (2018) coined the term social resource management for their review and integration of human resource management and social networks. Network applications exist for such familiar organizational behavior topics as leadership (Cullen-Lester et al. 2017), teams (Grosser et al. 2020), organizational citizenship behavior (Brass 2018), and creativity (Perry-Smith & Mannucci 2017, Soda et al. 2021). Rather, I organize the review around two broad social network topics: structural holes and brokerage and the nature of ties. I attempt to generate as well as identify new directions in social network theory and research. My goal is to focus on concepts rather than measures or analytic tools, as I attempt to identify promising new developments in social network research in organizations. Three stalwarts of organizational psychology and organizational behavior encompass many of my predicted trends: affect (including attitudes such as satisfaction), behavior (including implied behavior associated with personality, traits, and orientations), and cognition (including audience perceptions as well as mental representation and awareness and accuracy of networks). New developments are also occurring in the nature of ties where affect, behavior, and cognition is ever present. This is not to overlook the most visible symbol of social network analysis—the structure of networks. Network structure has become an established predictor of important organization outcomes, and the trend is to add affect, behavior, and cognition to the structural approach. I suggest a structural trend that is best described as going beyond the triad. I begin with some foundational definitions and assumptions that are useful for navigating through the article and for those less familiar with social network analysis.

SOCIAL NETWORK FOUNDATIONS

A social network is a set of ties representing some connection or lack of connection between a set of social actors (individual, groups, organizations, etc.). Actors can be connected in many

different ways: similarities such as location, group membership, or attributes such as gender; social relations such as kinship, roles, friendship, or "knows about"; interactions such as communicates with or gives advice to; or flows such as information (Borgatti et al. 2009). Multiplexity refers to actors being connected in multiple ways (see discussion below). Different types of connections will result in different networks (Borgatti & Halgin 2011b), although some overlap is typical of most actors' networks and can be a benefit in promoting internetwork connections. In organizational research, the ties often involve information flow resulting from some form of interaction, such as communication or advice, or a more abstract connection, such as trust, friendship, or influence. I refer to a focal actor in a network as ego; the other actors with whom ego has direct connections are called alters.

Actors are often said to be embedded in a network of relationships. The term embedded gained popular use following Granovetter's (1985) classic critique of transaction costs economics. Granovetter argued that all economic transactions occur within the context of social relationships. The social aspects affect future behavior such that actors tend to repeat transactions with previously established partners. The concept of embeddedness has evolved to represent an inertial quality to all types of ties. Actors show a preference to repeat established network connections, or to forge new ties within, rather than outside, their local community of ties (Kilduff & Brass 2010).

Dyadic connections are the basic building blocks of social networks, consistent with the social network assumption that individuals cannot be considered in isolation. Indeed, the often-repeated phrase "bringing the individual back in" (originally Kilduff & Krackhardt 1994) does not include treating the individual as an isolated actor. Individual perceptions are not formed in isolation, and personality may be as much a function of network position as the reverse proposition (Kilduff & Lee 2020, Tasselli et al. 2018). Dyadic social network data can be collected from archival records (i.e., organizational alliances, email records), observation (i.e., the bank-wiring room in the Hawthorne studies), interviews, or respondent reports. In organizational research, questionnaires are often used, asking respondents to list the names of actors they are connected to in an open-ended name-generator format or to select actors from a roster of names. Freeman et al. (1987) have shown that although respondents are not very accurate about specific times or events, they are accurate in reporting recurring, everyday connections. New technology can increase accuracy, supplementing the perceptual information provided by respondents.

Social network data capture relationships and are typically entered into a square, actor-by-actor adjacency matrix where each cell represents the presence or absence of a connection between the two actors (or the valued data describing the connection). See Borgatti & Halgin (2011a) for alternative "affiliation" networks. Ties may indicate direction such as resources flowing from Actor A to Actor B, or Actor A chooses Actor B as a friend, although some types of ties are inherently symmetric or bidirectional (Actor A communicates with Actor B). The unique contribution of a social network perspective is that it goes beyond the dyad and provides a way of considering the structural arrangement of more than two actors, including indirect linkages or paths. For example, Travers & Milgram (1969) traced the path lengths of volunteers attempting to reach a target person, resulting in the well-known six degrees of separation and subsequent small-world research (compare with Watts 2003). Just as actors are not considered in isolation, neither are dyadic relationships; it is the connections among the dyadic building blocks that form the network.

Social network research focuses on relationships (connections), and the structure of these relationships, rather than (and in addition to) the attributes of the actors. Social networks provide the opportunities and constraints—patterned relationships among multiple actors affect attitudes, behaviors, cognitions, etc. But actors are not passive recipients of network structure. Actors have

agency; it is their ongoing actions and interactions that produce and reproduce the network structure (Tasselli & Kilduff 2021). However, even in voluntary dyadic interactions, each actor has only unilateral control over declining or severing a connection, and even less control over connections among alters.

Correlates of tie formation include spatial and temporal proximity, embeddedness (Kilduff & Brass 2010), reciprocation, homophily (tendency to interact with similar others), balance/transitivity (a friend of a friend is a friend), social foci (Feld 1981), personality (Tasselli et al. 2018), and, in organizations, required workflow and hierarchy connections (Brass 2012, Dahlander & McFarland 2013, Kleinbaum 2012, Rivera et al. 2010). Self-monitoring (extent to which individuals monitor and adapt their behavior to different situations) has proven to be a useful personality correlate of network structure (Kilduff & Buengerler 2020, Mehra et al. 2001, Oh & Kilduff 2008, Sasovova et al. 2010, Tasselli & Kilduff 2018). Many of the studies are cross-sectional and although some antecedents are fixed, it is likely that antecedents and networks coevolve such that each affects the other over time.

An extensive variety of network measures have been developed over the years (see Brass 2012 or Kilduff & Tsai 2003 for a glossary), as social network researchers have examined how the pattern of connections among the actors affects various outcomes. Such measures are often referred to as structural, as they represent the structure or configuration of relationships. These structural measures can be further classified as point measures when they describe an actor's position within a network and whole network measures when they describe the configuration of the entire network (or some subnetwork within it). For example, an actor's point centrality within a network can be captured in several ways (i.e., degree: number of ties; closeness: number of direct and indirect ties needed to reach every other actor in the network; or betweenness: the extent to which the actor falls on the shortest path connecting any other two actors in the network) (Borgatti & Brass 2020).

Whole network data are collected by designating a bounded group of actors (such as a department or an organization) and collecting relational data on all the actors within the group (compare with Brass 1984). The whole, bounded network may be used to calculate actors' point measures that involve indirect ties, or a whole network measure can be calculated to describe the entire configuration. A frequently calculated whole network measure is density: the number of actual ties divided by the total number of possible ties in the network. Whole networks are sometimes described as small-world or clique structures in which tightly connected clusters of actors have a few bridging ties that connect the clusters, or core periphery structures in which a core consists of a few connected actors with peripheral actors connected to the core but not to each other (compare with Maoret et al. 2020). Structural measures can be enhanced by consideration of affect, behavior, and cognition; I focus below on structural holes in particular.

I refer to ego-network measures as those that have been developed to characterize a focal actor's pattern of direct ties in the absence of, or regardless of, indirect extended ties. An ego network contains only the focal actor ego's direct ties to alters and any ties between the alters. Ego networks typically produce point measures (although one could calculate ego-network density), but not all point measures are calculated on direct ties only (see above examples of closeness and betweenness centrality). An ego network may be extracted from whole network data but more typically is constructed based on information obtained from the focal actor (see Perry et al. 2018 for a more detailed explanation of ego networks). For example, Burt (1992) developed an ego-network measure called constraint to capture the extent to which ego's direct-tie alters are connected to each other. Network measures have also been developed to identify groups (i.e., cliques, n-cliques, k-plexes, and groups based on structural equivalence) (Brass 2012). We find few examples of these techniques in the organizational literature because organizations as well as groups within organizations are formally bounded (departments, divisions, etc.).

In addition to a structural approach focusing on the configuration or pattern of relationships, network research has also adopted a relational approach focusing on the nature of ties. Structural networks capture whether ties exist and sometimes how they exist; the nature of ties focuses on the substance of what the ties are and why they exist. For example, one of the foundational works in social network analysis is "The Strength of Weak Ties" (Granovetter 1973). Granovetter distinguished between strong and weak ties based on frequency, emotional intensity, intimacy, and reciprocal services. He found that weak ties were more often the source of finding jobs because such ties connected different social circles and produced nonredundant job-related information. Recent attention has focused on negative ties as well as positive or neutral ties (see discussion below). The relational approach typically includes entering values (i.e., 1–7 on a Likert-type scale) in the network matrix cells. The relational approach overlaps with my focus on affect, behavior, and cognition, and I attend to the nature of ties in more detail below.

In addition to the structural and relational approaches, Lin (1999) has advocated a resource-based approach in which the focus is on the resources of the alters. For example, connections to central, powerful alters may be more helpful than connections to peripheral actors (Brass 1984, Sparrowe & Liden 2005). All three approaches—structural, relational, and resource-based—can be combined. For example, Seibert et al. (2001) found that career success was related to structural holes (structural), weak ties (relational), and contacts at higher levels and career sponsorship (resource).

Additionally, network researchers have developed a cognitive approach. For example, a distinction is sometimes made between perceived and "actual" networks, leading to what Krackhardt (1987) refers to as cognitive social structure—the actors' mental maps of networks. For example, Krackhardt & Porter (1985) argued that perceived connections (between employees who quit an organization and those who stayed) were a more appropriate predictor of "stayers" satisfaction than "actual" connections. In addition, Kilduff & Krackhardt (1994) found that audience perceptions of connections to high status alters were a better predictor of perceived performance than actual connections (actual connections were measured as reciprocated agreement between specified respondents). Although actual networks may be important when predicting objective outcomes [i.e., the spread of the coronavirus disease 2019 (COVID-19)], perceived networks may be more important when predicting subjective outcomes such as satisfaction or perceived performance. Thus, cognitive representations of networks, or networks as "prisms" as well as "pipes" (Podolny 2001), have been the focus of network studies. For a review of the cognitive approach to networks, see Brands (2013). Also see Cannon-Bowers et al. (1993) for applications of mental maps to team performance.

Smith et al. (2012) provide a useful classification for thinking about an actor's ties. They refer to the potential network as all the possible ties that actors have, including dormant, inactive ties (see discussion below). The activated network is a subset of potential ties that come to mind in a particular situation, or when prompted by a particular stimulus—the emphasis here is on the cognitive nature to ties. Awareness plays an important role (Borgatti & Cross 2003) as ego transitions to the mobilized network (a behavioral component)—the connections that people actually make in responding to a situation. Actors choose whom to mobilize among possible potential ties, a largely unexplored area (Brennecke 2020, Casciaro & Lobo 2008, Nebus 2006, Walter et al. 2015). Actors may, of course, choose to forge a new tie, although the principle of embeddedness suggests that people may be more comfortable relying on previously established connections. Rather than forge a new tie, an existing tie may be appropriated for a different use, as in the case of an employee asking work colleagues to buy Girl Scout cookies. Appropriation can lead to multiplex ties. However, asking friends for money, for example, may be perceived as an abuse of friendship and jeopardize

the connection. Adding to the Smith et al. typology, the actual network will depend not only on the individual's mobilized alters but also on whether those alters will chose to form a connection.

A recent study of creativity sheds some light on whom actors tend to mobilize/activate. Mannucci & Perry-Smith (2021) found that individuals with large networks of both strong and weak ties were more likely to rely on strong ties and less likely to switch ties during different phases of the creative process than individuals with smaller networks. Choice of tie to activate affected creativity. Choosing the wrong tie (strong or weak) corresponding to different phases of the creativity "journey" (idea generation or idea elaboration) resulted in either abandoning creative ideas or pursuing uncreative ideas.

A recent new development in cognitive networks focuses on tracing the neural response of actors. Parkinson et al. (2018) used functional magnetic resonance imaging to scan subjects' brains while watching movies. They found that similarity of neural responses was a function of social distance in the network: Friends had exceptionally similar neural responses. Exploring the physiology of social networks is an intriguing new development.

In summary, social network analysis presents several possible paths for research and several design decisions for researchers seeking to supplement the traditional focus on attributes with a relational, social network approach. Which type of tie should I focus on, and should I collect data on multiple types of ties? Should I treat the ties as binary (present or absent) or collect valued data on the frequency or salience of the ties? Should I focus on the actual network, using archival records or observations, or should I rely on the perceived network of respondents, using questionnaires or interviews? Should I collect ego-network data on the assumption that indirect connections (i.e., friends of friends) are not important (compare with Burt 2007)? Or, should I attempt to collect whole network data? If I decide on whole network data, where should I bound the network? For example, Brass (1984) found that individual workflow centrality within departments was positively related to influence and promotions, but centrality within the entire organization was not. Should I adopt a structural, relational, or resource approach, or include all three? Is a cognitive approach focusing on networks as prisms rather than pipes appropriate? The answers to these design issues will, of course, depend on one's theory and research question. There is no one best way to collect network data.

Social network research in organizations has traditionally focused on two broad research issues: social capital and social influence. Social capital research focuses on why actors are different. Why are some actors more successful than others with respect to power, performance, rewards, etc.? For example, Burt (1992) has theorized that social capital accrues to individuals who have ties to alters who are not themselves connected, or structural holes, an idea I address in more detail, below. He reasons that such ties provide one with diverse, nonredundant information that can enhance creativity and performance. However, Coleman (1990) has theorized that densely connected networks, where alters are connected to each other, increase social capital because they provide the opportunity for monitoring and sanctioning of behavior and norms of trust and reciprocity to develop. Both are examples of network theories focusing on social capital.

Social influence research focuses on why actors are similar. Why do actors make similar choices in fashion, technology, and organizational structure or exhibit similar attitudes and behaviors? Networks have been used to analyze contagion—the diffusion process involving actors being influenced by other actors. Contagion occurs through simple contact as in contagious diseases, through simple observation and imitation, or through more complex persuasion by others in decision-making. For example, Coleman et al.'s (1957) classic study of the diffusion of a new drug among physicians has been reanalyzed several times, and Iyengar et al.'s (2011) more recent, similar study confirmed contagion effects via social networks. Centola (2010) theorized that attitudinal and behavioral similarity involves complex contagion—exposure to consistent influence from more

than one alter (as opposed to the simple single contact, infectious-disease model). For example, a simple contagion model will predict or trace the spread of COVID-19, but a complex contagion model may be necessary to predict if and when people will wear masks, observe social distancing guidelines, or get vaccinated. Social networks can help us understand where new ideas come from, identify opinion leaders, trace paths, and estimate how quickly things spread.

There is no one overarching theory of social networks, just as there is no one theory of psychology, However, there are some overarching similarities based on the flow model of networks as pipes through which some resource, such as information, flows (Borgatti & Halgin 2011b). For example, it is often assumed that resources flow more quickly through shorter paths than longer paths, and actors in central positions are more likely than peripheral actors to receive whatever is flowing through the network or to receive it more quickly. Both Burt (1992) and Coleman (1990) base their social capital outcomes on another underlying proposition: People who are embedded in densely tied networks receive the same information. The difference in the two theories is that Coleman sees the dense connections as opportunities to develop trust and reciprocity, whereas Burt views them as a constraint on receiving diverse, nonredundant information. Although social network analysis is often characterized by mathematical measures, there is no shortage of theories of networks or network theories (Borgatti et al. 2014). And the one basic foundation of all social network theory is that the affect, behavior, and cognition of actors, whether they be individuals, dyads, triads, groups, or organizations, cannot be fully understood if treated as if they exist in isolation of other actors.

Several excellent reviews of social network analysis exist (Borgatti et al. 2009, Brass et al. 2004, Burt et al. 2013, Kilduff & Tsai 2003), and I attempt to not be too repetitive. I refer you to Kilduff & Brass (2010) for core ideas and debates, Borgatti & Halgin (2011b) for network theories, and Borgatti et al. (2014) for confusions, criticisms, and controversies. For a comprehensive volume on analysis, see Borgatti et al. (2018); for ego networks, see Perry et al. (2018).

OLD NEW DIRECTIONS

I would be remiss if I did not mention a couple of new directions that have become old refrains in many network reviews and research articles: longitudinal networks and multilevel networks. Significant gaps in longitudinal analyses of networks occurred in the time between Newcomb's (1961) 15 weekly data collections in a fraternity and recent research (Battilana & Casciaro 2012, 2013; Burt 2002; Burt & Merluzzi 2016; Kleinbaum 2018; Sasovova et al. 2010; Soda et al. 2021). Interest has peaked in the persistence and decay of network ties and how networks may change over time, and recent statistical advances have fueled longitudinal research (compare with Harris 2014, Snijders & Koskinen 2013). However, compared to cross-sectional research, we still know little about network persistence or change and how networks may react to external environmental changes (Barley 1990, Burkhardt & Brass 1990) such as COVID-19 (Yang et al. 2021).

Longitudinal research complements the recent, rapidly adopted coevolutionary perspective on social networks. Network structure is seen as coevolving with affect, behavior, and cognition (Lazer 2001, Tröster et al. 2019). For example, network centrality leads to power, which in turn leads to network centrality (Brass & Burkhardt 1993). Friendship ties promote gossip, and gossip promotes friendship ties (Ellwardt et al. 2012). However, time delays in network flows have yet to be explored longitudinally (Kwon et al. 2020). For example, current information acquired through a tie may be transferred to a new tie that was not present when the information was initially acquired. When transferring the information to an existing tie at a later time, the benefits of the tie may be delayed. Such time delays often occur in diffusion processes and could be particularly evident when ties go dormant and are later reconnected.

The other familiar future research direction is multilevel networks. Although social network analysis is often touted for its ability to cross levels of analysis, multilevel network analysis has typically consisted of applying the same network theory to explain individual, group, or organizational outcomes (Brass et al. 2004). For example, structural hole theory has been applied to both individuals and organizations (Burt 1992).

Several theoretical articles provide foundations for simultaneously considering point and whole network measures (Brass & Borgatti 2018, Moliterno & Mahony 2011, Paruchuri et al. 2018). In addition to the typical individual/group/organization classification of levels of analysis, social network analysis presents the possibility of considering dyads, triads, and cliques of various sizes as social entities and levels of analysis (Brass & Borgatti 2018, Contractor et al. 2006). However, instances of research combining different levels of analysis are rare (Bizzi 2013, Cummings & Cross 2003, Maoret et al. 2020, McFadyen et al. 2009, Paruchuri 2010, Sasidharan et al. 2012). Multilevel network analysis is an old future direction that has yet to be fully realized, but a multitheoretical, multilevel analytic approach (and data) proposed by Contractor et al. (2006) may spur more research.

Alternatively, one could combine, for example, interpersonal networks and intergroup/interorganizational networks, based on Breiger's (1974) notion of the duality of persons and groups. He notes that anytime two actors interact, they represent not only themselves but any group they are affiliated with. Using both interpersonal and intergroup network data, research might compare the satisfaction and performance of central actors in peripheral groups/organizations (big frog in a little pond) with the satisfaction and performance of peripheral actors in central groups/organizations (little frog in a big pond). This approach is illustrated by Lazega & Snijders (2015) and Lazega (2020) and seems to be a promising development in multilevel network analysis.

STRUCTURAL HOLES AND BROKERAGE

Structural holes and brokerage have dominated the social network literature over the past 15 years. A structural hole exists when ego, designated as the broker, has connections to two or more alters who are not themselves connected. Simmel (1950) is often credited with the concept and the label *tertius gaudens*—the third who benefits. Granovetter (1973) echoed the concept when he argued that weak ties often provide connections to different, disconnected social circles, thereby providing nonredundant information. The research moved from weak ties as a proxy for structural holes to a more straightforward, structural measure of the network connections—simply analyzing the network patterns to identify instances of ego connecting to disconnected alters, or open triads. Freeman (1979) proposed the measure of betweenness centrality (a measure of structural holes including indirect ties), and Brass (1984) operationalized it in a field sample, showing that it was positively related to influence and subsequent promotions in an organization. However, the research on structural holes and brokerage did not increase exponentially until Burt's (1992) book, *Structural Holes*. Burt argued that social capital accrued to individuals with structural holes in their networks by virtue of acquiring nonredundant information and the ability of ego to play the alters off against each other. His theory of structural holes was typically contrasted with Coleman's (1990) notion that monitoring of behavior and trust and norms of reciprocation provided social capital to actors who are densely connected to each other (closed triads and larger groups). Densely connected networks are more constraining—a good outcome from Coleman's point of view but a bad outcome from Burt's focus on acquiring novel, nonredundant information. Consistent with both theories, Reagans et al. (2004) found that groups with external range (measure of structural holes) and internal cohesion (densely connected) performed well, and

Uzzi (1997) explored the costs and benefits of "arms length" versus embedded ties. Burt's ego-network measure of constraint (the inverse of structural holes), calculated across a combination of five different types of networks, was successfully adopted by many researchers and applied across many different samples. Although the actual theoretical mechanisms underlying structural holes remain unmeasured, the research results provided consistent support for the performance and career benefits associated with structural holes and brokerage (see Kwon et al. 2020 and Burt et al. 2013 for more detailed reviews).

Kwon et al. (2020) reviewed more than 170 studies dealing with structural holes and brokerage, and there seems to be no end in sight. Research has identified moderators of the structural hole–outcome relationship, such as trust (Levin et al. 2016), power and status (Burt & Merluzzi 2014, Landis et al. 2018, Rider 2009), gender (Brands & Kilduff 2014, Brands & Mehra 2019), cognitive style (Carnabuci & Diószegi 2015), and culture (Bian 1997, Burt & Burzynska 2017, Burt et al. 2000, Xiao & Tsui 2007). Having established a structural connection with performance, rewards, and career success, research has turned to refining the structural hole–outcome relationship. As with any social science measure, structural holes do not explain all the outcome variance. Research is trending toward exploring the question "Why do some actors benefit more from structural holes than other actors?"

To answer the question, research began focusing on brokerage behavior—adding a behavioral component to the structure of relationships. Obstfeld (2005) introduced the label *tertius iungens* to refer to the third who joins (alters) as contrasted with the *tertius gaudens* orientation, modified to indicate the third who separates alters. Whereas Burt (2004) found that structural holes were related to "good ideas," Obstfeld found that a *tertius iungens* orientation and densely connected networks predicted involvement in innovations. Quintane & Carnabuci (2016) refer to the *tertius iungens* and *tertius gaudens* orientations as embedded and unembedded, adding a temporal dimension to the discussion of brokerage behavior. Soda et al. (2018) view brokerage behavior as arbitrage (leveraging the informational asymmetries by maintaining disconnections among alters) and collaborating (sharing information and uniting, enlisting, and connecting alters). They find moderation effects for orientations. Compared to the arbitrage orientation, the collaborating orientation significantly decreased the positive relationship between structural holes and performance. Grosser et al. (2019) further divide the *tertius gaudens*/arbitrage orientation into mediation and separation. Thus, research focusing on brokerage behavior as implied by ego orientations has followed a "keep them separated" versus "bring them together" perspective. In addition, although almost all brokerage research adopts an open triad approach, scholars (e.g., Halevy et al. 2019, Obstfeld et al. 2014) have also suggested analyzing brokerage behavior as third-party influence within a closed triad (all three actors connected to each other). Research may continue in this direction, focusing on behavior, but closed triads are not theoretically or empirically comparable to open triads and structural holes.

Although brokerage behavior has gained research traction in recent years, little attention has been given to the affective components of structural holes and brokerage. Priority has been given to establishing performance, creativity/innovation, and career outcomes (Kwon et al. 2020). We know little about the satisfaction derived from structural holes by either ego or alters, or how the affective nature of ties may alter relationships. For example, alters may be disconnected because they do not trust or like each other, or they may be disconnected simply because they do not know each other. Brokerage may differ depending on the nature of the disconnection. Adding cognition, we have yet to fully explore awareness and accuracy of ego or alters (Brands 2013, Kilduff et al. 2008, Krackhardt 1990, Krackhardt & Kilduff 1999). For example, ego's attempts at arbitrage may fail if ego mistakenly perceives a lack of connection between the alters. Accurate perceptions can

be obscured when alters are disconnected in one type of network but connected when considering a different type of network.

Structural hole theory and research have focused almost exclusively on ego, as if ego is the only agentic actor in an open triad. With the recognition that ego has limited control—alters can forge or sever relationships as well—recent reviews (Halevy et al. 2019, Kwon et al. 2020, Stovel & Shaw 2012) have called for a more alter-centric approach. For example, there may be performance benefits for alters connecting to a broker, such as decreased costs of search or benefits of referrals (Brass 2009, Galunic et al. 2012), or alter dissatisfaction may lead to the rapid decay of the structural hole. Combining cognition and affect in one of the few examples of an alter-centric approach, Kleinbaum et al. (2015) found effects for alters' perceptions of ego's empathy (see also Brands et al. 2021). In addition, Buskens & van de Rijt (2008) showed that if everyone is motivated to be a broker, then brokerage benefits are unstable and/or unlikely to materialize.

In moving beyond structure to add affect, behavior, and cognition, it is important to keep in mind a basic premise of social network analysis—individual affect, behavior, and cognition cannot be fully understood if considered in isolation. Although the call for an alter-centric approach to brokerage is justified, considering all parties in an open triad is a new direction for structural hole research and social network analysis in general. Rather than a focus on affect, behavior, or cognition of an individual actor (be it ego or alter), research on the relative aspects of a relationship may prove more useful.

Beyond the Triad

Although almost all the structural hole research has theoretically and empirically focused on the triad, moving beyond the triad to explore the larger network leads to several important conceptual implications. We recognize that brokerage is not solely about the ego-centric advantages related to the separation of alters. Connections to disconnected alters represent connections to otherwise disconnected social circles that provide the avenues for the flow of resources and the mobilization of larger social entities as well (Granovetter 1973, Kwon et al. 2020, Stovel & Shaw 2012). Thus, research that focuses on how ego can exploit the open triad (Brass et al. 1998), or ascribes success to secrecy on the part of ego (Hahl et al. 2016, Krackhardt 1999), is addressing only part of the brokerage concept. With the outbreak and persistence of the COVID-19 virus, I expect to see more research on this second aspect of structural holes: social influence and contagion. Ties to disconnected alters spread the virus to otherwise disconnected social circles worldwide. However, these ties can also be the underlying mechanism that unites disparate communities in reaching masking, social distancing, and vaccination goals.

Moving beyond the triad, network scholars have suggested consideration of the group membership of ego and alters. For example, Fernandez & Gould (1994) identified five different brokerage structures (coordinator, gatekeeper, itinerant, liaison, and representative), with expected brokerage activity, depending on the group membership of the actors and the directional flow of information. It appears that brokers can play many roles, even within the more general arbitrage/coordination dichotomy. I expect to see future attention given to expanding and fully elucidating the roles and associated behaviors of brokers.

Also moving beyond the triad, Krackhardt (1999) has pursued the notion of "Simmelian brokerage," when ego is embedded in two cliques and is the sole link between them (see also Tasselli & Kilduff 2018). Rather than "the third who benefits," the Simmelian broker may be pulled in two directions at once, caught between the obligations and time demands of being a member of two cohesive groups that are otherwise disconnected. More research is expected here as well. However, it is important to keep Burt's (2007) results in mind. His research findings suggest that a local

neighborhood/ego-network approach can explain significant variance in employee performance without reliance on more global analysis of indirect ties and paths or group membership.

Alters as Brokers

Perhaps more importantly, moving beyond the triad reveals new developments in our conceptualization of ego and alters. The above discussion changes conceptually when one moves beyond the triad to acknowledge the additional links of the actors involved in a structural hole. We move beyond treating the triad in isolation. Any time ego makes a connection with an alter who is not directly connected to any of ego's other alters, ego creates a structural hole. However, one only has to change focal actors to see that the alter has also created a structural hole between ego and all of the alter's other contacts. As such, ego and alter both act as brokers.

Just as demography research moved to a relative demography approach (Wagner et al. 1984), research on structural holes and brokerage may fruitfully move toward a relative approach, treating ego and alters as simultaneously similar. For example, rather than ego-centric join/separate behavior, it may be more fruitful to look to the negotiation and power literatures to identify relevant structural hole behavior (Brass & Burkhardt 1993, Brass & Krackhardt 2012, Grosser et al. 2018). The suggested focus on brokerage behavior as negotiation skills is consistent with the continued evolution and refinement of structural hole theory. Beginning with access and control of nonredundant information, the theory has moved to the vision and skill advantages that accrue to brokers (Burt et al. 2013). Novel, diverse information from new contacts provides a positive "shock" that pushes individuals to creatively change the way they organize and process information (Soda et al. 2021). Successfully utilizing the structural opportunities provided by structural holes requires "the intellectual and emotional skills developed in the process of encoding and decoding information to communicate between diverse contacts" (Burt et al. 2013, p. 536). In keeping with the foundations of social networks, such vision and skill is not an isolated attribute of ego (or alters) but a relative assessment.

Similarly, relational affect and cognition may prove important. For example, to what extent are all the actors involved satisfied? What are the effects of the relative awareness of the actors as to positional advantages, or their relative motivations in the exchange? Instead of ego-advantage, future research may focus on relative or mutual advantage. Moderators might include relative status or power, relative or mutual trust, and relative personality or orientation (e.g., actors are equal status or have similar or different *tertius gaudens* and *tertius iungens* orientations). Relative status or power may predict which actor benefits most from the exchange and is most satisfied. Relative trust may predict whether the structural hole persists or quickly dissolves.

Moving conceptually beyond the triad does not change previous results. Statistical analyses treat both ego and alters as brokers when calculating results. Whether these more nuanced analyses prove useful when compared to the more parsimonious focus on ego remains an empirical question. Regardless of the results, moving beyond the triad adds conceptual insight as to the mechanisms underlying structural holes and brokerage and represents a new direction in brokerage research.

NATURE OF TIES

I have thus far focused on structural holes and brokerage due to the dominance of this network research. New developments are also occurring in the conceptualization of the nature (or content) of ties. Casciaro (2020) has argued that all ties have an affective component. I would add that all ties have a cognitive component as well and at least an implied behavioral component. I now turn to some of the recent developments in the way we characterize the ties between the actors.

Strength of Ties

I begin with strength of ties due to its classic nature in the network literature. Granovetter's (1973) strength of weak ties remains a frequently measured variable. The fundamental premise that weak ties provide connections for acquiring nonredundant information has been largely replaced by structural holes and, to a lesser extent, Lin's (1999) resource-based focus, or simply added as a sidebar (i.e., Vedres 2017 strong versus weak ties in structural holes). Burt (1992) shifted the causal emphasis from the weakness of a tie to the structural hole it spans. Although Hansen (1999) confirmed the search benefits of weak ties, the ease of search on the Internet may have negated these search benefits (Hasan 2020). Researchers have turned to investigating the benefits of strong ties with a focus on the affective components (emotional intensity, intimacy, trust) that had been relatively ignored due to the focus on the structural outcomes. For example, strong ties are significantly related to such outcomes as the transfer of tacit, noncodifiable knowledge (Hansen 1999, Tortoriello et al. 2012), organizational change (Battilana & Casciaro 2013), job referrals (Bian 1997), and knowledge creation (McFadyen et al. 2009). Perry-Smith & Mannucci (2017) argue that weak ties facilitate idea generation whereas strong ties are beneficial for elaboration of ideas. Aral & Van Alstyne (2011) found that strong ties often have high "bandwidth" (greater frequency of interaction and richer information flows than weak ties) and can be the source of novel, nonredundant information. Extending the affective component of strong ties to include emotions, Baker (2019) and Cross & Parker (2004) have proposed energizing ties—interactions that result in increases in vitality and energy. Emotional energy can become contagious through energizing networks that offset de-energizing ties and promote individual and group performance (Baker 2019). With the increased focus on adding affect to structure, research on energizing ties is a promising new direction in social network analysis.

Putting aside the structural aspects, new developments may include a focus on the affective, behavioral (frequency, reciprocation) and typically ignored or taken for granted cognitive aspects of strong and weak ties (awareness, intention, accuracy). This may involve looking at asymmetric aspects of awareness and reciprocation. Differing respondent reports of the presence or value/salience of a relationship (i.e., Actor A chooses Actor B, but Actor B does not choose Actor A) have always presented a methodological challenge for network researchers. Newly developed insights might be gained by focusing on asymmetries or relational misperceptions rather than trying to reconcile them (Byron & Landis 2020).

Relatedly, future research might focus on how weak ties become (or fail to become) strong ties. Krackhardt (1994) proposed a progression from weak to strong as a function of dependence, intensity (frequency and duration), and affect. He suggests that dependence leads to increased intensity, which in turn leads to increased affect. When the increased affect is positive, strong, trusting ties develop. If the affect increasingly becomes negative, intensity will decrease and the tie will dissolve or remain weak depending on dependency.

Negative Ties

Although strength of tie research, and network research in general, has almost exclusively focused on positive or neutral ties, Labianca & Brass (2006) revived a mostly forgotten literature on negative ties and introduced social ledger theory. They defined a negative tie as an "enduring, recurring set of negative judgments, feelings, and behavioral intentions toward another person: a negative person schema" (Labianca & Brass 2006, p. 597). Negative relationships are conceptualized as a function of strength/intensity, reciprocity, cognition/awareness, and social distance (direct and indirect ties). Although the label is decidedly affective, the definition includes both behavioral and cognitive components (Yang et al. 2020).

In addition to predicting the outcomes of negative ties, the challenge is to predict how they might combine with positive ties in the social ledger. Labianca & Brass (2006) suggested negative asymmetry, in which negative ties have additional impact due to their diagnostic emphasis by people and their rarity. Subsequent research has modified the social ledger, finding that positive ties have a stronger positive effect on workplace social satisfaction when employees have more negative ties but are irrelevant when employees had fewer negative ties (Venkataramani et al. 2013). Positive ties become more important when experiencing negative ties. Although individuals may quickly seek to sever the behavioral component of negative ties, this may not be possible due to workflow- and hierarchy-required interactions in organizations. In addition, cognition and emotions may linger and affect new tie formation, especially with others who are connected to or perceived as similar to a severed alter. Although negative ties to outgroups may damage intergroup relations, they may also be a source of ingroup solidarity. In addition, Halgin et al. (2020) propose that in competitive settings possessing a negative tie with a high status alter brings attention to ego and can lead to reputational benefits. It is difficult to foresee social network analysis moving forward absent a realistic accounting for negative ties in the social ledger. See Yang et al. (2020) for a more detailed discussion of research on negative ties in the workplace.

Multiplex Ties

Although typically acknowledged, multiplex relationships have until recently received little attention in the social network literature. They are usually noted as an indicator of strength of tie or a force prohibiting opportunistic behavior (Brass et al. 1998). When data on different types of networks are collected, each network tends to be analyzed separately, despite the likelihood that two actors are connected in multiple ways (i.e., advice, friendship, work colleague). Recent research has begun to treat multiplexity as a concept worth investigating. For example, multiplex ties can produce competing pressures such as when the person you supervise is also your close friend. In focusing on multiplexity, Methot et al. (2016) found it can be a mixed blessing. Multiplex relationships involving friendship and work-related interactions enhanced trust and job performance and also detracted from performance due to emotional exhaustion and obligations associated with tie maintenance (Methot et al. 2016).

Further exploring multiplexity, Brennecke (2020) extended social ledger theory by investigating dissonant ties—ties to the same alter that are simultaneously positive and negative. Likewise, Methot & Rosado-Solomon (2020) note that relationships are often multiplex and interactions with a single alter may have both positive and negative aspects. They refer to such ties as ambivalent. For example, Casciaro & Lobo (2005) compared the "component jerk" to the "lovable fool," finding that employees need positive affect to seek task-related help from potential partners. Although our first choice may be the lovable, component alter, Brennecke (2020) found that seeking assistance from difficult colleagues was, nevertheless, positively associated with performance. The relevance of multiplex ties becomes obvious when considering kinship ties in family-owned or -run organizations. Given the various combinations of types of ties (Borgatti et al. 2009), coupled with affective components, we are likely to see much more research on multiplex ties.

Dormant Ties

Dormant ties refer to past connections that have fallen into disuse (inactive for some period of time) and may not readily come to mind unless prompted (Levin et al. 2011, Walter et al. 2015). Dormant ties can provide novel insights because the alters have had different experiences than ego during the elapsed dormancy. Dormant ties fit nicely into the Smith et al. (2012) classification

as potential ties (although infrequently activated) and raise the question of whether a tie, once formed, ever dies. From a cognitive perspective, ties may remain as long as both actors' memories of the tie remain. But the awkward possibility that one actor remembers and the other does not is likely a hinderance to reactivation. From the perspective of actual ties, a tie may cease to exist when either party chooses to discontinue the connection. Of course, the type of ties, or the content of the connection, will affect decay (i.e., kinship ties are forever). Burt (2002) has noted that bridging ties (to disconnected others) decay quickly, and Krackhardt (1999) has shown that Simmelian ties (actors are reciprocally connected to one another and each is reciprocally connected to the same third party) are unlikely to become dormant and, if dormant, may be easily reactivated. The following question remains: Will the traditional predictors of tie formation also predict the reactivation of dormant ties?

Although tie decay and persistence of ties have been examined, little attention has been given to the duration of ties—the length of time that a relationship has been maintained. Tie duration may be a strong predictor of trust, mutual influence, and motivation to help. Social media platforms such as Facebook and Zoom have replaced the yearly "Happy Holidays" or birthday card, and made ties easier to maintain even when locations are distant. Differences between old friends and new friends (or work colleagues) have yet to be explored. Such research would be a new direction for social network analysis.

Redundant Ties

In an effort to highlight the value of novel, diverse information via weak ties and structural holes, redundant ties have by default become ties to be avoided. Redundant ties are structurally defined as ties to alters who are connected within the same social circle. Although acknowledging that closed, densely connected ties can provide trust, norms of reciprocation, and monitoring and sanctioning of inappropriate behavior (Coleman 1990), redundant information is not viewed as a benefit. Even Aral & Van Alstyne (2011) decry redundancy while endorsing broad bandwidth ties. Indeed, access to diverse, nonredundant information underlies much of the theoretical explanation for successful individual performance.

Strong ties and closed networks are more likely to produce redundant information. I take note of the search and transfer advantages of strong and weak ties (Hansen 1999), the value of embedded ties and arm's length ties to small businesses (Uzzi 1997), the internal cohesion and external range that lead to group effectiveness (Reagans et al. 2004), and the coordination benefits of closure in implementing innovations (Obstfeld 2005). However, I hope to generate interest in redundant ties in the exercise of power, in providing verifiable information, and in the case of complex contagion and behavioral change.

One of the often-mentioned advantages of structural holes is the power that accrues to ego by virtue of being able to play one alter off against another alter. However, power is acquired via having access to multiple sources of the same resource. Thus, in order to play one alter off against the other, both alters must be sources of the same resource—they must be redundant. This does not negate the advantage of receiving nonredundant resources from alters. It only suggests that the "play one off against the other" and the nonredundant advantages of structural holes are distinct and may involve different sets of alters. And there may be an advantage to redundant alters.

Redundant ties also provide verifiable information. It is unlikely that successful managers would accept novel, nonredundant information from one source without verifying it through another source. For example, reporters in the news business were often required to verify nonredundant, newsworthy information via a second, independent source—a redundant source. However, the criterion of independent sources suggests that the second source would not likely occupy the same

social circle or be directly connected to the initial source. Thus, the sources provide verifiable, redundant information through the disconnections provided by weak ties or structural holes. However, Ter Wal et al. (2020) found that dual networking (connecting to two different alters within the same social circle) created an innovation performance advantage. There is also an analogy to our research as social scientists. We include multiple (redundant) items on our questionnaires in order to assess reliability, and independent sources of data add credibility to our findings.

Finally, the famous Asch (1951) conformity experiments shed light on the value of redundant ties in behavioral change. Asch found that unanimous redundant choices by a minimum of three alters led to subject conformity. More recently, Centola (2010) found that redundant information from two sources was needed to bring about behavioral change. Thus, wearing a mask or getting vaccinated may require endorsement from at least two alters. People will be more likely to change behavior when receiving redundant information from multiple sources.

Although the conformity value of redundant information overlaps considerably with Coleman's (1990) theory of the value of closed networks in forming norms, the power and verifiable information value of redundant information suggests that the value of weak ties and structural holes may not lie solely in acquiring diverse, nonredundant information. Indeed, the structural benefits of connecting to alters who are not themselves connected may come from acquiring redundant as well as nonredundant information. Ties are a proxy for nonredundancy, but we need to separate ties from content (Aral & Van Alstyne 2011). This suggests moving beyond the structural proxy for redundancy to investigate the actual information that is acquired—a possible future research direction with the aid of email or text messaging.

CONCLUSIONS

What's next in social network analysis? It is often difficult to predict or generate new research directions. However, some trends are apparent. Research on structural holes and brokerage will continue to flourish with the addition of affective, behavioral, and cognitive components. Researchers will move beyond the ego-centered focus to consider the alters and extend their research beyond the isolated triad to consider alters as brokers and the triad within the larger network. The focus on affect, behavior, and cognition of actors will move toward a relational perspective. Researchers will develop the affective, behavioral, and cognitive aspect of the nature of ties with more research on negative, multiplex, dormant, and redundant ties. Those are the predictions. We'll see what develops.

SUMMARY POINTS

1. Adding affect, behavior, and cognition to the traditional structural analysis of social networks is an ongoing development in social network analysis.
2. New developments include adopting an alter-centric perspective to the traditional egocentric approach, including a relational approach to ego and alters.
3. Moving beyond the triad in structural holes and brokerage represents a new conceptual development, recognizing that alters, as well as ego, are brokers.
4. Expanding the nature of ties to include negative, multiplex/dissonant, and dormant ties adds to the traditional strong/weak tie focus of social network research.

5. Redundant information may be a hidden benefit of structural holes. Exploring the value of redundant ties and information, especially from independent sources, represents a new, counter perspective in social network research.

FUTURE ISSUES

1. Do the relative networks, and affective, behavioral, cognitive, and demographic attributes of alters, as well as ego, affect brokerage success?
2. Are political skills/bargaining behaviors better predictors of brokerage success than join/separate behaviors?
3. What are the effects of asymmetric ties of affect (strength), behavior (reciprocation), or cognition (awareness/accuracy) on important organizational outcomes?
4. How do positive and negative ties to different alters combine in the social ledger? Are there positive outcomes to negative ties?
5. How do multiplex relationships that contain both positive and negative ties to the same alters affect network mobilization and outcomes?
6. Do the traditional predictors of tie formation (homophily, balance, proximity, etc.) also predict the reactivation of dormant ties?
7. Is there value (brokerage success, second opinions, or behavioral change) to redundant ties and the information/resources they can provide?

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