TEAM NETWORK MULTIPLEXITY, SYNERGY, AND PERFORMANCE

By

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To my mom and dad who made me what I am,
to my wife who makes me even better,
and to my kids who make me want to be the best

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In this dissertation I examine the implications of team social structure for work team functioning and performance. I apply a social network perspective to examine the balance of team structural cohesion and structural repulsion, where structural cohesion is indicated by the density of overlapping instrumental and positive expressive ties, and structural repulsion is indicated by the density of overlapping instrumental and negative expressive ties. I then examine the implications of these social structures for team performance through their associations with synergistic team process gains indicated by teamwork, team motivation indicated by team engagement, and team process losses indicated by team relationship maintenance. I test the predictions of this model with a sample of 109 student teams operating in the Master of Business Administration (MBA) programs of a large southeastern university. Overall, findings suggest that the structure of social relationships in the team matters for team effectiveness. Structural cohesion was beneficial for team performance because of its association with increased teamwork. It was also associated with increased team engagement and reduced team maintenance, bit it did not exhibit indirect relationships with team performance through these mechanisms. On the other hand, structural repulsion was detrimental for team

performance because of its association with reduced teamwork. It was also associated with decreased team engagement and increased team maintenance, but it did not exhibit indirect relationships with team performance through these mechanisms.

CHAPTER 1
INTRODUCTION

Team-based structures have become an increasingly important unit of work organization (Devine, Clayton, Philips, Dunford, & Melner, 1999). Recent estimates suggest that 82 percent of companies with 100 employees or more use some form of work teams, and of those companies using work teams, over half of employees within the company are members of teams (Gordon, 1992). Scholars argue that groups and teams are the central building blocks for getting work done in organizations (Goodman, Ravlin, & Schminke, 1987). As such scholars have focused a great deal of attention to understanding the factors contributing to the effective structure, function, and performance of teams (Mathieu, Maynard, Rapp, & Gilson, 2008). Researchers have long been interested in the implications of social interaction processes for team effectiveness (Bales, 1953; Bion, 1961; Shaw, 1964; Guzzo & Shea, 1992). While scholars are converging on the perspective that teams are complex, dynamic systems (Ilgen et al., 2005; McGrath, 1997; McGrath, Arrow, & Berdahl, 2000), and are increasingly recognizing that team member interaction occurs in discontinuous, complex, and non-linear patterns (Kozlowski, Gully, Nason, & Smith, 1999; Kozlowski & Klein, 2000; Mathieu et al., 2008; Stewart, Fulmer, & Barrick, 2005), current conceptions of team social interaction have yet to account for this complexity.

Researchers have long recognized that team social interaction may be categorized as either instrumental, concerning the exchange of work- and task-related information, or expressive, concerning the exchange of affect, support, or friendship (Bales, 1953; Ibarra & Andrews, 1993; Lincoln & Miller, 1979; Stewart et al., 2005), but scholars disagree on the relative importance assigned to instrumental and expressive member interactions as predictors of team effectiveness (Guzzo & Shea, 1992). Some schools of thought heavily emphasize the importance of expressive interactions in models of effectiveness (e.g., Bion, 1961; Schutz, 1967), while others give more weight to instrumental interactions (e.g., Hackman, 1987), while yet others, such as sociotechnical systems theorists, emphasize both (e.g., Kolodny & Kiggindu, 1980; Rousseau, 1977; Trist, 1981). Though different schools of thought have emphasized the relative importance of either instrumental, expressive, or both types of interaction, each of these perspectives has failed to consider the simultaneous overlap of these types of interaction among members in the team. In addition, when considering expressive interactions, researchers tend to focus solely on positive manifestations of expressive interaction (e.g., friendship, liking, support), while negative manifestations of expressive social interaction (e.g., adversarial, disliking, distrusting) receive far less attention (Labianca & Brass, 2006).

Thus, while researchers recognize that team interaction occurs in both instrumental and expressive forms, current conceptions of social interaction are underdeveloped because they do not consider the implications of the overlap in these types of interaction, nor do they consider the importance of both positive and negative forms of expressive interaction. Thus, the purpose of my study is to develop a more replete conception of team social interaction, which I call team chemistry, based on the intersection of instrumental and expressive team interactions in both their positive and negative forms. I use the concept of multiplexity in social network analysis to model the overlap of instrumental and positive expressive ties, and instrumental and negative expressive ties, respectively, in the team. I then propose that team chemistry consists of team structural cohesion defined as the density of positive multiplex ties in the team, and team structural repulsion defined as the density of negative multiplex ties in the team. I propose to test the implications of this model of team chemistry for team effectiveness in a large sample of teams operating in the Master of Business Administration (MBA) programs of a large southeastern university.

CHAPTER 2
LITERATURE REVIEW

Teams and Team Member Interaction

A team, as defined by Hackman (1987) and Guzzo and Shea (1992), is a social system with the following properties: It is an entity with boundaries perceived by its members and nonmembers familiar with it; it has one or more tasks to perform resulting in discernable and potentially measurable group products; it has a differentiation of roles and some degree of interdependence; and it operates within an organizational context. Hackman (1987) notes that this is actually a fairly inclusive statement, with the definition applying, for example, to a group of executives deciding where to locate a new plant, a team of manufacturing workers assembling a product, a group of students writing a case assigned by their instructor, a health-care team tending to the needs of a set of patients, or a group of economists analyzing the budgetary implications of a proposed new public policy. Hackman does exclude from this definition other sets of people commonly referred to as “groups,” such as social groups (no task), reference groups (not an intact social system), groups of employees reporting to the same manager but who have their own, individual tasks to perform (no group task), and freestanding groups (no organizational context).

The dominant paradigm for studying team effectiveness is an input-process-output (I-P-O) model, first put forth by McGrath (1964) and later expanded upon by Steiner (1972), McGrath (1984), and Hackman (1987). This model emphasizes that inputs consisting of individual (e.g., member characteristics and abilities), team (nature of the task and group leadership), and organizational (contextual and environmental influences) factors combine to influence team processes, which refer to team member interactions to transform inputs into outcomes (Marks, Mathieu, & Zaccaro, 2001). Outcomes are the results achieved or products created by the team and generally include the quality or quantity of output as well as team member affective reactions such as team satisfaction and viability (Hackman, 1987; Mathieu et al., 2008). The major proposition underlying this model is that the key to understanding why some groups perform better than others lies in the varying level and quality of team member interactions, and that better team interactions are more likely to emerge from optimal arrangements of team inputs (Hackman, 1987).

Researchers have since updated this I-P-O model to consider a broader array of mediators including cognitive, motivational, and affective states of teams, as well as to account for the episodic and cyclical, as opposed to linear, nature of team performance. Ilgen, Hollenbeck, Johnson, and Jundt (2005) proposed an input-mediator-output-input (IMOI) model to account for these concerns. They suggested that substituting "M" for "P" reflects the broader range of variables that are important meditational influences on team effectiveness. Adding the extra "I" at the end recognizes the notion of cyclical performance feedback whereby the outcomes at the end of one performance episode can become inputs for the next. Finally, they eliminate the hyphens to suggest that causal linkages may not be linear or additive, but rather non-linear or conditional, recognizing that researchers have documented and should continue to investigate interaction effects between inputs and processes (I x P), between processes (P x P), and between processes and affective/motivational emergent states (P x ES).

In either the case of I-P-O models or IMOI models, the nature of the mediators between team inputs and outcomes is derived from the interactions between team members. Katz and Kahn (1978, p. 187) argued that the substance of collective organization is the pattern of interaction among its members (Katz & Kahn, 1978: 187). Collective structures emerge and persist through the interactions of members of the collective. Absent collective interaction, a collective structure simply does not exist (Morgeson & Hoffman, 1999). Thus, the basic unit of analysis of a collective phenomenon is not the individual, nor the team, nor the dyad, but the relationship or interaction between the individuals in the collective (Brass, 1995).

Traditional Approaches to Team Member Interaction

Because collective structures originate in the interaction of individual-level members, the nature of the emergence of team-level constructs must be explicitly specified by theory. Kozlowski and Klein (2000) distinguished unit-level constructs that emerge from the characteristics, behaviors, or cognitions of unit members as having either shared or configural properties. Shared unit constructs describe characteristics that are common to or shared by the members of the unit. Shared unit properties emerge as a consensual, collective aspect of the unit as a whole, and are based on composition models of emergence. Composition models assume isomorphism between manifestations of constructs at different levels, and rely on within-unit consensus (agreement) or consistency (reliability) to justify composition of the unit-level construct. Configural unit constructs capture the array, pattern, or configuration of individual member characteristics or interactions. Unlike shared unit properties, configural unit properties are not assumed to converge or coalesce among members, and instead are based on compilation models of emergence. Compilation models do not assume isomorphism and convergence but assume instead discontinuity and complex non-linear emergence of constructs between levels. As a result, compilation models are not concerned with agreement or consistency for aggregation, but rather rely on depicting patterns, distribution, and variability among member contributions to create unit-level constructs. If the structure of a team construct is defined as the series or pattern of interactions between team members (Morgeson & Hoffman, 1999), then compilation models of emergence that provide the means for examining the configuration or pattern of interaction are a prerequisite for depicting team structure.

Interestingly, team constructs have most frequently been conceptualized and measured by adopting composition models of emergence. Chan (1998) proposed a typology of composition models consisting of additive, direct-consensus, or referent-shift models in which the team-level variable is created by summing or averaging individual ratings (either by team members or subject-matter experts) as to the extent to which a given team phenomenon occurs generally in the team (e.g., Mathieu et al., 2006; Marks, DeChurch, Mathieu, Panzer, & Alonso, 2005; Hirschfeld, Jordan, Feild, Giles, & Armenakis, 2006; Stewart & Barrick, 2000). The additive composition model creates a straightforward sum or average of individual team member self-referent perceptions, such as the extent to which each member perceives they themselves perform a given process or fill a specific role in the team. The direct consensus composition model also averages member self-ratings, but adds the requirement that there be sufficient agreement or consistency within the individual ratings to justify aggregation to the team level. Statistics used to justify agreement and consistency include within-group agreement (r_{wg}, James et al., 1984) and intraclass correlations (ICC[1] and ICC[2], Bliese, 2000). Referent-shift composition models also average individual member ratings and require sufficient within-group agreement and consistency, but the referent of individual ratings prior to aggregation is shifted from the members rating themselves to their rating “the team” or “team members” generally. The referent of the ratings is changed from the individual to the team, creating a collective construct conceptually distinct from the original form. Whether composed by additive, direct consensus, or referent-shift models, the measure of the collective construct results in a single index of the average extent to which a specific type of interaction is perceived to occur among team members.

Despite the likelihood of team interactions occurring in non-uniform, complex patterns, team constructs rarely are described using compilation models of emergence[1] (Kozlowski & Klein, 2000). Composition models sufficiently explain team interactions only if the assumption holds that all interactions, communications, and contributions occur uniformly among all members of a team. However, it is far more likely that members exert disproportionate influences on team functioning by virtue of the positions that they occupy, their relative status, and so forth (Mathieu et al., 2008). For example, the construct of cohesion, originally defined by (Festinger, 1950: 274) as “the resultant forces which are acting on the members to stay in a group” consisting of interpersonal attraction, liking the group task, and group prestige or pride (Beal, Cohen, Burke, and McLendon, 2003; Mullen & Cooper, 1994), is configural in nature because it is based on interpersonal evaluations and relative differences in intergroup prestige. Yet cohesion is most often measured instead in terms of composition models of shared perceptions and average indices (e.g., Barrick, Stewart, Neubert, & Mount, 1998; Elfenbein & O’Reilly,

[1] Recent studies adopting compilation models of team constructs include Stewart, Fulmer, & Barrick’s (2005) adoption of variance and skewness measures of team task and social roles; and LePine’s (2003) modeling of team role structure as recurring patterns of team messaging in an experimental task.

2007; O'Reilly, Caldwell, & Barnett, 1989; Stokes, 1983). For example, Barrick et al. (1998, p. 383) measured cohesion by indexing members' shared agreement with statements such as "Team members consistently help each other on the job" and "The members of this team got along well with each other." However, this approach is unable to capture whether all team members were uniformly liked, whether there were only one or two members who were especially liked (or disliked, for that matter), or whether there were subgroups that liked their own members, but not those of the other subgroups. Such is the case as well with helping—members may have uniformly helped others, or a central few helped all others, or subgroups helped only their own members. Likewise, the traditional approach is unable to capture the overlap in helping and liking (or disliking) at the relationship level among team members. In other words, certain individuals may consistently help and like each other but not share those types of overlapping relationships with other members of the team. Or it is even possible that, because of team task constraints, some members of the team must help another whom they simultaneously dislike, a phenomenon that has important implications for the functioning of the team. In each case, the traditional composition model approach with its emphasis on emergence through uniformity fails to provide information about these complex interactions, and thus traditional composition models of emergence are highly restricted in their usefulness for conceptualizing and modeling non-linear team interactions.

Social Network Analysis As a Useful Alternative

These limitations require a shift in thinking in order to advance our understanding of team interaction. Indeed, Ilgen and colleagues have noted that "the empirical research on teams in organizational contexts is moving in the direction of increased complexity, but this work still has a way to go to match developments in the conceptual domain" (Ilgen et al., 2005, p. 519), and McGrath (1997, p. 16) has suggested that "researchers need to borrow and invent new ways of thinking about groups and new tools for doing research on them—conceptions and tools that allow us to seriously (not just rhetorically) conceptualize and study groups as complex, adaptive, dynamic systems."

I propose the use of social network analysis as an ideal means to accomplish this purpose in the study of teams generally and for the study of team member interaction specifically. Because social network analysis is directly concerned with the pattern, content, and variation of the connections, or ties, among actors, or nodes, in a collective (Hanneman & Riddle, 2005), it represents a useful perspective on which to base compilation models of collective construct emergence that capture the more complex patterns of interactions in teams. As a simple example in the case of cohesion, a network approach to modeling cohesion, in contrast to the traditional approach (e.g., Barrick et al., 1998), would begin by asking members directly which of the other team members they liked (or which of the other members they helped). Increasing cohesion would be modeled by increasing density in the network of liking or helping. Further, overlap between individuals of multiple types of cohesion—e.g., individuals who indicate that they both like and help each other—is easily modeled through the network concept of multiplexity, which accounts for the simultaneous overlap of multiple types of relations between individuals. Increasing cohesion in this sense would be modeled by increasing density in the multiplex network of individuals that both like and help each other. This accounts for multiple types of cohesion at the relationship level, and team-level cohesion emerges as the configuration or pattern of these multiplex relationships in the team. Thus, adopting a network perspective allows researchers to model the structural patterns of cohesion based on a compilation model of emergence rather than shared perceptions about cohesion based on traditional composition models of emergence.

Viewing team interaction through a social network lens not only increases the clarity of our observation through improved methods and operationalizations, but more importantly it introduces altogether new concepts that are highly useful to increase our understanding and usage of compilation models of collective construct emergence. A network perspective enriches teams theory by allowing scholars to move beyond typical traditional composition models to examine the structural patterns of team interactions in a configural sense. This approach can also enrich network research by expanding scholars' focus beyond the structural properties of networks to "pay [more] attention to the kinds of relationships that bind a network together" (Baker, Cross, & Wooten, 2003, p. 328-329). Balkundi and Harrison (2006) showed through meta-analysis that social network structures have important implications for team performance and team viability. They assumed this was so because the pattern of ties facilitates or constrains the flow of interpersonal resources and information between members of the team, yet recognized that research is needed to pinpoint the actual information and resources that flow through network ties to influence these team outcomes. Below I provide a brief overview of social network analysis terminology, and in a subsequent section I review research on teams from a social network perspective.

Social Network Analysis[2]

Social network analysis seeks to model relationships or interactions between sets of actors to depict the structure of a collective and how this structure impacts the functioning of the collective as well as influences actors within this collective (Wasserman & Faust, 1994). Because network structures are implicitly based on compilation models of emergence, they are well suited to describe configural concepts that depict the pattern or array of interactions or relationships within a team (Kozlowski & Klein, 2000). Thus, the purpose of social network analysis as applied to team interactions is to (a) observe team phenomena at the basic unit of analysis—their interactions, (b) model the emergence of structure from the "ground up" as networks or patterns of interaction, and (c) examine how these team structures impact the functioning of the team as well as the individual members within it. I briefly introduce social network terminology and concepts below.

Social Network Terminology

The network perspective allows for new leverage in describing the configural approach to team phenomena by providing terminology and precise formal definitions for aspects of the structure of team interaction. The term social network refers to a set of actors and the ties or relationships among them. As I have described earlier, structure refers to patterns of relationships or interactions among units or individuals. Structural variables refer to quantities that measure aspects of structure. I first describe basic terminology adopted by social network analysts to describe the building blocks of

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[2] The exposition of concepts in this section draw heavily from Wasserman & Faust (1994); Scott (2000); Hanneman & Riddle (2005); and Brass (1995). Other statements requiring specific citation have been referenced within the section accordingly.

social networks; and then, based on these definitions, I discuss the structural variables relevant to describing the team structures pertaining to this study.

Actors (also called nodes or vertexes) represent any discrete entity in the network, whether a person, an organization, a place, or a collective social unit. Applied to the present research, we view actors as individual members of a group or team. The social network perspective is also able to incorporate actor attributes in the traditional social science sense of actor characteristics and traits, but attributes of actors are not required for social network analysis since the focus is on the patterns of relationships among them.

Ties represent the linkages between actors, which are formed by some type of connection, relationship, or interaction occurring between actors. Some examples (among a myriad) of ties include those created from one actor's evaluation of another; by transfers of material resources between actors; by actors' joint associations or affiliations with some social event or other entity; by actors' behavioral interaction and communication; by formally specified relationships between actors; or by biological, physical, or contractual relationships between actors. It is important to note that a distinct tie represents each different type of connection. Ties may be directed, in which one actor is the source (sender) and another actor is the destination (receiver) of the tie; or undirected, in which the tie has neither a sender nor receiver but rather constitutes joint presence. Ties may be dichotomous—the tie is either present or absent, or valued—a range of numbers are used to give an indication of the strength, intensity, or frequency of the tie. A graph is a visual depiction of a network in which actors are represented with circles (usually), and ties between actors are represented with lines connecting the circles. Actor attributes may be incorporated into the graph by modifying nodes with different colors or shapes (to represent categorical differences) or different sizes or shades (to represent continuous differences). Directed ties are represented by lines with arrowheads pointing to the actor receiving the tie. A directed tie that is reciprocated—both sender and receiver nominate each other—is usually depicted by a single line with double-headed arrows rather than by two separate lines with opposing arrows.

A dyad consists of a pair of actors and the (possible) ties between them. A triad consists of a trio of actors and the (possible) ties among them. A subgroup of actors is any subset of actors and all ties among them. Wasserman and Faust (1994, p. 19) defined a group specifically as “a finite set of actors who for conceptual, theoretical, or empirical reasons are treated as a finite set of individuals on which network measurements are made.” A relation, in graph theoretic terms, is the set of all ties of one specific type among actors in a network. With these terms defined, I am able to adopt Wasserman and Faust’s (1994, p. 20) more explicit definition of a social network as “a finite set or sets of actors and the relation or relations defined on them.”

Types of Ties

Network ties are viewed as pipes, or conduits, through which contents or resources flow (Podolny, 2001). As indicated earlier, while the number of different types of ties is limited only by the researcher’s imagination (Brass, 1995), network analysts have offered a general taxonomy of different types of ties based on different resources that are assumed to be exchanged through the tie (Tichy, Tushman, & Fombrun, 1979, p. 508; Brass, 1992; Brass, Galaskiewicz, Greve, Tsai, 2004; Podolny & Baron, 1997): workflow ties involve the exchange of goods and services; communication ties involve the exchange of information and ideas; friendship ties involve the exchange of affect; and authority ties involve the exchange of influence or power. However, network analysts have simplified this taxonomy still to recognize two broad categories of ties: instrumental ties that primarily involve the exchange of information as a resource, and expressive ties that primarily involve the exchange of affect as a resource (Brass, 1992; Ibarra, 1993; Balkundi & Harrison, 2006).

Instrumental ties

Instrumental ties are those that arise in the course of work-role performance and involve the exchange of job-related resources including information, expertise, professional advice, political access, and material goods or services (Ibarra, 1993). In this study of teams, instrumental ties are those involving the exchange of task-related information, ideas, and work output. Instrumental ties are not necessarily prescribed merely by virtue of team membership. For example, self-managing teams have discretion over how to structure their workflow and exchange of information and ideas among team members (Wageman, 2001), and researchers recognize that even in relatively similar environments, one should be able to observe quite different patterns of task-oriented behavior among groups at work (Shea & Guzzo, 1987).

Expressive ties

Expressive ties are informal social relations such as friendship and support that primarily involve the exchange of affect including liking, trust, and positive regard (Ibarra, 1993; Lincoln & Miller, 1979). Interestingly, network researchers' focus on expressive ties has generally been on its positive aspects, while lesser attention has been focused on negative expressions of affect such as disliking, distrust, or adversarial intentions (Brass et al., 2004). Negative expressive relationships may be relatively rare compared to positive ones (Baldwin, Bedell, & Johnson, 1997; Labianca, Brass, & Gray, 1998), but as Labianca and Brass (2006, p. 598) noted, “their rarity belies their importance.” They suggest that, owing to research on negative asymmetry that has shown that negative stimuli have been found to have greater explanatory power than positive or neutral stimuli in a diverse range of situations (Taylor, 1991), negative expressive relationships, despite their rarity, may have a greater effect on relevant outcomes than positive relationships. Thus, in this study of teams, I consider positive expressive ties as those based on exchanges of positive affect such as liking, trust, and friendship; and I also consider negative expressive ties based on exchanges of negative affect including disliking, distrust, and being adversaries.

Multiplex ties

Network researchers most often analyze networks of instrumental or expressive ties separately (e.g., Ibarra, 1993; Baldwin et al., 1997). However, relationships between actors are usually more complex, in that individual relationships are composed of simultaneously occurring “bundles” of interaction (Burt & Schøtt, 1985) including those that are both instrumental and expressive. This idea is captured in the network concept of multiplexity, which refers to connections between actors of multiple different types of ties (Brass, 1995; Scott, 2000). Max Gluckman (1967) originally made the distinction using the terminology of simplex (where persons are only linked in one context) and multiplex (where persons are linked in more than one context) relations and argued that the central property of a multiplex relation is that it allows the resources of one relationship to be appropriated for use in others. Multiplexity is not a structural network variable itself, but it is used to depict structural variables in terms of only those actors with multiple types of ties existing between them.

Studying configural patterns based on multiplex ties is important because multiplex ties capture networks in a level of detail and complexity that more closely approximates the reality of team interactions. Simplifying the natural complexity of relationships increases the likelihood of random errors in modeling team interaction, and accordingly, as in any data analysis, random errors in network data can be expected to attenuate standardized effects, amplify standard errors, and suppress evidence of true effects (Burt & Schøtt, 1985). Research has shown that multiplex relationships are fundamentally different than those composed of simplex tie content in terms of their implications for work functioning (Methot, 2010). Because a multiplex tie can be viewed as a stronger form of relationship (Scott, 2000), multiplexity of ties has the potential to amplify the importance of configural patterns of team interaction. Researchers have acknowledged two components to tie strength: communication frequency and emotional closeness (Granovetter, 1973; Marsden & Campbell, 1984; Burt, 1990). Communication frequency is how frequently individuals speak with each other, and emotional closeness is the level of affect associated with the interaction (Reagans & Zuckerman, 2001, p. 508). The concept of multiplexity makes it possible for researchers to combine both instrumental and expressive aspects into a single relational tie. In this study I will examine the intersection of instrumental ties with both positive and negative expressive ties among members in the team. I define positive multiplexity as the overlap of instrumental and positive expressive ties between team members, and negative multiplexity as the overlap of instrumental and negative expressive ties between team members. In sum, multiplexity is important because it will allow me to model multiple types of interaction simultaneously in order to observe their joint influences on team functioning and effectiveness.

Network Density

I have thus far described basic network terminology and categories of ties, and now I describe how those building blocks compile to describe team network structure. The most common way to describe the pattern of relationships is with the concept of network density, which refers to the connection, interrelatedness, and general level of linkage among the members of the network (Scott, 2000). Density is perhaps the most widely used structural variable (Scott, 2000, p. 69) and is important because it largely determines the level of information and resources that can move throughout the network (Balkundi & Harrison, 2006). Creating a density measure of team interaction first requires gathering information on the relationships or ties among team members. This can be accomplished by providing individual team members with a list of all other members and instructing them to rate whether (for dichotomous ties) or the extent to which (for valued ties) they perceive to have a specific type of interaction with every other member of the team. Ratings are recorded in matrix form where the row labels indicate the team member giving the rating and column labels indicate the team member about whom the rating was given. Ratings are recorded in each cell of the matrix corresponding to presence or absence (1s and 0s) of interaction between a particular pair of team members. Alternatively, ratings of the strength of interaction (range of values) can be recorded in the matrix. In the dichotomous case, ties are then modeled between team member pairs with 1s in corresponding cells. In the valued case, the researcher may choose based on theory or conceptual reasons at which minimum level of strength to model ties. Density is then calculated as the number of observed ties divided by the number of all possible ties (or the number of 1s present in the matrix divided by the total number of cells). Alternatively the researcher can employ a strength-based measure of density that accounts for the value of each tie without dichotomizing (for an application see Reagans, Zuckerman, & McEvily, 2004, p. 114). In a network of N actors, the number of possible undirected ties is $(N^2 – N)/2$; the number of possible directed ties is $(N^2 – N)$. A complete network exists when every team member is connected to every other member, resulting in a density of 1.0, but such completeness is relatively rare, even in small networks (Scott, 2000).

Density is an important structural pattern to model because the number of connections between team members is thought to indicate the team’s capacity to coordinate its actions and thereby enhance its performance (Reagans & Zuckerman, 2001). Teams with many members interacting with many other members are likely to have higher levels of information sharing and collaboration necessary for successful task completion, while teams with few members interacting are unlikely to be able or willing to share important knowledge and information to accomplish their tasks (Balkundi & Harrison, 2006; Hansen, 1999). Further, teams whose members interact and communicate frequently are more likely to be able to build norms of support to smooth the functioning of the group (Coleman, 1988; Reagans, Argote, & Brooks, 2005). Balkundi and Harrison’s (2006) meta-analysis of 37 network studies showed that teams with higher densities of ties were associated with higher levels of team performance as well as team viability. Thus, the interconnectedness of the pattern of team member interaction has important implications for the success of the team.

Density of Multiplexity

While it is common to model network density based on a single type of relation (e.g., density of either instrumental or expressive ties), relationships among team members, as we indicated earlier, are usually more complex, in that they involve the simultaneous overlap of both instrumental and expressive ties (in both positive and negative forms). For this reason, and to more fully capture the level of complexity of team member interactions, it becomes important to model the structural properties of networks based on the overlap of instrumental and expressive ties—or in other words, the structural properties of networks based on multiplex ties as a relation of their own. This can be accomplished by modeling the density of multiplex ties. This type of density captures the connectedness of actors in the network through simultaneous instrumental and expressive ties. In this study, I examine the density of overlapping instrumental and positive expressive ties in the team, and I label this density of positive multiplexity team structural cohesion. I also examine the density of overlapping instrumental and negative expressive ties in the team, and I label this density of negative multiplexity team structural repulsion. My general proposition is the mix of both team structural cohesion and team structural repulsion, operating as simultaneous opposing forces, has important implications for team effectiveness beyond those accounted for by the densities of instrumental, positive expressive, or negative expressive ties alone. Below I review the research literature applying network analysis in team contexts to illustrate that the networks of teams do have implications for team functioning and effectiveness.

Teams As Social Networks

The research applying a social network perspective to teams finds its origins in laboratory experiments by conducted by social psychologists in the early 1950s seeking to understand the impact of different designs of communication networks on team group efficiency in problem solving (see Shaw, 1964, for a review). For example, Leavitt (1951) conducted an experiment with a simple group problem-solving task while constraining groups' communication networks to conform to certain patterns. He found that groups whose communication networks were constrained to have high centralization—in this case a 'star' pattern of communication—were much more efficient at solving the problem, but he also found that members of these groups were much less satisfied with the group experience. On the other hand, Leavitt found that groups whose communication networks were constrained to have low centralization—in this case a 'circle' pattern of communication—were much less efficient at solving the problem, but the members of these groups were more satisfied with the group experience.

After this early period, however, research on groups and teams in social psychology generally waned (McGrath, 1997; Levine & Moreland, 1990), and it wasn't until the early 1990s, coinciding with the increasingly widespread adoption of teams in organizations (Gordon, 1992; Manz & Sims, 1993; Devine et al., 1999; Hoerr, 1989), that researchers gained renewed interest in applying a network perspective to groups and teams, albeit this time in fields other than social psychology, such as organizational psychology (Levine & Moreland, 1990). In the sections that follow I review research that has examined instrumental, expressive (positive and negative), and multiplex networks within and between teams, departments, or organizational sub-units.

Research on Instrumental Team Networks

Research on instrumental team networks has focused mainly on work-related communication and advice networks. In one of the earlier studies of instrumental networks within the team, Lucius and Kuhnert (1997) measured "who are your top choices to be associated with" across several task scenarios among 129 cadets attending military college arranged into 29 squads (average team size was 4.4 members). They found marginal support indicating that the density of the squads' instrumental choice networks was positively associated with military supervisor ratings of squad performance aggregated across 80 military field exercises, but surprisingly, density was not related to the squads' self-ratings of performance. However, given the small sample size (performance regressions were restricted to only 21 squads), this study may have lacked power to detect an association, if one existed. Additionally, the density of these instrumental choice networks was, surprisingly, not associated with a measure of team cohesion (using a traditional composition model measure), but it was positively associated with team member satisfaction. They acknowledged that they may not have observed a relationship between density and composition model cohesion because the measure of cohesion they used suffered from low reliability (alpha = .59).

In a much larger sample, Reagans and Zuckerman (2001) measured the frequency of communication among work contacts in a sample of 224 corporate research and development teams and found that the density of communication frequency within the team was positively related to team productivity. They additionally found that the heterogeneous range of communication contacts to other teams was also positively related to focal team productivity. They argued that high network density improves performance through improved team coordination, and that high network heterogeneity enhances performance through improved learning capacities and access to a broader range of external information, though they did not examine these mediators directly. In a similar study Reagans, Zuckerman, and McEvily (2004) replicated these findings showing in a sample of 1,518 corporate project teams that both the density of internal team communication frequency and the heterogeneous range of external communication frequency were associated with faster project completion times. They additionally showed that diversity in functional background and tenure were negatively related to internal team density, but positively related to external team range.

Cummings and Cross (2003) also examined communication frequency ties among 182 project teams from a worldwide corporation and found that the density of communication ties, employing a strength-based measure of density, was positively related to both manager- and member-rated team performance. Additionally they found that, controlling for the density of communication, hierarchical communication in the team, in which communication is ordered or tiered in a chain of command, was negatively associated with team performance. They also found that teams with core-periphery structures of communication, in which communication revolved around a central core of members who communicated with a periphery of team members unconnected to each other, also exhibited decreased collective performance. Finally, teams with group leaders who maintained structural holes of communication between team members, rather than actively seeking to connect the team members around them, also exhibited diminished collective performance. These findings are interesting in that, while network features such as structural holes and hierarchy are said to yield benefits for individual accomplishment (Burt, 1992), these same structures may be detrimental for collective performance.

Along those lines, Sparrowe, Liden, Wayne, and Kraimer (2001) conducted a field study involving 190 employees in 38 work groups from five different organizations and found that at the individual level, an employee's centrality in the employee advice network (in-degree centrality, measured as the number of other employees who named the focal individual as someone they "go to for help or advice on work-related matters") was positively related to manager ratings of that employee's individual performance. However, at the group level, the density of the work group advice network was not significantly related to ratings of work group performance. They did find marginal support indicating that the centralization of the advice network at the work group level, in which advice seekers tended to seek out a single individual in the work group for advice, was negatively related to group performance. They noted the paradox illustrated by their findings that at the individual level, centrality in the advice network was positively associated with individual performance, while at the group level, centralization of the advice network was negatively associated with group performance, suggesting that, in a manner similar to Cummings and Cross (2003), the determinants of group performance are different than those for individual performance.

A more recent study suggests, however, that individual centrality in the within-team advice network can be beneficial for group outcomes, given that the central individual is also the team's formal leader. Balkundi, Barsness, and Michael (2009) conducted a study of 19 manufacturing teams in a wood products company and found that having a formal team leader with high in-degree centrality in the team's advice network was positively related to team viability and negatively associated with team conflict. However, if this same leader brokered many structural holes between subordinates in the within-team advice network (subordinates sought advice from the leader but not each other—measured by normalized betweenness centrality), the team exhibited higher conflict and lower viability. Further, they found that team conflict mediated the relationships between leader centrality measures and team viability. These results parallel those of Cummings and Cross (2003) and Sparrowe et al. (2001) in that centralization of team advice networks, which was observed in Balkundi et al. (2009) as teams with leaders high in both in-degree centrality and betweenness centrality, appear to create problems for team effectiveness.

Hansen (1999) examined the benefits and drawbacks of strong and weak communication ties in terms of a different team outcome—information search and information transfer—in a study of 120 new-development projects undertaken by 41 divisions in a large electronics company. He found that weak communication ties between units facilitated the search for useful information in different divisions, but that those same weak ties inhibited the transfer of complex, non-codified information. On the other hand, strong communication ties between divisions restricted the search for information, but the transfer of complex information was facilitated by the strength of the communication ties. They suggested that having weak inter-unit ties, because they are less costly to maintain in terms of time and energy, speeds up project completion when knowledge is not complex, but slows them down when the knowledge transferred is highly complex. Hansen also found that the density of within-division communication ties was also positively associated with project completion.

Finally, in one of the only studies to examine the development of instrumental team network structure longitudinally, Zaheer and Soda (2009) tracked the co-membership networks (members of a current production team that had worked together as a part of a prior production team) of 501 production teams across a 12-year span in the Italian TV production industry. They found that the extent to which the current team spanned structural holes between teams (i.e., current team members bridge a hole between teams of a prior period because the current team members were selected from different prior teams, or current team members bridge a hole between other current teams because they work in both teams) was largely a function of the extent to which the current team members had bridged structural holes in the past, but also was a function of the prior status and centrality of the teams that members were part of in the past. Conversely, current spanning of structural holes was negatively related to past team cohesion, indicating that teams whose members had worked together frequently in the past were less likely to bridge holes between current teams. They found that current structural holes were positively related to team performance in terms of size of the TV production viewership audience, but that, ironically, it was the homogeneity, rather than the heterogeneity, of the teams' prior production content that influenced performance across those structural holes.

Research on Positive Expressive Team Networks

Nearly all research focusing on positive expressive networks has examined friendship ties. Two early experiments during this time period examined the impact of friendship networks on team performance. First, Jehn and Shah (1997) examined the impact of friendship ties on task performance in an experimental setting with 53 three-person teams of business students. Prior to the experimental task, the researchers asked each participant to list up to ten other students they considered friends. They then assigned two types of teams to complete both a cognitive task and a motor skills task. "Friendship" teams were those in which all three members assigned had mutually named each other as friends. "Acquaintance" teams were those in which each member had named one other member as a friend without the other reciprocating the friendship. Though Jehn and Shah did not explicitly recognize it, the friendship densities they had created in these two types of teams were 1.0 for friendship teams (six of six possible friendship ties indicated) and .50 for acquaintance teams (three of six possible friendship ties indicated). No teams were assembled with mutual strangers, which would have had a density of .0 (zero of six possible friendship ties indicated). Findings from the experiment revealed that friendship groups, those with higher friendship density, performed better on both the cognitive and motor tasks. Additionally, this study was one of very few that provides additional data as to why this might have been the case. Jehn and Shah found that friendship groups exhibited higher group commitment, in that they appeared to be more committed to their task and to each other and were generally more proud of their group in comparison to the acquaintance groups. In addition, the friendship groups exhibited higher group cooperation, in that each member appeared to put greater effort toward completing the task and toward helping each other. However, they found no difference between the groups in terms of their efforts to plan, make critical evaluations of their work, or their monitoring of each other.

A second experiment highlights the implications for the structure of friendship ties between groups, as well as within them. Krackhardt and Stern (1998) conducted an organizational simulation with business students to observe whether the nature of their friendship ties within and between their assigned teams would influence the teams' abilities to respond to an induced organizational crisis. Krackhardt and Stern used the friendship network within each of six student cohorts to create two types of simulated organizations. The first type of organization, called a "natural" organization, was created to maximize the number of friendships occurring within the sub-unit teams. The second type, called an “optimal” organization, was created to maximize the number of friendships occurring between the sub-unit teams. At a certain point in the simulation, the researchers induce different crises requiring the organization sub-units to respond immediately to unfamiliar and unlearned situations. Across the six trials, they found that the “optimal” organizations, those with greater friendships between sub-units, were able to respond more effectively. Krackhardt and Stern presumed the performance differences were due to variation in cooperation and conflict between the organizations, and provided anecdotal data taken from diary entries made during the trials that the subdivisions in the optimal organizations were seen to cooperate with each other in the face of the dilemmas that they encountered, while the subdivisions in the natural organizations frequently directed their members’ attention to protecting or enhancing the resources of their own division rather than those of the entire group.

Three recent field studies have also examined the association of team friendship ties and performance. First, Mehra, Dixon, Robertson, and Brass (2006) examined friendship ties between the leaders of 88 sales groups of a financial services firm, and also the friendship densities within a subset of 28 of those sales groups ranging in size from 8 to 22 group members. They found that group leader centrality in the friendship network of sales group leaders was positively related to objective measures of performance including sales revenue and customer loyalty. They also found that friendship density among the subset of 28 groups was positively but not significantly related to sales revenue, and significantly positively related to customer loyalty. Their reasoning for the former was that leader ties to leaders of other sales groups provided faster and fuller access to novel information located outside the group, and their reasoning for the latter was that increased interconnectivity, or structural “closure” (Coleman, 1988), ensured that knowledge and support was easily shared among all group members. However, in neither case were these mechanisms examined directly. They suggested that the non-significance of the relationship between friendship density and sales performance was in part due to the lower power inherent in the small sample size of groups.

Second, Balkundi, Kilduff, Barsness, and Michael (2007), in an earlier study of the same 19 wood products manufacturing teams involved in Balkundi et al. (2009), examined both antecedents and outcomes of structural holes in the within-team friendship networks. First, they found that neither ethnic nor gender diversity predicted structural holes in teams. They did find that age diversity was associated with fewer structural holes in teams, likely because the older members of teams formed mentoring relationships with younger members, as opposed to isolating them in rigid age clusters. In regards to performance, they found an inverted-U-shaped relationship between structural holes and team supervisor ratings of performance. They suggested that teams with few structural holes were likely to be unable to be innovative, while teams with too many structural holes likely have difficulty coordinating, yet they did not measure or test these proposed mediators.

Finally, Oh, Chung, and Labianca (2004) found similar inverted-U-shaped associations between informal socializing ties (i.e., “To what extent did you go out with this person for social activities outside work such as going out to informal lunch, dinner, or drinks?”) and CEO ratings of work group performance in a study of 60 work groups drawn from 11 different organizations in Korea. They suggested, but did not directly show, that work groups draw benefits of dense informal social ties through increased group solidarity, stronger norms of reciprocity, greater trust, and greater sanctions against self-serving or opportunistic behavior (e.g, free-riding). However, teams only derive these benefits to a point, as they argued that excessive group density negatively impacts performance because strong in-group biases can develop that can restrict access to outside information, creating homogenous and redundant information in the team.

Research on Negative Expressive Team Networks

Only three studies have measured some aspect of negative expressive networks in a team setting. First, in addition to measuring advice networks, Sparrowe et al. (2001) also measured what they labeled “hindrance networks” (i.e., relationships with work group members who “make it difficult for you to carry out your job responsibilities”) among the members within the 38 work groups studied. They found that in-degree centrality in the hindrance network—being the one who made it difficult for others to do their jobs—was negatively related to supervisor ratings of in-role and extra-role performance. They also found that density of the work group hindrance network was negatively related to group performance. They reasoned that performance suffers in groups where many individuals thwart the job performance of others by withholding information, opportunities, and resources.

Second, in addition to measuring friendship ties, Labianca, Brass, and Gray (1998), also measured “prefer to avoid” relationships among 83 employees spread across 11 work groups of a university hospital center. They found that between-unit “prefer to avoid” relationships were positively associated with perceptions of between-unit conflict, while between-unit friendship were unrelated to between-unit conflict perceptions. Additionally, in somewhat of a spillover effect, they found that the density of within-unit “prefer to avoid” relationships was also positively related to between-unit conflict perceptions, such that if members perceived they had negative relationships within their work groups, that appeared to influence their perceptions about the relations occurring between units as well. Interestingly, they did not examine whether “prefer to avoid” work group density was related to within-unit conflict perceptions. An important finding from this research is that the positive expressive tie—friendship—was not related to conflict perceptions, while the negative expressive tie—“prefer to avoid”—was related. This is consistent with research on negative asymmetry (Taylor, 1991) that suggests that negative stimuli have greater influence than do positive stimuli across a range of perceptual outcomes.

Last, Baldwin, Bedell, and Johnson (1997) examined adversarial networks (i.e., “with whom do you have an adversarial or difficult relationship?”) among 250 full-time, residential MBA students divided into 62 teams within four cohorts, and found, controlling for cognitive ability indicated by Graduate Management Admissions Test (GMAT) scores, that individual centrality in the adversarial network was negatively associated with an individual’s satisfaction with team-based learning as well as with general program satisfaction, but it was not associated with individual grades. At the team level, in-group preference of adversarial ties (related to density, it is a measure of the extent to which team members named those within, as opposed to outside, their assigned teams as adversaries) was negatively related to team satisfaction, team workload sharing and perceptions of the effectiveness of team interactions, but was surprisingly positively associated with team grades. A second counterintuitive finding was that team workload sharing was actually negatively related to team grades. They found these results disappointing but not inexplicable. In the first case, they speculated that adversarial relationships may have been instrumentally beneficial for task performance because it may have allowed team members to challenge each other's assumptions and enhance decision quality. In the second case, they speculated that certain teams may have benefitted from relying on a highly intelligent "star" to carry the workload alone, lending credence to MBA instructors' fears that teams allow one bright member to complete team projects to the detriment of the learning of the other team members.

Research including Instrumental and Expressive Team Networks

Thus far I have reviewed studies as having generally focused on either instrumental or expressive networks (whether positive or negative). However, a handful of studies have included both types of networks in the same study, though they have been analyzed separately within the study. For example, Baldwin et al. (1997) also examined friendship and communication networks, in addition to adversarial networks. They found that within-group communication was positively related to workload sharing and perceptions of effectiveness of team interaction but was not significantly related to the team grades. They also found that within-group friendship was positively related to perceived interaction effectiveness, which in turn was positively related to team grades. It was not, however, related to general satisfaction with the program. Interestingly, they found that the expansiveness of friendship (the degree to which the team's members chose members of other teams as friends) was negatively associated with team grades, suggesting that the teams that had the most socially extraverted members were not necessarily the highest performing teams. Labianca et al. (1998) also measured communication and friendship networks in addition to the “prefer to avoid” network in their study of inter-unit conflict. As mentioned earlier, friendships were not related to perceptions of inter-unit conflict. The frequency of between-unit communication was also unrelated to perceptions of inter-unit conflict.

In an earlier study, Rosenthal (1997) examined individual friendship, advice, and discussion relationships among all the contacts—both within and outside the team—of the members of 15 cross-functional teams in a robotics manufacturing company. She was interested in how the constraint created by the pattern of the team members’ ties would affect the focal cross-functional teams’ performance. Constraint is an individual network measure indicating essentially the extent to which all of a person’s contacts are connected to each other, thus constraining opportunities to broker between disconnected contacts (Burt, 1992). It is unclear from the study how the instrumental (e.g., advice, discussion) and expressive (e.g., friendship) networks were used to create the measure of individual constraint. However, after calculating a measure of constraint for each team member and then averaging those measures within the team, zero-order correlational results indicated that the average level of team member constraint was negatively associated with supervisor-rated team performance.

Reagans et al. (2004) measured emotional closeness (respondents’ rating of “how close [they] are with each [contact]” on a scale of “especially close,” “close,” “not so close,” and “distant”) in addition to communication frequency, but because they found the two measures were highly correlated, they presented their analysis based on communication frequency, noting the results did not change if they conducted the analysis based on the emotional closeness measure, or on the average of the two. Cummings and Cross (2003) also collected data on emotional closeness (labeled "psychological closeness" in their study) networks, and although it was not a focal aspect of their analysis, their results indicated that the density of the emotional closeness ties, in addition to the density of communication frequency ties, was positively associated with both manager- and member-rated team performance.

Finally, in an attempt to summarize the team network literature, Balkundi and Harrison (2006) showed in a meta-analysis of 37 team network studies that the density of instrumental ties and the density of expressive ties (analyzed separately) are each positively related to both team task performance and team viability. They also examined whether team network structure was more likely a cause or a consequence of team performance and found strong inferential evidence that the former was the case. Thus, network structures are more strongly positioned in time as antecedents to team performance, rather than as by-products of it. They argued their findings provide compelling support for the view that social networks have important implications for team performance and viability, and urged researchers to increasingly incorporate social network concepts into theories of team effectiveness.

Research on Multiplex Team Networks

As described above, researchers have incorporated communication, friendship, and adversarial networks into the same study (Bedell et al., 1997; Labianca et al., 1998), but to date no research has directly examined the overlap in any of these types of networks. The limited work that has been done has been conducted at the individual level of analysis (Ibarra, 1995; Casciaro & Lobo, 2008; Methot, 2010). As mentioned earlier, Rosenthal (1997) collected data on individual friendship, advice, and discussion relationships, but it was not apparent in her study how these networks were combined in her analysis. Only one study I am aware of has examined the overlap in multiple network relations in a team setting. In an experimental team simulation with first-year undergraduate business students, Parise and Rollag (2010) examined the overlap of prior instrumental ties (fellow students that had collaborated on prior school projects) with existing instrumental ties (students within the 10-member team that collaborated a great deal during the two-hour task simulation). The researchers collected data on the students' prior-existing friendship ties as well. They found that the density of overlap in current and prior work ties (multiplexity that the authors referred to as the "re-enacted" work network) was positively associated with performance, beyond the positive association of prior-existing work or friendship ties with performance. Thus, the authors suggested that emergent work relationships based on pre-existing work relationships are likely to be more productive (at least initially) than collaboration between strangers. They suspected from their observations that this overlap may have impacted the degree of enthusiasm and competitive spirit seen while completing tasks but did not gather data concerning these mechanisms. Instead they called for research to evaluate the degree to which coordination, trust, and commitment are a factor in driving group performance based on team network structure.

Limitations of Existing Team and Network Literatures

The broad implication of this literature review is that the social network structure of team interaction has important implications for team functioning and effectiveness. However, this review also highlights several limitations in the existing team and network literatures. First, the general proposition underlying the traditional approach to modeling team phenomena in general is that team-level constructs emerge from the interactions of individuals in isomorphic, shared, and uniform compositions, rather than in discontinuous, complex, and non-linear configurations, despite researchers' acknowledgements that real team interaction likely emerges according to the latter rather than the former (Kozlowski & Klein, 2000; Mathieu et al., 2008; McGrath et al., 2000). The dominant use of traditional composition models to conceptualize and model team constructs that are configural in nature creates mismatches between the levels of team researchers' theoretical and rhetorical complexity and the levels of researchers' empirical and observational reality.

Second, while some researchers have begun to apply a social network perspective as a useful alternative in order to capture more of the complexities of team interactions, the research has tended to focus on only one type of network relation, such as communication frequency (e.g., Reagans & Zuckerman, 2001), advice (e.g., Balkundi et al., 2009), or friendship (e.g., Mehra et al., 2006). Only limited research has examined more than one type of team network in the same study, and only three studies have looked at negative relations (e.g., Baldwin et al., 1997; Labianca, et al., 1998; Sparrowe et al., 2001). Thus, limited team research is beginning to examine instrumental and positive expressive networks, but more work is needed to examine these networks in addition to incorporating negative expressive networks that have been relatively under-examined (Labianca & Brass, 2006). Related to this issue is that very little research provides any evidence, one way or the other, as to whether multiple measured networks are in fact distinct, or whether they are measuring the same underlying relations. Thus, research is needed that validates the distinctiveness of instrumental, positive expressive, and negative expressive networks.

A more important corollary of the preceding limitation is that although some research does include multiple networks, to date no research has examined the multiplexity, or simultaneous overlap, of those networks. There is no research linking multiplexity of instrumental and expressive ties—positive or negative—to team outcomes of any sort. This is unfortunate because, as mentioned earlier, a multiplex tie is a unique relation of its own (Methot, 2010). Multiplexity captures the network in a level of detail that more closely approximates the reality of team interactions, and simplifying the natural complexity of team member relations may introduce random errors in network data that attenuate standardized effects, increase standard errors, and suppress evidence of true effects (Burt & Schøtt, 1985). Thus, research is clearly needed which not only examines instrumental, positive expressive, and negative expressive networks, but also research that examines the multiplexity, or overlap, in these networks.

A final limitation is that very little research has directly examined intervening processes that would explain why network structure is associated with team performance. Research has linked network features to either team performance (e.g., Reagans & Zuckerman, 2001; Reagans et al., 2004) or to some type of team process or emergent state (e.g., Lucius & Kuhnert, 1997), but limited research has examined these associations jointly in the context of a broader structural model in order to examine whether the effects of one are mediated by the other, as implied by most models of team effectiveness. Jehn and Shah (1997) found that group commitment and cooperation mediated the relationship of friendship density with task performance as tested in a Baron and Kenny (1986) causal steps fashion, but this experimental finding has not yet been replicated in a natural group setting with teams of a longer duration, and the Baron and Kenny approach has been shown to have low power for testing mediation effects (MacKinnon, Lockwood, Hoffman, West, & Sheets, 2002). Both Krackhardt and Stern's (1998) and Parise and Rollag's (2010) evidence on the meditational influence of cooperation and coordination was merely anecdotal. Only Balkundi and colleagues' (2009) study found that conflict mediated the relationship between the team leader's centrality in the advice network and team viability. Thus, on the whole, although researchers propose that the effects of network structures on team performance occur because of benefits associated with improved coordination, cooperation, solidarity, support and effort, these associations remain largely the function of argument and assumption rather than empirical observation and testing. No studies to date have comprehensively modeled the indirect links from network structure to performance through various proposed mechanisms.

CHAPTER 3
THEORY AND HYPOTHESES

The preceding review makes clear that a social network perspective is a useful approach for the study of team phenomena and that social network structures have important implications for team effectiveness. However, multiplex network structures have not been examined, nor have their linking mechanisms to performance. Accordingly, this dissertation seeks to make the following contributions to the team and network literatures. First, I develop a more complete conceptualization of social interaction in teams incorporating instrumental, positive expressive, and negative expressive relationships. This formulation is composed of both team structural cohesion, defined as the density of overlapping instrumental and positive expressive relationships in the team; and team structural repulsion, defined as the density of overlapping instrumental and negative expressive relationships in the team. These two components act as countervailing social forces that pull team members closer together or push them further apart. I contribute to network research by accounting for instrumental and both positive and negative ties, whereas previous conceptions often take for granted that expressive ties are positive (Brass et al., 2004; Labianca & Brass, 2006) and prior research fails to account for their overlap. I contribute to team research by illustrating how social network concepts allow compilation models of emergence to be operationalized. This approach directly addresses recent calls for researchers to incorporate to a greater degree social network concepts and variables that allow social relations in groups and teams to be captured and understood with greater complexity (Kozlowski & Klein, 2000; Klein & Harrison, 2007; Mathieu et al., 2008; Balkundi & Harrison, 2006).

Second, I incorporate theory from both the team effectiveness (e.g., Hackman, 1987) and social capital (e.g., Coleman, 1988) literatures to examine a systematic set of variables that explain how and why these components of team network structures influence team performance. In essence, I argue that structural cohesion and repulsion affect team performance through their influence on group synergy, consisting of maximizing team process gains, minimizing team process losses, and increasing team motivation (Hackman, 1987). I examine team process gains in terms of team members' use of effective teamwork processes (Marks, Mathieu, & Zaccaro, 2001), while I examine team process losses in terms of team relationship maintenance (Wright, 1984). I draw from motivational research on individual employee engagement (Kahn, 1990; Rich, LePine, & Crawford, 2010) to conceptualize team engagement as a representation of team-level motivation. I make a contribution to the networks literature by systematically examining mechanisms that have previously been assumed or only anecdotally observed as explanations as to why team structure is associated with team performance. I make a contribution to team effectiveness literature by exploring how team network structures function as antecedents to these intervening mechanisms.

In sum, I propose that social network analysis applied to team interaction will be useful to model both the contents and structure of team chemistry among team members, and that those structures will have important implications for team performance. Further, I include a set of intervening mechanisms to explain why these network structures influence team performance. I then empirically test these predictions in a structural model systematically including the indirect links from team network structure to team performance through these proposed mediators. The model in Figure 3-1 summarizes the combination of these predictions.

Team Synergy and Performance

Because one of the main components of the definition of a team is that it has tasks to perform that result in discernable products, the key aspect of team effectiveness I focus on in this study is team task performance, defined by Hackman (1987) as the productive output of the group as evaluated against the standards of the people who receive and/or review the output. The criteria is appropriate because, as Hackman suggested, if a group's output is not acceptable to either its clients or to supervisors charged with evaluating the group's performance, then it cannot be considered effective. Further, for teams in organizational settings, it is rare for valid and reliable objective criteria to be available (for a notable exception see Mehra et al., 2006). In addition, Hackman argued that the implications of performance for a group often depend far more on others' assessments of the group's output than on any objective index, even if those assessments are made on whatever objective measures may be available.

Hackman's (1987) model of effectiveness emphasizes three classes of variables proposed to impact team task performance, including the design of the group (e.g., the structure of the team's task; the size of the group), the organizational context (e.g., the reward and information systems influencing the group; the material resources available to the group), and group synergy (e.g., process gains and losses; motivation) that results from team members' social interactions. In this current study, because of the nature of the sample, the first two classes of variables are relatively fixed in that the teams all complete similar tasks and are of similar sizes, and they have the same reward systems and material resources available to them. Because of the lack of variance in these first two categories of variables, they are of less relevance to explain differences in team performance in this context. On the other hand, because the nature of team interaction in this context is not specified, structured, or mandated, I expect substantial differences to emerge in the group synergy available to the teams as a result of their varying patterns of social interactions. Shea and Guzzo (1987) acknowledged that even under the constraints of similar group designs and operating environments, teams will differ substantially in their patterns of working together, and this should be especially the case where decisions on how to structure team member interaction are left to the members' discretion.

In relation to group synergy, Steiner (1972) originally modeled team productivity as the difference between a team's maximum possible productivity minus its process losses. Actual productivity fails to match maximum possible productivity because of losses stemming from less than optimal ways of combining members' efforts into a group product. Hackman (1987) added that actual productivity is also a function of process gains in addition to process losses, and that productivity is affected by a group's "spirit"—or its members willingness to work hard to make the team its best. Hackman holds that the balance of synergy, whether positive as process gains and motivation exceed process losses, or negative as process losses overwhelm process gains and motivation, will serve to explain why some groups are able to excel given certain performance conditions, and why others are not. In the sections that follow I describe theory and hypotheses for how elements of synergy affect team performance, and then how the network structures of team chemistry function as antecedents to that synergy and performance in turn.

Team Process Gains

Team process gains involve getting more from a team than you would expect from the capabilities of individual members. Process gains result in new resources and capabilities that did not exist before the team created them (Hackman, 1987). One manner by which teams achieve these resource gains is through their teamwork processes. Teamwork processes are members' interdependent acts that convert inputs into outcomes through cognitive, verbal, and behavioral activities directed toward organizing task work to achieve collective goals (Marks et al., 2001). Though researchers have disagreed on the meaning of team processes (Kozlowski & Bell, 2003), Marks and colleagues identified the content domain of team process interaction with ten narrow processes that map onto three higher order categories of transition, action, and interpersonal processes. These higher order dimensions are embedded in a time-based framework that stipulates that teams perform different types of processes at different times corresponding to performance episodes—distinguishable periods of time over which task work is performed and feedback becomes available.

Transition processes describe team member activities that occur between performance episodes. During these phases, member interaction and communication focuses primarily on evaluation and planning activities to guide team accomplishment of objectives. These narrow processes consist of (a) mission analysis, (b) goal specification, and (c) strategy formulation and planning. Action processes describe team member activities that occur during performance episodes. During these phases, member interaction and communication focuses on activities that relate directly toward the accomplishment of objectives. These narrow processes consist of (d) monitoring progress toward goals, (e) resource and systems monitoring, (f) team monitoring and backup, and (g) coordination of action sequence and timing. Finally, interpersonal processes describe team member activities that are ongoing and salient at all times and is argued to lay the foundation for the effectiveness of the other processes. Occurring throughout transition and action phases, this member interaction and communication is focused on managing interpersonal relationships. These narrow processes consist of (h) conflict management, (i) motivating and confidence building, and (j) affect management or regulating member emotion.

Teamwork processes are integral to effective team performance because they allow team members to coordinate and combine their separate ideas, inputs, and expertise into collective group output. Transition processes allow team members to identify and prioritize team goals and develop plans as to how to achieve them. Teams that fail to identify goals or plan how to achieve them risk misallocating team member efforts until it is too late to recover (Gersick, 1988). A team that disregards transition processes likely ends up with no shared understanding of the team's purpose (Marks et al., 2001). On the other hand, teams that agree on specific, difficult goals and develop strategies for how to achieve them should exhibit higher collective performance (Locke & Latham, 1990; O'Leary-Kelly, Martocchio, & Frink, 1994).

Action processes allow team members to coordinate their activities, track their progress, and provide feedback to members so that they are aware of their likelihood of achieving success within a given period of time. Teams that are unaware of their progress cannot provide appropriate feedback necessary to make adjustments in order to achieve goals (DeShon, Kozlowski, Schmidt, Milner, & Wiechmann, 2004). Alternatively, teams that more extensively coordinate their activities and report regularly on progress are more likely to understand when they need to speed up, slow down, or help each other out to get back on track to successfully complete their work (Marks et al., 2001; Marks, DeChurch, Mathieu, Panzer, & Alonso, 2005).

Interpersonal processes allow teams to develop conditions for managing interpersonal relationships in a way that preempts or amicably resolves conflicts, encourages team members to maintain high levels of performance, and regulates team member emotions for productive team uses (Marks et al., 2001). If team members know they will be working together for any significant duration, they are less able to simply ignore unpleasant interpersonal relations until the team disbands, and their ability to smoothly manage interpersonal relations will significantly contribute to the effectiveness of the team's goal accomplishment (Bradley, White, & Mennecke, 2003; Druskat & Kayes, 2000; Mathieu & Schulze, 2006). Taken together, the effective use of each type of teamwork processes facilitates team task accomplishment that should relate positively to team performance (Mathieu, Gilson, & Ruddy, 2005). Recent meta-analytic evidence has shown that teamwork processes are indeed significantly predictive of team performance, and this relationship is even stronger as team tasks become more interdependent (LePine, Piccolo, Jackson, Mathieu, & Saul, 2008). Thus, I hypothesis the following:

Hypothesis 1: Teamwork processes are positively associated with team performance.

Team Process Losses

Team process losses refer to directing team members' time, energy, and talent away from task accomplishment in order to manage interdependencies of collective interaction (Hackman, 1987). Some losses are due to coordination loss, viewed as "overhead costs" inherent in all group task settings where team members must direct time away from direct task accomplishment to coordinate members' activities (Steiner, 1972; Hackman, 1987). However, other losses are due to motivation loss (Steiner, 1972), often conceived in terms of "social loafing," where team members contribute less effort to the group task than they would were they to perform the task individually (Latané, Williams, & Harkins, 1979). However, most social loafing research occurs in experimental studies where individual participants complete relatively simple tasks where they are only led to believe they are working in a group context (Karau & Williams, 1993). Drawing from the literature on social relationships and distractions (e.g., Wright, 1984; Winstead, Derlega, Montgomery, & Pilkington, 1995; Jett & George, 2003), another form of process loss can be captured by the concept of team relationship maintenance. This literature acknowledges that while social relationships such as good friendship are typically beneficial, a potential by-product of increasing social closeness is the difficulty of maintaining these strong forms of relationships. Relationship maintenance refers to the time, effort, and difficulty of coping with misunderstandings, disagreements, and incompatibility of goals in social relationships (Winstead et al., 1995). Adapted to the team level, I define team maintenance as the time, effort, energy and difficulty that members of a team experience in building and managing their social relationships.

Team maintenance reduces team performance because time directed toward building and maintaining social relationships reduces the overall level of energy and attention that would otherwise be applied to team task performance (Cohen, 1980).

More specifically, in a team context, the additional requirements of having to expend effort to resolve disputes, smooth disagreements, and provide assurances that team members are on positive standing with each other may deplete members' energy to the point where they become less capable of dealing with problems, are less committed to working on tasks, and have less desire to see the team succeed and achieve its goals (Maslach & Leiter, 1997). These efforts may come to be viewed as distractions whereby individuals feel time and energy is being wasted on activities that are not instrumental in completing the tasks they are performing (Jett & George, 2003). When team members become exhausted and frustrated under the influence of these additional taxes on their capabilities and resources, they will not be able to perform well because their energetic resources are diminished (Bakker, Demerouti, & Verbekke, 2004). Issues that distract team members from dedicating all of their energy and attention to task-focused activity can reduce their effectiveness at performing that activity by limiting the amount of time available for and increasing the amount of interruptions in task completion. Recent evidence has shown that, at the individual level, difficulty in maintaining interpersonal relationships is negatively associated with job performance (Methot, 2010). However, to date, no research has examined the relationship between team maintenance and team performance. Therefore, I hypothesize:

Hypothesis 2: Team maintenance is negatively associated with team performance.

Team Motivation

Guzzo and Dickson (1996, p. 313) note that motivation in teams has received more theoretical than empirical attention. The purpose of this has been to understand motivation at a collective level rather than strictly confining the construct to an individual analysis. At the individual level, motivation refers to the allocation of personal resources toward role performance, and also how intensely and persistently those resources are applied (Kanfer, 1990). Two concepts attempting to represent motivation at the team level are group potency (Guzzo, Yost, Campbell, & Shea, 1993) and collective efficacy (Bandura, 1982). Both refer to shared team member beliefs that the team can be effective, but the distinction among them generally made that potency refers to general efficacy beliefs across situations while collective efficacy refers to task- or situation-specific efficacy beliefs (Stajkovic, Lee, & Nyberg, 2009). However, these two concepts only speak in terms of team members' beliefs in its capabilities to be effective rather than in terms of the direct motivational implications of how the team actually employs those capabilities in order to accomplish its tasks. A related concept is team commitment (Jehn, Northcraft, & Neale, 1999; Bishop & Scott, 2000), which is a team-adapted version of Mowday, Porter, and Steers's (1982) Organizational Commitment Questionnaire (OCQ) that emphasizes an individual's identification with, and involvement in, a particular organization (or team). However, this concept focuses on team members' affective appraisals of their team experiences, rather than their actual investment of effort and energy on the team's behalf.

Another concept that more directly and more completely captures the investment of team members' personal resources toward role performance implied by team motivation is team engagement. Kahn (1990, p. 700) originally defined engagement at the individual level as "the simultaneous employment and expression of a person's 'preferred self' in task behaviors that promote connections to work and to others, personal presence (physical, cognitive, and emotional), and active, full performances." Engaged individuals harness their full selves in active, complete work role performances by driving personal energy into physical, cognitive, and emotional labors. Kahn (1992) described engaged individuals as being psychologically present, fully there, attentive, feeling, connected, integrated, and focused in their role performances. They are open to themselves and others, connected to work and others, and bring increasing depths of their personal resources to perform. Engagement is observed through the behavioral investment of personal physical, cognitive, and emotional energy into work roles (Kahn, 1992). People exhibit engagement when they become physically involved in tasks, whether alone or with others; cognitively vigilant, focused, and attentive; and emotionally connected to their work and others in the service of their work (Kahn, 1990). Kahn’s engagement concept is clearly motivational because it directly refers to the investment of personal resources toward role performance. And while it was originally conceptualized at the individual level, it is possible that it exhibits emergent group properties as team members each exhibit characteristic levels of personal engagement that come to define a shared level of team engagement. Researchers have argued that individuals spread their level of engagement to others in their work groups (Bakker, 2008), and empirical research has demonstrated that engagement has collective group properties, independent of the engagement of individual members (Bakker, van Emmerik, & Euwema, 2006; Salanova, Llorens, Cifre, Martínez, & Schaufeli, 2003; Salanova, Agut, & Peiró, 2005). Thus, I define team engagement as team members’ shared investment of their collective physical, cognitive, and emotional energies into team role performance.

While Kahn (1990) did not explicitly outline a relationship between engagement and performance, recent research by Rich, LePine, and Crawford (2010) provides theoretical and empirical evidence at the individual level as to why this would be the case. Engagement should be beneficial for work role performance because individuals who are highly engaged not only focus their physical effort in the pursuit of role related goals, they are also cognitively vigilant and emotionally connected to the endeavor (Kahn, 1990; Ashforth & Humphrey, 1995). On the other hand, individuals who are highly disengaged withhold their physical, cognitive, and emotional energies, and this is reflected in team task activity that is, at best, robotic, passive, and detached (Goffman, 1961; Hochschild, 1983; Kahn, 1990). Investment of physical energy contributes to performance because it facilitates the accomplishment of tasks and goals through increased levels of effort over sustained periods of time (Kahn, 1992; Brown & Leigh, 1996). Investment of cognitive energy contributes to performance because behavior that is more vigilant, attentive, and focused reduces errors resulting from failures to see, take note of, or be attentive to one’s work role (Weick & Roberts, 1993). Investment of emotional energy contributes to performance because individuals become more authentic and complete during role performance in a way that enhances connection among coworkers in the pursuit of task accomplishment (Ashforth & Humphrey, 1995).

In regards to how engagement translates to performance at the team level, as a team on the balance has more individuals that are personally engaged in their team work roles, and as this engagement spreads among team members to reinforce a characteristic level of team engagement, a highly engaged team should exhibit superior performance. These types of teams are those that are willing to invest the time and energy to do what is necessary to produce high-quality work (Maslach & Leiter, 1997) because the members value their membership in the group and find it rewarding to work collaboratively with their teammates, and as a result they are willing to work especially hard on group tasks (Hackman, 1987). Thus, I hypothesize the following:

Hypothesis 3: Team engagement is positively associated with team performance.

The Role of Team Chemistry in Relation to Synergy and Performance

The notion of “team chemistry” is often invoked as an after-the-fact explanation in popular press articles as to why sports teams succeed or fail irrespective of the individual talents of the members composing the team (e.g., McGregor, 2006; Gauthier-Villars, 2010). However, occurrence of the concept in the management and groups or teams literatures is surprisingly sparse. In fact, a search of the terms “team chemistry” or “group chemistry” in the PsycINFO, Academic Source Premier, and Business Source Premier databases yielded only two articles. The first was a survey of United States Olympic team coaches as to what factors they attributed their teams’ successes, and among them they listed strong team chemistry—but without defining what team chemistry was (Gould, Greenleaf, Guinan, & Chung, 2002). The second was a study examining pharmaceutical companies’ decisions to select and sponsor clinical research organizations to conduct clinical trials. One of the deciding factors listed was good team chemistry, described as a positive relationship between the sponsor and the clinical research organization, which are required to work closely together (Glass & Beaudrey, 2008). Much to my surprise, I found no articles or chapters in the groups and teams in organizations literature even discussing the concept.

An expanded search of the sports psychology literature yielded some studies that discussed team chemistry loosely without actually defining the construct. For example, in an article describing applied team building interventions with sports teams, Yukelson (1997) stated that the objective of a successful team-building program is to enhance team chemistry while getting everyone to work together toward common goals. However, Yukelson never actually defines what is meant by team chemistry, though he indirectly alludes to what it is by quoting the coach of a university hockey team who believed his team had good chemistry (p. 85):

> This is one of the best teams we have ever had in terms of camaraderie and team chemistry… As the season progressed, the chemistry of the team became real tight, we became more and more of a family, almost like a brotherhood. The team did everything together, they would eat together, socialize together, pick each other up in practice, genuinely ask how each other is doing, and, in general, interact like a close knit family.

Yukelson suggested that teams that sports teams that develop good chemistry become very much like families; that no matter what, good or bad, everyone sticks together for the betterment of the team. “Teammates may not like each other, they may not agree with each other, they may have very little in common with one another, yet they know they belong to each other and are bound together by these family ties” (p. 85).

Only Bond (2007) has even discussed chemistry in a work setting, but this was in the context of a case study of one organization trying to achieve greater workplace diversity. However, Bond (2007, p. 1) did describe “good chemistry” as a work situation where “things are going well because of naturally occurring forces of nature.” In this situation, individuals mix and complement one another well, and as a result they may also synergistically bring out something new and positive in one another. “Bad chemistry” implies an interpersonal mess, even “an explosion” (p. 1), as personal elements collide and refuse to transform peacefully on contact. The players in this second scenario may simply not mix, like oil and water, or worse, may bring out something quite negative in one another. In personal life, people can choose friends and associates based on “natural chemistry” and decide to foster those relationships that offer a relatively spontaneous connection. In the workplace, however, people often need to work closely with people in situations where there is little natural connection.

I have referred to team chemistry as the mix of structural team cohesion, or the density of overlapping instrumental and positive expressive ties within the team, with structural team repulsion, or the density of overlapping instrumental and negative expressive ties within the team. Structural cohesion results when members of the team both work closely together and like, trust, and are friends with each other. Structural repulsion results when members of the team work closely together but dislike, distrust, and are adversaries with each other. Below I discuss several components of this definition that are important to recognize.

The first component is that, for team chemistry to exist, team members must develop instrumental ties or, in other words, depend on each other to some degree to accomplish their work (Guzzo & Shea, 1992; Thompson, 1967; Van de Ven, Delbecq, & Koenig, 1976). Team members who work in complete isolation cannot develop team chemistry because, absent team member interaction, a collective structure cannot exist (Morgeson & Hoffman, 1999). In research practice, it is usually taken for granted that members of the team depend on each other equally (whatever the level) and is often modeled simply by using composition model indices of respondents' shared perceptions of interdependence (e.g., Campion, Medsker, & Higgs, 1993; Campion, Papper, & Medsker, 1996; Langfred, 2007). However, interdependence is configural in nature in that it describes relational dependence requiring coordination among team members—a system described by Kozlowski and Klein (2000, p. 17) as requiring "networked contributions." Tesluk, Mathieu, Zaccaro, and Marks (1997, p. 201) even used network diagrams to depict their adaptation of Thompson's (1967) patterns of task interdependence or workflow. Because members of a self-managing team have flexibility in the degree to which they choose to interact and depend on each other to accomplish work (Wageman, 2001), the network approach to team chemistry requires modeling the structure of task interdependence directly by depicting as instrumental ties who depends on whom to accomplish their work, team member by team member, rather than only indicating whether members agree that they generally depend on one another to accomplish their work. Thus, one requisite component of team chemistry is that team members work more rather than less closely together.

The second component required for team chemistry is that team members must have some expressive relation between themselves. While it is often the case that the nature of expressive ties is assumed to be positive (e.g., Ibarra, 1993), it is more likely that among the various relations within a single team some expressive ties are positive while others can be negative. Further, the formation of negative relationships is not the mere opposite of positive relationship formation (Labianca & Brass, 2006). Research has shown that friendships take longer to develop and are included in more fine-grained ranking distinctions, while negative relationships develop much faster and are included in more coarse-grained categories such as rival or enemy (Wiseman and Duck, 1995). Thus, a fuller conception of team chemistry involves both positive and negative expressive ties. A tie between two people is positive if it conveys positive affect, such as liking or love, socioemotional support, trust, or friendship (Baker, Cross, & Wooten, 2003). Positive ties vary in type, as well as strength or quality. Strength, for example, can range from mild liking to what Dutton and Heaphy (2003) call "High Quality

Connections.” A tie between two people is negative if it conveys negative affect, such as disliking, distrust, animosity, or hostility. It represents a recurring set of negative judgments, feelings, and behavioral intentions toward another person—a negative person schema (Labianca & Brass, 2006). Labianca and Brass note that negative ties are rare, with recent empirical studies suggesting that they make up only 1 to 8 percent of the total number of relationships in an organization (e.g., Baldwin et al., 1997; Gersick, Bartunek, Dutton, 2000; Kane & Labianca, 2005; Labianca, Brass, & Gray, 1998); but despite their rarity, they suggest that, because of the principle of negative asymmetry (Taylor, 1991), negative ties may have even larger implications for task performance and socioemotional outcomes than positive ties.

The third required component of team chemistry is tie overlap. The overlap of instrumental and positive expressive ties creates structural cohesion, a force that pulls members closer together and reinforces their bonds. The overlap of instrumental and negative expressive ties creates structural repulsion, a force that pushes members further apart to relieve their tension. A simple analogy relating structural cohesion and repulsion to bar magnets may serve to illustrate this point. The force generated between magnets is a joint function of two factors: magnet position and magnet polarity[3]. If magnets are positioned far apart, the orientation of their polarities matters little because the distance precludes them from exerting any force on each other. On the other hand, if the two magnets are positioned close together, then the orientation of their polarities matters a great deal. Closely positioned magnets with polarities that “match” generate a strong force that quickly pulls the magnets together (in the case of magnets, a “match”

[3] The force is also a function of the relative strengths of each magnet, but for the sake of simplicity in the analogy, I assume magnets of equal strength.

is positively charged pole oriented toward a negatively charged pole). Alternatively, closely positioned magnets with polarities that "mismatch" generate a strong force that repels them apart (a "mismatch" is either two positively charged poles or two negatively charged poles oriented toward each other). In a team, the instrumental ties represent team member positions, while the expressive ties represent polarities. If team members are "far apart," or in other words they lack or have very weak instrumental ties, then the "orientation" of their expressive ties, whether positive or negative, activates very little force that either attracts or repels. Because the individuals don't work together, their affective feelings towards each other have few implications for team effectiveness. On the other hand, if team members work closely together, or have strong instrumental ties, then the orientation of their expressive ties matters a great deal more as exchanges of positive affect reinforce and strengthen the bonds of team members working together while exchanges of negative affect destabilizes them and breaks them apart.

In sum, the chemistry of the team is based on strong ties. Multiplex ties are strong forms of ties (Scott, 2000) that are capable of generating social forces that pull and push team members beyond those of simplex ties. The density of overlapping instrumental and positive expressive ties creates structural cohesion, or positive team chemistry resulting not just from working closely with other team members, but from liking, trusting, and being friends with those one must work closely with. Likewise, the density of overlapping instrumental and negative expressive ties creates structural repulsion, or negative team chemistry that does not result from merely disliking other team members, but from disliking, distrusting, and being adversaries with those that one must work closely with.

Because researchers have suggested and shown that instrumental ties have a tendency to overlap with positive expressive ties (Borgatti & Foster, 2003; Balkundi & Harrison, 2006; Reagans et al., 2004; Ibarra & Andrews, 1993; Ibarra, 1995; Methot, 2010), an interesting argument is whether highly interdependent team members are even able to develop negative ties, such that team structural repulsion never comes into existence. In other words, working closely constrains the development of negative affect between team members. There is no empirical evidence to test this argument one way or the other, but Labianca and Brass (2006) argued that while high-density and high-task-interdependence networks should serve to reduce the likelihood of negative relationship formation (because of the high monitoring ability and incentives to minimize disruptions), high-density instrumental networks will serve to amplify the impact of negative relationships that do occur on task performance and socioemotional outcomes.

In these descriptions we see elements of team chemistry as I have proposed it, consisting of team structural cohesion and team structural repulsion. The notion of teams creating strong bonds (e.g., “family ties,” Yukelson, 1997) is captured through the network concept of multiplexity as stronger than normal ties. The concept of structural cohesion implies the willingness of teams to “stick together” because of strong bonds forged through close working relationships with those who trust and like each other. The concept of structural repulsion recognizes that negative relationships with team members act as a counterveiling force that would try to break the team apart because team members are unwilling or unable to continue working closely with those whom they dislike and distrust. Bond (2007) recognized these opposing forces in discussing both “good chemistry” and “bad chemistry”. Greve, Baum, Mitsuhashi, and Rowley

(2010) have also recognized these dual forces of cohesion and repulsion (their label was 'friction') in studies of interorganizational alliance networks.

Positive Multiplex Density (Structural Cohesion)

The meta-argument for why network structure influences team performance is because of its influence on team social capital (Coleman, 1988; Portes, 1998), defined as the aggregate of the actual or potential resources which are linked to possession of a durable network of relationships in a social system (Bourdieu, 1985). More specifically, a dense, cohesive network structure is a form of social capital that allows a team to make more effective use of its individual and collective resources, which is assumed to contribute to the effectiveness of team production. Increasing closure (Coleman, 1998), or density, of positive multiplex ties ensures the existence of sufficient strong bonds between team members that coordination is facilitated, information spreads more quickly, and norms against deviant or opportunistic behavior are more easily enforced (Portes, 1998). Gittell's (2003) theory of relational coordination argues that high-quality connections, such as the positive multiplex ties of structural cohesion, promote more effective coordination of interdependent work because they result in more frequent, timely, and accurate communications dedicated to team problem-solving. Increased proportions of positive multiplex ties in the team foster shared understanding of team goals, shared understanding of team members' knowledge, and increased levels of mutual respect. Other research has shown that strong positive relationships facilitate knowledge transfer that improves group or organizational performance (Hansen, 1999; Tsai, 2001). In essence, increasing structural cohesion promotes greater and more effective use of teamwork processes. It fosters greater attention to transition phase planning and goal setting; action phase monitoring, feedback, and coordination; and interpersonal conflict and confidence management throughout. Thus, I hypothesize:

Hypothesis 4: Structural cohesion is positively associated with teamwork processes.

Social capital created from structural cohesion enhances teamwork resources, but it also promotes team energetic resources in the form of increased team engagement. Kahn (1990) described the psychological conditions that precede individual decisions to engage more completely in work role performances as experienced meaningfulness, in which individuals sense a return on investments of the self through feeling worthwhile, useful, and valuable; psychological safety, in which individuals feel able to invest oneself without fear of negative consequences because situations are trustworthy, secure, predictable, and clear in terms of behavioral consequences; and personal availability, in which individuals feel prepared to drive their physical, cognitive, and emotional energies into role performances. Kahn recognized that one of the most important factors driving the development of these conditions for individuals was the supportiveness of the social relationships with those whom they interact with the most.

Along these lines, Dutton and Heaphy (2003) argued that positive, high-quality relationships indeed afford the opportunity and safety for individuals to craft identities that fit who they are or who they wish to be, which makes them feel worthwhile. These valued identities help them derive positive meaning about the work they are doing. Baker et al. (2003) supplemented this line of argument even more directly with qualitative interviews asking members of work groups to report the physical and psychological consequences of positive relationships with those they worked with (labeled as ‘energizing relationships’ in their work). They found that nearly all of the 66 informants they interviewed described some physical consequence of the energizing relationships such as feeling more “there,” more up, more aroused, more intense, and more attuned to what is going on, and that this was reflected in voice inflection, body language, how they felt, and was even contagious to others. They also described cognitive consequences such as being more attentive to and processing information more rapidly and more thoroughly, often reflected in being able to retrieve more ideas from memory or being able to make connections to other ideas more quickly in a way that generated new insights. All of the informants described emotional consequences as a result of the energizing relationships such as feeling more enthused and drawn into the issues of a conversation or problem-solving session, and this enthusiasm carried over into commitment to interactions and a willingness to devote discretionary time to issues after interactions. In sum, the high-quality and energizing connections involved in a team with high structural cohesion facilitates greater creation and investment of team members’ physical, cognitive, and emotional energy that should be reflected as greater engagement into team role performance. Thus, I hypothesize the following:

Hypothesis 5: Structural cohesion is positively related to team engagement.

While it seems natural to assume that a high degree of positive multiplexity in a team is universally beneficial, excessive structural cohesion in a team may have drawbacks as well, a fact recognized by Ingram and Zou (2008) who argued that members to positive multiplex relationships experience both benefits and tensions from those relationships. Bond (2007) argued that positive relationships among coworkers are not naturally occurring and require effort to be created and maintained. Along these lines, Katz and Kahn (1978) also argued that social structures are essentially contrived, not held together by any set of biological givens, and require considerable energy to be maintained. Indeed, as Wright (1984) argued, growth in friendship is reflected in increasingly broad and detailed acquaintance, and as such, the more one learns about a friend, the greater potential one has to become aware of aspects of that friend's behavior that one may not like. This can result in incompatibilities in motives, interests, or momentary goals. Thus, creating and maintaining positive multiplex ties among team members requires additional attention, effort, and energy beyond that which is already being dedicated directly toward task performance.

In this sense, maintaining structural cohesion in the team can be viewed as a team challenge stressor (Lazarus & Folkman, 1984; LePine, Podsakoff, & LePine, 2005; Crawford, LePine, & Rich, 2010), a demand which if met results in considerable benefits to the team, but the extra effort required to meet such a demand can result in depleted team energy. Granovetter (1973) noted that, in general, strong ties are more difficult to maintain. In addition, Portes (1998) argued that high structural cohesion, despite its benefits, may also restrict individual members' freedom to act by create excessive claims and expectations on team members, and may even be the source of downward leveling norms. Research has shown that the density of team social relationships was positively associated with performance, but only up to a point (Oh et al., 2004), suggesting that there are costs associated with maintaining high density within the team, and other research has shown that positive multiplex relationships are indeed more difficult to maintain (Methot, 2010). This maintenance can be seen as a tax on team members' resources, the management of which requires effort, and in turn creates additional draws on team members' energy. Thus, I hypothesize the following:

Hypothesis 6: Structural cohesion is positively related to team maintenance.

I have to this point argued that structural cohesion acts as a force that pulls members together to make greater use of teamwork processes and increases team engagement, but that energy and attention must also be directed away from task accomplishment in order to maintain these relationships. I had previously argued that this set of mechanisms contributes to team effectiveness in turn through their balance of team process gains, losses, and team motivation. What I have implicitly described is a model in which team structural cohesion exhibits indirect effects on team performance through its association with these intervening mechanisms. I expect structural cohesion to exhibit positive indirect effects with team performance through its positive relationships with teamwork processes and team engagement, while I expect it to exhibit a negative indirect effect through its positive relationship with team maintenance.

Hypothesis 7: Structural cohesion has positive indirect relationships with team performance, as mediated by (a) its positive relationship with teamwork and (b) its positive relationship with team engagement, and (c) a negative indirect relationship with team performance, as mediated by its positive relationship with team maintenance.

Negative Multiplex Density (Structural Repulsion)

Just as positive multiplex density impacts performance because it builds a team's social capital, negative multiplex density reduces performance because it creates team "social liabilities" (Labianca and Brass, 2006) described as decrements to the availability and use of the potential resources available to a team resulting from structures of increasingly strong, direct negative relationships between team members. The presence of negative relationships between team members that must work together impedes their exchange of performance-enhancing information and may also result in covert and overt behaviors, such as attempts to harm each other (Pondy, 1967; Pruitt & Rubin, 1986), that are disruptive to accomplishing work and achieving goals (Labianca & Brass, 2006).

In addition, Labianca and Brass (2006) do not equate negative multiplex relationships with conflict episodes but argue instead that they may lead to conflict and other behaviors such as avoidance efforts and workflow redesigns that will have negative repercussions for the team. In these situations team members are more likely to find ways to operate as individuals attempting to avoid getting in one another's way rather than to attempt to enhance their performance as a group (Maslach & Leiter, 1997). Langfred (2007) provided empirical evidence supporting this line of reasoning, showing that self-managing team members unintentionally restructured their workflow processes inefficiently as a response to conflict. Because of negative multiplex relationships, team members may ignore or retreat from setting goals and making plans to achieve them during transition phases; they may give less attention during action phases to tracking and communicating information related to performance progress, failing to give needed assistance to each other as a result; and they may have greater difficulties managing the interpersonal tensions and confidence deflations resulting from negative interactions. In sum, structural repulsion pushes team members apart such that it reduces their desire to coordinate their efforts as an integrated work group. Thus, I hypothesize the following:

Hypothesis 8: Structural repulsion is negatively related to teamwork processes.

Team negative multiplex density will also likely be detrimental to team motivation in terms of its members' willingness to invest their energies into team role performances. Kahn (1990) noted that among separate samples of camp counselors and architects, negative interactions among coworkers that communicated a lack of care, appreciation, and respect diminished the parties' sense of meaningfulness and feelings of being valuable and worthwhile. One camp counselor noted that negative interactions diminished his willingness to invest energy in the work as a result, commenting that, “you put the energy where it will be appreciated” (p. 708). In such situations, team members will prefer to be psychologically absent rather than investing energy on the team’s behalf (Kahn, 1990).

Negative multiplex density also erodes the psychological safety in the team as it fosters a threatening and stifling climate where members fear the dangers of taking risks because mistakes will be held against them (Kahn, 1990; Edmondson, 1999). In order to cope with the perceived dangers, team members may adopt a less authentic and more detached approach so as to not run the risk of offending others to the point of reinforcing already negative relationships (Goffman, 1961; Hochschild, 1983). One architect described such an approach with a coworker as “knowing to stay away from him. But the problem is, I have to deal with him… So we interact, but I keep it short… I get monotonic, almost moronic with him” (Kahn, 1990, p. 709).

Negative multiplex density can also reduce members’ perceived availability for investing themselves into role performances as negative relationships can deflate members’ confidence and security that they even have the resources and energy necessary to produce for the team. Strong negative relations between teammates can undermine their self-confidence and their willingness to express themselves because they become increasingly self-conscious and focused on how others perceive them, rather than on how they might contribute to the team (Kahn, 1990). Negative comments about the team’s competence can reduce members’ confidence levels (Marks et al., 2001), leading them in a downward spiral that drags down both team confidence and performance over time (Lindsley, Brass, & Thomas, 1995). In sum, structural repulsion creates a psychologically disadvantageous team climate of reduced meaning, safety, and availability that undercuts members' willingness to invest their energies into active and full team role performances. Thus, I hypothesize the following:

Hypothesis 9: Structural repulsion is negatively related to team engagement.

Negative multiplex density can also be expected to contribute to team maintenance to an even greater degree than positive multiplex density and for different reasons. The demands of social relationships and the patterns of difficult interpersonal communications within them were the original impetus for studying the causes of strain (Maslach, 1993). The social environment for most employees, and for members of teams specifically, is comprised of the day-to-day interactions within their immediate work groups (Maslach & Leiter, 1997). Negative expressive ties among those who must work closely together severely undermine the sense of solidarity and mutual support that are used as resources to accomplish team goals. They are an emotional drain on the energy those team members need for creative and productive task work as the team in conflict works against itself. As these resource bases are fractured, the team members can be expected to more quickly accrue the anxieties and frustrations associated with perceiving that they will be unable to meet the team task demands they must confront.

In this sense, high structural repulsion in the team can be viewed as a team hindrance stressor (Lazarus & Folkman, 1984; LePine et al., 2005), a socially taxing demand that is appraised as having the potential to harm team productivity, growth, and gain, and as a result triggers negative emotions (e.g., fear, anxiety, anger) collectively in the team. These emotions are unpleasant and team members will be required to consume energy coping with them that would otherwise be available for task productive uses. Research has shown that negative social interactions require greater cognitive processing than positive ones (Taylor, 1991; Porath & Erez, 2007) resulting in fewer cognitive resources available for task performance activity. This additional draw on team resources creates a smaller reserve of team energy dedicated to team task performance. In essence, structural repulsion causes team members to waste time and energy dealing with unpleasant interactions rather than accomplishing tasks and goals (Maslach & Leiter, 1997). Thus, a social liability of increasing structural repulsion is that it results in additional team maintenance.

Hypothesis 10: Structural repulsion is positively related to team maintenance.

Taking these arguments together, structural repulsion creates social liabilities for teams in the form of reduced teamwork, reduced team engagement, and increased maintenance. Given the previous arguments that these elements of team process gains, losses, and motivation influence team performance, I expect that team structural repulsion will exhibit indirect effects on team performance through these intervening mechanisms. More specifically, team structural repulsion will have negative indirect relationships with team performance through its negative associations with teamwork processes and team engagement, and through its positive association with team maintenance.

Hypothesis 11: Structural repulsion has negative indirect relationships with team performance, as mediated by (a) its negative relationship with teamwork, (b) its negative relationship with team engagement, and (c) its positive relationship with team maintenance.

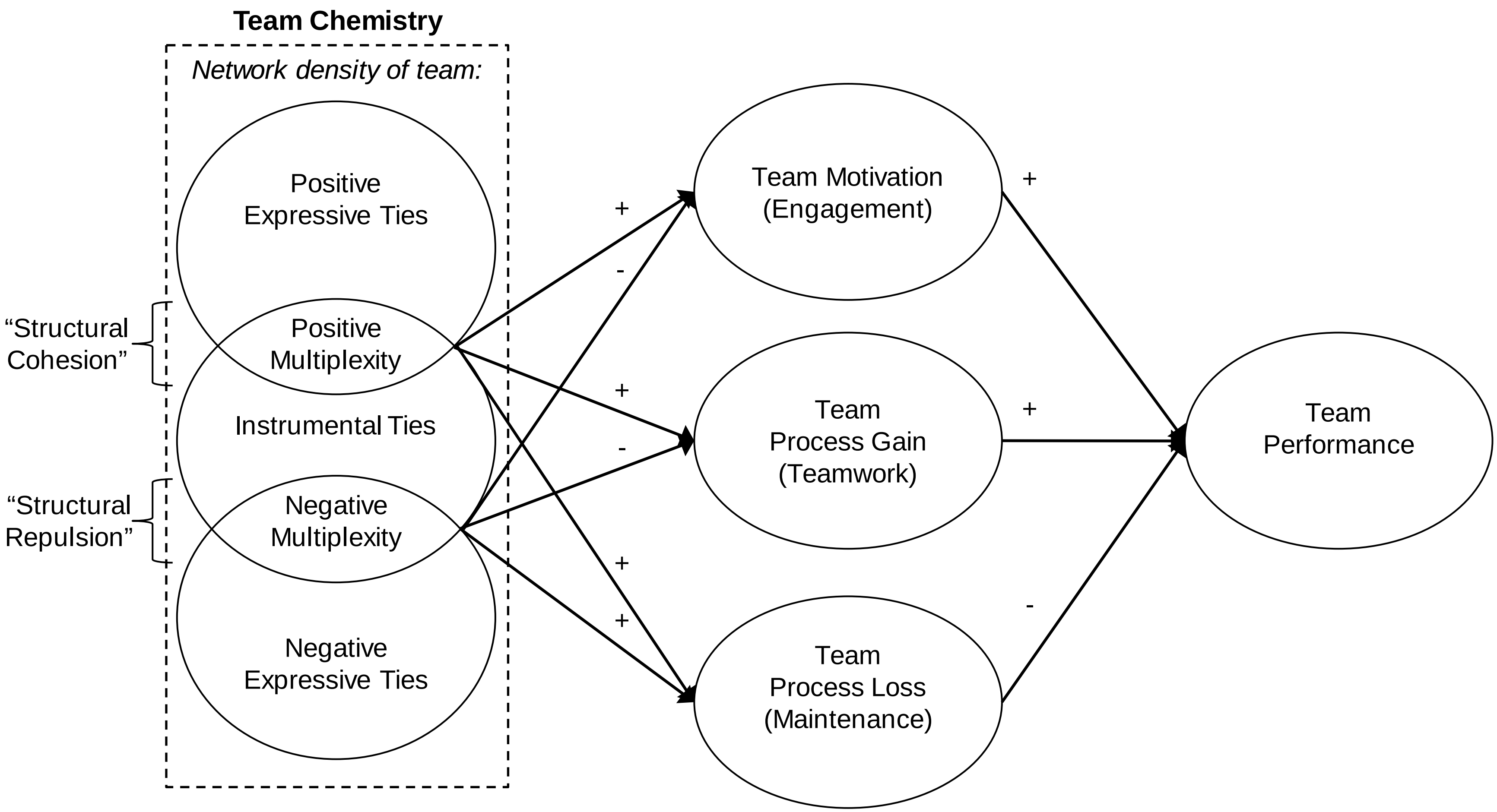

Figure 3-1. Model of hypothesized relationships

CHAPTER 4
METHODS

Sample and Procedure

Students enrolled or beginning enrollment in the Fall 2010 semester in the Master of Business Administration (MBA) programs of a large southeastern university participated in this study. The MBA admissions office requested that the 823 students arranged in 175 teams across 16 MBA programs (including traditional, executive, professional, and distance-Internet programs) participate in the study. Because the research methodology required that as many members as possible from each team complete the surveys, participation was strongly encouraged but remained voluntary and confidential.

Students were asked to complete two surveys. The first was administered during the initial half of the semester and consisted of questions to assess team members' instrumental, positive expressive, and negative expressive ties on a team member by team member basis. This survey also assessed team-level control variables including team member tenure, as well as traditional team-level referent-shift (Chan, 1998) measures of task interdependence and cohesion. The second survey was administered during the latter half of the semester before any final grades were assigned and assessed referent-shift perceptions regarding teamwork processes, team engagement, and team maintenance.

During participant recruiting, participants were informed and gave their consent that, by participating in this study, they would be granting the researchers access to their team project grades as well as their background information that was collected by the MBA office as a part of the admissions process. Participants were assured that only the principal investigator of this study would have access to this information and it would be used exclusively for research purposes. Furthermore, participants were assured that all personally identifying information would be destroyed, such that no participant would be able to be identified based on their responses.

For each of the two rounds of surveys, I sent a personalized email with a unique link and password to each student to access his or her survey. I sent up to four follow-up reminder emails over a period of two weeks following the initial distribution of the survey links to encourage non-respondents to participate. Surveys were completed online (via www.surveygizmo.com) and transmitted to a secure server. A total of 629 of the 823 students completed the first survey for a response rate of 76%. A total of 574 students completed the second survey for a response rate of 70%. To be included in the analysis, teams could be missing no more than one member's response to the first survey involving the network ties, and no more than two members' responses to the second survey involving the team mediators. These inclusion criteria resulted in 109 usable teams composed of 511 individuals for a team response rate of 62%. Average team size was 4.69 members. Respondents were 73% male and 27% female; 65% were Caucasian, 10% were Hispanic, 8% were Asian, 3% were African American, 5% indicated "Other," and the remaining 9% did not specify their ethnicity. Average age was 29.48 years (SD = 5.17).

Following the conclusion of the semester, I contacted each of the 38 professors instructing in the 50 classes for which the participating MBA students were registered to ask for available team project grades to be used as the study's measure of student team performance. I sent up to three reminder emails to professors who did not respond to my initial inquiry. A total of 34 of the 38 professors (representing 43 of the 50 classes) responded for professor response rate of 89% (representing 86% of classes). Of those who responded, 25 professors (representing 31 classes) indicated that they assigned team projects, while 9 professors (representing 12 classes) indicated that they did not. I followed up with the 25 professors who assigned team projects with documentation of the students' signed consents to have their team project grades released to me. Of these 25 professors, 20 (representing 25 classes) provided the student team project grades, while 5 professors (representing 6 classes) were unwilling or unable to provide the team project grades. Thus, team project scores were obtained for 81% of the 31 classes in which team projects were assigned. All 16 cohorts of MBA students had at least one professor provide team project grades. Across all cohorts, in only courses in which team projects were assigned, team-based projects constituted 34% of the students' total work. Across all courses (including those in which no team projects were assigned), team-based projects constituted 23% of the students' total work.

In accordance with students' consent, the MBA admissions office provided student background demographic information collected during the admissions process, including student age, gender, ethnicity, and Graduate Management Admissions Test (GMAT) composite score. After matching this information with the students' survey responses as well as the provided team project scores, all personally identifying information was destroyed such that students and teams were only identified by anonymous identification codes.

Measures

Network Relations

I used a roster method to collect complete within-team relations among team members whereby each team member was presented a list of his or her teammates and was asked to assess the extent to which they have instrumental, positive expressive, and negative expressive ties with each other team member (1 = To a very small extent, 2 = To a small extent, 3 = To some extent, 4 = To a regular extent, 5 = To a good extent, 6 = To a great extent, 7 = To a very great extent, NA = 0 = Does not apply). The raw data collected from the respondents was used to create three independent team networks corresponding to instrumental ties, positive expressive ties, and negative expressive ties. Square matrices were created for each network as an array of cells with the random identification numbers of team members listed as labels for both the rows and columns (Scott, 2000). By convention, the value in each cell corresponds to the response of the person listed in the cell row about the person listed in the cell column, or in other words, the row person is rating his or her relationship with the column person.

Instrumental networks

To assess team instrumental networks, I asked each team member to indicate for every other team member “how much do you interact with this teammate to get your group work done (e.g., communicating either in person, on the phone, or via email, webinar, or video conferencing)?” This measure of work-related communication frequency is similar to that used by Reagans and Zuckerman (2001), Reagans et al. (2004), and Cummings and Cross (2003).

Positive expressive networks

The most common positive expressive network is that of friendship. To measure friendship relations, I asked team members to indicate for every other team member "to what extent would you say you are friends with this teammate (for example seeing them socially outside of class, sharing extra-curricular hobbies, or confiding in them about personal matters)?" The additional stipulation clarifying what is meant by friendship is included to ensure greater consistency in respondents' understanding of the definition of friendship (Fischer, 1982). In addition, because Baker et al. (2003) suggested that measures of positive expressive networks include other types of positive ties, I also measured liking relations ("How much do you like this teammate [by 'liking,' I mean thinking about this person helps you feel positive, upbeat, and energized]?") and trust relations ("How much do you trust this teammate [that is, you would be willing to depend on this person without having a way to check up on them]?"). In the same way that confirmatory factor analysis (CFA) can be conducted on individual items of scales to confirm the extent to which they measure a common underlying construct, a CFA can be conducted on individual network relations to gauge the extent to which they measure the same underlying connection between actors. Thus, given appropriate confirmatory evidence, the three positive relations will be averaged to create a single network of positive expressive ties.

Negative expressive networks

Negative expressive networks are less commonly studied, but these relations can include adversarial networks (e.g., Baldwin et al., 1997), as well as more direct measures of negative affective exchanges such as dislike and distrust (Labianca & Brass, 2006). To measure adversarial relations, I asked respondents to indicate in regards to every other team member “to what extent would you say you have a difficult relationship with this teammate (for example your personalities clash, you feel tension between you, or you tend to disagree or argue)?” To measure disliking relations, I asked, “How much would you say you dislike this teammate (by ‘disliking,’ I mean thinking about this person really drains, annoys, or de-energizes you)?” To measure distrust relations, I asked “How much do you distrust this teammate (that is, you have to monitor them, or you’d feel safer having things in your own hands rather than under this person’s control)?”). Given appropriate confirmatory evidence from a network CFA, the three negative relations will be averaged to create a single network of negative expressive ties.

Positive and negative multiplex networks

After creating the instrumental, positive expressive, and negative expressive networks, I calculated positive and negative multiplex networks. Calculating multiplexity can be done in two ways. The first, used by Methot (2010), involves dichotomizing the valued data in the instrumental, positive expressive, and negative expressive networks at a given value such that responses greater than or equal to that value indicate the presence of a tie and responses less than that value indicate the absence of the tie. The positive multiplex network would then be created by combining the instrumental and positive expressive matrices such that in the resulting multiplex matrix, a zero (0) indicates there is neither an instrumental nor a positive expressive tie; a one (1) indicates there is an instrumental but not a positive expressive tie; a two (2) indicates there is a positive expressive tie but not an instrumental tie; and a three (3) indicates there is both an instrumental and a positive expressive tie—a positive multiplex tie. The same procedure would be used to combine the instrumental and negative expressive networks to create the negative multiplex network. Combining the multiple relations in this way yields a qualitative typology of the kinds of network relations that are present among the actors or nodes (Hanneman & Riddle, 2005). Methot notes, however, that the values in the combined matrices do not represent the strength of a tie (such that a zero would be the weakest form and a three would be the strongest). Rather, they are nominal values that simply distinguish between the qualitative types of ties that exist between a pair of actors. The disadvantage of this approach is that it sacrifices variance by having to dichotomize the network relation data.

An alternative approach, used by Parise and Rollag (2010), allows the researcher to preserve the tie strength values (as opposed to dichotomizing for presence versus absence) by combining the instrumental and expressive matrices using cell-wise matrix multiplication. In this approach, the value of the cell corresponding to two actors in the instrumental matrix is multiplied by the value of the cell corresponding to the two actors in the expressive matrix, and the resulting value gives an indication of the strength of their multiplex interaction. For positive multiplexity, the strength values would be indicated as follows:

- 7 X 7 = 49: means that the person had very strong instrumental ties with someone whom they also had very strong positive expressive ties.
- 7 X 0 = 0: means that the person had very strong instrumental ties with someone whom they had no positive expressive ties.
- 0 X 7 = 0: means that the person had no instrumental ties with someone whom they had very strong positive expressive ties.
- 0 X 0 = 0: means that the person had neither instrumental nor positive expressive ties with the other.
- 4 X 4 = 16: means that the person had regular instrumental ties with someone whom they also had regular positive expressive ties.

For negative multiplexity, the strength values would be indicated as follows[4]:

- 7 X -7 = -49: means that the person had very strong instrumental ties with someone whom they also had very strong negative expressive ties.
- 7 X 0 = 0: means that the person had very strong instrumental ties with someone whom they had no negative expressive ties.
- 0 X -7 = 0: means that the person had no instrumental ties with someone whom they had very strong negative expressive ties.
- 0 X 0 = 0: means that the person had neither instrumental nor negative expressive ties with the other.
- 4 X -4 = -16: means that the person had regular instrumental ties with someone whom they also had regular negative expressive ties.

Structural cohesion and repulsion

I then calculated structural cohesion as the valued density of the within-team positive multiplex network for each team, respectively. I calculated structural repulsion as the valued density of the within-team negative multiplex network for each team likewise. The valued density measure accounts for both the number and strength of each multiplex tie as a proportion of all possible multiplex ties in the network. Because the network data was directed, the maximum number of possible ties for each team network was ($N^2 – N$) as opposed to ($N^2 – N$)/2 for undirected (or symmetrized) data. Thus, in a team of five members, there were 20 possible ties of each type of multiplexity, both positive and negative. The multiplex density calculation sums the values of the team members' multiplex ties and divides it by their maximum number, such that the valued positive multiplex density ranges from 0, no positive multiplex relations between team members; to 49, maximum strength positive multiplex relations

[4] For didactical clarity, I present these values as negative. However, because of network software requirements, these values were treated as positive numbers in the analysis, such that a higher positive number indicated a stronger negative multiplex relationship.

between all team members. Likewise the valued negative multiplex density ranges from 0, no negative multiplex relations between team members; to -49, maximum strength negative multiplex relations between all team members[5].

Team Perceptions

Team perceptions were modeled using a referent-shift consensus composition model of emergence (Chan, 1998) in which team members rated their perceptions of the team or its members generally in regards to the following variables.

Teamwork processes

Teamwork processes were assessed with 27 items from Mathieu and Marks' (2006) measure of the Marks et al. (2001) teamwork processes. Example transition process items include asking members to rate to what extent their team actively worked to "Identify our main tasks," "Set goals for the team," "Ensure that everyone on our team clearly understands our goals," and "Develop an overall strategy to guide our team activities." Example action process items include to what extent the team actively worked to "regularly monitor how well we are meeting our team goals," "Monitor and manage our resources," "Develop standards for acceptable team member performance," "Assist each other when help is needed," "Balance the workload among our team members," "Smoothly integrate our work efforts," and "Coordinate our activities with one another." Example interpersonal process items include to what extent the team actively worked to "Deal with personal conflicts in fair and equitable ways," "Maintain group harmony," "Develop confidence in our team's ability to perform well,"

[5] Once again, for didactical clarity, I present these values as negative. However, as before, these values were treated as positive numbers in the analysis, such that a higher positive number indicated greater negative multiplex density.

“Encourage each other to perform our very best,” and “Keep a good emotional balance in the team.” All items were assessed on a seven-point scale (1 = To a very small extent, 2 = To a small extent, 3 = To some extent, 4 = To a regular extent, 5 = To a good extent, 6 = To a great extent, 7 = To a very great extent). Cronbach alpha reliability for this scale at the individual team-member level was .97. A high level of within-group agreement (median r_{wg} = .81) and significant intra-class correlation coefficients (ICC[1] = .20; ICC[2] = .50) justify aggregating the individual referent-shift ratings to the team level.

Team engagement

Team engagement was measured with the Rich et al. (2010) job engagement scale with 20 items adapted for use at the team level. Team physical engagement is indicated by six items asking respondents to rate their extent of agreement as to, when the team members do their group project work, whether “We work with high intensity,” “We exert our full effort,” “We devote a lot of our energy,” “We try our hardest to perform well,” “We strive as hard as we can to complete our project work,” and “We exert a lot of energy.” Team cognitive engagement is indicated by six items including “We are mentally focused,” “We give our full attention to our assignments,” “We think hard about our projects,” “We concentrate completely,” “We are focused on the group project work we do,” and “We pay a lot of attention to our assignments.” Team emotional engagement is indicated by eight items including “We are emotionally connected,” “We put our emotions into what we do,” “We are really into our projects,” “We really care about what we do,” “We put our feelings into our projects,” “We bring a lot of passion,” “We work with a sense of excitement,” and “We are enthusiastic.” All items were assessed on a seven-point scale (1 = Strongly disagree, 2 = Moderately disagree, 3 =

Slightly disagree, 4 = Neutral, 5 = Slightly agree, 6 = Moderately agree, 7 = Strongly agree). Cronbach alpha reliability for this scale at the individual team-member level was .97. A high level of within-group agreement (median r_{wg} = .81) and significant intra-class correlation coefficients (ICC[1] = .13; ICC[2] = .36) justify aggregating the individual referent-shift ratings to the team level.

Team maintenance

Team maintenance was measured with five items created specifically for this study including “Building relationships with my team members takes a lot of time,” “Maintaining relationships among team members uses up a lot of our energy,” “It is difficult to maintain friendships with teammates,” “Interpersonal interactions in our team can distract us from accomplishing our tasks,” and “Maintaining our team's relationships takes time away from getting our work done.” All items were assessed on a seven-point scale (1 = Strongly disagree, 2 = Moderately disagree, 3 = Slightly disagree, 4 = Neutral, 5 = Slightly agree, 6 = Moderately agree, 7 = Strongly agree). Cronbach alpha reliability for this scale at the individual team-member level was .85. This scale also exhibited a high level of within-group agreement (median r_{wg} = .76), but the intra-class correlation coefficients (ICC[1] = .06; ICC[2] = .20) were lower than those of other reported variables, indicating that although teams tended to agree on their characteristic levels of team maintenance, team maintenance exhibited less between-team variability than did other variables. However, Bliese (2000) noted that ICC(1) values are commonly observed in the range of .05 to .20, and that ICC(2) values typically range from .00 to .50. Taken together then, this evidence suggests it is also appropriate to aggregate these individual referent-shift ratings to the team level.

Team Performance

Team performance was measured as the average of student team project scores across classes. As described earlier, team project grades were provided for 81% of the classes in which team projects were assigned. Within each of the 16 cohorts, students functioned as consistent team members in each of their classes, ensuring that team membership was constant across all assigned projects. Projects were generally graded on a 100-point scale, and in the limited cases where a different scale was used (e.g., graded on a 10-point or 50-point scale) I arithmetically converted the scores to a 100-point scale.

Control Variables

I controlled for several team characteristics that might provide alternative explanations of team performance. First, I considered team tenure, since the amount of time members have worked together may have impacted the formation and cultivation of their interpersonal relationships, as well as their performance on team projects. I asked each team member to indicate, in months, how long they had been teammates with every other member of the team (acknowledging that some team members may have switched prior to the semester of study). I then averaged these person-by-person tenures to create an index of team tenure. To control for any demographic differences in performance, I considered team composition characteristics including the percentage of the team that was male as well as the percentage of the team that was Caucasian. Also, in order to control for the simple explanation that smarter teams are higher performing teams, I controlled for team cognitive ability by including the team average GMAT score. Next, because the task structure of the assigned team projects might influence the extent to which team members interact to accomplish their work, I controlled for team members' perceptions of task interdependence using a three-item scale from Campion et al. (1993). Items include, "I cannot accomplish my tasks without information or materials from other members of my team," "Other members of my team depend on me for information or materials needed to perform their tasks," and "Within my team, tasks performed by team members are related to one another." Items were assessed on a seven-point scale (1 = Strongly disagree, 2 = Moderately disagree, 3 = Slightly disagree, 4 = Neutral, 5 = Slightly agree, 6 = Moderately agree, 7 = Strongly agree). Cronbach alpha reliability for this scale at the individual team-member level was .66. A high level of within-group agreement (median r_{wg} = .75) and significant intra-class correlation coefficients (ICC[1] = .11; ICC[2] = .34) justify aggregating the individual ratings to the team level. Finally, in order to examine the non-redundancy of the configural network approach to team interactions, I also controlled for a traditional composition model of shared perceptions of self-reported team cohesion an eight-item scale from Dobbins and Zaccaro (1986). Items were measured on the same seven-point scale as task interdependence, and included, "If given the chance, I would choose to leave my team to join another" (reverse-scored), "The members of my team get along well together," "The members of my team will readily defend each other from criticism by outsiders," "I feel that I am really a part of my team," "I look forward to being with the members of my team each day," "I find that I generally do not get along with the other members of my team" (reverse-scored), "I enjoy belonging to this team because I am friends with many team members," and "The team which I belong to is a close one." Cronbach alpha reliability for this scale at the individual team-member level was .90. A high level of within-group agreement (median r_{wg} = .83) and significant intra-class correlation coefficients (ICC[1] = .27; ICC[2] = .61) justify aggregating the individual ratings to the team level.

CHAPTER 5
RESULTS

Network Characteristics

Before examining the social structure of each team in terms of positive and negative multiplex density and its influence on team functioning and team performance, I first examined the descriptive statistics and correlations among the networks themselves across all teams. These results, presented in Table 5-1, indicate that instrumental ties (Interact, mean = 4.82, s.d. = 1.44) and positive expressive ties (Like, mean = 5.29, s.d. = 1.47; Trust, mean = 5.50, s.d. = 1.54; Friends, mean = 3.89, 1.98) occurred with greater strength and frequency than did negative expressive ties (Dislike, mean = 0.73, s.d. = 1.14; Distrust, mean = 0.96, s.d. = 1.41; Difficult, mean = 0.72, s.d. = 1.06). Of note, although the average value of the negative expressive ties is low, the standard deviations of these ties are similar to those of the instrumental and positive expressive ties. Also, the minimum and maximum values (not reported in the table) for all of the seven networks were 0 and 7, respectively, indicating that the full range of each rating scale was used in regard to each network including the negative expressive ties. Taken together, these descriptive suggest that when individuals had negative expressive relationships with other team members, they were willing to indicate it at least to some extent.

The correlations between the networks indicate that positive expressive ties were positively related to instrumental ties (average correlation = .49), while negative expressive ties were negatively related to instrumental ties (average correlation = -.28). The average correlation among the positive expressive ties was .56, while the average correlation among the negative expressive ties was .59. The average correlation between the positive and negative expressive ties was -.37. This pattern of correlations indicates that positive expressive ties and negative expressive ties tended to be more strongly related within the positive and negative categories than between them. This pattern also indicates that, while positive and negative expressive networks are negatively related, the magnitude of this relation is small enough to suggest that a substantial portion of these relationships may co-occur. In this regard, the correlations between mirrored-opposite networks are also revealing. Compared to the range of correlations where 0.00 indicates independence and -1.00 indicates a perfect negative relationship, the magnitudes of these correlations would seem to indicate that, of the three pairs, trust versus distrust comes closest to measuring strict opposites (correlation = -.62), while friend versus difficult appear to be measuring more independent networks (correlation = -.19). The correlation between like and dislike networks was -.49. However, even the large negative relationship between trust and distrust networks is only 62% of the way toward perfect negative collinearity, indicating that there is still substantial room for these relations to occur independently.

While many of the correlations in Table 5-1 appear to be large in magnitude, the question remains as to whether these correlations could simply be observed by random chance. To answer this question, I needed to compare my observed correlation to the standard error of a sampling distribution of correlations that one would expect from repeated sampling. However, in this case classical formulas underestimate the standard error because my network data violates assumption of independence. Underestimates of the standard error increase the likelihood of making a Type I error, or concluding that two network relations are significantly associated when the association could be driven by chance. The appropriate alternative to test for network associations and correctly estimate standard errors is called “Quadratic Assignment Procedure” or QAP correlation (Hanneman & Riddle, 2005). To conduct this procedure, I used a non-parametric bootstrapping method to generate 20,000 random sub-samples of my network data, and the correlations from each of the 20,000 sub-samples were used to estimate a sampling distribution of correlations for each network. To test the hypothesis that there is an association between networks, I compared the observed correlation to the sampling distribution of correlations generated from the random sub-sampling of networks. The proportion of correlations as large as (or as small as in the case of negative correlations) indicates the probability of obtaining my observed correlation by chance. Results of these QAP correlation tests indicate that, of the correlations presented in Table 5-2, the probability of observing the correlation by chance was less than .05 only for liking and trust network ties. The probability of observing the correlation by chance was less than .10 for interact and liking ties, for interact and trust ties, for liking and friend ties, for liking and dislike ties, for trust and distrust ties, for dislike and distrust ties, and for dislike and difficult ties. Taken together, this pattern indicates that although the magnitude of the correlations between the networks on the whole appears to be large, a significant proportion of these correlations have a decent probability of merely occurring because of random chance. Thus, this evidence would suggest that each of these types of networks captures unique information about the social relationships that team members have amongst themselves.

Network Measurement Model

As I indicated earlier, I conducted a CFA to confirm the extent to which liking, trust, and friendship networks reflected a common underlying relation of positive expressive ties, and the extent to which disliking, distrust, and difficult networks reflected a common underlying relation of negative expressive ties. To conduct this analysis, I specified four models to test the factor structure of my measured networks using MPlus 4.0 (Muthén & Muthén, 2006). In Model 1, I specified three factors: Instrumental, Positive Expressive, and Negative Expressive, which were allowed to correlate. I then loaded each network onto its corresponding higher order factor. The instrumental factor was indicated by the interaction network only (by fixing the residual variance of the interact network to 0); the positive expressive factor was indicated by liking, trust, and friendship networks; the negative expressive factor was indicated by disliking, distrust, and difficult networks. In Model 2, I estimated a two-factor model by combining the instrumental and positive expressive factors. In Model 3, estimated a two-factor model by combining the positive expressive and negative expressive factors. In Model 4, estimated a single factor model reflected by all seven networks. As can be seen by the fit statistics presented in Table 5-2, Model 1 consisting of three factors produced the best fit in an absolute and relative sense (χ^2 [12] = 148.12; CFI = .91; SRMR = .063; RMSEA = .149). Factor loadings of the like (.86), trust (.81), and friend (.59) networks on the positive expressive factor were strong and significant at $p < .01$. Factor loadings of the dislike (.86), distrust (.73), and difficult (.72) networks on the negative expressive factor were also strong and significant at $p < .01$. Specifying either two-factor model (M2 to M1 $\Delta\chi^2$ [1] = 3.22, $p = .07$; M3 to M1 $\Delta\chi^2$ [2] = 223.23, $p < .01$), or a one-factor model ($\Delta\chi^2$ [2] = 223.23, $p < .01$) resulted in significant decrements in fit of the estimated model with the underlying data. Based on this confirmatory evidence, I averaged the like, trust, and friendship networks to create the positive expressive network, and I averaged the dislike, distrust, and difficult networks to create the negative expressive network.

Mediator Measurement Model

Consistent with convention, I also assessed the fit of the data involving the team mediators to a measurement model prior to assessing their substantive relationships with the network variables and team performance. In Model 1, I loaded each individual item onto its corresponding higher order factor (teamwork, team engagement, and team maintenance), which, by default, I allowed to correlate. As the fit statistics in Table 5-3 indicate, Model 1 fit the data fairly well (χ^2 [1,271] = 3262.51; CFI = .72; SRMR = .082; RMSEA = .120). Additionally, all of the loadings of the items onto their respective latent variables, shown in Table 5-4, were statistically significant and strong (average estimate/standard error = 9.04; average loading = .80). I also compared this model to four other more parsimonious models that combined latent constructs to assess discriminant validity of the latent variables. In the alternative models, I combined team engagement and teamwork (Model 2), team engagement and team maintenance (Model 3), teamwork and team maintenance (Model 4), and all three mediators into a single factor model (Model 5). The statistics and fit indices in Table 5-3 show that none of the alternative models fit the data as well as the hypothesized model. Chi-square difference tests indicate statistically significant differences in model fit favoring Model 1. Taken together, this analysis supports the adequacy of my measures to test my hypothesized structural relationships.

Descriptive Statistics and Correlations

Table 5-4 reports the means, standard deviations, and zero-order correlations among all study variables. As shown in the table, the study variables (when applicable) each possess an acceptable degree of internal consistency reliability. The exception is the task interdependence control variable that is slightly below the conventional cutoff of .70 at .66. Among the control variables, traditional self-report cohesion is positively related to team tenure, the percentage of the team that is male, the percentage of the team that is Caucasian, and team task interdependence. Between the control variables and the study variables of interest, task interdependence and self-report cohesion are both positively related to team structural cohesion (positive multiplex density), and self-report cohesion is negatively related to team structural repulsion (negative multiplex density). Task interdependence is also positively related to teamwork and team engagement, but it exhibits no significant relationship with team maintenance. Self-report cohesion is also positively related to teamwork and team engagement, and it is negatively related to team maintenance. Of the control variables, only team tenure is significantly associated with team performance. It exhibits a counterintuitive negative relationship, however, such that teams that have been together longer on average tend to be poorer performing teams.

In examining preliminary support for study hypotheses, as expected, structural cohesion (positive multiplex density) is positively related to teamwork and team engagement. Contrary to expectations, structural cohesion is negatively related to team maintenance. As expected, structural repulsion (negative multiplex density) is negatively related to teamwork and positively related to team maintenance; in addition, while it was negatively related to team engagement, this zero-order relationship was not significant. Finally, teamwork, team engagement, and team maintenance are positively related to team performance, but only the relationship of teamwork with team performance approaches significance ($p < .10$).

Analysis of Independence

Because the sample of student teams was drawn from 16 different MBA cohorts, I assessed the possibility of a cohort-level effect distorting variance in the team performance data (such that student team grades could likely be higher or lower by virtue of the lenient, strict, or range restricted grading by the professors associated with the teams' specific MBA cohort class) by conducting a one-way ANOVA to produce estimates of variance in team performance at the team-level within cohorts and between cohorts. Results revealed that MBA cohort membership did in fact explain significant variation in the team performance dependent variable (F [15, 93] = 3.89, $p < .001$; ICC[1] = .30). Thus, because a significant portion of the variance in team performance scores is found between the cohorts relative to within them, the observations of team performance are not independent of cohort membership, and the necessary assumption of independence for ordinary least squares regression is violated. As a result, in testing my hypotheses, I needed to estimate my models using a method that accounts for the clustering of the team performance data by cohort.

Structural Models

I used Mplus 4.0 (Muthén & Muthén, 2006) to estimate structural models to test my hypotheses. Like other structural equation modeling programs, Mplus allows for the simultaneous examination of a model of theoretical relationships while correcting for the biasing effects of measurement error. Unlike other programs, Mplus also has the capability to provide maximum likelihood parameter estimates with standard errors and chi-square test statistics that are robust to the non-independence of nested outcome data. Given non-independence was the case in my data, I estimated structural models with the Mplus multilevel analysis (type = TWOLEVEL; estimation method = MLR) using a categorical identification number to specify each team's cohort membership.

Consistent with the theory outlined above, I specified a partially latent structural model at the team level of analysis where team structural cohesion and team structural repulsion simultaneously predicted teamwork processes, team engagement, and team maintenance, which in turn predicted team performance. I also included the control variables team tenure, percent male, percent Caucasian, team average GMAT, task interdependence, and self-report cohesion as independent predictors of team performance. To correct for measurement unreliability in teamwork processes, team engagement, team maintenance, task interdependence, and self-report cohesion, I set the residual variances of these factors equal one minus Chronbach's alpha reliability for the corresponding scale reported in Table 5-5. I first specified a model including both direct and indirect paths from the network variables to team performance (Model 1) and a second, more parsimonious model eliminating the direct paths from the network variables to team performance (Model 2). This latter model corresponds exactly to the hypothesized model. Comparing Model 2 to Model 1 tests whether significant direct effects remain between the network variables and team performance after including the mediators. A statistically non-significant decrement in fit would provide evidence for full mediation of the network variable effects, while a statistically significant decrement in fit would imply partial mediation, provided that the indirect effects through the mediators are statistically significant. Results reported in Table 5-6 indicate that the fit of Model 1 (χ^2 [21] = 75.26; CFI = .79; SRMR = .086; RMSEA = .154) is very similar to that of

Model 2 (χ^2 [23] = 79.81; CFI = .78; SRMR = .087; RMSEA = .151). Because the MLR estimation method's chi-square test statistics are only asymptotically (rather than exactly) distributed according to a regular chi-square distribution, the chi-square statistics for the comparison and nested models must be corrected by their respective scaling factors when testing for significant decrements in fit. For this reason the chi-square test statistic is slightly adjusted from the simple difference between the chi-squares reported in Table 5-6. The scaled chi-square difference test ($\Delta\chi^2$ [2] = 3.37, p = .19) indicates that there was no significant decrement in model fit of the hypothesized Model 2 with the direct paths from the network variables to team performance removed relative to the fit of Model 1 with the direct paths included. As a result, all hypotheses were tested on the more parsimonious Model 2 where the direct paths from the network variables to team performance were removed.

Tests of Hypotheses for Team Synergy and Performance

The standardized path estimates from Model 1 are depicted in Figure 5-1. These estimates indicate support for Hypothesis 1 in that the path from teamwork processes to team performance (β = .40, p < .05) was positive and statistically significant. Hypotheses 2 and 3 were not supported, however. Contrary to expectations, team maintenance was positively related to team performance (β = .17, p < .05), while team engagement was negatively related to team performance (β = -.18, p < .05). While these estimates are statistically significant, the hypotheses are not supported because the estimates are in the opposite direction of what I hypothesized. Thus, my results supported my expectation that teams reporting more extensive use of teamwork would have higher levels of performance. On the other hand, my results did not support my expectations that teams exhibiting higher levels of team motivation, and that were able to focus less time and energy on relationship maintenance would have higher levels of performance. Instead, the opposite was the case. Teams reporting higher motivation in the form of greater team engagement exhibited lower performance, while teams reporting increased levels of time and attention toward maintaining team relationships exhibited higher performance. However, before concluding that team motivation in the form of team engagement is negatively associated with team performance, it is important to note that the estimated relationship may actually be an artifact of multicollinearity between team engagement and teamwork processes as the zero-order correlation between these two study variables reported in Table 5-5 is quite high (r = .72, $p < .01$). Accordingly, the estimated negative relationship is more likely a statistical artifact rather than a substantive relationship.

Tests of Hypotheses for Structural Cohesion to Team Synergy

Standardized path estimates in Figure 5-1 provided support for Hypothesis 4 in that the path from structural cohesion to teamwork processes ($\beta = .53$, $p < .05$) was positive and statistically significant. This provides support for my expectation that increasing structural cohesion facilitates coordination, communication, and information sharing reflected in the effective use of teamwork processes. Hypothesis 5 was also supported in that the path from structural cohesion to team engagement ($\beta = .44$, $p < .05$) was positive and statistically significant. This supported my expectation that increasing density of high-quality positive multiplex connections in the team would be associated with team members' collective willingness to invest greater amounts of physical, cognitive, and emotional energy into team role performance. Contrary to my expectations, Hypothesis 6 was not supported. Although the path from structural cohesion to team maintenance was significant ($\beta = -.29$, $p < .05$), it was in the opposite direction of my expectation. While I expected that structural cohesion would have drawbacks in the form of extra time and energy required to maintain those social connections (a positive hypothesized relationship), the relationship was actually negative in that teams that reported stronger positive multiplex ties apparently viewed maintaining those ties as less burdensome.

Tests of Hypotheses for Structural Repulsion to Team Synergy

Standardized path estimates in Figure 5-1 indicated support for Hypothesis 8 in that the path from structural repulsion to teamwork processes ($\beta = -.26$, $p < .05$) was statistically significant and negative. This provided support for my expectation that teams with increasing prevalence of strong negative relationships between team members would impede their exchange of information and work-related communication important for coordinating teamwork activity. Hypothesis 9 was supported in that the path from structural repulsion to team engagement ($\beta = -.15$, $p < .05$) was negative and statistically significant. This result was consistent with my expectation that negative multiplexity would be detrimental to team members' willingness to invest their energies into active, complete team role performances. Hypothesis 10 was also supported in that the path from structural repulsion to team maintenance ($\beta = .29$, $p < .05$) was positive and statistically significant. This indicates that, consistent with my expectation, negative multiplexity is also detrimental in that it additionally taxes team members' energy and resources that must be devoted to coping with unpleasant team interactions rather than to activities focused on team task accomplishment.

Tests of Indirect Effects

Estimates of indirect effects of structural cohesion and structural repulsion on team performance through the three proposed mediators are presented in Table 5-7.

Hypothesis 7a was supported in that the indirect effect through teamwork processes (β = .21, $p < .05$) was positive and significant. Hypothesis 7b was not supported in that the indirect effect of structural cohesion on team performance through team engagement was actually negative (β = -.08, $p < .05$) when I expected a positive relationship. This is due to the unexpected negative relationship between team engagement and team performance. Next, although Hypothesis 7c technically was supported in that I found an offsetting negative indirect effect of structural cohesion on team performance through team maintenance (β = -.05, $p < .05$), the observed negative indirect effect was created from the unexpected negative association of structural cohesion with team maintenance, and the unexpected positive association of team maintenance with team performance. Taken together, the product of these two direct effects still resulted in the expected negative indirect effect but for precisely the opposite reasons. I expected teams with increasing structural cohesion to need to devote increased energy and attention to maintaining those relationships and the maintenance of those relationships to be detrimental for team performance. Instead, structural cohesion was associated with less team maintenance, and the resulting decrease in team maintenance was associated with decreased team performance. Thus, support for Hypothesis 7c was qualified in that although it was statistically supported, it was not logically supported. Taken together, results for structural cohesion in this study indicate that it was only positively associated with team performance through its relationship with teamwork processes.

Turning to structural repulsion, Hypothesis 11a was supported as evidenced by the indirect effect of structural repulsion on team performance through teamwork processes (β = -.11, p < .05) that was negative and significant. On the contrary, Hypothesis 11b was not supported as indicated by the non-significant indirect effect through team engagement (β = .03, p > .05). Hypothesis 11c was also not supported as indicated by the non-significant indirect effect through team maintenance (β = .05, p > .05). Thus, it appears that structural repulsion is negatively associated with team performance, but the indirect effect is manifest in this study only through its negative association with teamwork processes. The non-significant chi-square difference test in favor of the more parsimonious structural Model 2 over structural Model 1 indicated that there were no significant decrements in fit after removing the direct paths from structural cohesion and structural repulsion to team performance. Thus, the effects of structural cohesion and structural repulsion on team performance were fully mediated, and it appears that this mediation occurs primarily through the teamwork processes mechanism. Finally, as shown in Figure 5-1, the study variables including the controls jointly explained 31% of the variance in team performance.

Table 5-1. Descriptive statistics and correlations for networks

	Mean	s.d.	1	2	3	4	5	6	7
1. Interact	4.82	1.44	--						
2. Like	5.29	1.47	.54†	--					
3. Trust	5.50	1.54	.53†	.68*	--				
4. Friends	3.89	1.98	.40	.56†	.44	--			
5. Dislike	.73	1.14	-.29	-.49†	-.47	-.24	--		
6. Distrust	.96	1.41	-.38	-.44	-.62†	-.25	.61†	--	
7. Difficult	.72	1.06	-.18	-.34	-.31	-.19	.65†	.51	--

n = 511 nodes reporting between 1,691 and 1,705 ties for each network. Correlation significance values obtained from quadratic assignment procedure (QAP) correlation test based on 20,000 permutations.
* $p < .05$, one-tailed; † $p < .10$, one-tailed.

Table 5-2. Network measurement model

Structure	χ^2	*df*	CFI	SRMR	RMSEA	$\Delta\chi^2$ (*df*)
Model 1: 3 Factors	148.12*	12	.91	.063	.149	
Model 2: 2 Factors, I & PE combined	151.34*	13	.91	.064	.144	3.22 (1)†
Model 3: 2 Factors, PE & NE combined	371.35*	14	.77	.100	.223	223.23 (2)*
Model 4: 1 Factor	371.35*	14	.77	.100	.223	223.23 (2)*

n = 511. I, instrumental network; PE, positive expressive network; NE, negative expressive network. CFI, comparative fit index; SRMR, standardized root mean square residual; RMSEA, root-mean-square error of approximation. $\Delta\chi^2$ tests relative to Model 1. * $p < .05$; † $p = .07$

Table 5-3. Mediator measurement model

Structure	χ^2	*df*	CFI	SRMR	RMSEA	$\Delta\chi^2$ (*df*)
Model 1: 3 Factors	3,262.51*	1,271	.72	.082	.120	
Model 2: 2 Factors, TE & TW combined	4,240.02*	1,273	.59	.110	.146	977.51 (2)*
Model 3: 2 Factors, TE & TM combined	3,492.29*	1,273	.69	.089	.126	229.78 (2)*
Model 4: 2 Factors, TW & TM combined	3,469.67*	1,273	.69	.084	.126	207.16 (2)*
Model 5: 1 Factor	4,450.48*	1,274	.56	.111	.151	1187.97 (3)*

n = 109. TE, team engagement; TW, teamwork; TM, team maintenance. CFI, comparative fit index; SRMR, standardized root mean square residual; RMSEA, root-mean-square error of approximation. $\Delta\chi^2$ tests relative to Model 1. * $p < .05$

Table 5-4. Study items and factor loadings

Team engagement	Factor loading
We work with high intensity.	.84
We exert our full effort.	.89
We devote a lot of our energy.	.86
We try our hardest to perform well.	.84
We strive as hard as we can to complete our project work.	.82
We exert a lot of energy.	.85
We are mentally focused.	.85
We give our full attention to our assignments.	.87
We think hard about our projects.	.84
We concentrate completely.	.84
We are focused on the group project work we do.	.92
We pay a lot of attention to our assignments.	.89
We are emotionally connected.	.72
We put our emotions into what we do.	.68
We are really into our projects.	.85
We really care about what we do.	.79
We put our feelings into our projects.	.67
We bring a lot of passion.	.85
We work with a sense of excitement.	.80
We are enthusiastic.	.78

Teamwork	
To what extent does your team actively work to…	
Identify our main tasks?	.67
Identify the key challenges that we expect to face?	.68
Determine the resources that we need to be successful?	.79
Set goals for the team?	.76
Ensure that everyone on our team clearly understands our goals?	.80
Set specific timelines for each of our goals?	.72

Table 5-4. Continued.

Develop an overall strategy to guide our team activities?	.80
Prepare contingency ("if-then") plans to deal with uncertain situations?	.69
Know when to stick with a given working plan, and when to adopt a different one?	.79
Regularly monitor how well we are meeting our team goals?	.79
Use clearly defined metrics to assess our progress?	.72
Know whether we are on pace for meeting our goals?	.80
Develop standards for acceptable team member performance?	.71
Balance the workload among our team members?	.71
Assist each other when help is needed?	.82
Communicate well with each other?	.90
Smoothly integrate our work efforts?	.88
Coordinate our activities with one another?	.91
Deal with personal conflicts in fair and equitable ways?	.78
Show respect for one another?	.81
Maintain group harmony?	.88
Take pride in our accomplishments?	.79
Develop confidence in our team's ability to perform well?	.88
Encourage each other to perform our very best?	.84
Share a sense of togetherness and cohesion?	.91
Manage stress?	.86
Keep a good emotional balance in the team?	.86
Team maintenance	
Building relationships with my team members takes a lot of time.	.87
Maintaining relationships among team members uses up a lot of our energy.	.95
It is difficult to maintain friendships with teammates.	.62
Interpersonal interactions in our team can distract us from accomplishing our tasks.	.50
Maintaining our team's relationships takes time away from getting our work done.	.66

n = 109. All factor loadings are significant at $p < .01$.

Table 5-5. Descriptive statistics and correlations for study variables

	Mean	s.d.	1	2	3	4	5	6	7	8
1. Team tenure in months	9.55	6.02	--							
2. Percent male	0.73	0.18	-.01	--						
3. Percent Caucasian	0.65	0.26	.10	-.13	--					
4. Team average GMAT	600.48	42.41	-.12	.13	.14	--				
5. Task interdependence	4.73	0.72	-.14	.04	-.05	.05	(.66)			
6. Self-report cohesion	5.89	0.67	.25**	.24*	.20*	.05	.27**	(.90)		
7. Structural cohesion	22.45	6.77	-.03	.14	-.03	.00	.37**	.61**	--	
8. Structural repulsion	3.09	2.01	-.09	-.10	-.06	.05	.07	-.33**	.02	--
9. Team engagement	5.47	0.64	-.18	.08	-.06	-.01	.37**	.49**	.42**	-.14
10. Teamwork	5.51	0.67	.01	.04	-.05	.02	.35**	.57**	.51**	-.25*
11. Team maintenance	2.75	0.66	-.05	-.12	-.15	-.03	-.00	-.39**	-.23*	.23*
12. Team performance	91.67	4.04	-.28**	.14	-.17	.16	-.04	-.05	.08	.07

n = 109. Coefficient alpha reliabilities on diagonal. † $p < .10$, * $p < .05$, ** $p < .01$.

Table 5-5. Continued

	9	10	11	12
1. Team tenure				
2. Percent male				
3. Percent caucasian				
4. Team GMAT average				
5. Task interdependence				
6. Self-report cohesion				
7. Structural cohesion				
8. Structural repulsion				
9. Team engagement	(.97)			
10. Teamwork	.72**	(.97)		
11. Team maintenance	-.28**	-.36**	(.85)	
12. Team performance	.07	.16†	.07	--

n = 109. Coefficient alpha reliabilities on diagonal. † *p* < .10, * *p* < .05, ** *p* < .01.

Table 5-6. Structural models

Structure	χ^2	*df*	CFI	SRMR	RMSEA	$\Delta\chi^2$ (*df*)
Model 1: Model with all direct and indirect paths	75.26*	21	.79	.086	.154	
Model 2: Hypothesized model	79.81*	23	.78	.087	.151	3.37 (2)

n = 109. CFI, comparative fit index; SRMR, standardized root mean square residual; RMSEA, root-mean-square error of approximation. $\Delta\chi^2$ tests relative to Model 1. * *p* < .05

Table 5-7. Tests of indirect effects

	Indirect effect through		
Relationship	Team engagement	Teamwork	Team maintenance
Structural cohesion to team performance	-.08*	.21*	-.05*
Structural repulsion to team performance	.03	-.11*	.05

n = 109. Estimates from Structural Model 2. All estimates are standardized. * *p* < .05, one-tailed

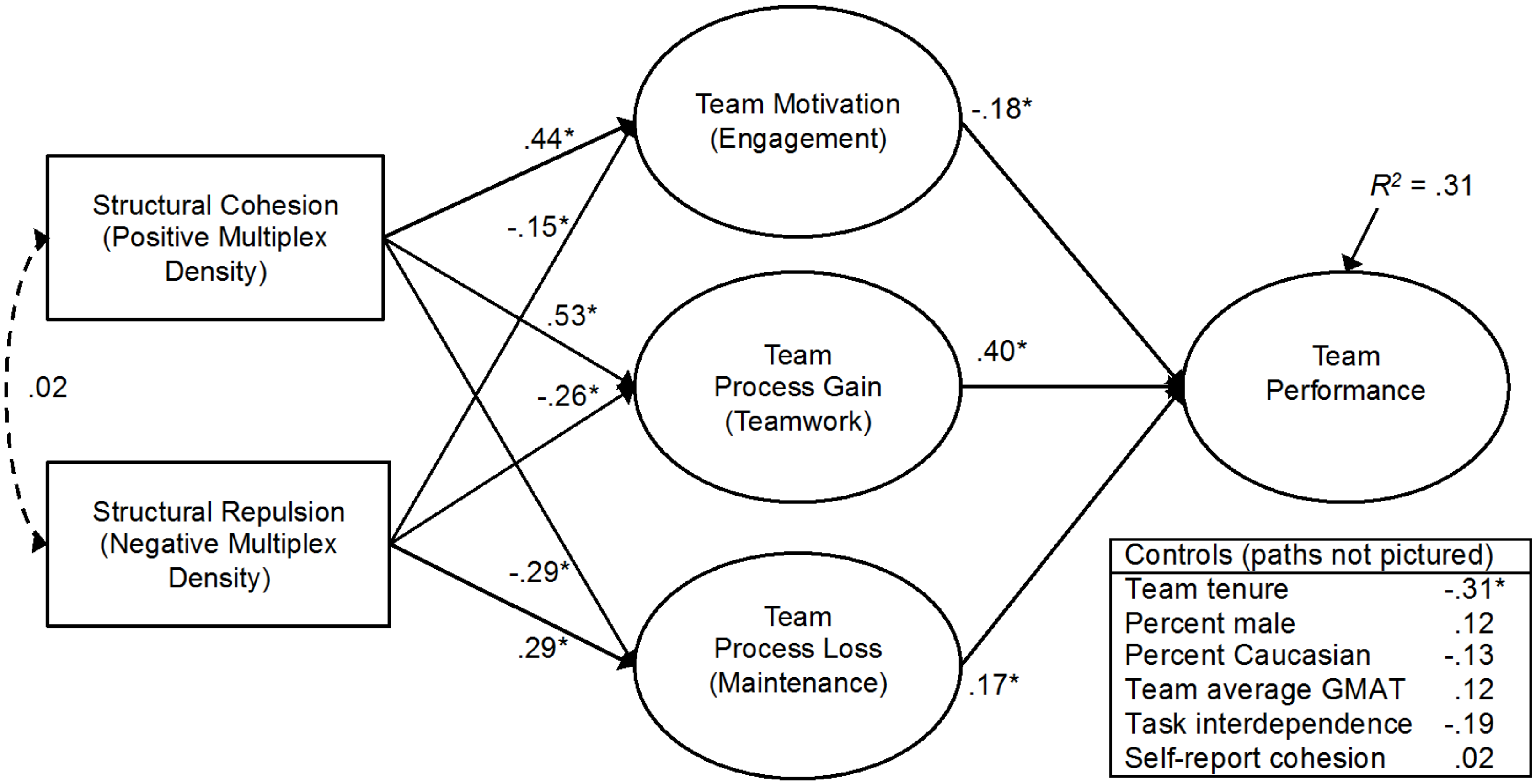

Figure 5-1. Structural model relationships. All paths standardized. Dashed line indicates path not hypothesized in Figure 3-1. Control variables estimates are from direct relationships with team performance. * $p < .05$, one-tailed

CHAPTER 6
DISCUSSION

Summary of Findings

Scholars have long been interested in the implications of social interaction for the functioning and effectiveness of work teams and are increasingly recognizing that teams' social interaction occurs in complex, discontinuous, and non-linear patterns. However, current conceptions of team social interaction have yet to account for this complexity. Social network analysis provides an ideal avenue for examining the complexity of social relationships in teams, but network research to date has generally examined either instrumental (work- or task-related) or positive expressive (social friendships) relationships in isolation. I examined a more replete conception of team social interaction based on the intersection of instrumental and expressive relationships in both their positive and negative forms. I used the concept of positive multiplexity to capture the overlap in instrumental ties with positive expressive ties such as liking, trust, and friendship. I used the concept of negative multiplexity to capture the overlap in instrumental ties with negative expressive ties such as disliking, distrust, and difficult or adversarial relationships. I then drew on social capital theory and team design theory to examine the implications of teams' densities of positive multiplex relationships, termed structural cohesion, and negative multiplex relationships, termed structural repulsion, for team functioning and effectiveness.

Altogether, there is evidence that the structure of social relationships in the team matters for team effectiveness. Specifically, I found that structural cohesion had positive indirect effects on team performance through its positive association with teamwork processes. Although I expected structural cohesion to have drawbacks for team performance in terms of increased time and energy required to maintain those relationships, this turned out not to be the case, as structural cohesion's negative indirect effect on team performance was actually created by a decrease in team relationship maintenance, which was in turn unexpectedly positively related to team performance. In addition, although I expected additional benefits of structural cohesion to team performance to occur through increased team motivation, this also turned out not to be the case as team engagement was unexpectedly negatively related to team performance. However, this latter relationship may be more likely due to a statistical artifact caused by the multicollinearity of team engagement with teamwork rather than being a substantive relationship of its own. Thus, in this sample, structural cohesion was beneficial for team performance primarily through more extensive teamwork. As for structural repulsion, I found that it had a negative indirect effect on team performance through its negative association with teamwork processes. Although I expected additional negative indirect effects through decreased team engagement and increased team maintenance, neither was the case as these indirect effects were not significant. Thus, in this sample, structural repulsion was detrimental for team performance, but mainly through its association with less effective teamwork. Notably, each of these effects hold after simultaneously controlling for other factors that might influence team performance, including team tenure, team demographic makeup, team intelligence, team task interdependence, and self-reported team cohesion.

Theoretical Contributions

Positive and Negative Multiplex Relationships

One of the most important contributions of this research is that it examined multiple forms of both positive and negative expressive ties in conjunction with simultaneously occurring instrumental ties. To my knowledge, this is the first study to provide evidence on the relationships between multiple forms of positive and negative expressive ties. Although it would seem reasonable to assume that positive and negative relationships would be manifest as opposite ends of a single continuum, my observed correlations are much smaller in magnitude than they would need to be if this were actually the case. In addition, evidence from a confirmatory factor analysis suggests that modeling positive expressive and negative expressive ties as separate factors is a much better fit to the underlying data than is modeling them as a single combined factor. Thus, an important contribution of my research is evidence suggesting the distinctiveness of positive and negative expressive ties within teams, and even within individual relationships, providing additional support to the notion that individual social relationships are richer and more complex than might be initially assumed.

A second major contribution is that I examined the multiplexity, or the simultaneous overlap, of instrumental ties with both positive and negative expressive ties. This multiplexity is useful to capture more of the richness and complexity involved in the bundles of multiple simultaneous interactions of interpersonal relationships. In addition, the densities of positive and negative multiplexity were correlated only at .02, providing further evidence for the distinctiveness of positive and negative expressive relationships. Further, each type of density exhibited unique structural effects with team functioning and effectiveness variables, indicating that both provide incremental contribution in predicting important team outcomes. Taken together, these results support examining the joint occurrence of instrumental with positive and negative expressive ties as a more replete conception of the social structure of teams.

Mediating Role of Teamwork, Engagement, and Maintenance

A third important contribution is that I specified and tested the extent to which mechanisms suggested by research on team synergy serve as mediators of the relationships between team social network structures and team effectiveness. This is an important contribution because researchers frequently assume that network structures affect team performance through improved coordination, cooperation, and solidarity, but these associations have yet to be tested in a comprehensive meditational model. To date only Balkundi et al. (2009) have found that conflict mediated the relationship between team leader centrality in the advice network and team viability. I examine a broader range of mediating mechanisms, including team process gains in the form of teamwork processes, team process losses in the form of team maintenance, and team motivation in the form of team engagement. I show that each of these mediators has important relationships with the social structure of the team. In particular, increasing density of positive multiplex relationships is associated with increased use of teamwork, increased team engagement, and decreased team relationship maintenance. On the other hand, increasing density of negative multiplex relationships is associated with decreased use of teamwork, decreased team engagement, and increased team relationship maintenance. However, only teamwork processes played a particularly important mediating role in relationships between team social structure and team performance. More specifically, teams with increasing density of positive multiplex relationships had increased team performance primarily because of their more effective use of teamwork processes such as planning and coordination, rather than because of the level of team motivation or team relationship maintenance. Similarly, teams with increasing density of negative multiplex relationships had decreased team performance primarily because of less effective teamwork, rather than the level of team motivation or team relationship maintenance. Thus, while each of these mediators is associated with team social structure, it appears that association of social relationships with teamwork processes is what really matters for team performance. These findings are a valuable contribution in that they expand our knowledge of the mechanisms that are responsible for the effects of team network structure on team effectiveness outcomes.

Implications for Team Effectiveness and Social Capital Theories

This study has important implications both for team effectiveness theory (Hackman, 1987) and group social capital theory (Oh et al., 2006). First, team effectiveness theory has traditionally focused on group design elements consisting of task structure, group size and diversity, or group norms; and contextual design elements such as the group reward system, technical resources, and training opportunities. The assumption is that by focusing on optimal arrangements of these design features, team effectiveness improves through the natural outflow of increases in members' levels of effort and application of knowledge and skill. My research shows that another key element to be incorporated into team design theory is the structure of social relationships among team members. A network of strong positive relationships between team members is associated with increases in the levels of team member effort and use of teamwork processes, while networks of strong negative relationships are associated with decrements in teamwork and increases in process losses of managing difficult relationships instead of focusing on task accomplishment. For these reasons, the structure of social relationships in a team is an important input to be incorporated along with other features of group design in team effectiveness theory. Additionally, I have also drawn from the literatures on personal engagement (Kahn,

1990) and personal relationship maintenance (Wright, 1984) to further develop the notion of group synergy within team effectiveness theory by articulating conceptualizations of team motivation in terms of team engagement, and team process loss in the form of team relationship maintenance. Although the relationships of these two concepts with team effectiveness were somewhat unexpected, after additional refinement, these concepts may yet prove useful in allowing team researchers to further examine how the elements of group design influence team effectiveness through these mediating process criteria of effectiveness.

My research also has important implications for social network theory and group social capital theory in particular. Specifically, my work reinforces the importance of examining both the potential benefits and the potential liabilities of social relationships in a more complete social ledger (Labianca & Brass, 2006) by including positive and negative expressive ties as separate relationships rather than opposites of a single expressive continuum. This will allow network theory to develop a more complete understanding of the different ways in which positive and negative relationships contribute to and detract from individual and group effectiveness. A second implication is that network theory consider not only both positive and negative expressive ties, but also their multiplex overlap with instrumental ties, and how these stronger, richer descriptions of the complexity of social relationships have the potential to explain outcomes beyond the explanation of ties that were previously assumed to be solely instrumental or expressive in nature. Finally, while group social capital theory emphasizes resources that groups accumulate by virtue of their social structures in terms of access to information, political connections, trust, and emotional support, my research further develops the nature of group social capital resources in terms of increased teamwork, team engagement, and reduced maintenance. Thus, this research helps to elaborate group social capital theory by further articulating the nature of the resources that accumulate to groups with beneficial social structures.

Practical Implications

From a practical standpoint, my findings indicate that social relationships in teams matter for team effectiveness, and should be taken into account when considering how to create teams with the best possible chance of succeeding. Team members who like, trust, and are friends with each other tend to coordinate better together, they work harder together, and they spend less time off-task managing relationships, while team members who dislike, distrust, and have difficult relationships with each other tend to coordinate less, invest less energy, and are distracted from task-work in order to deal with the difficulties of being together. Thus, when designing work teams, it is important to consider the potential social interactions among team members. In particular, if team members are having a hard time getting along, their teamwork and team performance will suffer. Instead of forcing them to work it out, one simple implication is that an easier fix might be to break the team apart and rearrange it with new members so that the new team has a better chance to get along with each other. To the extent that it is possible to know among a set of potential team members who is friends with whom, one simple idea is to form teams based on existing friendships, or to allow teams to form on their own based on their existing friendships if friendships are unknown. If potential team members are all relatively new acquaintances, allowing some time for social relationships to form before teams are selected could facilitate this process. If there is simply no opportunity to form social relationships before forming teams, team members should be encouraged to develop positive social relationships through extra-curricular socializing and other activities that build liking and trust among team members. Ultimately, to the extent that leaders and managers of teams can develop positive social relationships and limit or remove negative social relationships among team members, teamwork, team engagement, and team performance should improve.

Limitations

There are several limitations in my work to be considered before my results are used to guide managerial practice. First, the sample is comprised of student teams in an MBA program rather than work teams in actual organizations. Thus, the degree to which my findings generalize to other work teams of longer duration in differing places of employment needs to be assessed. Second, my findings should not be interpreted as indicating causal relationships between team social structure and team functioning and effectiveness. I did not manipulate (nor could I have) the level of team social relationships in order to examine their causal influence on teamwork, team engagement, and team relationship maintenance. However, this concern is limited somewhat by prior experimental research (Jehn & Shah, 1997; Krackhardt & Stern, 1998) that manipulated the levels of team friendships to find causal effects on team performance outcomes. Third, although group social capital theory implies that group social structure precedes team performance, it is possible that the relationship occurs in reverse, such that high performing teams are more likely to evaluate their social relationships more positively than lower performing groups. While I made an effort to address this possibility by collecting team social network data earlier in the semester before final team performance grades were assigned, this concern is not totally mitigated because many teams in the sample had been in existence and had received performance feedback prior to the semester I conducted the study. Because prior semester team performance data was not available for these teams, I could not control for the effect of prior team performance on current social relationships nor on current semester performance, though I did include team tenure as a control to address this to the greatest extent possible. Future research should measure network relationships both before and after multiple performance evaluation episodes to further investigate the underlying temporal nature of network relationships and additionally address causality implications of network relationships. Fourth, one of the limiting factors in my ability to explain variance in team performance was the relative range restriction in the team project scores provided by the MBA course professors. Although the scores were provided on a 100-point scale, only a very small portion of that scale was typically in use. For example, in nine of the sixteen MBA cohorts, the standard deviation in team project grade scores was less than three points. In the other seven cohorts, the standard deviations in team project grade scores ranges from 4.31 to 10.13 points. While multilevel analysis was able to control for the unequal variances in team performance distributions across the cohorts, the limited range of scores within many of the cohorts likely attenuated the strength of my observed relationships. Future research might observe stronger effects of team network structure on team performance if the team performance outcome discriminates to a greater extent between high- and low-performing teams.

Future Research

Although future research could address the limitations I mentioned above, this research illuminates several additional interesting questions that scholars might address to move our knowledge even further forward. For example, given that positive and negative social relationships in teams are associated with team functioning and effectiveness, what predicts how these structural relationships form in the first place? The homophily principle suggests that relationships form between similar people at a higher rate than among dissimilar people (McPherson, Smith-Lovin, & Cook, 2001). Thus, the extent to which personal similarities and differences predict the formation of different types of social relationships in teams is worthy of continued investigation. Yet what characteristics are encapsulated by the term similar is often taken for granted without examining how individuals belong to multiple social groups simultaneously. As a result, individual identity characteristics on which to base similarity judgments can be defined in numerous ways, including in terms of gender, race/ethnicity, age, marital status, occupation, parental status, educational background, social class, place of residence, place of work, position relevant to others in a network (i.e. central, leader, or opinion leader), behavioral patterns (achievement versus delinquent), values, beliefs, attitudes, personality, etc. Indeed, self-concept is a cognitive organization of various identities and attributes negotiated and developed from interactions in social roles and group memberships (Gecas, 1982; Ibarra, 1999). Thus, in any context, the reasoning that similarity perceptions among actors increase the probability of tie formation between them (and thus the formation of a team network structure composed of individual dyadic linkages based on homophily effects) implicitly assumes that the researcher knows which aspects of identity have been considered as most important in the similarity comparison process of the individuals who are exploring potential tie formation. The likelihood of a network tie formation based on similarity of characteristics may depend in turn on how salient a given set of characteristics is to a particular situation. In other words, in a knowledge-intensive work setting, similarity in intelligence may be a more relevant characteristic for tie formation than is race or gender. In a creative context, similarity in openness to experience may be more relevant than age or educational background. Thus, when examining homophilous network tie formation, researchers should be careful to investigate which types of characteristics are most salient to a given context and whether similarity of those characteristics versus less salient characteristics is a stronger driver of network tie formation.

A second avenue of future research involves examining the implications of positive and negative multiplex relationships for other outcome criteria including team creativity, viability, member satisfaction, and customer satisfaction. It is possible that the effects of structural cohesion and repulsion differ across the varying criteria. For example, it is possible that for team creative performance, the relationships are the opposite in that increasing structural cohesion actually stifles creativity through greater pressures toward conformity and consensus, which constrains innovation and novel thinking necessary to produce creative solutions. On the other hand, teams with increasing structural repulsion may exhibit greater willingness to challenge, argue, and fight with each other to the point where taken-for-granted assumptions are re-examined and novel solutions emerge. Thus, whereas team task performance is benefitted from structural cohesion, the opposite may be true for team creative performance. However, while teams with members who have difficult and adversarial relationships may produce more innovative and creative solutions, these same teams may suffer from a lower degree of team member satisfaction and decreased viability because of the unpleasantness of the experience of dealing with conflict and argument within the team. Thus, future research would be useful that examines the implications of positive and negative relationships in teams beyond what I have considered here.

A third area of future research involves investigating whether social relationships matter more or less as teams become increasingly virtualized and geographically dispersed. In this context it may be that friendship relationships become less relevant simply owing to the fact that fewer opportunities to socialize are available to a virtual or geographically disperse team. On the other hand, it may be that trust relationships become increasingly important because of the reduced capability of team members to monitor each other on a consistent basis. In regard to negative relationships, it may be that disliking relationships become less relevant since the virtual environment limits the frequency and duration with which team members must come in contact, and as a result team members are more easily able to tolerate limited instances of unpleasantness that would otherwise distract more heavily from task accomplishment. On the other hand, it may be possible that distrust relationships become even more dysfunctional for team effectiveness in virtual or geographically disperse team environments as members worry about the reliability of the work of other team members, and, because of the uncertainty, end up wasting time and effort duplicating efforts as a contingency.

Finally, an area of future research more specific to the MBA student sample setting involves examining the extent to which social relationships formed during the MBA program translate into future collaboration and working relationships following graduation. Many students enroll in an MBA program in part because of the education, but also in part because of the opportunity to expand their professional networks. MBA program admissions officers often tout the opportunity to network as one of the major benefits of enrolling in a university's program. For this reason, future research could collect detailed network data on the quality of the relationships MBA students form within their cohorts during the program of study, and follow up with students at regular intervals following graduation (e.g., two years, four years, etc.) with a list of the members from their original MBA cohort to ask with whom they currently collaborate, from whom have they obtained employment opportunities, and with whom have formed other professional relationships. Observing the correlation between the quality of the relationships formed during the MBA program and the number and quality of future collaboration relationships would provide fascinating empirical evidence as to whether MBA programs are able to accomplish one of their purported goals of giving their students a new network that will become highly useful in the future.

Conclusion

This study is the first in the organizational literature to examine the relationships between multiplex instrumental ties with positive and negative expressive ties among team members and resulting team performance through a systematic set of synergistic team mechanisms. I found that positive multiplex density, termed structural cohesion, had a positive indirect relationship with team performance mainly through its association with increased teamwork. Structural cohesion was also associated with increased team engagement and reduced team maintenance, bit it did not exhibit indirect relationships with team performance through these mechanisms. On the other hand, negative multiplex density, termed structural repulsion, had a negative indirect relationship with team performance mainly through its association with decreased teamwork. Structural repulsion was also associated with decreased team engagement and increased team maintenance, but it did not exhibit indirect relationships with team performance through these mechanisms. Taken together, these results show that the balance of positive and negative social structures among team members has important implications for team functioning and effectiveness.

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