3-9-2006

Leadership in Groups: Social Networks and Perceptions of Formal and Informal Leaders

Mitchell D. Stratton

LEADERSHIP IN GROUPS: SOCIAL NETWORKS AND PERCEPTIONS OF FORMAL AND INFORMAL LEADERS

THESIS

Mitchell D. Stratton, Major, USAF

AFIT/GSS/ENV/06M-01

DEPARTMENT OF THE AIR FORCE
AIR UNIVERSITY

AIR FORCE INSTITUTE OF TECHNOLOGY

Wright-Patterson Air Force Base, Ohio

AFIT/GSS/ENV/06M-01

LEADERSHIP IN GROUPS: SOCIAL NETWORKS AND PERCEPTIONS OF FORMAL AND INFORMAL LEADERS

THESIS

Presented to the Faculty

Department of Aeronautics and Astronautics

and

Department of Systems and Engineering Management

Graduate School of Engineering and Management

Air Force Institute of Technology

Air University

Air Education and Training Command

In Partial Fulfillment of the Requirements for the

Degree of Master of Science in Space Systems Engineering

Mitchell D. Stratton, BS, MS

Major, USAF

March 2006

AFIT/GSS/ENV/06M-01

LEADERSHIP IN GROUPS: SOCIAL NETWORKS AND PERCEPTIONS OF FORMAL AND INFORMAL LEADERS

Mitchell D. Stratton, BS, MS
Major, USAF

Approved:

// Signed //	9 Mar 06
Kent C. Halverson, Maj, USAF (Chairman)	date
// Signed //	9 Mar 06
Nathan A. Titus, Lt Col, USAF (Member)	date
// Signed //	9 Mar 06
Sonia E. Leach, Maj, USAF (Member)	date

Abstract

The labors of organizational and behavioral science researchers have resulted in a literature robust in the study of leadership and social networks. Empirical examination of both topics has shown significant organizational outcomes, but breadth is lacking both within and between the disciplines. Studies of leadership have seen the preponderance of the effort focused on formal leaders, while most social network studies examine only one informal structure. Moreover, there exists a paucity of studies, which have sought to examine the interrelationships between leadership and social networks.

In an effort to address these voids, this thesis investigated: 1) The concurrent existence of multiple social networks, 2) How leaders, both formal and informal, are positioned within the networks, 3) How leader positions in the network change over time, 4) How network positioning affects group members' perceptions of formal leader performance, and 5) How a member's position in the network relates to peer selection as an informal leader.

The Expressive-Instrumental Leadership Model, based on behavioral science theory and past empirical studies, was proposed as a means of investigation. A population of 431 military students and instructors was surveyed seven times over a period of eight weeks to gather longitudinally-based social networks data. Additionally, both instructors and students were peer-rated on their leadership performance. The results were statistically analyzed and compared to outcomes predicted by the model.

The results showed partial support for the proposed model as three of six hypotheses were supported. Partial support was found for remaining hypotheses, with unique environmental factors possible impacting study results. The author proposed further study of the model to gain additional insight.

AFIT/GSS/ENV/06M-01

To My Favorite Flight Attendant and "The Kids." Infinity + 1.

Acknowledgments

Thanks to Maj Kent Halverson for introducing me to social networks research and for the assistance in completing this project. Also, thanks to my committee members, Lt Col Titus and Maj Leach, for your time and the valuable feedback you've provided. A big "thank you" goes out to the members of AFIT section GSS-06M. You've made my job as section leader easy and all the help provided throughout the program is much appreciated. Most of all, thanks to my wonderful wife for putting up with me as I worked toward the completion of this degree. Welcome to the military!

Mitch D. Stratton

Table of Contents

Page

List of Figures

List of Tables

Table Page

LEADERSHIP IN GROUPS: SOCIAL NETWORKS AND PERCEPTIONS OF FORMAL AND INFORMAL LEADERS

I. Introduction

Background

The concept of an *organization* is extremely prevalent in today's society. Although a mélange of definitions appears throughout academia, two competing definitions, offered 30 years apart, provide an introduction to the term. Organizations are:

(1) "Social units deliberately constructed and reconstructed to seek specific goals" (Etzioni, 1964)

(2) "Deliberately created and maintained social institutions within which consciously coordinated behaviors by members aim to produce a limited set of intended outcomes" (Jelinek & Litterer, 1994; McPhee & Zaug, 2000)

Based on the above definitions, corporations, schools, armies, and churches all fit the definition of organizations, while ethnic groups, social classes, tribes, and families do not. Organizations typically make their goals or intended outcomes known, if not to the public at large, then at least to organizational members. Often, intended organizational goals are formally published as a purpose statement or mission statement. For example, the mission statement of the United States Air Force is "is to deliver sovereign options for the defense of the United States of America and its global interests -- to fly and fight in Air, Space, and Cyberspace" (Wynne & Moseley, 2005).

As illustrated by the example, an organizational goal can be very complex, requiring a vast number of people and a myriad of skill sets to accomplish. Therefore, in an effort to enhance the realization of intended goals, many organizations partition themselves into segments or organizational subunits. The specific manner in which organizations design patterns of connections and interdependencies among organizational units is a form of organizational *structure* (Zack, 2000). Often, when people think of the structure of an organization, they may think of the "organizational chart" or the authority relationships within the organization (e.g., owner, manager, and line-worker). This concept of organizational structure describes the organization's *formal structure* (McPhee, 1985).

The formal structure has been studied extensively by theorists, and has proven to be an important antecedent to a variety of organizational outcomes. However, surprisingly, the formal structure (who reports to whom) may not be in control of, nor even an accurate representation of, real-world organizational processes. True organizational process may be uncovered from studying the manner in which groups interact. Organizational subgroups develop informal processes that define actual information exchange and work flow (who depends on whom), and interpersonal interaction (who likes whom) (Zack, 2000). Thus, actual work and interaction patterns manifest *informal structure* within the overarching context of the formal group structure. These informal structures can be conceptualized as the pattern of relationships and interactions among individuals. The structures themselves are called *social networks*, and the patterns of network activity are based primarily on either work-related or friendship-related interactions (Casciaro & Lobo, 2005).

Organizational and behavioral researchers have been studying informal group structures since the 1930s, when the discipline was called *sociometry*. Early research sought to create and standardize methods for identifying and classifying differing structural patterns. In fact, in the eyes of a sociometry researcher, "the world is composed of networks, not groups" (Haythornthwaite, 1996). Such a researcher would examine the relationships that exist among people before labeling them a group. Today, the research associated with the field is known as *social network analysis* and is focused more on understanding how varying informal structures may be antecedents to a variety of individual and organizational outcomes (Baker, 1994; Krackhardt, 1996; Wasserman & Galaskiewicz, 1994).

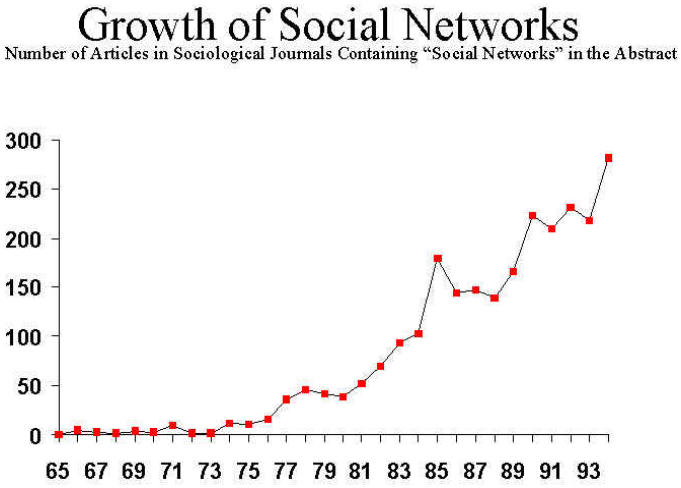

Figure 1. The Growth of Social Networks Research
(http://www.analytictech.com/networks/topics.htm)

Social network analysis saw a steady rise in popularity, beginning in the 1970s (Figure 1), and is a field of behavioral science study that is increasing in importance to those interested in studying how organizations operate. Group structures and individual positions within those structures have been empirically associated with many individual

and group outcomes, some of which include: performance (Baldwin, Bedell, & Johnson, 1997; Friedkin & Slater, 1994; Sparrowe, Liden, Wayne, & Kraimer, 2001; Mehra et al., 2004), team effectiveness (Oh, Chung, & Labianca, 2004), attributions of charisma (Pastor, Meindl, & Mayo, 2002), satisfaction (Baldwin et al., 1997), power (Cook, Emerson, & Gillmore, 1985), and community integration (Granovetter, 1973).

The study of leadership has also been important to organizational researchers because of its important implications for organizational outcomes. A cyclopean amount of research has been done on leaders and leadership, the majority of which has focused on the individual placed in a position of authority by the organization, called the *formal leader* (Pescosolido, 2002; Pielstick, 2000). However, within the last 15 years, the study of other individuals who exercise power in groups, the *informal leaders*, has become increasingly prevalent, possibly due to the growing trend of self-managed work teams (Pescolido, 2002). Leaders, both formal and informal, have been tied to organizational outcomes like effects on group goals (De Souza & Klien, 1995), group efficacy (Pescosolido, 2001), productivity (Ekvall & Ryhammar, 1998), and performance (Day, Sin, & Chen, 2004)

Unfortunately, despite the acknowledged importance of both formal and informal structures, and both formal and informal leaders to organizational outcomes, little research has attempted to tie all these variables together in the same study. This is surprising, because a group's leaders are an inherent part, to one degree or another, of any informal structures within the group. Although, at first, it may seem logical that leaders might be associated more with task-related networks, actors do not belong to just one network (Haythornthwaite, 1996). Leaders, after all, do not live in a "social vacuum" and

are simultaneously embedded in social relationships with organizational subordinates, peers, and superiors (Boyd & Taylor, 1998). Yet, most social network research has ignored the informal network ties of leaders (Yukl, 2002; Mehra et al., 2004). Thus, thesis was borne in an attempt to begin to fill this gap.

Research Questions and Hypotheses

The purpose of this research is to answer the following questions: 1) How does a leader's position change in social networks over time? 2) How is a leader's position in a social network associated with others perceptions of him as a leader? A model is presented in an attempt to answer these questions. The model is built around the following hypotheses:

Hypothesis 1: Formal leader centrality in the affect network will decrease over time.

Hypothesis 2: Formal leader centrality in the task-competency network is positively associated with perceptions of leader performance.

Hypothesis 3: Formal leader centrality in the affect network will moderate the relationship between leader centrality in the task-competency network and followers' perceptions of his performance, such that, as affect centrality increases, perceptions of the leader's performance will also increase.

Hypothesis 4: Informal leader centrality in the affect network will increase over time.

Hypothesis 5: A group member's centrality in the task-competency network is positively associated with other's perceptions of him as an informal leader.

Hypothesis 6: A group member's centrality in the affect network will moderate the relationship between member centrality in the task-competency network and others' perceptions of him as an informal leader, such that, as affect centrality increases, perceptions the member as an informal leader will also increase.

Benefits

This research has the potential to provide benefits to Air Force leaders at each and every echelon of command. Leadership development is a focus throughout the entire career of each and every Airman serving in today's Air Force (AFDD 1-1, 2004). In published Air Force doctrine, General Ronald R. Fogleman, former USAF Chief of Staff, speaks to effective Air Force leadership:

> To become successful leaders, we must first learn that no matter how good the technology or how shiny the equipment, people-to-people relations get things done in our organizations. People are the assets that determine our success or failure. If you are to be a good leader, you have to cultivate your skills in the arena of personal relations. (AFDD 1-1, 2004)

An important aspect of interpersonal relations involves how one is perceived by others around him. This self-awareness skill is important to leaders, as it is positively related to performance (Gouws, Beukes, & Elmann, 2003). Therefore, gaining insight into how informal social networks within group impacts perceptions could provide valuable insight to Air Force officers and non-commissioned officers (NCOs) at all levels.

Thesis Structure

The remainder of this thesis is organized as follows: Chapter II provides a review of the literature as it relates to organizational structure, leadership, and social networks. Chapter III discusses the research methodology employed in conducting this research effort. Chapter IV covers the results of statistical data analysis. Finally, Chapter V presents conclusions of the study and recommendations for future research.

II. Literature Review

Organizational Structure

The literature is ripe with studies directed at organizational structure (e.g., Blumberg, Hare, Kent, & Davies, 1983; Hare, 1976; Weber, 1978). Most investigations of organizational structure treat the concept as a management tool that can be planned and physically imposed onto an organization. This reality is readily apparent from the variety of definitions, which describe an organization's structure as "the arrangement of duties…" (Krokosz-Krynke, 1998), "the means by which the organization sets limits and boundaries…" (Thompson, 1966), and "[the] allocation of work roles and administrative mechanisms…that allows the organization to conduct, coordinate, and control its work activities" (Jackson & Morgan, 1982). In laymen's terms, what exactly is organizational structure? It may be best represented in modern terms as the "organizational chart" (Thompson, 1966). It includes the breakout of an organization's subgroups, the official differentiation of divisions, departments, and work units, as well as official job titles, standard operating procedures, work-flow diagrams and the like (Weber, 1978). For the purposes of this research, this concept of organizational structure is referred to as the organization's *formal* structure. The formal structure has several defining features. It is both descriptive, explicitly stated and made available to any authorized person, and prescriptive, telling individuals both inside and outside the organization just what the organization should be like (Weber, 1978).

Formal Structure.

The bulk of research on formal structure has focused either on creating new or modified types of formal structures (e.g., Burns & Stalker, 1964; Burns & Stalker, 1964; Weber, 1978) or on the impacts of organizations choosing one formal structure over another. With this approach, studies have shown that an organization's formal structure is an antecedent to outcomes such as economic profitability (Ogden & Teece, 1978), efficiency (Muscarella & Vetsuypens, 1990), culture (Krokosz-Krynke, 1998), decision-making (Fredrickson, 1986), and employee efficacy (Oldham & Hackman, 1981). So, the formal structure of an organization is a very important concept. However, authoritative as it may be, it is not necessarily powerful, and it is not simply "in control" of, nor an accurate representation of, organizational processes (McPhee, 1985). Thus, it seems reasonable to conclude that other processes are at work in conjunction with the formal structure. With this in mind, research that focuses only on the formal structure may be quite limiting. Considering the amount of research effort expended to better understand impacts of formal structures on organizational outcomes, it is reasonable to assume that the identification and better understanding of these processes is of great interest as well. For more insight into this matter, we turn to group development research.

Because work in most organizations is accomplished via a division of effort among subgroups or teams of individuals (Gerard, 1995), it is not surprising that the study of groups and their development is eminently represented in the literature. Research associated with group development thrived until the mid-1960s, when ancillary topics more centered on the individual received the preponderance of the effort (Smelser

& Baltes, 2001). However, recent trends have seen the reemergence of group research (Thye, Lawler, Macy, & Walker, 2001). The renewed focus on interaction presents new opportunities for organizational insight.

Within formal organizational structures, subgroups perform task-oriented functions in support of the larger organization. Today's literature often supplants "group" with the term "team." Teams have become the basic unit through which work is carried out in organizations (Gerard, 1995; Manz & Sims, 1993; Mohrman, Cohen, & Mohrman, 1995). The predomination of team structures in present-day organizations has been paralleled by a cascade of associated theory and applied research (Ilgen, 1999). Foundational work done by researchers (Alderfer, 1977; Hackman, 1992) identified joint presence attributes that properly define a team, namely shared goals, interdependence, boundedness, control over internal processes, and operation within a social context. Although some researchers (Katzenback & Smith, 2001) posit that much of the historical research on groups is not applicable to teams, focused definitions of the terms narrow the scope sufficiently to treat the two terms interchangeably. Whereas the term group has been used expansively in the social sciences to include aggregates that share no interdependence, Alderfer (1977) and Hackman (1992) include interdependence as a required attribute. Thus, the definition of work group easily accommodates the term team (West, 1996). This research treats the two as synonyms and uses the term group from this point forward.

Informal Structure.

An organization's formal structure might be very different from the informal relationships through which work is actually accomplished (Morey & Luthans, 1991; Oh, Labianca, & Chung, 2005). Underneath the formal organizational structure, group development researchers have long understood that informal structures are manifested by organizational subgroups (Homans, 1950; Rothlisberger & Dickson, 1939). This manifestation of informal group structures differs from that of the formal structures. While the formal structure is typically imposed on a group, the informal structure is created as a byproduct of processes associated with the socialization of members into their groups (Moreland & Levine, 1982; Wanous, Reichers, & Malik, 1984). Member-to-member "ties" based on interpersonal exchange behaviors are key building blocks of these informal structures (Hare, 1976). The result is a bifurcation of structure, partly formal, partly informal, within a group. Both the formal and informal structures co-exist in the same time and space, but they are independent entities (Doloff, 1999). Of the two, the formal structure is commonly the more visible and may be readily known to individuals both inside and outside the organization. The informal structure, however, is another matter. It is typically much less visible, and its complete form may not be known, even to the group members themselves.

Social Network Analysis

Although informal structures may be difficult to discern to the untrained eye, network analysts have developed distinctive approaches to unearth them. Once identified, these informal structures are known as social networks and the discipline associated with identifying and mapping them is known as social network analysis. The

so called structure of a social network is the pattern of connections among parties (Nadel, 1957). Using a variety of techniques, researchers can measure and express these patterns or regularities of the social environment. The resulting social arrangement has important implications for each node and for the entire network. This emphasis on the pattern of connections or ties within a group makes social network analysis unique in the study of social phenomena (Mayhew, 1980). The network can then be viewed and examined in a manner similar to the formal structures in an organization. It is important to note that the informal or social network (the terms will be used interchangeably) consists not only of the group members, but the social process ties among them (Wasserman & Faust, 1994). The methodology of social network analysis allows these social processes to be defined in precise ways so that we may reason logically about the social world (Freeman, 1984). Once the informal structure is "captured," a researcher may then study the impact of this structure on either the group as a whole, or on individuals within the group.

History.

The foundation for social network analysis has its roots in sociology, social psychology, and anthropology (Wasserman & Faust, 1994). In the developmental stages of the discipline, the term *sociometry* was used to label the area of study (Moreno & Jennings, 1938). Early research in the field centered on the methodologies for collecting, depicting, and analyzing social network data. Researchers argued for the use of various mathematical techniques including matrix algebra, topology, graph theory, and set theory (Scott, 2000; Wasserman & Faust, 1994).

Beginning in the 1950s, a level of consensus was reached with regard to basic analytical approaches and research work began a turn toward application of the

discipline. Then, since the early 1970s, an avalanche of technical work and specialist applications appeared (Scott, 2000). Research has shown social network structures to be an antecedent to a variety of individual and organizational outcomes. Among them are job and workplace features, including job satisfaction (Rice & Mitchell, 1973; Roberts & O'Reilly, 1979; Dean & Brass, 1985), perceptions of ability to take risks (Cancian, 1967), access to information (Coleman, Katz, & Menzel, 1966; Brass, 1984), feelings of belonging or acceptance (Miller, 1980), organizational commitment (see Hartman & Johnson, 1989, for a review), and individual performance (e.g., Brass, 1981; Mehra, Kilduff, & Brass, 2001).

As one can gather, the use of social network analysis can benefit researchers studying a wide range of interests. It is then, no surprise that social network approaches to team research have shown a recent gain in popularity (Borgatti & Foster, 2003). Depending on the focus of the study at hand, meaningful analysis calls for a different approach to employing social network methods and applications. Before exploring the analytical tools at hand, a discussion on leadership and its connection with a group's informal networks is warranted.

Leadership

Leadership has been a focus of study since the emergence of human civilization (Bass & Stogdill, 1990). The early roots of leadership study were tightly interwoven with the study of history. Although the terms *leader* and *leadership* did not find their way into the English language until the early 1300s and mid-1800s respectfully, ancient Egyptian, Greek, and Chinese writings, for example, spoke of what various great figures did and why they did it (Bass & Stogdill, 1990). Leadership study remained mostly an historical

endeavor until the twentieth century. It was at this point that the scientific study of leadership began (Yukl, 2004).

The formal study of leadership has been a much divided effort since its inception. The term itself was extracted from the layman's vocabulary and introduced into the discipline of research science without the benefit of a specific definition (Yukl, 2004). This lack of specificity, combined with the use of various proxy terms like power, control, management, authority, and administration, for example, lead to much ambiguity surrounding the term and its study. As a result, researchers typically define leadership based on their individual perspectives and examine aspects of it that most pique their interest (Yukl, 2004). In fact, a comprehensive review of the leadership literature shows that "there are almost as many definitions of leadership as there are persons who have attempted to define the concept" (Stogdill, 1974). However, despite the disparate analogues of the term, leading researchers argue that there is sufficient similitude in definitions to permit "a rough scheme of classification." (Bass & Stogdill, 1990) The rough scheme divides leadership study into categories, which may be examined either singularly or in combination. These categories include leadership as: the focus of group processes, a matter of personality, a matter of inducing compliance, the exercise of influence, particular personal behaviors, a form of persuasion, a power relation, a goal-attainment instrument, an effect of interaction, a differentiated role, and an initiating structure (Bass & Stogdill, 1990). This diverse framework makes it very difficult for the researcher to settle on a single definition of leadership that is both general enough to accommodate the variety of meanings and specific enough to serve the specific research purposes.

This thesis subscribes to the notion that researchers should strive to design leadership studies, such that they "provide information relevant to the entire range of definitions, so that over time it will be possible to compare the utility of different conceptions and arrive at some consensus on the matter." (Yukl, 2004) Thus, in this spirit, a broad definition of leadership is in order. This study adopts a modified definition of leadership taken in parts from Bass & Stogdill's (1990) and Yukl's (2004) handbooks on the matter.

> *Leadership* is an interaction between two or more members of a group, where influence is exerted by one person over others to guide, structure, and facilitate relationships, activities, and perceptions in that group.

This definition of leadership is appropriate for three reasons. First, it provides a broad perspective, allowing for the possibility that results from this research will be applicable to other scholars, whom will certainly take varying approaches to the subject area. Next, it addresses the concept as an interaction rather than a one-way flow of influence. Finally, the definition supports the specific intent of this study. It addresses the leadership phenomena in the context of a group setting and, moreover, ties the act of leadership to the structure of the group.

Formal vs. Informal Leader.

With the term leadership properly defined, the definition of the group's leader may now be established. But to which group does this refer? It has been previously established that an organization is composed of multiple structures, both formal and informal. It is easy to conceptualize that these structures may differ, sometimes greatly,

in form. Thus, although each structure is comprised of the same individuals, the same group, they may be treated as distinct groups: the formal group and one or more informal groups. Because the possibility exists that each group, whether formal or informal, will have a different leader, we must allow for this condition with two definitions – that of formal leader and informal leader. The definition of a leader is simply "a person who engages in leadership behavior." (Shaw, 1981) By re-examining our definition of leadership, one can see that a leader must then be able to influence other members of the group through interaction. Although the generic definition of leader holds true for both formal and informal leaders, the differentiation can be seen in just how this influential interaction occurs.

An attempt to cover the many approaches taken to explain the leader's ability to influence is beyond the scope of this thesis. The historical attraction to leadership study and the many approaches taken have led to "a vast and bewildering literature" on the subject matter (Yukl, 2004). The variables examined in an attempt to understand this influence include, but are certainly not limited to, at least six major groups and well over 100 sub groupings (Bass & Stogdill, 1990). The major groupings include studies on leaders' personal attributes, power and legitimacy, transactional exchanges between leader and follower, leadership methodologies, situational moderators, and group composition (see these for an overview of the many studies: Yukl, 2004; Hare, 1976; Bass, 1990).

For the purposes of this study, a much simpler approach is sufficient. The difference lies in the categorization of the interaction. Interactions are termed "formal" if they occur between occupants of formally designated positions, regardless of who the

particular occupants happen to be. Contrarily, they are informal if they are between persons, regardless of the positions they occupy (Bass, 1960). The formal leader is one who exercises influence based on his formal position. He is chosen by the organization. This is not to say that the formal leader may not use additional means to exert influence, but his formal position is the defining factor, as it provides him with a number of power sources for influencing group members (Raven, Schwarzwald, & Koslowsky, 1998; Raven, 1993). In contrast, the informal leader exerts influence based on phenomena other than his formal power sources such as hierarchical position or authority (Argyris, 1971; French & Raven, 1959; Rahim, 1989). Unlike the formal leader, the informal leader comes from the group and is chosen by the group (Wheelan & Johnston, 1996).

One can see that, based on this concept, the formal and informal leader could be one and the same. However, research has shown that this is not likely. One study (Pielstick, 2000) compared formal leaders (n = 62) with informal leaders (n = 33) with respect to 161 different leadership variables using both peer and subordinate ratings. Approximately equal numbers of peer and subordinate ratings were used. The results of the study showed that there were significant differences in ratings in 54% of the 161 variables between formal and informal leaders, with all but one of these showing higher ratings for the informal leader. These results make it very clear that there are important and significant differences between formal and informal leaders (Pielstick, 2000). Because of these differences, this study suggests that a group is likely to "select" an informal leader who is different from the imposed formal leader.

At this point in the discussion, several key concepts have been covered that, when taken together, set the stage for this research. First, formal organizational structures have

been shown to be antecedents to organizational outcomes of interest. A preponderance of the literature on organizations is focused on the formal structure. As part of this structure, organizations appoint formal leaders to positions of authority in groups to guide organizational goals (Stogdill, 1974). However, an additional informal structure also permeates these organizational groups. Though less represented in the literature, research on informal structures has also shown to impact organizational and individual outcomes (e.g., Rice & Mitchell, 1973; Roberts & O'Reilly, 1979; Dean & Brass, 1985; Mehra et al., 2001), thus they are of importance to researchers. Informal leaders, acknowledged by the group rather than selected by the organization, have influence within these informal structures. Unfortunately, despite the tremendous groundwork of past researchers, the body of literature does not fully reveal the connections between a group's formal structure, informal structure, and leaders. One cannot decipher the intricacies of these concepts alone, as the ideas are inextricably mixed (Balkundi & Kilduff, 2005). Therefore, it is appropriate to highlight some deficiencies in the existing literature as a prerequisite to a more detailed discussion of this research effort.

Research Focus

Organizations exist to enable groups of people to effectively coordinate their efforts and achieve certain goals or objectives (Shao, Lee, & Liao, 2000). The point has been previously made that teams have become the basic unit through which work is carried out in organizations (Gerard, 1995). Therefore, the effectiveness of these groups is of critical importance to organizational success (Buzaglo & Wheelan, 1999). Additionally, aside from this goal-centered approach, organizational groups, like individuals, exist to perform specific social roles and to meet specific social needs (Adler,

1982). The materialization of informal structures in groups may then facilitate the social requirements of the individual in conjunction with the objectives of the organizations. Researchers have suggested that not only is social engagement a basic human need, but that it is also mediates the relationship between the environment and performance (Skinner, Wellborn, & Connel, 1990). The ability to satisfy these needs inside an organization is important for the group members, group leaders, and the organization as a whole, because individuals become more cognitively and emotionally engaged when their needs are met (Harter, Schmidt, & Keyes, 2003; Kahn, 1990). This, combined with the impact that group leaders have on organizational outcomes (Bass & Stogdill, 1990), makes the case for a thorough understanding of the interaction of leadership and informal group structures. However, despite an impressive and growing body of research on team processes (Baldwin, Bedell, & Johnson, 1997; Reagans & Zuckerman, 2001), this potentially critical area of group research is lacking in depth (Brass, 1984; Brass, Galaskiewicz, Greve, & Tsai, 2004). There remains no consensus nor awareness surrounding what is known about social network effects in work groups or teams; perhaps because most such studies were conducted before current researchers and mentors were trained (Fiedler, 1954) or because of academic amnesia (Hunt & Dodge, 2000). It is, therefore, the goal of this research to shed some manner of light in this area and contribute to a better understanding of leadership and informal group structure. Thus, this research addresses the relative position of formal and informal leaders in multiple group social networks. Specifically, it examines: 1) The concurrent existence of multiple social networks, 2) How leaders are positioned within these social networks, 3) How a leader's position within the networks changes over time, 4) How network

positioning affects group members' perceptions of formal leader performance, and 5) How a member's position in the network relates to peer selection as an informal leader. The existing literature is lacking in each of these areas.

Gaps in the Literature

Multiple Social Networks.

Social network researchers classify social network ties on the basis of their content (Balkundi & Harrison, 2005). Two common types of tie content studied in groups are *instrumental* and *expressive* ties (Lincoln & Miller, 1979). Instrumental ties are pathways of work-related advice (Ibarra, 1993) and are thought to be vital to effective task performance. The primary content exchanged via such ties is information resources or knowledge relevant to completing a group's assigned tasks. These types of ties are elicited by researchers with questions like "who do you speak to regularly about business matters?" In contrast, expressive ties reflect friendships and are more affect-laden (Balkundi & Harrison, 2005). These ties are important conduits of social support and values (Ibarra, 1993; Lincoln & Miller, 1979) and are revealed with queries like "who have you met with privately outside of work?" The two forms of ties are not mutually exclusive; there tends to be an overlap in the two types of connections (Borgatti & Foster, 2003). One type might even lead to the other (Krackhardt & Stern, 1988), as the work context provides the physical proximity and opportunity for interaction vital to friendship formation (Festinger, Schachter, & Back, 1950). Still, the primary context of the two types of ties remains theoretically distinct; not all work colleagues are friends, or vice versa (Balkundi & Harrison, 2005). Therefore, it seems reasonable to study these ties as distinct social networks. Yet, the usual approach is to treat group structure as a single

concept (Bennis & Shepard, 1956; Tuckman, 1965; Tuckman & Jensen, 1977). One notable exception is the research performed by Tiziana Casciaro and Miguel Lobo (2005). Their study concurrently addressed two informal group networks, categorized by content, and aligned with the concept of both instrumental and expressive ties. Their instrumental network, the *task-competency network*, captured intragroup exchange regarding work-related activity. The expressive *affect-network* addressed the structure generally based on "likeability" (Casciaro & Lobo, 2005). This thesis adopts the Casciaro and Lobo terminology for social networks and attempts to build on their foundation by a concomitant investigation of two informal networks. Additionally, this study seeks to link the networks to group leadership, a concept not addressed in the previous study.

Leadership and Social Networks.

Reviews of the social network literature frequently make the point that "little empirical work has been done on leadership and social networks (Brass et al., 2004)." Some researchers have theorized that there are two types of leadership behaviors – task oriented and socioemotional (Bales & Slater, 1955; Slater, 1955). These behavior types match nicely with informal task-competency and affect networks. This thesis examines the interplay between a group's formal and informal structures with regard to formal leadership. This is important, because although the perception of and the management of social networks are intrinsic to the formal leadership role, research in this discipline routinely fails to link leadership to social networks (Balkundi & Kilduff, 2005).

Longitudinal Change.

The group development research is in agreement that once formed, groups change over time. However, temporal issues have been acknowledged as one of the most

neglected aspects of group research (Kozlowski & Bell, 2003; McGrath & Argote, 2001). Possibly because of this research deficit, there is some disagreement on just how this change occurs. The classic work of Tuckman (1965) identified four stages of group development: "forming, storming, norming, and performing." Later, a fifth stage, "adjourning", was added to this model (Tuckman & Jensen, 1977). Although other stage models have been proposed (Worchel, Coutant-Sassie, & Grossman, 1992), many agree that the modified Tuckman five-stage model can be used as a good first approximation (Cissna, 1984). Network analysis can also be used to study the process of change within a group over time (Wasserman & Faust, 1994). If one applies the Tuckman model to informal group networks, an argument can be made that as the group progresses through various stages, a resulting change in the network structure might be seen. In fact, some recent social network research states that as individuals move in and out of organizational contexts, their structural positions change (Balkundi & Kilduff, 2005). This makes the case for researchers to take a longitudinal approach to social networks in general, and specifically, to the positions of group leaders in networks over time. However, the dynamic nature of social networks structures has received much less attention than static connections (Kilduff & Tsai, 2003). The majority of research on both networks (Kilduff & Tsai, 2003) and teams (Kozlowski & Bell, 2003) are time insensitive. Thus, studies tend to gain insights about group statics, not dynamics (McGrath, 1986). This research aims to consider both static and dynamic impacts of informal network structures in teams.

Perceptions of Leaders.

Finally, this study attempts to examine individuals' positions in social networks and how they relate to perceptions of leadership. To my knowledge, no studies have

examined or linked the formal leader's position in social networks to the group's perception of his leadership performance. This study examines just this relationship. Additionally, the small amount of leadership research that has considered a social network perspective has looked primarily at formal leaders (Balkundi & Kilduff, 2005). This research examines group members' positions in social networks, and attempts to associate particular positions with peer-acknowledged formal leaders.

In an attempt to address the highlighted gaps in the literature, this thesis proposes a model to explain the consanguinity between a task-competency network, affect network, formal leader, and informal leader. This model, dubbed the expressive – instrumental leadership model, addresses both direct and moderating processes and is depicted as a nomological network in Figure 2. Before examining the model in detail, a discussion is provided on social network measurements and applicability for this research. Then, model processes are addressed separately to develop the specific hypotheses for examination.

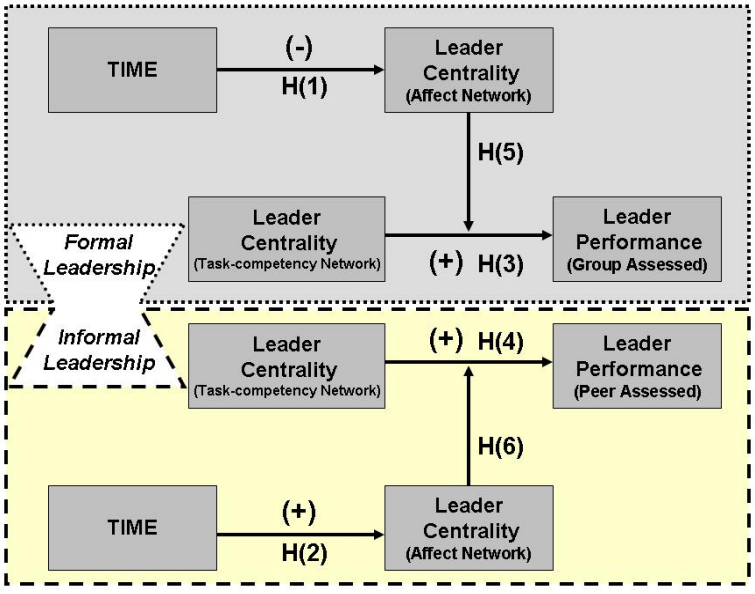

Figure 2. The Expressive – Instrumental Leadership Model

Measuring Social Networks

What social network analysis measures are most suitable for: 1) Capturing the state of multiple informal networks within a group, 2) Tracking the changes in these networks over time, and 3) Measuring the location of leaders within the networks? Network analysts have developed distinctive approaches to reveal the informal structures associated with social proximity (Wasserman & Galaskiewica, 1994). These structures, or "networks," can be measured with sociometric tests where members indicate their acceptance, rejection, frequency of association, and interaction content with other members (Hare, 1976).

Network Graphs.

The patterns discerned from the sociometric ratings can be used to produce graphical representations of informal group structures. This pictorial representation of the network is known as a *sociogram* (or *graph*) (See Figure 3), and it indicates relative positioning of a group's members (Scott, 2000). Originally invented in the 1930s by the scholars Moreno and Jennings (1938), the sociogram remains today as a key component of informal network analysis (Klovdahl, 1986). Within the diagram, each circle represents an individual member of the group (called an *actor* or *node*), and relationships among nodes are represented with lines linking the corresponding points (called a *relational tie, link, line,* or *tie*) (Wasserman & Faust, 1994). The sociogram represents one, and only one, network structure at a time. If one were to measure a social network at multiple time points for a longitudinal analysis, the result would be one sociogram per measurement. Likewise, if one were to measure multiple social networks at a given point in time (e.g. task-competency and affect networks), multiple sociograms would again result.

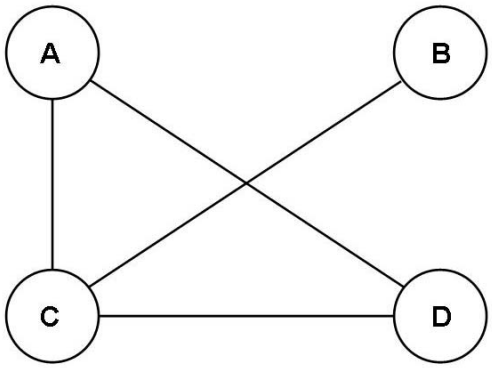

Figure 3. Sociogram (undirected)

It is first necessary to consider the type of line in graph construction to connect the network nodes. Graphs may use undirected, directed, or valued (Scott, 2000). The graph in Figure 3 is an undirected graph. Lines are either present or absent between nodes. Undirected graphs are used when it is simply the absence or presence of a relation that is important (Scott, 2000), such as when one is measuring kinship or affiliations (e.g., country club membership). A second type of graph is the directed graph (See Figure 4). A directed graph adds arrows to the lines to indicate the direction of the relation. For example, the graph in Figure 4 may indicate that A considers D a friend but not vice versa. A third type of graph is the valued graph, where numbers are added adjacent to the lines to indicate the intensity of the relation (Scott, 2000). Figure 5 is an example of a valued graph where individual A has been asked to assess the "strength" of ties with every member of the group. This research will utilize valued graphs in order to capture the intensity, from 1 to 5, of group relations.

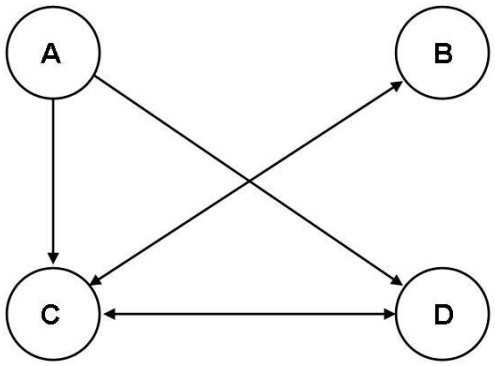

Figure 4. Sociogram (directed)

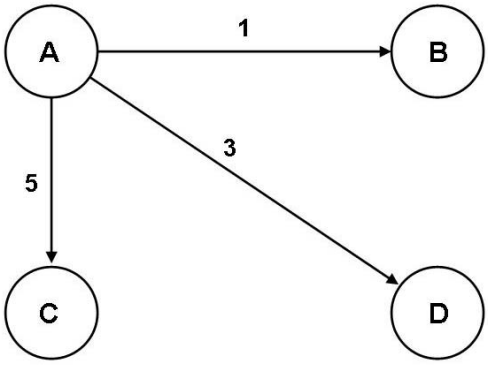

Figure 5. Sociogram (valued)

Network Position.

Sociograms may be used to calculate a variety of network measurements. Such measurements may relate to the network as a whole or they may relate to specific nodes within the network. Researchers utilize measurements like density, inclusiveness, and structural equivalence to analyze the network as a whole. This study, however, focuses on individual measurements within a group. Specifically, it examines the relative positioning of formal and informal leaders with respect to other group members: a measurement called *centrality*. The social network centrality measure is closely tied with

the concept of social power (Hanneman & Riddle, 2005). Although there is some disagreement on exactly definition of power, centrality is associated with an actor having a favored position, having greater influence, and appearing as a focus for deference and attention from those in less favored positions (Hanneman & Riddle, 2005). It is easy to conceptualize that the position of a node in an informal group network will influence the resources and potential benefits for the party who occupies it (Balkundi & Harrison, 2005). A node that is in a structurally advantageous position in the informal social network, read high centrality, tends to receive information and control benefits (Burt, 1992). As leadership can be concomitant with the concepts of control, influence, and the exercise of power (Berlew & Heller, 1983), this tie to social power and structural advantage is an appealing measure. The power possessed by individuals in a network, which varies with the number and intensity of interpersonal relationships, can be estimated with the centrality measure (Hanneman & Riddle, 2005). Three primary variants of centrality measures exist: closeness centrality, betweenness centrality, and degree centrality (Wasserman & Faust, 1994).

The idea behind closeness centrality is to measure how "close" a node is to every other node in the network. This measure can calculate a distance from one node to another, even if there is no direct link between them by considering third party ties (Hanneman & Riddle, 2005). Such measurements involve path-length calculations or eigenvector analysis to compute geodesic distances. Closeness centrality can be an effective measure when analyzing groups engaged in problem-solving; however, closeness centrality is typically used only with undirected graphs (Wasserman & Faust,

1994). Since this research utilizes valued graphs and includes an affective network, closeness centrality is not the best option.

The betweenness centrality measure was created to measure geodesic distances between non-adjacent (non-linked) nodes. It is used only on non-directed graphs (Wasserman & Faust, 1994).

The degree centrality measure is a simple, yet very effective measure of an actor's power potential (Hanneman & Riddle, 2005). The measure deals with the number of ties to other actors in the network and is directly related to advantageous position, actor prominence, and influence potential (Hanneman & Riddle, 2005; Wasserman & Faust, 1994). Degree centrality is an effective measure for working with directed or valued graphs and two distinct measurements are possible. Out-degree centrality measures an actor's perception of the number of ties and total intensity of relations he holds with the remainder of actors in the group. Conversely, in-degree centrality measures the perceived ties and intensity from every actor in the group toward a single individual (Hanneman & Riddle, 2005). Every group actor has both an out-degree and an in-degree score; however, the in-degree measure is most applicable to leadership in general, and this study in particular. Both centrality measures have the aforementioned tie to power and influence, but an actor who receives many ties is said to be *prominent*, or to have high *prestige* (Wasserman & Faust, 1994). That is, many other actors seek direct ties to him, and this may indicate his importance and influence potential (Hanneman & Riddle, 2005). Additionally, an actor's out-degree measurement seems more prone to error. People, in general, tend to perceive themselves to be more central in social networks than they actually are (Kumbasar, Romney, & Batchelder, 1994). This may be because they

prefer to see their own relationships (out-degrees) as reciprocated – they prefer not to perceive their friendship overtures as unrequited (Balkundi & Kilduff, 2005). Thus, they are apt to view themselves as having higher popularity or prestige than truly exists (Kumbasar et al., 1994). For these reasons, the in-degree measure is far superior for this research effort. Because this research utilizes valued graphs for analysis, the in-degree measurements are calculated as the ratio of tie intensity with other team members relative to the maximum possible value of such ties. For example, in Figure 6, the intensity range for in-degree ties is one to five. Actor A's in-degree total is nine (5+3+1=9) and the highest possible total, 5 * (4-1), is 15. The in-degree centrality for actor is then his total divided by the maximum possible. In this case, 9 divided by 15, or .6. In sum, the highlighted social network measures provide the tools required to analyze the hypotheses that follow.

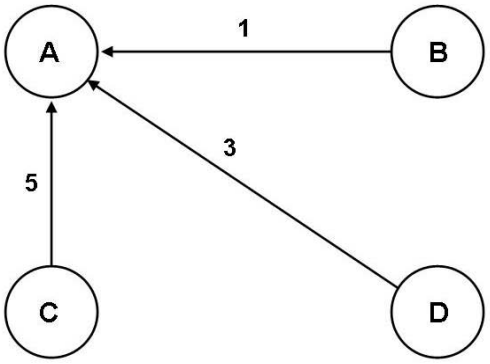

Figure 6. In-degree Calculation Example (Actor A's in-degree = .6)

Hypotheses Development

Formal Leadership and the Informal Affect Network.

A group's formal leader is placed in a position of authority in the formal organizational structure to facilitate the discharge of his responsibility for group task

completion. But, what position will the formal leader occupy in the group's informal affect network? The answer may vary depending on the stage of group development. In initial "forming" and "storming" stages of the group (Tuckman, 1965; Tuckman & Jensen, 1977), the formal leader functions as a "completer" (Schutz, 1961). In this role, he maintains the conception of the group's purpose as well as providing problem-solving skills, concern for member solidarity, and techniques for social control (Hare, 1976). As group members look to the formal leader for both social and task guidance, the leader may hold a position of high relative centrality in the informal affect structure. However, over time, informal structures are likely to change, with the predominant effect seen in the affect network for several reasons.

First, research has shown that groups need to manage relationships with other groups and external members of the organization to ensure task accomplishment (Ancona, 1993). This boundary management responsibility is a crucial task for formal leaders. The formal leader can be considered a "boundary-spanner" who manages not only the group itself, but also represents the group to other groups within and without the organization (Balkundi & Kilduff, 2005). One might conceptualize this responsibility as the maintenance of a position in a kind of inter-group task-competency network. This responsibility likely increases the number of ties that the formal leader is required to maintain over and above the other members of the group. Maintaining a large number of external network ties can drain an individual's own resources because they can be labor intensive to maintain (Mayhew & Levinger, 1976). Unfortunately, there is a limit to the time and attention that group members can spend on tie cultivation and maintenance (Oh et al., 2005). If the formal leader becomes overburdened with large number of external

ties, it seems logical that the first ties he would cease to maintain would be those of the informal affect network. This is because the formal leader is charged with goal completion and likely does not have the option of eliminating task-oriented relationships, both those inside and outside the group.

Additionally, having many ties to others also tends to constrain individual behavior within the role defined by those ties (Krackhardt, 1999). When an individual is required to play the role of both the task and the social-emotional leader, he may find incompatible aspects of these roles resulting in role conflict (Seeman, 1953). This may be because centrality in the affect network requires closeness and intimacy, while the position of formal leader, where task-based assignments must be made without regard to personal feelings, may require distance (Hutchins & Fiedler, 1960). Thus, leaders who maintain a high centrality in the affect network might be constrained by these connections to subordinates and might be unwilling or unable to punish subordinates (Fiedler, 1957; Taylor, Hanlon, & Boyd, 1992). Furthermore, the leader might be influenced by subordinates to an extent that leader and subordinates think alike; therefore, the leader might be unable to discern poor performance in group members (Dobbins & Russell, 2001; Krackhardt & Kilduff, 1990) – a typical formal leader responsibility. Support for this position is shown in recent studies where leaders who are central in a team's network of friendship ties have a burden of maintaining too many close relationships (Boyd & Taylor, 1998). Again, since leaders cannot put aside their formal structure responsibilities, they are likely to resolve this role conflict by reducing their centrality in the affect network.

H(1): Formal leader centrality in the affect network will decrease over time.

The Task-Competency Network and Perceptions of Formal Leadership.

Formal leaders must be perceived by subordinates as exercising leadership in order to go beyond a formal role (the formal leader title) in influencing others (Lord & Maher, 1991). Perceptions of leader performance come from a variety of sources and directions. They can come from both inside and outside of an organization. Within the organization, they may come from one's self, his superiors, his peers, or his subordinates (Atwater, Waldman, & Brett, 2002). Within the formal structure of a group, however, the formal leader has no superiors or peers – only subordinates. Thus, for the purposes of this study, two considerations of performance perception may be eliminated. The two remaining sources, subordinate perception and leader self-perception, are likely to differ significantly (Smircich & Chesser, 1981). In order to eliminate the bias associated with self-ratings (Podsakoff & Organ, 1986; Atwater & Yammarino, 1992; Ashford, 1993), this study will focus on the subordinate perceptions of formal leader performance within the group. Examination of the literature produces several arguments, which leads one to believe that subordinate perceptions of leader performance are directly tied to the leader's centrality in the task-competency network.

Identification and measurement of leader performance is said to be one of the most intractable measurement in group processes (Guion, 1990). With regard to formal leaders, the sources of performance perceptions are not obvious. In fact, it is difficult to articulate with any level of specificity, exactly what it is that leaders do (Newsome, Day, & Catano, 2002). Subordinate perceptions of formal leaders can be inferred from outcomes of salient events (Den Hartog et al., 1999), often those associated with task accomplishment activities. However, individuals dubbed formal leaders don't

necessarily lead the work processes within a group (Pielstick, 2000). Thus, subordinate perceptions are often based on the fit between the formal leader's characteristics with the subordinate's implicit ideas of what a leader is (Den Hartog et al., 1999). Research shows that this perception plays an important role in attributions of leadership and can occur via the use of categorization processes (Lord & Maher, 1991). That is, the matching of an observed person against an abstract prototype of a leader stored in memory (Lord & Maher, 1991). While leadership perceptions may not be reality, they are used by perceivers to evaluate the effectiveness or ineffectiveness of leaders (Den Hartog et al., 1999; Lord & Maher, 1991). Additionally, this type of attribution process provides a basis for social power and influence (Lord & Maher, 1991).

What are subordinates' implicit leadership models likely based on? Some research has shown that a group's leader is usually evaluated with respect to his competence (Hollander, 1960). Competence is the capability that a person brings to a situation (Bass & Stogdill, 1990). Formal leaders are, by definition, placed in a position of formal authority in the formal organizational structure. Organizational leaders are likely to choose formal group leaders that they believe have the ability to successfully deal with tasks facing a group. This is an historical leadership role and despite the vast array of views concerning leaders and leadership roles, this common theme appears: the leader provides the capabilities of structure, methods, tactics, and instruments for achieving group goals (Bass & Stogdill, 1990). But we may have to look outside the formal group structure to see how perceptions of competency and performance are forged.

We know that much of the work done by groups happens "despite the formal organization" and via the informal structure (Krackhardt & Hansen, 1993). The task-competency network is the means to task accomplishment inside the formal structure – the "way that work really gets done." (Cross & Parker, 2004). Each member of the group, including the formal leader, holds a position, with an associated quantitative measure of centrality, in this network. The more central an individual in this network, the more the other group members perceive him to be competent in task-related matters. It may be desirable for the formal leader to hold a position of high centrality in the task-competency network. The "holding" of such a position might explain why leaders that combine formal leadership roles with informal ones tend to be more effective (Barnes & Kriger, 1986; Etzioni, 1965). Yet, although purposely placed in a position of authority in the formal structure, the formal leader may not hold a position of high centrality in the informal task-competency network. This scenario may have ramifications on perceptions of his performance.

One important component of leader legitimacy is real or perceived leader competence (Read, 1974). A leader's source of authority, or legitimacy, may predict evaluation of his leadership effectiveness and performance (House & Baetz, 1979; McGlashan, Wright, & McCormick, 1995; Read, 1974). Because 1) the formal leader's position in the task-competency network is a reflection of the group's perception of his competency; and 2) leaders are assessed based primarily on their competency, the centrality measure in this network should be representative of subordinate perceptions of leader performance.

H(2): Formal leader centrality in the task-competency network is positively associated with perceptions of leader performance.

Affect Moderation on Perceptions of Formal Leadership.

From group formation to group termination, if it occurs, the formal leader will occupy some position, either more or less central, in the group's informal affect and task-competency structures. As suggested previously, the proximity in the task-competency network, based on a centrality measure, of group leader to individual member will influence members' perceptions of the leader. However, it is not clear that position in the competency network alone impacts perceptions of leader performance. Individuals' perceptions may be biased based on various aspects of the social context (Sparrowe, Liden, Wayne, & Kraimer, 2001). This study examines the impact of bias and social support apparatuses operating within the informal affect network, and its impact on perceptions of leader performance.

Research by Salancik and Pfeffer (1978) suggests that individuals' attitudes and perceptions derive from the social context in which they are formulated. This research stems from social-information-processing theory, which was developed to explain attitudes, perceptions, and beliefs about organizational phenomena (Ibarra & Andrews, 1993). The researchers posit that people develop attitudes and perceptions as a function of the information available to them through their social relationships and adapt their beliefs to the reality of their own situation (Salancik & Pfeffer, 1978). Other scholars agree that one's perceptions are shaped by the opinions of salient or relevant others (Rice, 1993). This salience or relevance may be based on different criteria associated with different types of informal networks, including interpersonal similarity and closeness (Ibarra & Andrews, 1993). Such traits may be manifested by ties in the affect network. Friendship ties tend to be stronger, more intimate links, and tend not only to connect

people who are similar on a variety of personal characteristics (Marsden & Friedkin, 1993), but also involve more frequent interaction than instrumental ties (Krackhardt & Porter, 1986; Krackhardt & Stern, 1988). Due to their strength and associated pressures for conformity, affective ties carry greater potential for persuasion and influence (Granovetter, 1982; Krackhardt, 1992; Rogers & Kincaid, 1981). Individuals central in the affect network, those with the greatest numbers of friendship ties, become the network's most salient or relevant players. Ties between them and others in the network represent localized social influence processes where attitudes and perceptions may be transferred via the relationships. These types of processes have been found to produce attitude convergence among socially proximate individuals (Ibarra & Andrews, 1993). This may result in individuals either molding or modifying their perceptions to conform to those of the more central individuals.

If highly central individuals in the socially-oriented affect network may impact the perceptions of others in the group, what is that effect likely to be? Well, if a central individual in the affect network is the formal leader, the social influence process may alter others' perceptions of their leadership performance. Research into performance ratings has repeatedly shown that an individual's perception of his own performance frequently differs from others' perception of his performance (Atwater, Roush, & Fischtal, 1995; Harris & Schaubroeck, 1988; Mabe & West, 1982; Thorton, 1980). When perceptions of performance differ, the most common discrepancy is for individuals to rate their performance higher than others rate them (Podsakoff & Organ, 1986; Atwater & Yammarino, 1992; Ashford, 1993). This is the so-called leniency effect. The reasons for this inflation vary, but may be caused by defensiveness, inability to recognize how others

see them, or even attempts to elicit better evaluations from others by evaluating themselves highly (Harris & Schaubroeck, 1988; Holzbach, 1978). Thus, if a formal leader is likely to perceive his own performance higher than others in his group and also likely, if central, to influence others' perceptions of his performance, then it may be that as a formal leader's centrality increases, group members are likely to rate his leadership performance higher than they might otherwise have.

Another social influence process may cause affect centrality to play a role in performance assessment. The general reverence associated with persons of high centrality may affect the perceptions of them by others. The higher the centrality of a formal leader in affect, the more his subordinates see themselves as tied to him. Some call this having a dense social circle (Balkundi & Kilduff, 2005). This central position has been called a "sociometric star" and holds a position of high popularity and leadership (Scott, 2000). Popularity is probably a result of a combination of charisma and social skills (Manasib, 2004). The term charisma may be defined as a relationship between a leader and his followers based on leader behaviors combined with favorable attribution on the part of the followers (House & Shamir, 1993; Waldman, Ramires, House, & Puranam, 2001). A charismatic relationship between a leader and followers generates confidence in the leader (Monin, 2003). This increased confidence level may impact followers' assessment of leader performance. This, in fact, was shown in a meta-analysis by Lowe et al., (1996) where a .81 corrected correlation was found between attributed charisma and subordinates' ratings of leader effectiveness (Lowe, Kroeck, & Sibasubramanian, 1996). Additionally, attributions of popularity or charisma to a formal leader may result in increased competency ratings due to the *halo effect* (Lovelock,

1996). The halo effect is a type of bias that occurs when one characteristic of a person, like popularity level, affects the evaluation of the person's other traits, like competency.

In sum, a combination of factors including increased influence associated with the salience and popularity of actors central in the affect network, together with the propensity of an individual to view their own performance highly, may serve to moderate perceptions formed on competency.

H(3): Formal leader centrality in the affect network will moderate the relationship between leader centrality in the task-competency network and followers' perceptions of his performance, such that, as affect centrality increases, perceptions of the leader's performance will also increase.

Informal Leadership and the Informal Affect Network.

The concept of an emerging leader, a group member who emerges from the ranks and assumes an informal leadership position, has been studied for over 80 years (Curtin, 2004). Research to date on emergent leaders in groups has focused primarily on personality traits, behaviors, group goals, and group efficacy (Pescolido, 2002). Little space in the literature has been directed toward examining the longitudinal positions, measured with centrality, of emergent leaders in a group's informal networks. This thesis will consider the predicted change in informal leader centrality over time for the affect network.

Emerging leaders within a group are likely to occupy a position of increasing centrality over time for several reasons. First, emergent leaders are likely to understand the importance that affective relationships play in fulfilling their leadership role. Timely access to information is enhanced for members in prestigious positions within a group's

affective structure (Adler & Kwon, 2002; Oh et al., 2005). This occurs not only because a central position increases the number of ties, but also because these expressive ties provide more frequent interaction (Granovetter, 1973; Krackhardt & Porter, 1986) and greater repetition of information (Salancik & Pfeffer, 1978) than other informal ties. This is important for would-be leaders because the quantity of participation is correlated with quality and often forecasts a person's emergence as a leader (Bass & Stogdill, 1990). Additionally, as addressed previously, affective ties have been found to produce attitude convergence among individuals with high social propinquity (Ibarra & Andrews, 1993). Not only do attitudes and perceptions of proximate individuals converge, they tend to converge toward those of the more central individual (Granovetter, 1982; Rogers & Kincaid, 1981). This may be because information received via these ties is more credible, relevant, persuasive, and influential (Brass, 1992). For an individual attempting to engage in leadership behavior, these all seem to be attractive byproducts of holding a central position in the affect network.

However, understanding the importance of the affect network is one thing, but capturing a position within it is another. Individuals who engage in leadership activities tend to have a more comprehensive view of the social structure of their teams (Greer, Galanter, & Nordlie, 1954). It seems reasonable then, that this ability to view the network structure also permits them to understand their relative position within it. If a current and desired position relative can be understood, an informal leader may be able to dictate a position change by focusing on "modifiable behaviors" (Holland, 1964) such as communication style (Schultz, 1978; Strickland, Gould, Barefoot, & Paterson, 1978) and conflict-handling behavior (Schneer & Hsu, 1989). Once a foothold in the affect network

is established, natural group process may work to increase the informal leader's centrality. An emerging leader who is perceived to be popular may benefit from a bandwagon effect. That is, people may want to associate with someone perceived to be a salient figure or "rising star (Balkundi & Kilduff, 2005)."

Even if informal leaders do not consciously work to manage their position within the affect network, the act of informal leading may dictate this outcome. Without any formal authority at their disposal, informal leaders must rely on "authentic leading" to influence other group members (Pielstick, 2000). Researchers have developed a leader profile based on authentic leading that emphasizes themes like communication, relationships and community (Pielstick, 2000) – all themes that sit well with expressive ties. The traits exhibited by informal, authentic leaders are conducive to the formation and maintenance of affective social ties. These leaders tend to be friendly, informal, and close to others and treat them as equals even if the leader has more expertise (Bass, 1985). They are more open to sharing, peer encouragement and motivation, and fully engaging others in interpersonal relationships (Pielstick, 2000).

H(4): Informal leader centrality in the affect network will increase over time.

The Task-Competency Network and Perceptions of Informal Leadership.

Try as one might to engage in leadership behavior and emerge as a leader within a group, the final determination of who is, and who is not, a formal leader does not rest with the individual, for the informal leaders are chosen by the group (Wheelan & Johnston, 1996). In order for an individual to emerge as an informal leader, he must demonstrate the ability to influence other group members without the formal authority

associated with a hierarchical position (Argyris, 1971; French & Raven, 1959; Rahim, 1989). This thesis examines the premise that a major source of this influence is associated with an individual's relative positioning in the informal task-competency network.

Inside a group's informal social networks, there exist some structurally advantageous positions (Balkundi & Kilduff, 2005). These positions are characterized by the ability of an individual to be a gatekeeper. That is, to regulate the flow of resources, dispensing what is needed to other group members (Krackhardt, 1996). The central nodes in the group's networks play this key role as they promote the exchange of resources and information necessary for task completion (Balkundi & Kilduff, 2005). We know that much of the work accomplished by groups occurs via the informal structure (Krackhardt & Hansen, 1993), specifically the task-competency structure (Cross & Parker, 2004). Therefore, the individuals who occupy these central nodes are provided with informal position power, which permits them to dispense task-related information, facilitate change, and guide the group toward goals (Brass & Burkhardt, 1992; Friedkin & Slater, 1994; Levi et al., 1954).

Should the occupation of a position of task-competency centrality cause group members to perceive the occupant as a leader? Both intuition and past research says yes. First, in network research, informal leadership is often equated with centrality such that more central individuals tend to be perceived as powerful (Brass & Burkhardt, 1992) and fulfilling leadership roles (Burkhardt & Brass, 1990). However, such research has focused on betweenness centrality rather than in-degree centrality. Betweenness centrality has emerged as a strong predictor of leadership perceptions (Balkundi &

Kilduff, 2005) and has been called "the key to understanding choice as leader (Freeman, Roeder, & Mulholland, 1979)." Does the same hold true for degree centrality measures? In general, group members who become more central to a group's interaction patterns or possess information that enables to contribute more than others to the solution of the group's task tend to emerge as leaders (Bass & Stogdill, 1990; Freeman et al., 1979). This competence to cope with the group's instrumental tasks is an important criterion for others to select an individual as a leader (Downton, 1973). Individuals develop idiosyncratic theories of leadership based on their own ideas about the nature of leaders and their expected behavior (Eden & Leviathan, 1975). While these leadership theories may not be reality, they are used by individuals to distinguish leaders from non-leaders (Den Hartog et al., 1999; Lord & Maher, 1991). The better the fit between the perceived individual and the pre-established prototype, the more likely the person will be viewed as a leader (Foti & Luch, 1992; Offermann, Kennedy, & Wirtz, 1994). Because individuals are usually evaluated with respect to their competence when making leadership evaluations (Downton, 1973; Hollander, 1960), the individual most central in the group's task-competency network is likely to be the recipient of favorable leader attributions. Thus, the following hypothesis is offered:

H(5): A group member's centrality in the task-competency network is positively associated with other's perceptions of him as an informal leader.

Affect Moderation on Perceptions of Informal Leadership.

A group's affect network impacts the selection and perception of informal leaders in manner similar to the way it affects performance assessments for the formal leaders. The theoretical arguments for both are mostly parallel. Each group member

simultaneously occupies a position in both the task-competency and affect networks. Because the centrality of an individual is determined not by one individual's perception of his position, but rather by the perceptions of the remainder of the group, this concept may be well suited to predict emergent leaders.

Work groups often divide leadership responsibilities among multiple members such that there is a task leader, central in the competency network and primarily concerned with task performance, and a social-emotional leader or best-liked man, central in the affect network and primarily concerned with affective relationships (Hare, 1976). This concept supports an informal structure with a minimum of two informal leaders. Yet, in most sociometric studies, including this one, a rank-ordered list of peer-recognized informal leaders will identify one member with the most influence. Relative position in the task-competency network has been argued to have a direct influence on the identification of this leader, but what is to be made of the affect network? Peer ratings in the affect network have been shown to influence task-competency ratings (Casciaro & Lobo, 2005). Thus, it appears a multi-network perspective is in order in predicting member's propensity to be chosen an informal leader.

It appears that the relative position within the affect network can serve to either increase or decrease previously-conceived competency perceptions. Some research has shown that if a person is rated low enough in affect, member perceptions of his competency rapidly decline, not matter how adept his intrinsic task skills (Casciaro & Lobo, 2005). The logical conclusion then, based on previous argument, is that the individual's overall rating as an informal leader should suffer in comparison to his rating had he been judged on competency alone. On the other hand, a highly central position in

the expressive network might provide the opposite effect. The sociometric star theory purports that high centrality equates to high popularity (Scott, 2000), which seems to be tied with increased charisma (Manasib, 2004), and therefore, more favorable perceptions of leadership from others (House & Shamir, 1993; Waldman et al., 2001). This jibes with prior research that finds more central individuals tend not only to play leadership roles (Burkhardt & Brass, 1990), but to be perceived by others as powerful (Brass & Burkhardt, 1992), a concept traditionally associated with leadership roles (Yukl, 2004). As one researcher put it, "to say a leader is preoccupied with power is like saying a tennis player is preoccupied with making shots his opponent cannot return (Bass & Stogdill, 1990)." In sum, this thesis argues that an individual's centrality in the affect network will impact peer ratings of leadership. Specifically:

H(6): A group member's centrality in the affect network will moderate the relationship between member centrality in the task-competency network and others' perceptions of him as an informal leader, such that, as affect centrality increases, perceptions of the member as an informal leader will also increase.

III. Methodology

Overview

This chapter outlines the methodology used in the evaluation of the investigative questions and hypotheses stated in Chapter II. The first section addresses the population studied. The second section discusses the procedures used in gathering data from the target population. The third section describes the instruments used in gathering the required data. The final section outlines the approach for statistical analysis of the research data.

Research Approval

Permission to conduct this research was granted in accordance with Air Force Instruction (AFI) 40-402. A waiver to the human experimentation requirements of the AFI was requested and granted. The survey was approved by both the Wright State Institutional Review Board and the Air Force Personnel Center Survey Control Office (AFPC/DPAFDS). This research was assigned protocol SCN 05-084. The waiver request and AFPC approval letters are included in Appendix A.

Participants

The population from which the sample was drawn was a military education institution for senior enlisted personnel. The total sample size of the school is 431 with 403 students and 28 instructors. The average age within the sample is 40.6 years, with 13.1 % of the sample being female. Ethnically, the sample is diversified as such: 70.1% White, 16.7% Black, 5.7% Hispanic, and 6% other. The student population was drawn from throughout the military establishment. Individual students came from all military

services, a myriad of geographic locations, and represented many different job specializations.

The school consists of 28 distinct groups called “flights.” The flight is the unit of analysis for my research and all 28 flights were sampled. Each flight was populated with approximately the same number of males, females, and minorities. Additionally, job specialization was accounted for, in that to the extent possible, each flight had a similar mix of specialty fields. The intended result was a homogeneous population between the flights and a heterogeneous mixture within each flight. Each flight has thirteen to seventeen military students and one military instructor. Some classroom size limitations caused the flights to differ in membership size. The hierarchical structure of the flight is very flat. The instructor is placed as the flight’s formal leader and is responsible for teaching and rating the flight’s students. All students within a flight are peer-equals and they each report individually to the flight instructor. Flights were formed at the start of training on 1 Sep 05 and remained intact until completion of training on 19 Oct 05. During this time, flight members lived in close proximity in dormitory-style housing to facilitate close coordination. Each flight attended all required training as a group. The schedule consisted of approximately nine hours a day of classroom education, five days a week. Outside of training periods, flight members were free to interact with members of their own flight or those of other flights at their own discretion. At the completion of training, the students returned to their original geographic locations to resume their military duties.

Procedure

The population under study was visited personally by the researcher after the initial formation of the flights. They were given an overview of the purpose of the study and a generic timeline as to how the data collection would flow. They were told that a series of paper surveys would be administered periodically during their time at the institution. Anonymity of participants was ensured and it was made clear that participation in the study was voluntary. The purpose given for the survey process was to study leadership and social network interactions. The researcher met separately with the group of flight instructors to cover the process in greater detail. Due to the large geographic distance between the researcher's workplace and the study population (≅ 600 miles), the survey administration plan was as such: The researcher personally administered the first three surveys to the flights in order to establish a standardized baseline procedure for administration. Thereafter, each flight instructor administered the remaining surveys to his flight at specified intervals and sealed the completed surveys for return to the researcher.

A total of seven surveys were administered to the target population. The first survey, administered 1 Sep 05, established a social network baseline by measuring any previous relationships an individual might have with other flight members. Surveys two through six measured the social network structure within each flight. The last survey measured final social network structures and additionally, it measured student assessments of the formal leader's (instructor's) performance.

Additional data required for the study was collected by the military institute and passed to the researcher after flight termination. This includes demographic data for the population and informal leadership ratings from the respective flights.

Measures

Formal Leader Performance.

Formal leader performance was measured using the Multi-Factor Leadership Questionnaire, version 5X (MLQ-5X) (Avolio & Bass, 2004). The MLQ, developed by Bass & Avolio and published by Mind Garden, Inc., has been developed, improved, and validated over the last two decades. An early version of the instrument was evaluated by an expert panel and recommendations were rolled into an updated version. Since then, 14 samples have been used to validate and cross-validate the instrument (Bass & Avolio, 2000b). It is now the standard instrument for assessing a range of transformational, transactional, and nonleadership scales (Rowold, 2005). The MLQ consists of two distinct instruments – one for self-rating of leaders and the other for peer or subordinate ratings of leaders. For this research, the self-rating instrument was not used. The MLQ instrument consists of 45 items, which measure five transformational, three transactional, one passive-avoidant, and three outcome subscales of leadership (Avolio & Bass, 2004). The transformational scales include inspirational motivation, idealized influence (attributed), idealized influence (behavior), intellectual stimulation, and individualized consideration. For example, one individual consideration item asks the rater to assess the degree to which the leader "helps [him] develop [his] strengths." The transactional subscales include contingent reward, management-by-exception (active), and management-by-exception (passive). An example of a contingent reward item is an

assessment of how the leader "provides [the subordinate] with assistance in exchange for [his] efforts." The passive-avoidant construct includes the laissez-faire or non-leadership subscale. Here, one example is the assessment of the extent to which the leader "avoids getting involved when important issues arise." Finally, the leadership outcome subscales include leaders' extra effort, effectiveness of leader behavior, and follower satisfaction. For example, the follower rates the degree to which the leader "increases [the follower's] willingness to try harder." (Avolio & Bass, 2004) Taken in combination, these subscales form the Full Range of Leadership, a comprehensive leadership model developed by Avolio and Bass (2002). For each formal leader rated, the mean of each subscale was calculated and the 12 means summed to determine an overall score. Items associated with management-by-exception (both active and passive) and laissez-faire leadership were reversed scored. Reliabilities for each subscale were calculated. Table 1 shows a comparison of reliabilities to those measured by the instrument's developers (Bass & Avolio, 2000a).

Table 1

Descriptive Statistics and Reliability Scores for MLQ 5x

Subscale	Current Research (N=303)			Bass & Avolio (N=2154)*		
	Mean**	SD	Reliability	Mean	SD	Reliability
Idealized Influence (Attributed)	3.34	.72	.87	2.56	.84	.86
Idealized Influence (Behavior)	3.34	.73	.38 (.77)***	2.64	.85	.87
Inspirational Motivation	3.42	.67	.85	2.64	.87	.91
Intellectual Stimulation	3.15	.74	.75	2.51	.86	.90
Individual Consideration	3.10	.74	.76	2.66	.93	.90
Contingent Reward	3.29	.71	.79	2.20	.89	.87
Management-by-Exception (Active)	1.75	1.05	.87	1.75	.77	.74
Management-by-Exception (Passive)	.80	.80	.79	1.11	.82	.82
Laissez-faire Leadership	.50	.41	.73	.89	.74	.83
Extra Effort	3.15	.91	.97	2.60	1.16	.91
Effectiveness	3.26	.72	.91	2.62	.72	.91
Satisfaction	3.39	.79	.94	2.57	1.28	.94

* Taken from (Bass & Avolio, 2000a)

** Means were adjusted to compare with Bass & Avolio. This research utilized a 1 to 5 Likert scale, Bass & Avolio used a 0 to 4 Likert scale.

***Item # 6 was deleted to raise the reliability from .38 to .77. Total items used dropped to 44 from 45.

Informal Leadership Ratings.

The informal leadership ratings are collected as a standard school product near the completion of the school's curriculum. This data is used by the flight instructors to assist in preparation of formal training reports for students. Each student is asked to identify the top three informal leaders in his flight and rank-order them. An individual ranked number one receives five points. An individual ranked second receives three points.

Finally, an individual ranked third receives one point. This assessment is anonymous so it is possible for an individual to vote for himself. Responses from all flight members are tallied and each student receives a score ranging from a minimum of zero to a maximum of five times the number of students in the flight. The student with the highest aggregate score is assessed to be the top informal leader of the flight.

Social Network Centrality.

A social network measurement instrument (Appendix B) was utilized to collect network data for both the affect and the task-competency networks. Scores were collected using a five-point Likert scale. Each member was asked to answer respond to statements with regard to every other member in their flight (including the instructor) with the following closed-ended response options: 1 = Not at all, 2 = Once in a while, 3 = Sometimes, 4 = Fairly often, and 5 = Frequently.

The affect network was assessed with the following questions: 1) I spend time in social-oriented activities with this person (dining out, movies, sports, etc.), and 2) I "hang out" with this person. The task-competency network was assessed with the following questions: 1) I spend time on work-related tasks with this person (projects, studying, etc.), and 2) I go to this person for work-oriented advice. These questions were analogous to those used in another study measuring similar informal group networks (Casciaro & Lobo, 2005a). However, the Casciaro & Lobo study used only one question per network. This study added a second question to allow the calculation of internal consistencies of the measures. These consistencies are shown in Table 2.

Table 2. Reliability Scores for Group Social Networks		
Survey #	Affect Network Questions (Chronbach's alpha)	Task-Competency Network Questions (Chronbach's alpha)
2	.89	.90
3	.86	.73
4	.93	.86
5	.95	.88
6	.90	.88
7	.91	.90

Once the network data was collected, each flight member was assessed a score based on the total value of the indegrees measured from the remainder of his flight. Once this actual number of indegrees in measured, the centrality of any flight member can be calculated via using Equation 1:

$$\text{Individual Centrality (flight with } n \text{ members)} = \frac{\text{\# of indegrees}}{5(n\text{-}1)} \qquad (1)$$

Although a total of seven surveys were administered to the study population, only the final six surveys measured individual centrality in the social networks. The first survey was use to identify any individuals who had previously worked together or had affective relationships. This approach helped to validate the assumption of random selection. To avoid any confusion in data interpretation, it is important to note that measured centralities at times one through six map to surveys two through seven. For

example, the variable Formal Leader Centrality, Affect Network, Time 5, was collected with survey number six.

Statistical Analysis

The data of this study is partly hierarchical in structure with two levels of analysis. That is, the individual subjects of study are arranged in groups which themselves may have qualities that influence the research. In this case, the individual subjects can be seen as level one units of study and the flights into which they are arranged are level two units.

The term "partly" is used because the formal leader side of the expressive-instrumental leadership model is non-hierarchical in nature. All dependent, independent, and control variables under study in this portion of the model reside at the first level of analysis. Level one data was analyzed using the SPSS® statistical package for Windows™ (version 13.0). The informal leader side of the expressive-instrumental leadership model consists of both group and individual level data. Again, SPSS® was used to analyze the level one data. Additionally, the level two data, specifically the group densities of each flight's social networks, required a more robust modeling package. The Hierarchical Linear and Nonlinear Modeling (HLM) software (version 6.02 student edition) was used in this portion of the analysis.

Prior to the onset of any statistical analysis, the data was examined for unusable case responses and cleaned. The data cleaning process resulted in no removals of responses for the MLQ questions; however, one entire flight (n=16) refused to provide any MLQ responses. Data from 66 respondents was removed and not considered in the social network computations due to irregular responses. The main criterion for removal

of a case was lake of differentiation in the responses, while a secondary criterion was an abundance of missing data. For example, if a respondent gave all "1s" or all "5s" for every survey administered, the data was not included in the analysis. Data was not typically eliminated for no differentiation in a single survey. The lack of differentiation had to be across several surveys, unless the respondent showed no differentiation in one or two surveys and then failed to provide any answers in the remaining surveys. In most cases where the data was removed, the respondents showed no differentiation of response across all the surveys.

Longitudinal Hypotheses.

Time is an important element is this research. Thus, unlike a cross-sectional study when only a single point in time is considered, data analysis must account for the measurements at differing points in time. There are two primary methodologies for analyzing longitudinal data – repeated measures and time series (Trochim, 2000). The best choice for analysis depends in the number of measurements over time. Time series analysis is typically used with 20 or more time measurements, while repeated measures are used when the number of observations is less than 20 (Trochim, 2000). This research considered social network measurements at six intervals (plus a baseline measurement). Thus, a repeated measures strategy, in this case a repeated measures ANOVA, was utilized. As with any ANOVA, a repeated measures ANOVA tests the equality of means. However, the repeated measures ANOVA is used when all subjects are measured under a variety of conditions or at different time intervals. In such circumstances, a standard ANOVA is not appropriate because the assumption of independence is violated (Hopkins,

2004). The SPSS® software was used to perform the repeated measures ANOVA calculations.

As with any statistical analysis, the repeated measures ANOVA has some underlying assumptions for its use. In this case, the four associated assumptions are random selection, normality, homogeneity of variance, and sphericity. The assumption of random selection was supported to the extent possible by the research design. The student population was selected from the larger population of the military establishment, and assigned to flights in an effort to produce heterogeneity of individual characteristics within the flight. Normality assumptions were validated using standard SPSS output products. Specifically, the Kolmogorov-Smirnov test of normality was used in conjunction with standard quantile-quantile (QQ) plots (Coakes, 2003; SPSS, 2004). The homogeneity of variance assumption was tested using the F-Max calculation of standard deviations (Equation 2) (Coakes, 2003; Hill & Lewicki, 2006). The smallest and largest standard deviations from the six time periods were considered. If the calculated value from Equation 2 was less than the critical value, taken from an F-Max distribution table (Coakes, 2003), then the assumption was validated.

$$F - Max = \frac{\sigma^2_{LARGEST}}{\sigma^2_{SMALLEST}} \qquad (2)$$

Finally, the sphericity assumption was tested via Mauchly's test of sphericity; a calculation performed as part of the SPSS analysis. When sphericity assumptions were violated, the F-statistic was adjusted using the Huynh-Feldt epsilon parameter, a correction automatically performed with SPSS® (Coakes, 2003).

Regression-Based Hypotheses.

Hypotheses two and four predict a positive association between an independent and dependent variable. The standard statistical measurement of the degree of relationship between two variables is correlation (Hill & Lewicki, 2006). This thesis employs the most commonly used measure of correlation, the Pearson product moment correlation coefficient (r) (SPSS, 2004).

The statistical significance of the Pearson correlation coefficient is determined with the use of a t-test. If the coefficient is determined to be statistically significant, then the strength of the relationship between the independent and dependent variable can be expressed by squaring the coefficient (R^2). This test statistic, known as the coefficient of determination, identifies how much of the variance in the dependent variable is explained by the independent variable (Urdan, 2005). There are five assumptions that accompany the correlation statistic and all are addressed by this research. The first two assumptions deal with the data collected. The data must be collected from related pairs and the data must be interval or ration in nature (Coakes, 2003). Both assumptions are supported via the research design. The normality assumption is tested as previously discussed in repeated measures ANOVA. The final two assumptions, linearity and homoscedasticity, are examined via the use of scatterplots (Coakes, 2003). SPSS® was used in the testing of these assumptions and the Pearson coefficient calculations.

If statistically significant correlations are shown between two variables, a multiple regression analysis is performed to allow a prediction of the effect of the independent variable on the dependent variable, while controlling for additional predictor variables

(Urdan, 2005), namely gender and age. This research addresses the assumptions that underlie the use of regression analysis. The first assumption is the ratio of cases to independent variables. It is difficult to ascertain the exact number of cases one must have to properly implement regression analysis. The literature argues a wide range of requirements from a high of 100 cases per independent variable to a low of 2 cases per independent variable (Huck, 2003). That said, the "rule of thumb" predominant in the literature is that one should have 10 cases for each independent variable to be included in regression analysis (Urdan, 2005). This research does not fulfill this rule of thumb with regard to predictors of formal leader centrality while simultaneously controlling for gender and age. In this case, the rule of thumb calls for 30 required cases, while the sample population contains only 26 cases, an average of 8.67 cases per independent variable. While this ratio violates the rule of thumb, there is some support in the literature, which claims that five cases per independent variable is adequate (Coakes, 2003; Goldman & Ausiello, 2004). Therefore, this study notes the possible limitation and proceeds on the that reasonable inferences can be drawn from the analysis. This research also addresses the issue of outliers, or extreme cases that may have considerable impact on the regression analysis. Univariate outliers are identified via the use of Cook's distance and multivariate outliers are identified using Mahalanobis distance (Coakes, 2003). Several extreme outliers were removed as part of this analysis. Finally, normality, linearity, homoscedasticity, and independence of residuals are all addressed using scatterplots of the data. SPSS® was used in the testing of assumptions and regression calculations.

A final level of analysis ensued to investigate level two group effects on the dependent variable. Two group-level (level-two) control variables, affect network density and task-competency network density, were added to the model and the HLM software package was used for analysis. Flight densities were calculated using Equation 5.

$$\text{Density (flight with } n \text{ members)} = \frac{\sum_{1}^{n} \text{indegrees}}{5(n^2 - n)} \qquad (3)$$

Both level one and level two data are input into HLM as regression equations. Equation Set 4 illustrates how the level one and level 2 equations combine to form the new regression equation. HLM produces only unstandardized coefficients (γ). Equation 5 was used to produce standardized coefficients (Γ) (Hox, 2002):

Level 1:

$$Y = \beta_0 + \beta_1(X_1) + \beta_2(X_2) + r$$

Level 2:

$$\beta_0 = \gamma_{00} + \mu_0$$
$$\beta_1 = \gamma_{10} + \mu_1$$
$$\beta_2 = \gamma_{20} + \mu_2 \qquad (4)$$

When Combined:

$$Y = (\gamma_{00} + \mu_0) + (\gamma_{10} + \mu_1)(X_1) + (\gamma_{20} + \mu_2)(X_2) + r$$
$$\Rightarrow\ Y = \gamma_{00} + \gamma_{10}X_1 + \gamma_{20}X_2 + (r + \mu_0 + \mu_1X_1 + \mu_2X_2)$$
$$\Rightarrow\ Y = \gamma_{00} + \gamma_{10}X_1 + \gamma_{20}X_2 + R$$
$$\Rightarrow\ Y = \Gamma_0 + \Gamma_1X_1 + \Gamma_2X_2 + R$$

$$\Gamma = \gamma * \frac{\text{Standard Deviation (Independent Variable)}}{\text{Standard Deviation (Dependent Variable)}} \quad (5)$$

Moderation Hypotheses.

Hypotheses three and six predict a moderation effect among three variables. Multiple linear regressions were used to assess the degree of, and significance of, any moderating effect. An interaction term is calculated by multiplying the values of the two independent variables (primary and moderator). An initial regression analysis was performed with all level one variables to include the dependent variable, primary independent variable, proposed moderating variable, interaction term, and control variables. The "rule of thumb" ratio calls for 50 cases in this instance. Although not an issue with the informal leadership dependent variables, the formal leadership variables produce a ratio of 5.2 cases per independent. This number is not ideal, but still enough to meet the lower ratio for validity (Coakes, 2003; Goldman & Ausiello, 2004). Again, a follow-on regression was performed with level two variables added for control. As before, all level one analysis utilized SPSS®, while level two analysis employed HLM.

IV. Results

Descriptive statistics and correlations among study variables were examined categorically by leader status. The results for formal leader variables (N = 28) are displayed in Table 3. The results for informal leader variables (N = 261) are displayed in Table 4.

Formal Leadership and the Informal Affect Network

The results of the repeated measures ANOVA indicate than the mean values of formal leader centrality in the affect network do not change significantly over time ($F_{3.4,97.5} = 2.20$, $p = .07$). An examination of the plotted means shows that formal leader centrality increases slightly over time (Figure 6); however, not to a statistically significant degree. This result is contrary to the hypothesis that formal leader centrality in the task competency network will decrease over time.

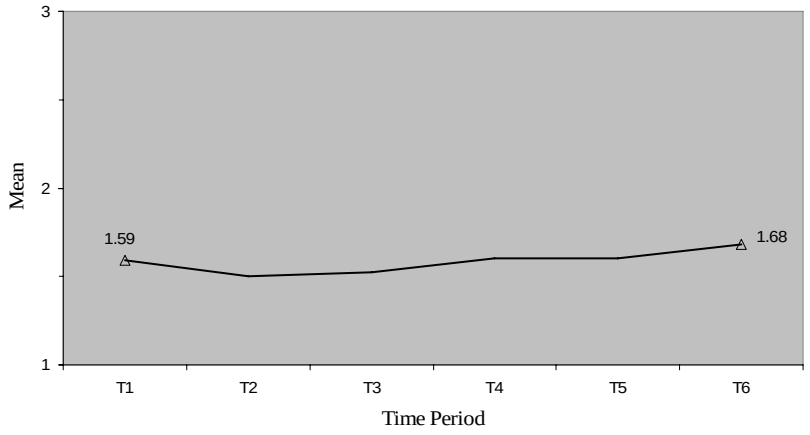

Figure 7. Formal Leader Affect Centrality (as rated by all students)

Exploratory Supplemental Analysis.

To gain possible additional insight into formal leader centrality, supplemental analysis was performed using a data set modified to highlight any moderating affects of informal leadership. Each flight member received some value of peer points from others in his flight. This value ranged from 0 to 63 overall, but the top point getter in each flight differed in value. Data from the three individuals in each flight who received the most peer points was put into one grouping called *informal leaders* (N = 89). This data reflects how formal leader centrality in the affect network was assessed by each flight's informal leaders. Data from the remaining students was placed into a grouping called *others* (N = 313). This data reflects how formal leader centrality in the affect network was assessed by those that didn't score in the top three in peer points. Formal leader centrality in the affect network was recalculated for both of the resulting data sets. Longitudinal change analysis was again performed.

The *others* data set was first examined. A repeated measures ANOVA indicated that, again, formal leader centrality in the affect network did not change over time ($F_{3.9,93.7} = .143$, $p = .96$). An examination of the plotted means shows that formal leader centrality decreases slightly over time (Figure 8), but not to a statistically significant degree.

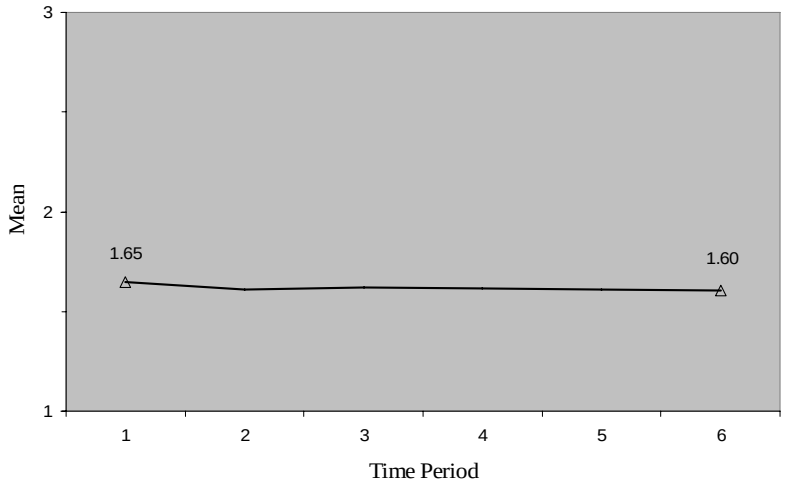

Figure 8. Formal Leader Affect Centrality (as rated by other students)

The *informal leaders* data set was then analyzed. A repeated measures ANOVA indicated that formal leader centrality in the affect network increased over time ($F_{2.6,62.6} = 7.74$, $p < .01$). Furthermore, the within-subjects contrasts indicated that the change was linear ($F_{1,24} = 14.96$, $p < .01$). An examination of the plotted means shows that centrality increases over time (Figure 9). Thus, when the longitudinal analysis is considered in total, not only is the hypothesis not supported, but the only statistically significant trend noted (as assessed by informal leaders) is in the opposite direction of that hypothesized.

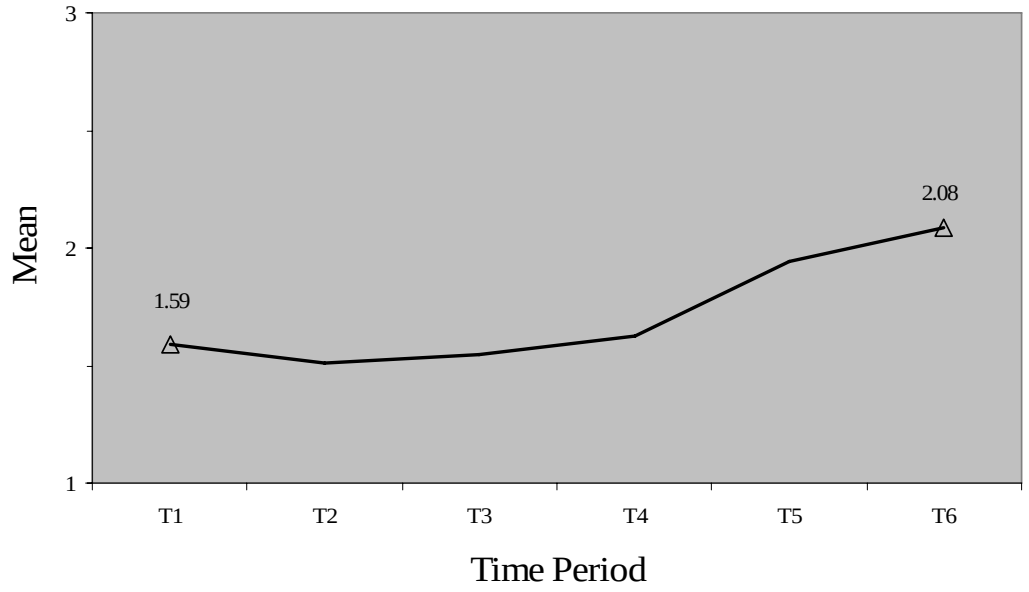

Figure 9. Formal Leader Affect Centrality (as rated by informal leaders)

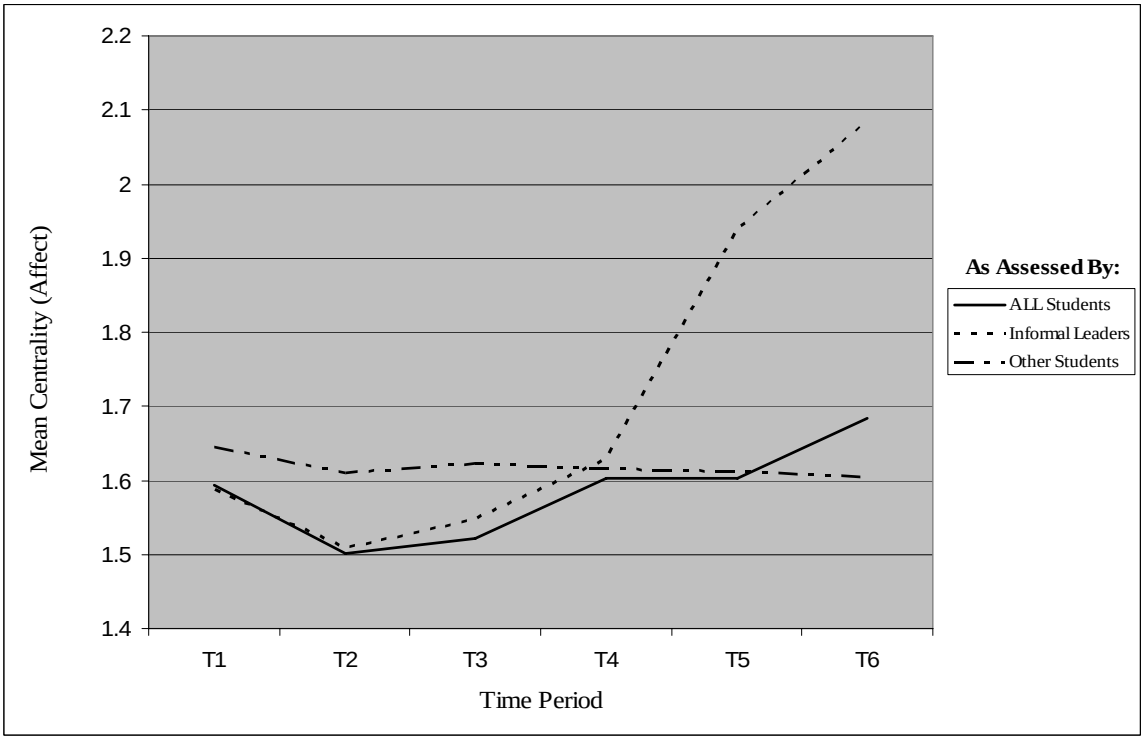

Figure 10. Consolidated Graph of Formal Leader Centrality (Affect Network)

Table 3. Descriptive Statistics and Correlations for Formal Leader Variables

	Mean	SD	1	2	3	4	5	6	7	8	9	10	11	12	13
1. MLQ	4.20	.245	--												
2. Centrality TC (time 6)	2.19	.485	.532*	--											
3. Centrality TC (time 5)	2.23	.476	.201	.635**	--										
4. Centrality TC (time 4)	2.28	.473	.231	.562**	.823**	--									
5. Centrality TC (time 3)	2.26	.383	.298	.608**	.754**	.723**	--								
6. Centrality TC (time 2)	2.48	.466	.191	.559**	.670**	.703**	.727**	--							
7. Centrality TC (time 1)	1.77	.308	.118	.398*	.503*	.350	.641**	.422*	--						
8. Centrality A (time 6)	1.64	.354	.489**	.718**	.630*	.528**	.537**	.388	.318	--					
9. Centrality A (time 5)	1.60	.423	.221	.494**	.582**	.410*	.384	.366	.268	.688**	--				
10. Centrality A (time 4)	1.60	.445	.153	.451*	.529**	.615**	.560**	.439*	.229	.828**	.698**	--			
11. Centrality A (time 3)	1.52	.371	.188	.515**	.456*	.455*	.531**	.430*	.166	.786**	.790**	.773**	--		
12. Centrality A (time 2)	1.50	.274	.025	.279	.460*	.586**	.417*	.602**	.019	.476*	.483*	.595**	.518**	--	
13. Centrality A (time 1)	1.59	.290	-.285	.169	.267	.274	.406*	.318	.482**	.406*	.217	.239	.257	.306	--

Note: These calculations are based on formal leaders only (N=28)
* Correlation is significant at the 0.05 level (2-tailed)
** Correlation is significant at the 0.01 level (2-tailed)
TC = Task-competency Network
A = Affect Network

63

Table 4. Descriptive Statistics and Correlations for Informal Leader Variables

	Mean	SD	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Peer Ranking	9.16	2.49	--												
2. Centrality TC (time 6)	2.62	.503	.167**	--											
3. Centrality TC (time 5)	2.66	.459	.270**	.783**	--										
4. Centrality TC (time 4)	2.66	.430	.269**	.671**	.721**	--									
5. Centrality TC (time 3)	2.53	.394	.248**	.677**	.700**	.831**	--								
6. Centrality TC (time 2)	2.47	.378	.249**	.362**	.468**	.530**	.593**	--							
7. Centrality TC (time 1)	1.55	.320	.010	.381**	.330**	.467**	.498**	.448**	--						
8. Centrality A (time 6)	2.71	.475	.157*	.788**	.684**	.482**	.550**	.245**	.266**	--					
9. Centrality A (time 5)	2.74	.396	.153*	.637**	.775**	.619**	.572**	.297**	.246**	.765**	--				
10. Centrality A (time 4)	2.65	.431	.093	.660**	.640**	.700**	.648**	.347**	.337**	.680**	.792**	--			
11. Centrality A (time 3)	2.60	.425	.092	.588**	.634**	.557**	.678**	.428**	.291**	.681**	.713**	.815**	--		
12. Centrality A (time 2)	2.41	.381	.145	.295**	.426**	.376**	.446**	.628**	.243**	.373**	.537**	.533**	.598**	--	
13. Centrality A (time 1)	1.89	.358	.044	.284**	.149**	.208**	.250**	.379**	.634**	.274**	.224**	.253**	.290**	.404**	--

Note: These calculations are based on informal leaders only (N=261)
* Correlation is significant at the 0.05 level (2-tailed)
** Correlation is significant at the 0.01 level (2-tailed)
TC = Task-competency Network
A = Affect Network

The Task-Competency Network and Perceptions of Formal Leadership

The Pearson correlation coefficient was calculated between two variables -- formal leader centrality in the task-competency network (time 6) and total MLQ scores for the leader. The two variables showed a positive correlation ($r = .406$, $p < .05$). Follow-on simple and multiple (stepwise) linear regressions were performed to determine the regression coefficients (β). When control variables were used, they were entered first. Both the simple regression ($F_{1,24} = 10.96$, $p < .01$) and multiple regression models ($F_{3,21} = 3.79$, $p < .05$) were statistically significant fits and the model with control variables explained more variance in the dependent variable ($R^2 = .331$) than did the model without the controls ($R^2 = .283$). The results from the simple and multiple regressions are shown in Table 5 and the effect is graphed in Figure 11. The data support the hypothesis that formal leader centrality in the task-competency network is positively associated with perceptions of leader performance.

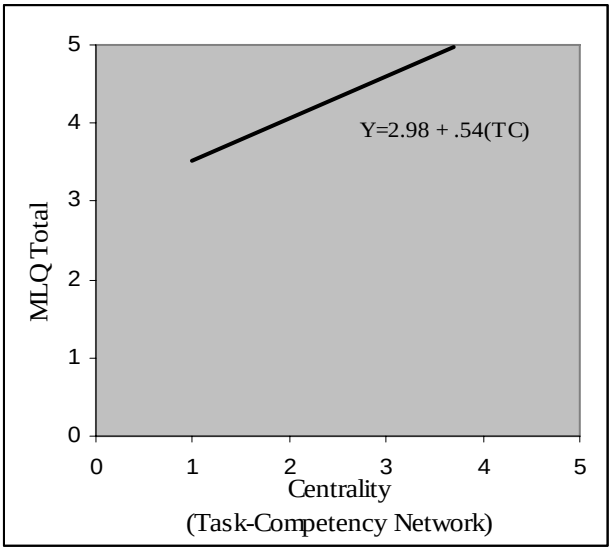

Figure 11. Relationship Between Task-Competency Centrality and MLQ Scores

Table 5. Regression Analysis for Formal Leader Performance

Model	r	R Square	F	IV	b	β	t
1	.532	.283	10.96**	Constant	3.61**	--	19.17**
				Centrality (TC)	.269	.532	3.21**
2	.575	.331	3.79*	Constant	2.98	--	4.87**
				Age	.016	.194	1.13
				Gender	-.016	-.031	-.181
				Centrality (TC)	.261	.537	3.12**

* $p < .05$
** $p < .01$

Affect Moderation on Perceptions of Formal Leadership

The formal leader affect centrality moderation hypothesis was evaluated using an interaction term in multiple regression analysis. The interaction term was computed by multiplying the mean value of the formal leaders' centrality in the affect network and their mean centrality in the task-competency network. An initial regression model included task-competency centrality, affect centrality, and the interaction term, entered in that order, as independent variables predicting MLQ scores. A second model added age and gender as independent control variables. Both the uncontrolled ($F_{3,22} = 5.10$, $p < .01$) and controlled regression models ($F_{5,19} = 4.31$, $p < .01$) were statistically significant fits. The model with the control variables explained more variance in the dependent variable ($R^2 = .531$) than did the model without the controls ($R^2 = .410$). The results from both regression models are shown in Table 6 and a graphical representation of the moderation

effect is shown in Figure 12. Although the analysis supports the notion of an interaction effect, the effect is not entirely as hypothesized. Instead of MLQ scores increasing with all levels of increased formal leader centrality in the affect network, the moderation is such that at lower levels of task-competency centrality (below 3.03), MLQ scores are increased with increasing affect centrality, but at higher levels of task-competency centrality (above 3.03), the opposite is true.

Table 6. Regression Analysis for Formal Leader Performance (Affect Moderation)

Model	r	R Square	F	IV	b	β	t
1	.640	.410	5.10**	Constant	3.26	--	12.96**
				Centrality (TC)	.277	.542	2.17*
				Centrality (Affect)	.395	.544	1.78
				TC x Aff (interaction)	-.079	-.574	-1.98
2	.729	.531	4.31**	Constant	2.52	--	4.31**
				Age	.016	.204	1.28
				Gender	-.007	-.014	-.085
				Centrality (TC)	.229	.469	1.89
				Centrality (Affect)	.533	.764	2.52*
				TC x Aff (interaction)	-.092	-.698	-2.48*

* $p < .05$
** $p < .01$

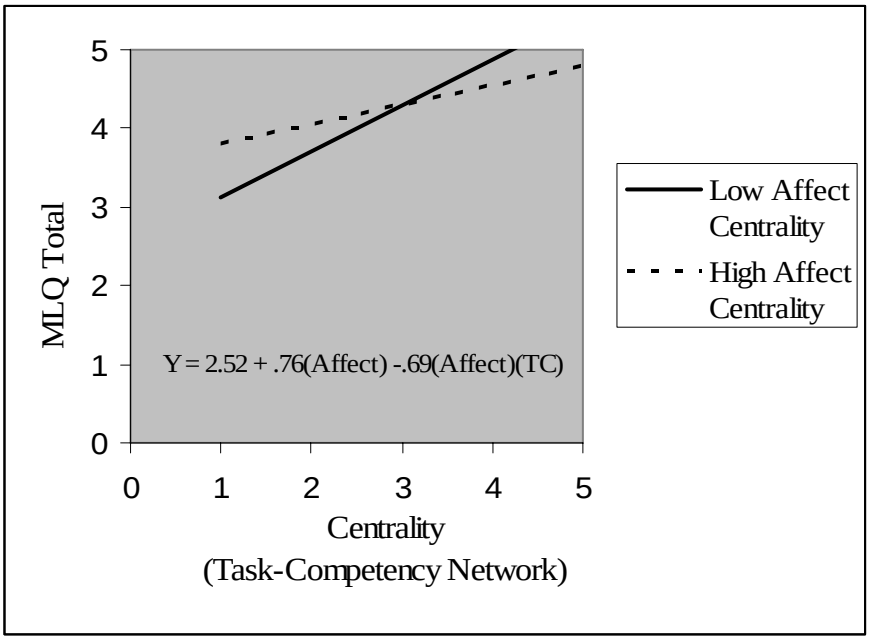

Figure 12. Affect Centrality Moderation on the Task-Competency/MLQ Relationship

Exploratory Supplemental Analysis.

Additional analysis was performed on the data to investigate possible reasons why the hypothesis was not fully supported. The analysis centered on the possibility that the coefficients produced by the regression software are inaccurate. This might happen for two reasons. The first is the small formal leader sample size and thus, the small ration of cases to independent variables in the regression analysis. Sample size is one of four inter-related features of a study design that can influence the ability to accurately detect relationships and interactions (Peers, 1996). As previously stated, the "rule of thumb" in social sciences for the use of multiple regression techniques calls for a minimum of 10 cases per independent variable (Urdan, 2005). Unfortunately, the number of formal leaders in our sample population produced a ratio of just over five cases per independent variable. This number barely meets the requirements as argued by some researchers

(Goldman & Ausiello, 2004), but doesn't pass muster with others. The small case ratio in this study may produce inaccurate interaction coefficients (Aguinis & Stone-Romero, 1997) or may lead to overfitting, "…making the results too specific to the sample, thus lacking generalizability" (Hair, Anderson, Tatham, & Black, 1995).

Another reason the results of this analysis may be suspect revolves around the issue of multicollinearity. Although multicollinearity does not adversely affect the ability of a regression equation to utilize independent variables to predict a dependent variable (i.e., does not affect the R^2, the associated regression coefficients may be highly variable and therefore, inaccurate (Neter, Wasserman, & Michael, 2004). The bottom line is that, if two or more highly correlated variables are in the model, coefficients cannot be interpreted in a reasonable way (Hayter, 1996).

There are several ways to determine if multicollinearity is present in model. The first involves checking the *variance inflation factor* (VIF) outputs generated automatically by the statistical software. Like the disagreements in case to independent variable ratio disagreement in the literature, the interpretation of the VIF is open to some debate. Most researchers agree that produced VIF should ideally be below two, and those above 10 are of great concern (Studenmund, 1992). Many researchers support the notion that VIFs above five are problematic and should receive closer scrutiny (Studenmund, 1992). No VIFs produced in this analysis were above five, however, the ones associated with task-competency centrality, affect centrality, and the interaction variables were all above two: 2.7, 3.7 and 3.3 respectively. A secondary check for multicollinearity involves examination of the eigenvalues produced by the analysis. Eigenvalues near zero are of concern and suggest issues with multicollinearity (Belsley, 1991). The eigenvalues

associated with task-competency (.018), affect centrality (.009), and the interaction term (.002) highlight multicollinearity as a probable issue in this case.

Before dismissing all confidence of the results produced by this regression analysis, a deeper examination of the level of correlation between these variables is in order. A multitrait-multimethod matrix (Campbell & Fiske, 1959) was produced (Table 7) to determine if convergent validity exists between the task-competency network and affect network measurements. High correlation between the variables might lead us to believe that the same construct is being measured rather than the intended distinct variables. Examination of the values in the heterotrait-monomethod blocks shows that, with exception of time period one, all correlations are above .6. More importantly, the correlation between the affect and task-competency measures at time 6 (.79), the time period use in the regression analysis, is nearly equal to the reliability of the affect network measure (.81) and exceeds the reliability of the task-competency network measure (.71).

Table 7. Multitrait-Multimethod Matrix (Formal Leader Variables)													
		Time 1		Time 2		Time 3		Time 4		Time 5		Time 6	
	Traits	TC	Aff	TC	Aff	TC	Aff	TC	Aff	TC	Aff	TC	Aff
Time 1	TC	(.53)											
	Aff	.48**	(.76)										
Time 2	TC	.42	.32	(.79)									
	Aff	.02	.31	.60**	(.86)								
Time 3	TC	.64	.41	.73	.42	(.72)							
	Aff	.17	.26	.43	.52	.63**	(.84)						
Time 4	TC	.35	.27	.70	.58	.72	.45	(.88)					
	Aff	.23	.24	.44	.60	.56	.77	.62**	(.95)				
Time 5	TC	.49	.27	.67	.44	.75	.47	.82	.51	(.83)			
	Aff	.27	.22	.37	.48	.38	.79	.41	.70	.67**	(.89)		
Time 6	TC	.27	.22	.53	.44	.59	.71	.63	.69	.66	.61	(.71)	
	Aff	.32	.41	.39	.48	.54	.79	.53	.83	.49	.69	.79**	(.81)

** heterotrait-monomethod blocks

One final set of calculations was performed to determine if the affect network measure and task-centrality measure may have been measuring the same thing. Using only responses from formal leaders, reliabilities were computed at each time period for the following: affect measure alone, task-competency measure alone, both affect and task-competency measures combined as a single measure. The results, shown in Table 8, provide evidence that the affect and task-competency measures are not distinct in this

environment for the formal leader. For each and every time period, the reliability of the combined measure was equal to or greater than at least of one of the individual measures. For time period six, the one used in this regression, the reliability of the combined measure surpassed that of each individual measure.

Table 8. Reliability Scores for Group Social Networks*

Time Period	Affect Network Measure (α)	Task-Competency Network Measure (α)	Affect / Task-Competency Network Combined Measure (α)
1	.76	.53	.72
2	.86	.79	.81
3	.84	.72	.80
4	.95	.88	.88
5	.89	.83	.85
6	.81	.71	.85

* Considers only formal leader responses (N = 28)

Informal Leadership and the Informal Affect Network

The results of the repeated measures ANOVA indicate than the mean values of informal leader centrality in the affect network change significantly over time ($F_{3.9,303.8}$ = 104.20, $p < .01$). An analysis of the within-subjects contrasts indicates that the difference among the means changes in a linear fashion ($F_{1,78}$ = 204.96, $p < .01$). When graphed (Figure 13), the change in means clearly illustrates an increase in centrality over time. This result supports the hypothesis that informal leader centrality in the task competency network will increase over time.

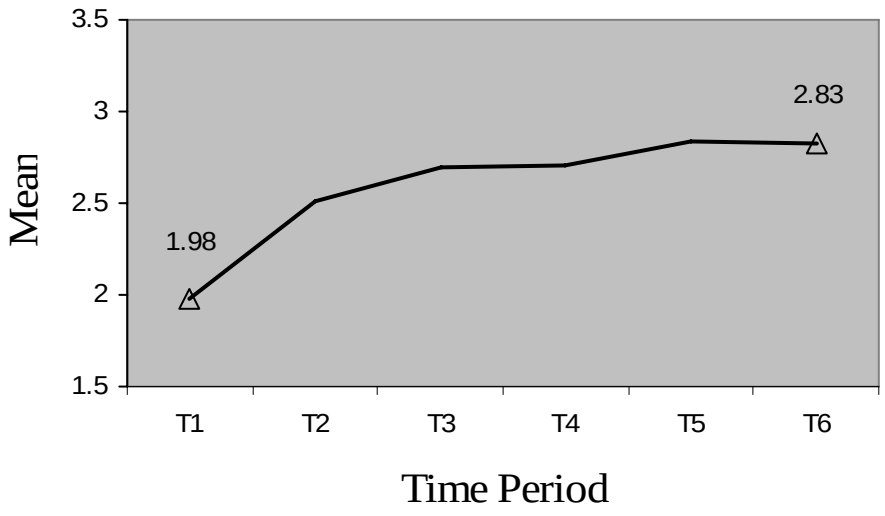

Figure 13. Longitudinal Informal Leader Affect Centrality

The Task-Competency Network and Perceptions of Informal Leadership

To evaluate this hypothesis, the members of each flight were rank ordered from 1 to n based on the total number of peer points received. The ranking was then reverse coded so the hypothesized correlation, if found, would trend in the appropriate direction (i.e., an increase in centrality results in an increase in leader ranking). Members who received no points were considered "non-leaders." They received no ranking and were removed from consideration. This reduced the sample size from N=403 to N = 313. Fifty additional cases were eliminated to standardize the flight structures. Due to the manner in which peer points were allocated, each flight had differing numbers of individuals receiving peer points. When rank ordered, several flights had as many as 13 ranked individuals. However, all flights had at least nine ranked members. Thus, the top 9 peer point recipients in each flight were considered in the analysis. The resulting sample size for the analysis was N = 261.

The Pearson correlation coefficient was calculated between two variables -- informal leader centrality in the task-competency network (time 6) and informal leader rank in flight (recoded). The two variables showed a positive correlation ($r = .166$, $p < .01$). Follow-on simple and multiple (stepwise) linear regressions were performed to first determine the β coefficient for the correlation and then to control for age and gender. When control variables were used, they were entered first in the model. Both the simple regression ($F_{1,240} = 6.81$, $p < .01$) and multiple regression models ($F_{3,236} = 4.15$, $p < .01$) were statistically significant fits and the model with control variables explained more variance in the dependent variable ($R^2 = .038$) than did the model without the controls ($R^2 = .028$).

Next, a 2-level regression analysis was performed using HLM to control for the group-level effects of flight density. For each flight, a group density was calculated for both the affect network and task-competency network. This resulted in the addition of a second interaction term (affect density x task-competency density). All results from the simple, multiple, and 2-level regressions are shown in Table 9 and the relationship is illustrated in Figure 14. The data support the hypothesis that formal leader centrality in the task-competency network is positively associated with perceptions of leader performance.

Table 9. Regression Analysis for Informal Leader Ranking

Model	r	R Square	F	IV	b	β	t	γ [1]	Γ [2]
1	.166	.028	6.81	Constant	7.04	--	8.46**		
				Centrality (TC)	.821	.166	2.61**		
2	.224	.050	4.15**	Constant	11.289	--	5.01**		
				Age	-.105	-.132	-2.08*		
				Gender	-.203	-.029	-.457**		
				Centrality (TC)	.903	.182	2.85**		
3	--[3]	--[3]	--[3]	Constant			2.48*	5.63	--
				Age			-2.11**	-.085	-1.39
				Gender			-0.233	-0.101	-.034
				Density (TC)			6.47**	-5.36	-1.09
				Centrality (TC)			-6.37**	5.37	5.60

* $p < .05$
** $p < .01$
Notes: [1] HLM does not report r, R Square, and F for 2-level hierarchical analysis
[2] γ is reported as the unstandardized 2-level coefficient and is equivalent to b
[3] Γ is reported as the standardardized 2-level coefficient and is equivalent to β

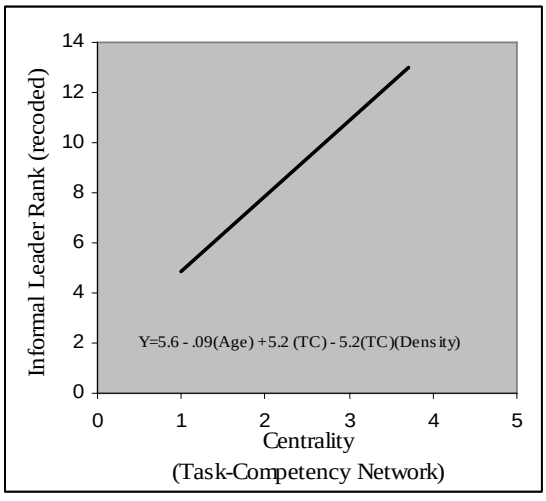

Figure 14. Relationship Between Task-Competency Centrality and Informal Rank

Affect Moderation on Perceptions of Informal Leadership

The informal leader affect centrality moderation hypothesis was evaluated through interaction terms in multiple regression analysis. The interaction term was computed by multiplying the mean value of the informal leaders' centrality in the affect network and their mean centrality in the task-competency network. An initial regression model included task-competency centrality, affect centrality, and the interaction term, entered in that order, as independent variables predicting the informal leader ranking. A second model added age and gender as additional independent control variables, with the control variables entered first. Both the uncontrolled ($F_{3,238} = 6.15$, $p < .01$) and controlled regression models ($F_{5,234} = 5.97$, $p < .01$) were statistically significant fits. The model with the control variables explained more variance in the dependent variable ($R^2 = .100$) than did the model without the controls ($R^2 = .051$).

Next, a 2-level regression analysis was performed using HLM to control for the group-level effects of flight density. For each flight, a group density was calculated for both the affect network and task-competency network (Equation 5). This resulted in the addition of a second interaction term (affect density x task-competency density). The results from both regression models are shown in Table 19 and a graphical representation of the moderation effect is shown in Figure 15. Although the analysis supports the notion of an interaction effect, the effect is not entirely as hypothesized. Instead of peer ranking increasing with all levels of increased informal leader centrality in the affect network, the moderation is such that at lower levels of task-competency centrality, peer rankings are increased with increasing affect centrality, but at higher levels of task-competency centrality, the opposite is true.

Table 10. Regression Analysis for Informal Leader Ranking (Affect Moderation)

Model	r	R Square	F	IV	b	β	t	γ [1]	Γ [2]
1	.225	.051	6.15**	Centrality (TC)	20.60	.941	3.04**		
				Centrality (Affect)	17.65	.735	3.01**		
				TC x Aff (interaction)	-6.72	-1.44	-2.88**		
2	.316	.100	5.97**	Constant	5.34	--	2.20*		
				Age	-.455	-.146	-2.74**		
				Gender	-3.46	-.111	-2.06*		
				Centrality (TC)	23.53	1.05	3.39**		
				Centrality (Affect)	19.36	.792	3.16**		
				TC x Aff (interaction)	-7.70	-1.62	-3.18**		
3	--[3]	--[3]	--[3]	Constant			-.015	-.05	--
				Age			-2.21*	-.092	-1.51
				Gender			-.263	-.110	-.038
				Density (TC)			-2.27*	-5.10	-.512
				Density (Affect)			-2.66**	-4.80	-.997
				Den x Den (interaction			1.40	1.29	.138
				Centrality (TC)			4.25**	6.80	7.10
				Centrality (Affect)			2.64**	5.18	5.62
				TC x Aff (interaction)			-1.98*	-1.10	-3.18

* $p < .05$
** $p < .01$
Notes: [1] HLM does not report r, R Square, or F for 2-level hierarchical analysis
[2] γ is reported as the unstandardized 2-level coefficient and is equivalent to b
[3] Γ is reported as the standardardized 2-level coefficient and is equivalent to β

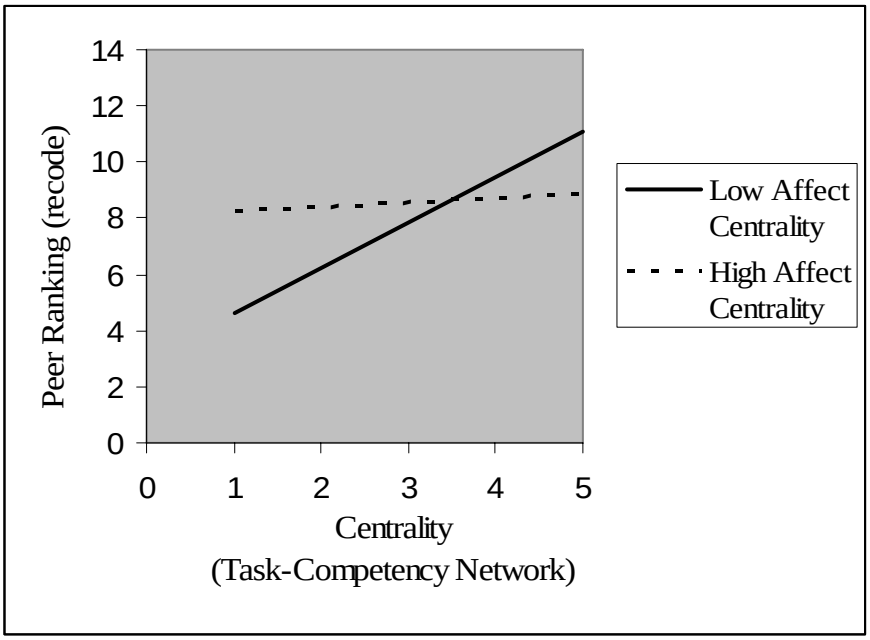

Figure 15. Affect Moderation on the Task-Competency/Leadership Relationship

Exploratory Supplemental Analysis.

Additional analysis was performed on the data to investigate possible reasons why the hypothesis was not fully supported. Again, the analysis centered on the possibility that the coefficients produced by the regression software are inaccurate. However, the area of focus is a bit narrower than the supplemental analysis done for the formal leader hypothesis. Sample size (N = 313) in this instance was not an issue, but multicollinearity remains a problem. Unlike previously, when the VIFs hinted at multicollinearity, the values obtained here for task-competency centrality (51.6), affect centrality (33.0) and the interaction term (139.7) immediately call the results into question. The associated eigenvalues confirm the problem: task-competency = .005, affect = .003, and the interaction term = .000.

To cover all bases, a multitrait-multimethod matrix was again generated (Table 11). The values in the heterotrait-monomethod blocks all reflect correlations ranging from .63 to .83. Again, the most significant correlation occurs at time period six, the time period used in the regression analysis.

Table 11. Multitrait-Multimethod Matrix (Informal Leader Variables)

		Time 1		Time 2		Time 3		Time 4		Time 5		Time 6	
	Traits	TC	Aff	TC	Aff	TC	Aff	TC	Aff	TC	Aff	TC	Aff
Time 1	TC	(.90)											
	Aff	.65**	(.88)										
Time 2	TC	.44	.34	(.74)									
	Aff	.37	.49	.63**	(.85)								
Time 3	TC	.50	.26	.57	.49	(.86)							
	Aff	.37	.40	.44	.62	.75**	(.92)						
Time 4	TC	.43	.12	.51	.40	.84	.58	(.90)					
	Aff	.37	.21	.38	.55	.73	.80	.78**	(.94)				
Time 5	TC	.31	.18	.47	.44	.74	.69	.77	.71	(.88)			
	Aff	.28	.29	.34	.56	.64	.78	.66	.83	.81**	(.86)		
Time 6	TC	.34	.21	.37	.33	.70	.67	.70	.73	.80	.69	(.87)	
	Aff	.26	.27	.28	.41	.62	.75	.55	.73	.73	.80	.83**	(.79)

** heterotrait-monomethod blocks

Once more, a final check was performed to verify multicollinearity was indeed problematic. Using only responses from the 313 student respondents, reliabilities were computed at each time period for the affect measure, the task-competency measure, and a combined affect and task-competency measure. The results, shown in Table 12, provide the strongest of evidence that the affect and task-competency measures are not distinct in this environment for the respondents. The results proved similar to those for the formal leaders. For each and every time period, the reliability of the combined measure was equal to or greater than at least of one of the individual measures. For time period six, the one used in this regression, the reliability of the combined measure surpassed that of each individual measure.

Table 12. Reliability Scores for Group Social Networks*

Time Period	Affect Network Measure (α)	Task-Competency Network Measure (α)	Affect and Task-Competency Network Combined Measure (α)
2	.88	.90	.88
3	.85	.74	.84
4	.92	.86	.91
5	.94	.90	.93
6	.86	.88	.92
7	.79	.87	.91

* Considers only student responses (N = 313)

V. Discussion

The primary objective of this research was to explore the interrelationships among leadership and informal group networks. Although social networks research has a prominent and increasing presence in the behavioral science literature, this thesis sought to explore several areas that have garnered sparse attention in previous studies. In an effort to address these gaps, this thesis proposed a model that outlined expected outcomes within a group and served as a basis for the six research hypothesis. Specifically, the expressive-instrumental leadership model (Figure 16) predicted: how a leader's position in the affect social network would change over time; how an individual's position in the task-competency social network would influence others' perceptions of him as a leader and, if officially designated a leader by the organization, others' perceptions of his leadership performance; and how an individual's position in the affect social network would moderate the perceptions described.

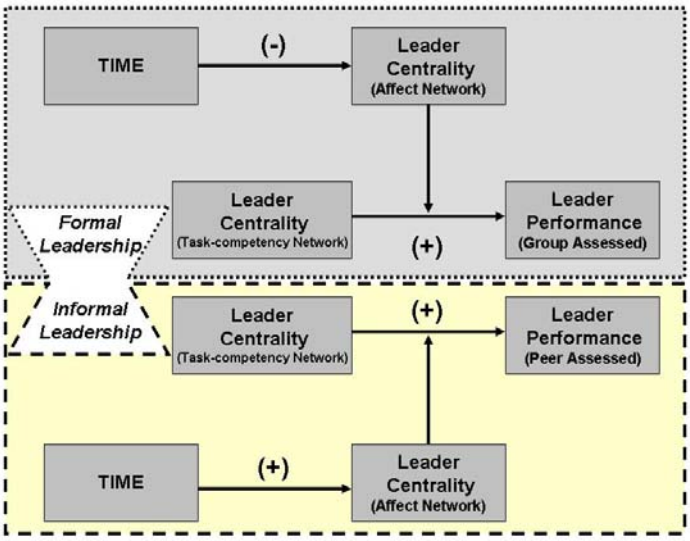

Figure 16. The Expressive – Instrumental Leadership Model

To test the study's hypothesis, a series of surveys were administered to instructors and students at a military educational institution. The administration of seven surveys over time allowed researchers to collect longitudinal social networks data. Data on leadership performance, both formal and informal, were collected concurrent with the final social network data. The results of the study provide field-based empirical support for most associations predicted in the model. The three categories of hypotheses and associated results are discussed below.

Longitudinal Hypotheses

The research model predicted opposing longitudinal outcomes for formal and informal leaders. That is, a formal leader's centrality in the affect network should decrease over time, while an informal leader's centrality should increase. Data analysis showed strong support for the increase in informal leader centrality over time; however, in the longitudinal hypothesis for the formal leader was unsupported as there was no statistically significant change in centrality. Several unique aspects of the target population may have led to this outcome.

The groups participating in this research were comprised of professional military men and women attending an eight week course at an educational institution and each group's instructor was designated the formal leader. The predictive research model argued for decreased formal leader centrality in the affect network over time, based on group development theory and previous empirical research. However, the role of the instructor, in this instance, may place him outside the typical formal leader position. Research showed that the "boundary-spanning" activities of formal leaders external to the group may overburden the leader's ability for tie maintenance (Balkundi & Kilduff,

2005; Mayhew & Levinger, 1976). This, combined with the leader's responsibility for group task completion and the possible role conflicts associated affective ties to subordinates (Hutchins & Fiedler, 1960; Seeman, 1953; Taylor et al., 1992), might cause them to first abandon affective ties within the group. The instructors in our group did have boundary spanning responsibilities outside the group; however the institution allows a break period in the time between the graduation of one student class and the influx of the next. Therefore, many of these boundary-spanning tasks might be accomplished during this down time and thus, the formal leaders are less likely to become overburdened by these duties. Additionally, although the instructor is designated the formal leader for the duration of the school, each student concurrently has another formal leader back at the location where he will return to work following graduation. In the military, this formal leader maintains much of the leadership burden for the students, even while they are in attendance at the educational institution, to include performance rating, family support, and administrative control. Thus, the possibility for role conflict between the instructor and the student may be reduced. Finally, the eight-week time period from group formation to termination may prove to be too short to see reduced affective ties for the formal leader. Even within this unique educational environment, there may be some peripheral support for the expressive-instrumental model. Although there was no significant change in formal leader centrality (affect), the centrality of the formal leader did decrease with respect to the group mean. As predicted, the group's informal leaders increased in affect centrality. In fact, they increased more than anyone, but it turns out that everyone, except formal leaders, increased in affect centrality over time. Even non-leaders, those that received zero informal leadership points, increased in

affect centrality over time. A graphical representation can be seen in Figure 17. Thus, when considering the unique aspects of the survey population along with the findings of this research, the predictive model is not ruled out. The model may receive support in populations with more traditional formal leaders.

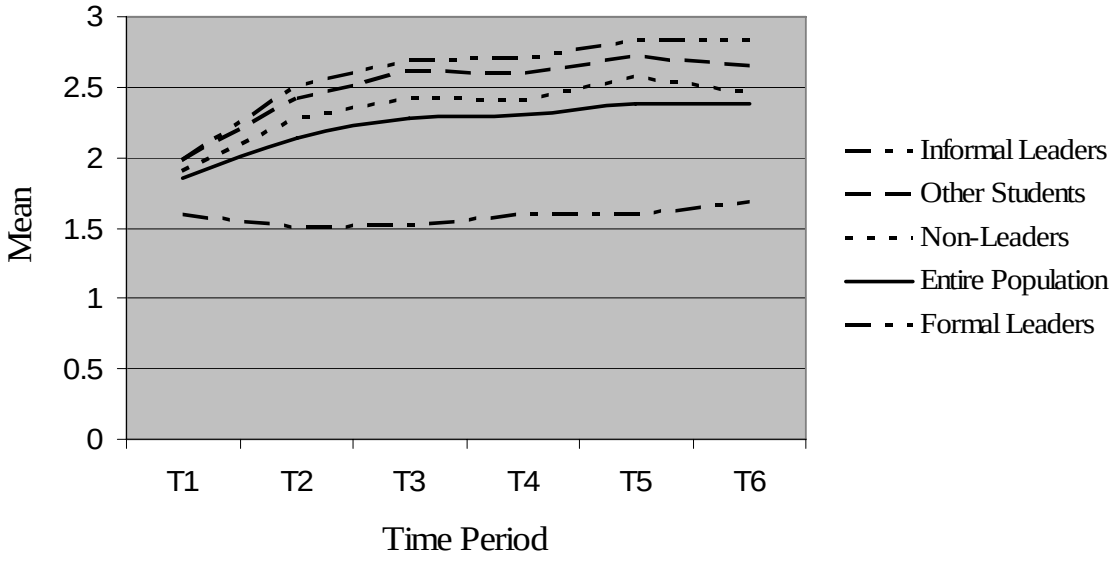

Figure 17. Comparison of Change in the Informal Affect Network

Regression-Based Hypotheses

The research model predicted similar outcomes for formal and informal leaders with respect to the task-competency network. That is, increased centrality in this network would correspond to an increase in either the perceptions of leadership performance (for formal leader) or increasing attributions of leadership (for informal leaders). As expected, the data showed a positive relationship between increased centrality, increased MLQ scores (formal leaders), and increased peer ranking (informal leaders). Leaders who were more central in the group's informal processes for task completion were rated higher by other group members. The data revealed a surprising additional result.

Although not a hypothesis of this study, the relationship between leader centrality in the affect network and MLQ/peer ranking was examined for comparison purposes. The graphs in Figures 18 and 19 show the results nearly identical relationships between affect centrality and task-competency centrality for both formal and informal leaders. This comparison provided some initial feedback on the possible level of correlation between the affect network and task-competency network variables.

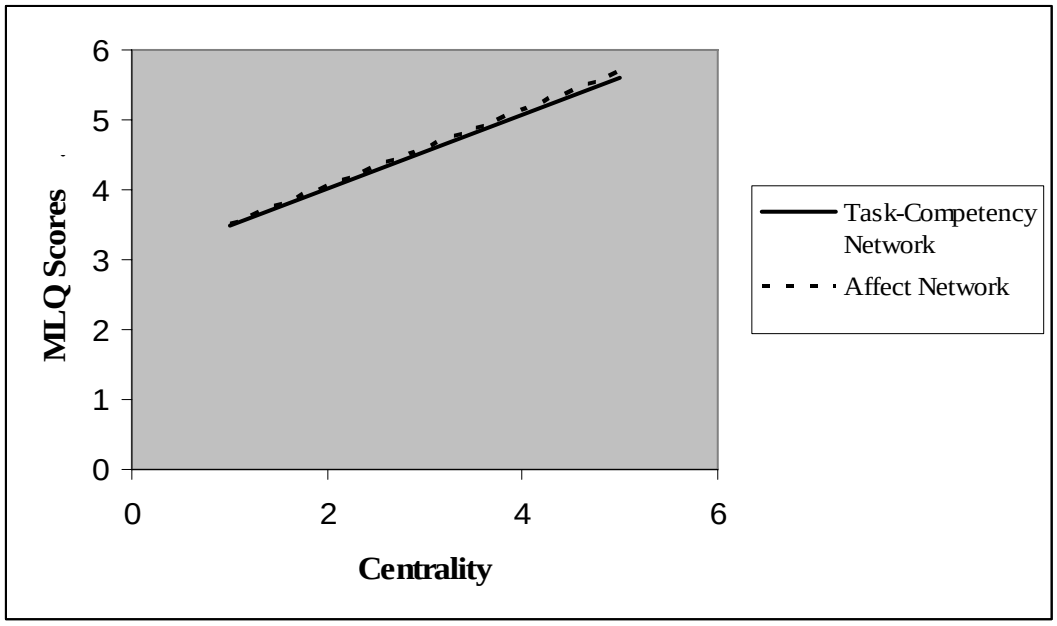

Figure 18. Formal Leader Centrality vs. MLQ Scores: A Network Comparison

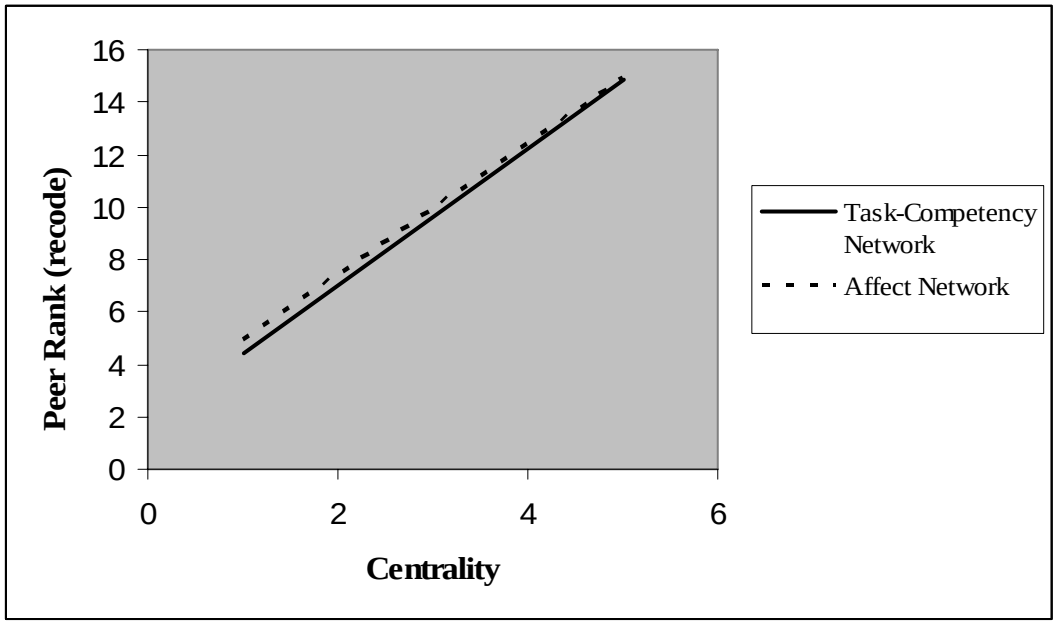

Figure 19. Informal Leader Centrality vs. Peer Rankings: A Network Comparison

Moderation Hypotheses

The research model predicted similar moderating affects for both formal and informal leaders. That is, leader's centrality in the affect network would moderate the relationship between his task-competency centrality and others' perceptions of his leadership, such that increased centrality in the informal affect network would increase the perceptions of leadership. The study results do show a moderating effect, however, the effect is not as expected across the board. For those leaders (both formal and informal) who were low in task-competency centrality, high centrality in the affect network was associated with higher ratings from group members. But, leaders (both formal and informal) who were high in task-competency centrality showed a depletion in ratings when they were high in affect centrality. As the hypotheses presumed that both formal and informal leaders at all levels of task-competency centrality would see

increased ratings with increased affect network centrality, the model is not supported. However, the result seems counter-intuitive and additional analysis was performed in an attempt to understand the discrepancy.

The supplemental analysis showed high degrees of correlation and multicollinearity between the task-competency network measure and the affect network measure. In essence, the two measures are, in this case, probably measuring the same thing. This conflicts with previous studies, where the task-related informal networks and friendship-related informal networks have been shown to be distinct entities (e.g., Umphress, Labiance, Brass, Kass, & Scholten, 2003; Brass et al., 2004; Casciaro & Lobo, 2005; Mayo & Pastor, 2005). This begs the question as to why, in this instance, these networks do not appear to be distinct and separate for both formal leaders and informal leaders. Several factors may be involved and they differ for formal and informal leaders.

A meta-analysis conducted on student performance and instructor ratings showed a high correlation between student performance and instructor ratings (Cohen, 1981). Analysis of the performance statistics for all students in the population yields the following results: the average student's academic score, as measured over six graded activities, was 89.54 out of 100. The grading scale used by the SNCOA awards an "A" for a score of 90 out of 100. Therefore, the average score for all students across all tests was only .46 points short of an A. This very high overall average might affect how formal leaders are evaluated in this environment – not on task-competency or affect, but on the grades received by student. There are several data points in the research, which may back up this argument. Ratings of the formal leader, via the MLQ instrument,

occurred with the administration of the last survey. At this point in time, the students had already received scores for all graded activities in the curriculum. As shown, overall, grades throughout the student population were very high, so it is arguable safe to assume the majority of students were satisfied with their rated performance. If students are likely to rate instructors based on student performance, it seems reasonable to assume that formal leader ratings would be high overall as well. This is exactly the case. When comparing the results of this study (N= 303) to the Bass & Avolio (2000) MLQ study, the reliabilities and standard deviations for the instrument are comparable, however, our study showed a marked increase in overall rating with a mean of 3.33 compared to Bass & Avolio's calculated mean of 2.58. Furthermore, between MLQ scores and network centrality (both affect and task-competency) were not statistically significant for time periods one through five, but were significant for time period six. Taken together, this may show that the formal leaders were actually rated on student performance instead of centrality in either informal group network.

Two factors may have led to the convergence of the task-competency and affect measures for the informal leader. The first involves the nature of the groups' task at hand. The educational environment may produce homogeneity of task requirements within the group. A powerful argument in the literature was that informal leaders were influential in guiding a group toward the accomplishment of group goals, and that centrality in the task-competency network provided an advantageous position of the accomplishment of this task (Brass, 1992; Friedkin & Slater, 1994; Levi et al., 1954). However, the curriculum-based environment of the population may have created a situation where group tasks were eliminated and only individual tasks (e.g., passing the

tests) remained. Because each student is presented with the information required to accomplish his individual task (via instructor lectures), a true informal task-network, directed at accomplishment of group goals, may not exist. Instead, the impact of the affect network may have been accentuated. The main reason for this may be the geographic relocation of group members from their normal workplace to the educational institution for the eight-week period. The military housed the students in a dormitory-like environment and the vast majority of students were separated from their families for the duration of the course. This environment may have facilitated more affect-laden interaction of students outside the workplace (classroom) than normally would occur. The data shows that every student subgroups (informal leaders, non-leaders, and others) increased in affect network centrality over time. Additionally, of all these subgroups, the informal leaders increased the most. Therefore, it may be the case that informal leadership ratings were actually tied to popularity rather that informal task-competency. Furthermore, since the environment may have diminished, if not eliminated the need for task-competency network, group members may have responded to task-competency measures based not on competency at all, but rather perceived competency based on friendship or popularity. This is consistent with research that shows individual are likely to rate those that like as more competent. Such a scenario would explain why the affect and task-competency ratings were so highly correlated.

Overall, the study provided support for several portions of the expressive-instrumental leadership model. However, other conflicting results were found for other portions of the model. These results, however, may have come about due to the unique environment associated with the sample population. Partial support for the model is

encouraging, and re-examination in differing population sets is required to fully test the model.

Limitations

This work is limited in several respects. The first possible limitation involves the environment surrounding the population under study. The unique environment surrounding the population under study, including the physical relocation of the students, the dorm-style house, isolation from families, and the limited responsibilities of the formal leader, may return results that differ from more typical leader-group environments. One must, therefore, exercise caution in generalizing the study results.

Another possible limitation is the case per independent variable ratio used to perform regression analysis. This study used a case to independent variable ratio that ranged from 5.2 to 8.7 for analysis of formal leader effects. Although there is support in the literature for using as few as five cases per independent variable (Coakes, 2003; Goldman & Ausiello, 2004), the "rule of thumb" predominant in the behavioral science literature calls for a minimum of 10 cases for each independent variable to be included in regression analysis (Urdan, 2005). This ration should be kept in mind when considering the results.

A third limitation of this study involves the survey instruments given to participants. There were several issues that merit mentioning. First, researchers from four concurrent thesis projects surveyed the population at each time interval. Although only social network and MLQ information was utilized in this study, all survey instruments were combined into one survey package for administration at each time interval. The sometimes lengthy survey packages may have contributed to a lowered

response rate, especially as time went on. Additionally, administering the survey in a military environment may have increased the amount of unusable data in returned surveys. That is, although completion of the surveys was voluntary, the fact that it was done in a military environment may have influenced some to feign participation when they otherwise might have refused any participation. Such a scenario may lead uninterested participants to casually enter random responses instead of providing meaningful responses. This may help to explain a significant number of instruments returned with no differentiation of response throughout the survey.

A final limitation of that study centers on the notion of causality. In correlational studies such as this, we cannot determine the extent to which increased centrality in the informal networks precedes or follows increased perceptions of leadership.

Future Research

This study lays the groundwork as a first examination of the expressive-instrumental leadership model. Several improvements might be made for future iterations of research. First, a sample population that adheres more to the norm should be used. Although it is difficult to classify any situation as normal, the avoidance of unique circumstances, for example the separation of the group members from their families for the study duration, should be avoided. However, another study based on an educational environment might be used as a comparison to these results. Additionally, future research might attempt to broaden the timeline associated with the study to permit more time between surveys points. Some longitudinal effects, especially those connected with maintaining a large number of interpersonal ties, may take longer to fully play out. Another possibility for research might add an instrument to account for the preferred

leadership type of formal leaders. Although traditional theoretical arguments lean may favor a reduction in formal leader affect centrality over time, "new" versions of transformational leadership (Tichy & Devanna, 1986) and "high involvement management" theories (Lawlor, 1986) may argue for a trend in the opposing direction. Both outline situations where leaders may substitute close affective relationships with subordinates in lieu of more traditional hierarchical leadership in an effort to inspire subordinates to greater performance. Understanding leadership preferences may add a valued control to future research. Finally, the manner in which informal leaders are judges can and should be improved. Allowing each group member to fully assess the informal leadership capabilities of each and every member of the group, using the MLQ for example, may provide superior results than the methodology used in this study: identifying only the top three informal leaders in each flight. This change would also standardize the manner in which formal and informal leaders are judged.

Summary

Group leaders and informal group structures are both central concepts in understanding and explaining organizational outcomes. Although each has seen a bevy of historical study independently, a paucity of research has attempted to examine any interrelationships between the two. This thesis attempted to do just that via the expressive-instrumental leadership model. Overall, statistical analysis showed support for the model in three of the six hypotheses offered. The remaining three hypotheses were unsupported in full, though alternative analysis of the results showed partial support. However, results may have been skewed by the unique environment surrounding the sample population. Future research in differing population sets may

show more robust support for the model. This study has taken a small step toward addressing gaps in the literature with respect to leadership and social networks. Hopefully, results generated from this effort, and limitations identified in its execution, will assist other researchers as they seek to build greater understanding of the subject matter.

References

Adler, P. S., & Kwon, S. W. (2002). Social capital: Prospects for a new concept. *Academy of Management Review, 27*, 17-40.

Adler, P. T. (1982). An analysis of the concept of competence in individuals and social systems. *Community Mental Health Journal, 18*(1), 34-45.

Aguinis, H., & Stone-Romero, E. F. (1997). Methodological artifacts in moderated multiple regression and their effects on statistical power. *Journal of Applied Psychology, 82*, 192-206.

Alderfer, C. P. (1977). Group and intergroup relations. In J. R. Hackman, & J. L. Suttle (Eds.), *Improving the quality of work life* (pp. 227-296). Pallisades, CA: Goodyear.

Ancona, D. G. (1993). The classics and the contemporary: A new blend of small group theory. In J. K. Murnigham (Ed.), *Social psychology in organizations: Advances in theory and research.* (pp. 225-243). New York: Prentice Hall.

Argyris, C. (1971). Management information systems: The challenge to rationality and emotionality. *Management Science, 17*, 275-292.

Ashford, S. (1993). Self-assessments in organizations: A literature review and integrative model. *Research in Organizational Behavior, 11*, 33-74.

Atwater, L., Roush, P., & Fischtal, A. (1995). The influence of upward feedback on self- and follower ratings of leadership. *Personnel Psychology, 48*(1), 35-59.

Atwater, L., Waldman, D. A., & Brett, J. F. (2002). Understanding and optimizing multisource feedback. *Human Resource Management, 41*(2), 193-208.

Avolio, B. J., & Bass, B. M. (2004). *Multifactor Leadership Questionnaire. Manual and Sampler Set.* (3rd ed.). Redwood City, CA: Mind Garden.

Avolio, B. J., & Bass, B. M. (2002). *Developing potential across a full range of leadership.* Mahwah, NJ: Lawrence Erlbaum Associates.

Baker, W. E. (1994). *Networking smart.* New York: McGraw-Hill.

Baldwin, T. T., Bedell, M. D., & Johnson, J. L. (1997). The social fabric of a team-based M.B.A. program: Network effects on student satisfaction and performance. *Academy of Management Journal, 40*, 1369-1397.

Bales, R. F., & Slater, P. E. (1955). Role differentiation in small decision-making groups. In T. Parsons, & R. F. Bales (Eds.), *Family, socialization, and interaction processes.* New York: The Free Press.

Balkundi, P., & Harrison, D. A. (2005). *Ties, leaders, and time in teams: Strong inferences about the effects of network structure on team viability and performance.* Unpublished manuscript.

Balkundi, P., & Kilduff, M. (2005). *The ties that lead: A social network approach to leadership.* Unpublished manuscript.

Barnes, L. B., & Kriger, M. F. (1986). The hidden side of organizational leadership. *Sloan Management Review, 27*, 15-25.

Bass, B. M. (1985). *Leadership and performance beyond expectations.* New York: Free Press.

Bass, B. M. (1960). *Leadership, psychology, and organizational behavior.* New York: Harper and Row.

Bass, B. M., & Avolio, B. J. (2000b). *Technical Report, Leader Form, Rater Form, and Scoring Key for the MLQ Form 5x-Short.* Binghamtom, NY: Center for Leadership Studies, Binghamton University.

Bass, B. M., & Avolio, B. J. (2000a). *MLQ: Multifactor leadership questionnaire, 2nd edition, technical report*. Redwood City, CA: Mind Garden.

Bass, B. M., & Stogdill, R. M. (1990). *Bass & Stogdill's handbook of leadership: Theory, research, and managerial applications.* (3rd ed.). New York: The Free Press.

Bennis, W. G., & Shepard, H. A. (1956). A theory of group development. *Human Relations, 9,* 415-437.

Berlew, D. E., & Heller, D. (1983). Style flexibility -- tools for successful leaders. *Legal Economics, 9*(6), 34-37.

Blumberg, H. H., Hare, A. P., Kent, V., & Davies, M. F. (Eds.). (1983). *Small groups and social interaction*. New York: John Wiley and Sons.

Borgatti, S. P., & Foster, P. C. (2003). The network paradigm in organizational research: A review and typology. *Journal of Management, 3*(6), 991-1013.

Boyd, N. G., & Taylor, R. R. (1998). A developmental approach to the examination of friendship in leader-follower relations. *Leadership Quarterly, 29*, 991-1013.

Brass, D. J. (1992). Power in organizations: A social network perspective. In G. Moore, & J. A. Whitt (Eds.), *Research in politics and society* (pp. 295-323). Greenwich, CT: JAI Press.

Brass, D. J. (1984). Being in the right place: A structural analysis of individual influence in an organization. *Administrative Science Quarterly, 29*, 518-539.

Brass, D. J., & Burkhardt, M. E. (1992). Centrality and power in organizations. In N. Nohria, & R. Eccles (Eds.), *Networks and organizations: Structure, form, and action.* (pp. 191-215). Boston, MA: Harvard Business School Press.

Brass, D. J., Galaskiewicz, J., Greve, H. R., & Tsai, W. (2004). Taking stock of networks and organizations: A multilevel perspective. *Academy of Management Journal, 47*(6), 795.

Burkhardt, M. E., & Brass, D. J. (1990). Changing patterns of patterns of change: The effects of a change in technology on social network structure and power. *Administrative Science Quarterly, 35*, 104-127.

Burns, T., & Stalker, G. M. (1964). *The management of innovation.* London: Tavistock.

Burt, R. S. (1992). *Structural holes: The social structure of competition.* Cambridge, MA: Harvard University Press.

Buzaglo, G., & Wheelan, S. A. (1999). Facilitating work team effectiveness: Case studies from Central America. *Small Group Research, 30*(1), 108-129.

Campbell, D. T. & Fiske, D. W. (1959). Convergent and discriminant validation by the multitrait-multimethod matrix. *Psychological Bulletin, 56*(2), 81-105.

Casciaro, T., & Lobo, M. S. (2005). *Affective microfoundations of instrumental ties in organizations.* Unpublished manuscript.

Cissna, K. N. (1984). Phases in group development: The negative evidence. *Small Group Behavior, 15*, 3-32.

Coakes, S. J. (2003). *SPSS: Analysis without anguish. Using SPSS v. 12.0.* Melbourne, Australia: Wiley and Sons.

Cohen, P. A. (1981). Student ratings of instruction and student achievement: A meta-analysis of multisection validity studies. *Review of Educational Research*, 51(3), 281-309

Cook, K. S., Emerson, R. M., & Gillmore, M. R. (1985). The distribution of power in exchange networks: Theory and empirical results. *American Journal of Sociology, 89*(2), 275-305.

Cross, R., & Parker, A. (2004). *The hidden power of social networks: Understanding how work really gets done in organizations.* Boston: HBS Press.

Curtin, J. L. (2004). Emergent leadership: Case study of a jury foreperson. *Leadership Review, 4*(Summer), 75-88.

Day, D. V., Sin, H., & Chen, T. T. (2004). Assessing the burdens of leadership: Effects of formal leadership roles on individual performance over time. *Personnel Psychology, 57*(3), 573-581.

Den Hartog, D. N., House, R. J., Hanges, P. J., Dorfman, P. W., & Ruiz-Quintanilla, S. A. (1999). *Emics and etics of culturally-endorsed implicit leadership theories: Are attributes of charismatic/transformational leadership universally endorsed?* Unpublished manuscript.

Department of the Air Force. Leadership and force development. Air Force Doctrine Document 1-1. Washington: HQ USAF, 18 February 2004.

De Souza, G., & Klein, H. J. (1995). Emergent leadership in the group goal-setting process. *Small Group Research, 26*, 475-496.

Dobbins, G. H., & Russell, J. M. (2001). The biasing effects of subordinate likeableness on leaders' responses to poor performers: A laboratory and a field study. *Personnel Psychology, 39*, 759-778.

Doloff, P. G. (1999). Beyond the org chart. *Across the Board, 36*(2), 43.

Downton, J. V. (1973). *Rebel leadership: Commitment and charisma in the revolutionary process.* New York: The Free Press.

Eden, D., & Leviathan, U. (1975). Implicit leadership theory as a determinant of the factor structure underlying supervisory behavior scales. *Leadership Quarterly, 60*, 736-741.

Ekvall, G., & Ryhammar, L. (1998). Leadership style, social climate and organizational outcomes: A study of a Swedish university college. *Creativity and Innovation Management, 7*(3), 126-141.

Etzioni, A. (1964). *Modern organizations*. Englewood Cliffs, NJ: Prentice Hall.

Etzioni, A. (1965). Dual leadership in complex organizations. *American Sociological Review, 30*, 688-698.

Festinger, L., Schachter, S., & Back, K. (1950). *Social pressures in informal groups: A study of human factors in housing.* (1st ed.). New York: Harper.

Fiedler, F. E. (1957). A note on leadership theory: The effect of social barriers between leaders and followers. *Sociometry, 20*, 87-94.

Fiedler, F. E. (1954). Assumed similarity measures as predictors of team performance. *Journal of Abnormal and Social Psychology, 49,* 381-388.

Foti, R. J., & Luch, C. H. (1992). The influence of individual differences on the perception and categorization of leaders. *Leadership Quarterly, 3*, 55-66.

Fredrickson, J. W. (1986). The strategic decision process and organizational structure. *Academy of Management Journal, 11*(6), 280-297.

Freeman, L. C. (1984). Turning a profit from mathematics: The case of social networks. *Journal of Mathematical Sociology,* (10), 343-360.

Freeman, L. C., Roeder, D., & Mulholland, R. R. (1979). Centrality in social networks ii - experimental results. *Social Networks, 2*, 119-141.

French, F. E., & Raven, B. (Eds.). (1959). *The bases of social power*. Ann Arbor: University of Michigan, Institute of Social Research.

Friedkin, N. E., & Slater, M. R. (1994). School leadership and performance: A social network approach. *Sociology of Education, 67*, 139-157.

Gerard, R. J. (1995). Teaming up: Making the transition to self-directed, team-based organizations. *Academy of Management Executive, 9*, 91-93.

Goldman, L., & Ausiello, D. (Eds.). (2004). *Cecil textbook of medicine.* (22nd ed.). New York: W. B. Saunders.

Gouws, J. J., Beukes, J. A., & Elmann, H. (2003). *Leader development* No. CR02-0609). Kingston, Ontario: Canadian Forces Leadership Institute.

Granovetter, M. (1982). The strength of weak ties: A network theory revisited. In P. V. Marsden, & N. Lin (Eds.), *Social structure and network analysis.* (pp. 105-130). Beverly Hills, CA: Sage.

Granovetter, M. (1973). The strength of weak ties. *American Journal of Sociology, 6*, 1360-1380.

Greer, L. F., Galanter, E. H., & Nordlie, P. G. (1954). Interpersonal knowledge and individual and group effectiveness. *Journal of Abnormal and Social Psychology, 49*, 311-313.

Guion, R. (1990). Personnel assessment, selection, and placement. In M. D. Dunette, & L. M. Hough (Eds.), *The handbook of industrial and organizational psychology.* (pp. 327-333). San Diego, CA: Consulting Psychologists Press.

Hackman, J. R. (1992). Group influences on individuals in organizations. In M. D. Dunnette, & L. M. Hough (Eds.), *Handbook of industrial and organizational psychology* (2nd ed.) (pp. 269-313). Palo Alto, CA: Consulting Psychologists Press.

Hair, J., Anderson, R., Tatham, R., & Black, W. (1995). *Multivariate data analysis.* Saddle River, NJ: Prentice Hall.

Hanneman, R., & Riddle, M. (2005). *Introduction to social network methods.* Online Text (available at http://faculty.ucr.edu/~hanneman/): University of California, Riverside.

Hare, A. P. (1976). *Handbook of small group research* (2nd ed.). New York: The Free Press.

Harris, M., & Schaubroeck, J. (1988). A meta-analysis of self-supervisor, self-peer, and peer-supervisor ratings. *Personnel Psychology, 41,* 43-61.

Harter, J. K., Schmidt, F. L., & Keyes, C. L. M. (2003). Well-being in the workplace and its relationship to business outcomes: A review of the Gallup studies. In Keyes, C. L. M., & J. Haidt (Eds.), *Flourishing: The positive person and the good life.* (pp. 205-224). Washington D. C.: American Psychological Association.

Hayter, A. J. (1996). *Probability and statistics for engineers and scientists.* Boston, MA: PWS Publishing.

Haythornthwaite, C. (1996). Social network analysis: An approach and technique for the study of information exchange. *Library and Information Science Research, 18*, 323-342.

Hill, T., & Lewicki, P. (2006). *Statistics methods and applications.* Tulsa, OK.: StatSoft.

Holland, E. P. (1964). *Leaders, groups, and influence.* New York: Oxford University Press.

Hollander, E. P. (1960). Competence and conformity in the acceptance of influence. *Journal of Abnormal and Social Psychology, 61*, 365-369.

Holzbach, R. (1978). Rater bias in performance ratings: Superior, self-, and peer ratings. *Journal of Applied Psychology, 63*, 579-588.

Homans, G. C. (1950). *The human group*. New York: Harcourt Brace.

Hopkins, W. G. (2004). *A New View of Statistics.* Online Text, Available at http://www.sportsci.org/resource/stats/index.html:

House, R. J., & Baetz, M. L. (1979). Leadership: Some empirical generalizations and new research directions. *Research in Organizational Behavior, 1*, 341-423.

House, R. J., & Shamir, B. (1993). Toward an integration of transformation, charismatic and visionary theories of leadership. In M. Chemmers, & R. Ayman (Eds.), *Leadership: Perspectives and research directions.* (pp. 81-107). New York: Academic Press.

Hox, J. (2002). *Multilevel analysis: Techniques and applications.* Mahwah, NJ.: Lawrence Erlbaum Associates.

Huck, S. W. (2003). *Reading statistics and research* (4th ed.). London: Allyn and Bacon.

Hunt, J. G., & Dodge, G. E. (2000). Leadership deja vu all over again. *Leadership Quarterly, 11*, 435-458.

Hutchins, E. B., & Fiedler, F. E. (1960). Task-oriented and quasi-therapeutic role functions of the leader in small military groups. *Sociometry, 23*, 393-406.

Ibarra, H. (1993). Personal networks of women and minorities in management: A conceptual framework. *Academy of Management Journal, 36*, 56-87.

Ibarra, H., & Andrews, S. B. (1993). Power, social influence, and sense making: Effects of network centrality and proximity on employee perceptions. *Administrative Science Quarterly, 38*(2), 277-304.

Ilgen, D. R. (1999). Teams embedded in organizations: Some implications. *American Psychologist, 54*, 129-139.

Jackson, J. H., & Morgan, C. P. (1982). *Organization theory*. New York: Prentice-Hall.

Jelinek, M., & Litterer, J. A. (1994). *Toward a cognitive theory of organizations. Advances in managerial cognition and organizational information processing.* Greenwich, CT: JAI Press.

Kahn, W. A. (1990). Psychological conditions of personal engagement and disengagement at work. *Academy of Management Journal, 33,* 692-724.

Kaplan, R. E. (1979). The conspicuous absence of evidence that process consultation enhances task performance. *Journal of Applied Behavioral Science, 15,* 346-360.

Katzenback, J. R., & Smith, D. K. (2001). *The Discipline of Teams.* American City Business Journals, Inc.

Kilduff, M., & Tsai, W. (2003). *Social networks and organizations.* London: Sage.

Klovdahl, A. S. (1986). VIEW-NET: A new tool for network analysis. *Social Networks,* (8), 313-342.

Kozlowski, S. W. J., & Bell, B. S. (2003). Work groups and teams in organizations. In W. C. Borman, D. R. Ilgen & R. Klimoski (Eds.), *Handbook of psychology: Industrial and organizational psychology.* (pp. 333-375). New York: John Wiley and Sons.

Krackhardt, D. (1999). The ties that torture: Simmelian tie analysis in organizations. *Research in the Sociology of Organizations, 16,* 183-210.

Krackhardt, D. (1996). Social networks and the liability of newness for managers. *Journal of Organizational Behavior, 3,* 159-173.

Krackhardt, D. (1992). The strength of strong ties: The importance of philos in organizations. In N. Nohria, & R. G. Eccles (Eds.), *Networks and organizations: Structure, form and action.* (pp. 216-239). Cambridge, MA: Harvard University Press.

Krackhardt, D., & Hansen, J. (1993, Informal networks: The company behind the chart. *Harvard Business Review*, (July/August) 104-111.

Krackhardt, D., & Kilduff, M. (1990). Friendship patterns and culture: The control of organizational diversity. *American Anthropologist, 92*, 142-154.

Krackhardt, D., & Porter, L. W. (1986). The snowball effect: Turnover embedded in communications networks. *Journal of Applied Psychology, 71*, 50-55.

Krackhardt, D., & Stern, R. N. (1988). Informal networks and organizational crises: An experimental simulation. *Social Psychology Quarterly, 51*, 123-140.

Krokosz-Krynke, Z. (1998). *Organizational structure and culture: Do individualism/collectivism and power distance influence organizational structure?*. Wroclaw, Poland: Wroclaw University of Technology.

Kumbasar, E. A., Romney, K., & Batchelder, W. H. (1994). Systematic biases in social perception. *American Journal of Sociology, 100*, 477-505.

Lawler, E. E. (1986). *High involvement management.* San Francisco, CA: Josey-Bass.

Levi, M., Torrance, P. E., & Pletts, O. G. (1954). Sociometric studies of combat air crews in survival training. *Sociometry, 46*, 304-328.

Lincoln, J. R., & Miller, J. (1979). Work and friendship ties in organizations: A comparative analysis of relation networks. *Administrative Science Quarterly, 24*, 181-199.

Lord, R. G., & Maher, K. J. (1991). *Leadership and information processing.* London: Routledge.

Lowe, K. B., Kroeck, K. G., & Sibasubramanian, N. (1996). Effectiveness correlates of transformational and transactional leadership: A meta-analytic review. *Leadership Quarterly, 7*, 385-425.

Mabe, P., & West, S. (1982). Validity of self-evaluation of ability: A review and meta-analysis. *Journal of Applied Psychology, 67*, 280-296.

Manasib, A. (2004). *Lifecycle of social networks: Relationship between human capital and social capital, and the importance of city size.* Unpublished manuscript.

Manz, C. C., & Sims, H. P. (1993). *Business without bosses: How self-managing teams are building high-performing companies.* New York: John Wiley and Sons.

Marsden, P. V., & Friedkin, N. E. (1993). Network studies of social influence. In J. Galaskiewicz, & S. Wasserman (Eds.), *Advances in social and behavioral science from social methods and research.* Beverly Hills, CA: Sage.

Mayhew, B. (1980). Structuralism versus individualism: Part 1, shadowboxing in the dark. *Social Forces, 59*, 335-375.

Mayhew, B. H., & Levinger, R. (1976). Size and density of interaction in human aggregates. *American Journal of Sociology, 24,* 406-420.

McGlashan, K. E., Wright, P. M., & McCormick, B. (1995). Preferential selection and stereotypes: Effects on evaluation of female leader performance, subordinate goal commitment, and task performance. *Sex Roles, 33*(9/10), 669-686.

McGrath, J. E. (1986). Studying groups at work: Ten critical needs for theory and practice. In P. Goodman, & Associates (Eds.), *Designing effective work groups* (pp. 362-391). San Francisco, CA: Jossey-Bass, Inc.

McGrath, J., & Argote, L. (2001). Group processes in organizational contexts. In M. Hogg, & R. Tindale (Eds.), *Blackwell handbook of social psychology: Group processes.* Oxford, UK: Blackwell.

McPhee, R. D. (1985). Formal structure and organizational communication. In R. D. McPhee, & P. K. Tompkins (Eds.), *Organizational communication: Traditional themes and new directions.* Beverly Hills, CA: Sage.

McPhee, R. D., & Zaug, P. (2000). The communicative constitution of organizations: A framework for explanation. *The western states communication association convention,* Sacramento, CA,

Mehra, A., Dixon, A. L., Robertson, B., & Brass, D. J. (2004). *The social networks of leaders: Implications for group performance and leader reputation,* Unpublished Manuscript.

Mohrman, S. A., Cohen, S. G., & Mohrman, A. M., Jr. (1995). *Designing team-based organizations: New forms for knowledge work.* San Francisco, CA: Jossey-Bass, Inc.

Monin, P. (2003). Relational quality, inter-individual trust and factionalism: Toward a socialized multi-level model of cooperation in strategic alliances. Washington, D.C., *2003/04*

Moreland, R. L., & Levine, J. M. (1982). Socialization in small groups: Temporal changes in individual-group interactions. *Social Psychology, 15*

Moreno, J. L., & Jennings, H. H. (1938). Statistics of social configurations. *Sociometry*, (1), 342-374.

Morey, N. C., & Luthans, F. (1991). The use of dyadic alliances in informal organization: An ethnographic study. *Human Relations, 44*, 597-618.

Muscarella, C. J., & Vetsuypens, M. R. (1990). Efficiency and organizational structure: A study of reverse LBOs. *Journal of Finance, 45*(5), 1389-1413.

Nadel, S. F. (1957). *The theory of social structure*. London: Cohen and West.

Neter, J., Wasserman, W., Michael, H. (2004). *Applied linear statistical models.* New York: Irwin.

Newsome, S., Day, A., & Catano, V. M. (2002). *Leader assessment, evaluation, and development.* No. CFLI Contract Research Report # CR01-0094). Kingston, Ontario: Canadian Forces Leadership Institute.

Offermann, L. R., Kennedy, J. K., & Wirtz, P. W. (1994). Implicit leadership theories: Content structure, and generalizability. *Leadership Quarterly, 5*(1), 43-55.

Ogden, H. A., & Teece, D. J. (1978). Organizational structure and economic performance: A test of the multidivisional hypothesis. *Bell Journal of Economics, 9*(1), 106-122.

Oh, H. S., Chung, M. H., & Labianca, G. (2004). Group social capital and group effectiveness: The role of informal socializing ties. *Academy of Management Journal, 47*(6), 860-875.

Oh, H., Labianca, G., & Chung, M. H. (2005). *A multilevel model of group social capital.* Unpublished manuscript.

Oldham, G. R., & Hackman, J. R. (1981). Relationships between organizational structure and employee reactions: Comparing alternative frameworks. *Administrative Science Quarterly, 26,* 66-83.

Pastor, J., Meindl, J. R., & Mayo, M. C. (2002). A network effects model of charisma attributions. *Academy of Management Journal, 45*(2), 410-420.

Pescosolido, A. T. (2001). Informal leaders and the development of group efficacy. *Small Group Research, 1,* 74-93.

Pescolido, A. T. (2002). Emergent leaders as managers of group emotion. *The Leadership Quarterly, 13,* 210-227.

Peers, I. (1996). *Statistical analysis for education and psychology researchers.* Bristol, PA: Falmer Press.

Pielstick, C. D. (2000). Formal versus informal leading: A comparative analysis. *North Arizona University College of Business Administration Working Paper Series*(4), 15 Oct 05

Podsakoff, P., & Organ, D. (1986). Self-reports in organizational research: Problems and prospects. *Journal of Management, 12,* 531-544.

Rahim, M. A. (1989). Relationships of leader power to compliance and satisfaction with supervision: Evidence from a national sample of managers. *Journal of Management, 15*, 545-556.

Raven, B. (1993). The bases of power: Origins and recent developments. *Journal of Science Issues, 49*, 217-253.

Raven, B. H., Schwarzwald, J., & Koslowsky, M. (1998). Conceptualizing and measuring a Power/Interaction model of interpersonal influence. *Journal of Applied Social Psychology*, *28*, 307-332.

Read, P. B. (1974). Source of authority and the legitimation of leadership in small groups. *Sociometry*, *37*, 189-204.

Reagans, R., & Zuckerman, E. W. (2001). Networks, diversity, and productivity: The social capital of corporate R&D teams. *Organization Science, 12*, 502-517.

Rice, R. E. (1993). Using network concepts to clarify sources and mechanisms of social influence. In G. Barnett, & W. Richards Jr. (Eds.), *Advances in communications network analysis.* Norwood, NJ: Ablex.

Rogers, E. M., & Kincaid, L. D. (1981). *Communication networks.* New York: Free Press.

Rothlisberger, F. J., & Dickson, W. J. (1939). *Management and the worker*. Cambridge, MA: Harvard University Press.

Rowold, J. (2005). *Multifactor Leadership Questionnaire: Psychometric Properties of the German Translation.* Redwood City, CA: Mind Garden.

Salancik, G., & Pfeffer, J. (1978). A social information processing approach to job attitudes and task design. *Administrative Science Quarterly, 23*, 224-253.

Schneer, J. A., & Hsu, T. (1989). Conflict-handling behavior and leadership perceptions in decision-making groups. *The second biannual conference of the International association for conflict management,* Athens, GA,

Schultz, B. (1978). Predicting emergent leaders: An exploratory study of salience of communicative functions. *Small Group Behavior, 9*, 9-14.

Schutz, W. C. (1961). The ego, FIRO theory and the leader as a completer. In L. Petrullo, & B. M. Bass (Eds.), *Leadership and interpersonal behavior* (pp. 48-65). New York: Holt, Rinehart, & Wilson.

Scott, J. (2000). *Social network analysis: A handbook* (2nd ed.). Thousand Oaks, CA: Sage Publications.

Seeman, M. (1953). Role conflict and ambivalence in leadership. *American Sociological Review, 18,* 373-380.

Shao, Y. P., Lee, M. K. O., & Liao, S. Y. (2000). Virtual organizations: The key dimensions. *Academia/Industry working conference on research challenges (AIWORC'00),* Buffalo, New York,

Shaw, M. E. (1981). *Group dynamics: The psychology of small group behavior.* New York: McGraw-Hill.

Skinner, E. A., Wellborn, J. G., & Connel, J. P. (1990). What it takes to do well in school and whether I've got it: A process model of perceived control and children's engagement and achievement in school. *Journal of Educational Psychology, 82,* 22-42.

Slater, P. E. (1955). Role differentiation in small groups. *American Sociological Review, 20,* 300-310.

Smelser, N. J., & Baltes, P. B. (2001). *International encyclopedia of the social & behavioral sciences* (1st ed.). Amsterdam ; New York: Elsevier.

Smircich, L., & Chesser, R. J. (1981). Superiors' and subordinates' perceptions of performance: Beyond disagreement. *Academy of Management Journal, 24,* 198-205.

Sparrowe, R. T., Liden, R. C., Wayne, S. J., & Kraimer, M. L. (2001). Social networks and the performance of individuals and groups. *Academy of Management Journal, 44*(2), 316.

SPSS, I. (2004). *Base SPSS 13.0 Users Guide*. USA: SPSS, Inc.

Stogdill, R. M. (1974). *Handbook of leadership: A survey of the literature.* New York: Free Press.

Strickland, L. H., Gould, P. D., Barefoot, J. C., & Paterson, S. A. (1978). Teleconference and leadership emergence. *Human Relations, 31*, 583-596.

Taylor, R. R., Hanlon, S. C., & Boyd, N. G. (1992). Can leaders and subordinates be friends? A classroom approach for addressing an important managerial dilemma. *Journal of Management Education, ,* 39-55.

Thompson, J. D. (1966). *Organization in action.* New York: McGraw-Hill.

Thorton, G. (1980). Psychometric properties of self-appraisal of job performance. *Personnel Psychology, 33*, 262-271.

Thye, S. R., Lawler, E. J., Macy, M. W., & Walker, H. A. (Eds.). (2001). *Advances in group processes*. Amsterdam: JAI Press.

Tichy, N. M., & Devanna, M. A. (1986). *The transformational leader.* New York: Wiley.

Trochim, W. M. (2000). *The research methods knowledge base.* (2nd ed.). Cincinnati, OH: Atomic Dog Publishing.

Tuckman, B. W. (1965). Developmental sequence in small groups. *Psychological Bulletin, 63*(6), 384-399.

Tuckman, B. W., & Jensen, M. C. (1977). Stages of small-group development revisited. *Group and Organizational Studies, 2*, 419-427.

Umphress, E.E., Labianca, G., Brass D.J., Kass, E., & Scholten, L. (2003). The role of instrumental and expressive social ties in employees' perceptions of organizational justice. *Organization Science,* 14, 738-753.

Urdan, T. C. (2005). *Statistics in plain English* (2nd ed.). Mahwah, NJ.: Lawrence Erlbaum Associates.

Waldman, D. A., Ramires, G. G., House, R. J., & Puranam, M. (2001). Does leadership matter? CEO attributes and profitability under conditions of perceived environmental uncertainty. *Academy of Management Journal, 44*(1), 134-143.

Wanous, J. P., Reichers, A. E., & Malik, S. D. (1984). Organizational socialization and group development: Toward an integrative perspective. *Academy of Management Review, 9,* 670-683.

Wasserman, S., & Faust, K. (1994). *Social network analysis: Methods and applications.* Cambridge, UK: Cambridge University Press.

Wasserman, S., & Galaskiewica, J. (1994). *Advances in social network analysis.* Thousand Oaks, CA: Sage.

Weber, M. (1978). In Roth G., Wittich C. (Eds.), *Economy and society: An outline of interpretive sociology.* Berkeley, CA: University of California Press.

West, M. A. (1996). *Handbook of work group psychology*. New York: John Wiley.

Wheelan, S. A., & Johnston, F. (1996). The role of informal member leaders in a system containing formal leaders. *Small Group Research, 27*, 33-55.

Worchel, S., Coutant-Sassie, D., & Grossman, M. (1992). A developmental approach to group dynamics: A model and illustrative research. In S. Worchel, W. Wood & J. A. Simpson (Eds.), *Group process and group productivity* (pp. 181-202). Newbury Park, CA: Sage.

Woodman, R. W., & Sherwood, J. J. (1980). The role of team development in organizational effectiveness: A critical review. *Psychological Bulletin, 88*, 166-186.

Wynne, M. W. Secretary of the Air Force, & Moseley, M. T. General, USAF, Washington DC. Personal Correspondence. 7 December 2005.

Yukl, G. (2004). *Leadership in organizations.* (5th ed.). Delhi, India: Pearson Education (Singapore).

Zack, M.H. (2000). Researching organizational systems using social network analysis. *Proceedings of the 33rd Hawaii International Conference on System Science*. Electronically available at: http://www.cba.neu.edu/~mzack/articles/socnet/socnet.htm

Appendix A

Research Approval Letters

24 MAY 05

MEMORANDUM FOR AFIT/ENV
AFIT/ENR
AFRL/HEH
IN TURN

FROM: AFIT/ENV/GEM

SUBJECT: Request for Exemption from Human Experimentation Requirements (AFI 40-402): Thesis Research, AFIT/ENV/GEM, Leadership and Informal Social Networks.

1. Request exemption from Human Experimentation Requirements of AFI 40-402 for the proposed survey to be conducted in conjunction with thesis research at the Air Force Institute of Technology. Purpose of this study is to identify predictors (i.e., personality attributes) of social network location and structure, analyze the relationship between social network characteristics and group and individual performance, and study the longitudinal development of social networks.

2. This request is based on the Code of Federal Regulations, title 32, part 219, section 101, paragraph (b) (2); Research activities that involve human subjects will be exempt when the research involves the use of survey procedures provided (i) information obtained cannot be directly or through identifiers linked to the subjects, and (ii) disclosure of subjects' responses does not place the subjects at risk of criminal or civil liability, financial strain, employability or reputation ruin. Methodology used to collect information for social network research is based on survey procedures. The following information is provided to show cause for such an exemption:

2.1. Equipment and facilities: The survey will be conducted via an Internet web-based survey administered on computers at the Air Force Squadron Officer School (SOS) and the Air Force Senior NCO Academy (SNCOA), inside each of the student flight classrooms. All data will be stored on AFIT computer servers.

2.2. Subjects: Students and instructors at SNCOA at Maxwell Air Force Base, AL.

2.3. Timeframe: May 2005 to May 2006. Both organizations listed above hold multiple five-week and six-week course offerings each year, respectively. This study intends to survey each class offered by measuring different predictors in each survey application. The list of all survey instruments included as attachments is at the bottom of this memorandum.

2.4. Description of the survey: The survey will consist of multiple administrations. The first survey administered will include instruments designed to measure individual attitudes and personality dimensions. The instruments used will be pre-existing reliable instruments that have been validated in the academic literature. The weekly surveys will consist of a social network instrument to measure social

network relationships between group members. Social network instruments require respondents to identify the strengths of relationships with other members of their group. In this research, a group will be defined as the training flight consisting of approximately 15 students led by a training instructor. The social network instrument will consist of a roster of that respondent's training flight and a few questions about the members on the roster. During this part of the survey, the names of the members will be displayed on the screen—without the names, there is no way for the respondent to identify relationships. However, names will be removed once data collection is complete. Student identification numbers which are used to track student data will be provided by the school. An example of a student identification number is 05021812, in which each two digits represent the year, the class offering, the flight, and the student number, respectively. The final survey will be administered at the end of each training class. In addition, the school administrative staff will provide individual performance measures (e.g., academic test scores, fitness test scores) identified by student identification number and other group performance measures, such as flight rankings.

2.5. Data collected: The data will be collected and stored on the AFIT computer server. The data will consist of the respondents' individual responses to all of the questions on the survey. Personal names will be removed from the data once all performance data is properly entered and attached to the appropriate student. At that point, respondents will be anonymous. Respondent data will use the student identification number as the key identifier.

2.6. Informed consent: All subjects are voluntary participants in the survey. No adverse action is taken against those who choose not to participate. Subjects are made aware of the nature and purpose of the research, sponsors of the research, and disposition of the survey results. A copy of the Privacy Act Statement of 1974 is presented for their review.

2.7. Risks to Subjects: Individual responses of the subjects will not be disclosed. This eliminates any risks to the subjects as noted in paragraph 2. There are no anticipated medical risks associated with this study.

3. If you have any questions about this request, please contact Maj. Kent Halverson or Maj Mitch Stratton at (937) 255-3636 x4709.

Atch: Survey

//signed//
KENT C. HALVERSON, Major, USAF
Dept of Systems and Engineering Management
Air Force Institute of Technology

5 JULY 2005

MEMORANDUM FOR MAJ KENT C. HALVERSON
FROM: AFPC/DPAFDS

SUBJECT: Request for Survey Approval

We have reviewed the Predictors and Consequences of Social Network Structure Survey and approved its use with instructors and students at SOS and SNCOA. We have assigned a Survey Control Number (SCN) of USAF SCN 05-084, valid until 31 August 2006. Please ensure that the SCN and expiration date appear within the survey, survey instructions or appropriate web site as well as on the initial document/e-mail introducing the survey.

With regard to the survey and its associated results, it is important to draw your attention to the provisions of the Freedom of Information Act (FOIA). Under the FOIA, the public can request the results of your survey. Furthermore, if the results will be released outside the Air Force, please follow proper approval procedures through Public Affairs before the results are released.

Questions or concerns can be directed to me at DSN 665-2448 or louis.datko@randolph.af.mil. We wish you much success with your data collection effort.

//Signed//

LOUIS M. DATKO
Chief, Air Force Survey Program

Appendix B

Social Networks Survey

SCN 05-084

Survey #3

Study Title: Predictors and Consequences of Social Network Structure

Participation: Your participation in this survey is completely voluntary. However, consider that the greater the participation in each flight, the more insightful and useful the data will be for researchers.

Anonymity: We greatly appreciate your participation. All of your responses and information provided in this survey are confidential. Although names are necessary for the collection of some of the data, after all the data has been collected, the names are erased from the database.

Contact Information: If you have any questions about the survey, please contact Maj Kent Halverson, DSN 785-255-3636x4709 or at kent.halverson@afit.edu.

Survey Instructions:

- **There are no right or wrong answers, so don't dwell on any one question—just answer honestly what first comes to mind.**
- **Please do not discuss your answers with other flight members—your responses should be independent. We don't want your opinions and responses to influence other participants.**

Name: _____

Flight: _____

Date: _____

SCN 05-084

DIRECTIONS: This section is used to describe your relationships with other flight members **during the past week**. Using the scale below, **write a number in each block** to indicate the applicability of each statement in regards to each flight member.

Not at all	Once in a while	Sometimes	Fairly often	Frequently
1	2	3	4	5

Flight Member Names	I spend time on work-related tasks with this person (projects, studying, etc.)	I spend time in social-oriented activities with this person (dining out, movies, sports, etc.)	I go to this person for work-oriented advice.	I enjoy hanging out with this person.	I have difficulty working with this person.
Student 01					
Student 02					
Student 03					
Student 04					
Student 05					
Student 06					
Student 07					
Student 08					
Student 09					
Student 10					
Student 11					
Student 12					
Student 13					
Student 14					
Student 15					
Instructor					

Vita

Major Mitchell D. Stratton was born in Toronto, Ohio and graduated from Toronto High School in 1984. He entered undergraduate studies at the University of South Carolina – Coastal in Conway, South Carolina where he graduated with a Bachelor of Science degree in Mathematics in 1989. He received his commission from the Air Force Officer Training School, Lackland AFB, Texas, in 1991. After commissioning, he attended Undergraduate Space Training at Lowry AFB, Colorado.

Since his designation as a space operations officer, Major Stratton has served 15 years in a variety of space operations positions. His space mission area qualifications include: satellite command and control, missile warning, space surveillance, space control, and theater support. Additionally, he served two joint duty tours at Headquarters, United States Space Command and Headquarters, United States Strategic Command, where he specialized in Special Technical Operations (STO) planning and operations. His duty stations have included Colorado, Nebraska, Ohio, Texas, England, Turkey, and Italy.

Major Stratton earned a Master of Science degree in Space Systems from the University of North Dakota in 2002. In September of 2004, he entered the Graduate School of Engineering and Management, Air Force Institute of Technology. Upon graduation, he will be assigned to Headquarters, United States Air Force in the Pentagon.

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 074-0188

1. REPORT DATE *(DD-MM-YYYY)*	**2. REPORT TYPE**	**3. DATES COVERED** *(From – To)*
03-2006	**Master's Thesis**	March 2005 – March 2006

4. TITLE AND SUBTITLE

Leadership in Groups: Social Networks and Perceptions of Formal and Informal Leaders

5a. CONTRACT NUMBER

5b. GRANT NUMBER

5c. PROGRAM ELEMENT NUMBER

6. AUTHOR(S)

Stratton, Mitchell D., Major, USAF

5d. PROJECT NUMBER

5e. TASK NUMBER

5f. WORK UNIT NUMBER

7. PERFORMING ORGANIZATION NAMES(S) AND ADDRESS(S)

Air Force Institute of Technology
Graduate School of Engineering and Management (AFIT/EN)
2950 Hobson Way
WPAFB OH 45433-7765

8. PERFORMING ORGANIZATION REPORT NUMBER

AFIT/GSS/ENV/06M-01

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)

N/A

10. SPONSOR/MONITOR'S ACRONYM(S)

11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT

APPROVED FOR PUBLIC RELEASE; DISTRIBUTION UNLIMITED.

13. SUPPLEMENTARY NOTES

14. ABSTRACT The labors of organizational and behavioral science researchers have resulted in a literature robust in the study of leadership and social networks. Empirical examination of both topics has shown significant organizational outcomes, but breadth is lacking both within and between the disciplines. Studies of leadership have seen the preponderance of the effort focused on formal leaders, while most social network studies examine only one informal structure. Moreover, there exists a paucity of studies, which have sought to examine the interrelationships between leadership and social networks. In an effort to address these voids, this thesis investigated: 1) The concurrent existence of multiple social networks, 2) How leaders, both formal and informal, are positioned within the networks, 3) How leader positions in the network change over time, 4) How network positioning affects group members' perceptions of formal leader performance, and 5) How a member's position in the network relates to peer selection as an informal leader. The Expressive-Instrumental Leadership Model, based on behavioral science theory and past empirical studies, was proposed as a means of investigation. A population of 431 military students and instructors was surveyed seven times over a period of eight weeks to gather longitudinally-based social networks data. Additionally, both instructors and students were peer-rated on their leadership performance. The results were statistically analyzed and compared to outcomes predicted by the model. The results showed partial support for the proposed model as three of six hypotheses were supported. Partial support was found for remaining hypotheses, with unique environmental factors possible impacting study results. The author proposed further study of the model to gain additional insight.

15. SUBJECT TERMS

Leadership, Social Networks, Formal Leaders, Informal Leaders, Group Development

16. SECURITY CLASSIFICATION OF:			**17. LIMITATION OF ABSTRACT**	**18. NUMBER OF PAGES**	**19a. NAME OF RESPONSIBLE PERSON**
REPORT	**ABSTRACT**	**c. THIS PAGE**			Kent C. Halverson, Major, USAF (ENV)
U	**U**	**U**	**UU**	137	**19b. TELEPHONE NUMBER** *(Include area code)* (937) 255-3636, ext 4709; e-mail: kent.halverson@afit.edu

Standard Form 298 (Rev: 8-98)
Prescribed by ANSI Std. Z39-18