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**THE EFFECTS OF SOCIAL NETWORK
CENTRALITY ON GROUP SATISFACTION**

THESIS

Peter M. Choi, First Lieutenant, USAF
AFIT/GEM/ENV/07-M2

**DEPARTMENT OF THE AIR FORCE
AIR UNIVERSITY**

AIR FORCE INSTITUTE OF TECHNOLOGY

Wright-Patterson Air Force Base, Ohio

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AFIT/GEM/ENV/07-M2

THE EFFECTS OF SOCIAL NETWORK CENTRALITY ON GROUP
SATISFACTION

THESIS

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Peter M. Choi, BS

First Lieutenant, USAF

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SATISFACTION

Peter M. Choi, BS
First Lieutenant, USAF

Approved:

/signed/	6 Mar 07
Kent C. Halverson, Lt Col, USAF (Chairman)	date
/signed/	6 Mar 07
Michael J. Hicks, PhD (Member)	date
/signed/	6 Mar 07
Sharon G. Heilmann, PhD (Member)	date

Abstract

The purpose of this research was to identify how various social network centralities affect a person's satisfaction level. Simple degree centrality has been utilized to specify an individual's location in a network by measuring the number of direct links with other members in the organization (Brass & Burkhardt, 1992, 1993). This study examines how location in friendship, task, and avoidance networks affect an individual's satisfaction with the group. To determine the relationship between social network centrality and work group satisfaction, a longitudinal field study was conducted on 440 active duty enlisted military members in a leadership development training course. While most research has indicated a positive relationship between task or friendship network centrality and satisfaction (Kilduff, Krachardt, 1993), other research suggests otherwise (Brass, 1981). The results of this study are similarly inconclusive. Task centrality only predicted work group satisfaction in one of six time periods, however the relationship was negative. Similarly, friendship network centrality predicted satisfaction in two time period, with a negative relationship. Avoidance network centrality negatively predicted work group satisfaction in two periods. These inconsistent results suggest that the relationship between network position and attitudes such as satisfaction are dynamic. This paper proposes that researchers must not neglect the dynamic nature of social networks as well as the dynamic nature of attitudes, and how they interact to influence individuals within social networks.

To my father and mother

Acknowledgments

I would like to express my sincere appreciation to my faculty advisor, Lt Col Kent Halverson. His enthusiasm, knowledge, and support encouraged me to take this project on even in the midst of a new topic selection six months into the program. Also, thanks to my committee members, Dr. Michael Hicks and Maj. Sharon Heilmann, for their time and the valuable feedback they've provided. Lastly, final thanks goes out to the other Leadership and Management track students whose help throughout the program is much appreciated.

Peter M. Choi

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THE EFFECT OF SOCIAL NETWORK CENTRALITY ON GROUP SATISFACTION

Introduction

One measure of social network strength in particular, simple degree centrality, has been utilized to measure the number of direct links within an organization (Brass & Burkhardt, 1992, 1993; Burkhardt, & Brass, 1990). The idea of centrality can be dated back as early as 1948 when Bavelas (1950) first introduced the concept as having an influence on the group processes (Freeman, 1978). One of the very first research applications of centrality, conducted by Bavelas (1950) in the Group Network Laboratory, Massachusetts Institute of Technology, reported that centrality was related to group efficiency in problem-solving, perceptions of leadership, and the personal satisfaction of group members (Freeman, 1978).

Centrality refers to the extent to which an individual is interconnected with others in a social network, and is most often associated with instrumental outcomes such as power (Brass, 1984), influences in decision making (Friedkin, 1993), and innovation (Ibarra, 1993). Enhancement of power through network centrality stems from the increase in ability to control resources as a result of one's central proximity to the core of the network system (Boje & Whetton, 1981). Another component of centrality is the access of ultra sensitive information within an organization (O'Hara, 1994). The act of sharing organizational secrets is "one of the commonest and most meaningful ways of accepting a new employee" (Roberts & O'Reilley, 1974). Lastly, centrality is often associated with opportunities to participate in decision making that affects the entire

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organization (Jans, 1985). The effects of centrality frequently converge on two principles, (a) "The higher the pervasiveness of the work flows of [employees], the greater [their] power within the organization, and (b) "The higher the immediacy of the work flows of [employees], the greater is [their] power within the organization" (Hinnings, 1971).

Being positively central in an organization should signify the acceptance by other members in a social network, especially by upper management (O'Hara, 1994). Acceptance by your work group leaders is sometimes suggested by the assignment of important tasks, receiving special privileges, and or being granted tenure. Those individuals who have gained trust and acceptance through their work group should be more likely to have greater opportunity for career progression (O'Hara, 1994). However, individuals that are not immediately accepted by their work group could fit into an alternative group often referred to as a negative social network.

Conversely, if an individual is central in a negative social network, this may signify the presence of relationship conflict due to interpersonal incompatibilities among group members often including tension, animosity, and annoyance (Jehn, 1995). Relationships within an organization could experience interpersonal tension, leading to lower job satisfaction within work groups due to negatively enhanced reactions such as anxiety and fear (Jehn, 1995). It is perhaps through such social interactions that may lay the groundwork for developing one's level of satisfaction.

The construct of job satisfaction has been thoroughly researched within the field of organizational psychology for several decades (Brayfield & Rotche, 1951; Herzberg, Mausner, & Snyderman, 1959), however, there exists a lack of consensus of social

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network theory and how it affects satisfaction. Most commonly, job satisfaction has been positively correlated to performance (e.g., Iaffaldano & Muchinsky, 1985; Petty, McGee, & Cavender, 1984), group commitment (e.g., Bateman & Strasser, 1984; Curry, Wakefield, Price, & Mueller, 1986), and organizational citizen behavior (e.g., Bateman & Organ, 1983; Smith, Organ, & Near, 1983), and negatively correlated to stress (O'Driscoll & Beehr, 2000), anxiety (Jex & Gudanowski, 1992), absenteeism behavior (e.g., Chadwick-Jones, Nicholson, & Brown, 1982; Steers & Rhodes, 1978), and turnover (Carson & Spector, 1987; Judge, 1993). Earlier studies have shown that central actors tended to be more satisfied in comparison to peripheral actors in small work groups (5 or less) (Brass & Labianca, 1999). Similarly, Roberts and O'Reilly (1979) found that individual isolates (zero or one link) in a task-based network were generally less satisfied in comparison to participants with two or more links (Brass & Labianca, 1999). However, Brass (1981) discovered no significant relationship between the levels of centrality (closeness) in workflow, workgroups, or departments and individual satisfaction. In fact, Brass (1981) found that the level of individual centrality within the entire workgroup was negatively related to levels of satisfaction (non-supervisory employees). The disparities between Kilduff, Krachardt (1993) and Brass (1981) demonstrate the fact that network centrality does not always lead to positive effects (Brass & Labianca, 1999) and should be further analyzed.

One common theme amongst group development research is that groups change over time (Tuckman, 1977). Longitudinal studies have been recognized as one of the most neglected areas of group research (Kozlowski & Bell, 2003; McGrath & Argote, 2001). One of the reasons why this research disparity exists is due to the uncertainty on

how group development occurs. Since groups have been theorized to change and develop over time, social network analysis would conceivably be a useful tool in monitoring such longitudinal effects (Wasserman & Faust, 1994). By applying Tuckman's (1977) five-stage model (forming, storming, norming, performing, and adjourning) to informal group networks, one can argue that as groups progress through the various stages, changes in the social network structure may occur. Recent social network studies suggest some individuals move in and out of organizational settings thus creating positional changes throughout the social structure (Balkundi & Kilduff, 2005). This exemplifies a greater need for researchers to conduct temporal based (longitudinal) social network analysis. At present state, the vast majority of social network studies are cross-sectional (e.g., Kilduff & Tsai, 2003) and have much more insight to gain from group dynamics.

This study will encompass the analysis of three distinctive social networks: friendship, task, and avoidance networks. A field study was performed on 440 active duty military members at a leadership development training. Based on the data collected from this study, analysis on three different social networks will be conducted.

Literature Review

Introduction

Factors that have an influential basis on the level of individual job satisfaction can be categorized into five areas: (a) pay; (b) nature of work; (c) promotion opportunities; (d) supervisor relations; and (e) co-worker relations (Smith, Kendall, & Hulin, 1969). Considering the vast research conducted on job satisfaction, most have evolved around the extrinsic factors that influence satisfaction (Loher & Noe, 1985). For instance, physical factors that influence levels of satisfaction may include inadequate lighting, an enclosed workspace with no window, or a synthetic fabric office chair. From an organizational perspective, systemic environmental constraints could involve the inability to obtain pertinent information or guidance from colleagues or supervisors, complicated or unnecessary corporate policies (Nicholson & Miljus, 1972), inadequate or confusing job descriptions (Good, 1988) or incompatible work demands from varying supervisors (Spector, 1997). Positively correlated systemic environmental constraints derived from co-worker relationships include recognition, support, and respect from colleagues and supervisors (Dinham & Scott, 1998; Evans, 1998; van der Doef and Maes, 2002; Voluntary Services Organization, 2000), perceptions of interaction (Shann, 1998), and the ability to contribute towards personal attainment (Schonfeld, 1990).

Individual job satisfaction has been analyzed alongside factors such as age, gender, and length of service (Oshagbemi, 1997). Though most demographic studies have concentrated specifically on age, the affects on satisfaction still remains uncertain (Spector, 1997). Earlier studies show that individuals exhibit a U-shaped or curvilinear relationship (Handyside, 1967; Herzberg, 1957), representing high levels of job

satisfaction in early stages of development, a sharp decline during mid-level development, followed by a incline towards the final stage of career development. On the other hand, modern researchers depict a completely different approach to longitudinal studies on age and job satisfaction as they argue that individual expectations alter with time, therefore being able to adjust to work-related complications (Oshagbemi, 1999). One explanation for the temporal nature of job satisfaction maybe attributed to the development, maintenance, and erosion of social networks (Kalish & Robins, 2006; Lein et al., 2004; Mehra, 2001; Borgatti & Foster, 2003). Overtime, an individual's position within a social network may alter due to the organizational and psychological processes. Presently, there is very limited research that has been able to incorporate this time based concept with the exception of the Affective Events Theory (Weiss & Cropanzano, 1996).

The Affective Events Theory (AET) states that an individual's behavior and performance are more likely to be affected by the way they feel on a moment-to-moment basis rather than generally defined by a set of attitudinal traits to explain levels of satisfaction (Fisher, 2000; Hodges & Wilson, 1993; Weiss, Nicolas & Daus, 1999). AET introduces the concept that environmental features will influence an individual's affective state through the use or creation of affective events (Tombs & McColl-Kennedy, 2003). In a social setting, fixed environmental attributes may seem to influence individual attitudes. In actuality, the dynamic interaction between individuals can also create affective events. Affective events can include moment-to-moment occurrences such as a simple facial gesture or a defamatory remark. Day-to-day occurrences that may contribute to negative affect include interactions with supervisors, peers, and subordinates inside and outside of the organization. However, these same sources of

negative emotion can also provide positive uplifts in the workplace (Ashkanasy, Hartel, & Daus, 2002). In the long term, these day-to-day occurrences of hassles and uplifts may have a cumulative nature. Prior research has shown that the intensity of such occurrences do not influence an individual's affective state as much as the frequency (Fisher, 2002). Over time, moods and emotions can accumulate to persuade a more sustainable work attitude such as satisfaction (Ashkanasy, Hartel, & Daus, 2002).

The nature and intensity of social interaction between individuals inside and outside of a work environment can indicate the frequency of affective events. Based on the theory of AET, individuals with a higher level of social interaction could experience a greater frequency of uplifting occurrences. By nature, these moment-to-moment uplifting events would accumulate over time, resulting in an elevated state of work group satisfaction. Conversely, individuals with a lower level of social interaction could experience a lesser frequency of uplifting occurrences. Such individuals would cumulatively have a lower level of positive affective occurrences in comparison to individuals that are more socially interactive to their specific social setting. The lack of positive affective occurrences could possibly reflect a lower level of overall work group satisfaction.

Work-based social support is an extremely promising avenue of organizational behavior research which could make a significant contribution to our understanding of the relationship between co-worker ties and satisfaction. Generally speaking, individuals who feel a lack of support from others may lead to decreases in their overall satisfaction and will contribute a less than optimal effort. On the other hand, when an individual feels that his or her co-workers are pitching in and working together effectively, performance

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and satisfaction levels may increase (Brass, 1981), as reason being, social support plays an integral role on an individuals' integration into a social setting. This is especially true in the workplace, where we would expect such support to originate from personal relationships and co-worker interdependencies (Ducharme & Martin, 2000). The benefits of having co-worker relations may perhaps serve as both affective and instrumental support to counterbalance any deficiencies in intrinsic or extrinsic rewards from work. Such social relationships at the workplace would also indicate a possible source of overall job satisfaction regardless of the type of work related stresses and rewards (Ducharme & Martin, 2000).

Introduction to Social Networks

The purpose of social network analysis is to understand patterns and the content of interactions between social units within an organization (Nelson, 1989). A social network can be simply defined as a "set of formal or informal, frequent or infrequent, affect-laden or purely utilitarian" ties connecting multiple individuals (Nelson, 1989, p.380). A basic assumption concerning ties is that they serve as a "conduit for the flow of interpersonal resources" (Balkundi, 2006). Ties can be classified into the distinction of strong and weak ties as first proposed by Granovetter (1973). Tie strength, as defined by Granovetter, is influenced by thee factors: (a) the frequency of contact; (b) reciprocity of favors and obligations; and (c) friendship (Nelson, 1989). Considering these factors, a strong tie would ultimately entail frequent contacts having friendly overtones as well as the inclusion of reciprocal favors (Neslon, 1989). On the other hand, weak ties would entail infrequent contacts that may have nonaffective or unfriendly overtone (Nelson, 1989).

The two most studied types of ties are instrumental and expressive (Lincoln & Miller, 1979). Instrumental ties or task based relationships, are defined as those ties that are determined to be vital to performing tasks effectively or associated to work related advice (Ibarra, 1993). The primary focus of the interpersonal communications in instrumental ties is information resources or relevant knowledge needed to complete a group task. Researchers elicit such ties by asking queries such as "who do you speak to regularly about business matters?"

Expressive ties are defined as friendship and are more affect-laden based (Balkundi & Harrison, 2005). Such expressive ties serve as a conduit for social support and values (Ibarra, 1993; Lincoln & Miller, 1979). An expressive based network, or friendship network, describes ties of affection or camaraderie associating team members (Baldwin, 1997). Researchers elicit such ties by asking queries such as, "who have you met with privately outside of work?"

All too often, social networks will exhibit both instrumental and expressive ties as one is not mutually exclusive from the other and often tend to overlap (Borgatti & Foster, 2003). Other times, a task related tie may develop into a friendship (Krackhardt & Stern, 1988), as the working relationship facilitates an opportunity for a friendship tie to form (Festinger, Schachter, & Back, 1950). Theoretically, the two types of network ties remain distinct in nature as not all co-workers are friends and vice versa (Balkundi & Harrison, 2005). Therefore, it would not be presumptuous to analyze these two social networks as distinct.

A third social network type is called a negative social network or an avoidance network. Avoidance networks signify the presence of relationship conflicts due to

interpersonal incompatibilities among group members which include tension, animosity, and annoyance (Jehn, 1995). Other negative reactions could include frustration, strain, and uneasiness when individuals dislike or are disliked by others in their group (Walton & Dutton, 1969), resulting in psychological or physical withdrawal (Peterson, 1983; Ross, 1989). Given the difficult nature in collecting valid data concerning negative relationships in field studies, researchers utilize negative exchange proxies such as avoidance (Labianca, 1998) to identify such network relations. Researchers elicit avoidance ties by asking queries such as, "do you have difficulty working with this person?"

Researchers studying social network theory utilize measurements such as density, inclusiveness, and structural equivalence in order to study an organizations or networks as a whole. In this particular study, focuses on the individual measurements from within their group. More specifically, this study will measure individual positions with respect to other group members, otherwise known as centrality. Centrality is a construct that indicates where an individual is positioned relative to others in a social network (see Balkundi, 2006; Burt, 1992). Higher levels of centrality have often been associated with the concept of social power (Hanneman & Riddle, 2005). Though there is a multitude of definitions of what actual power is, in a social network theory construct, power stemming from centrality refers to having a favored position. Holding a favorable position within an organization allows an individual to practice greater influences and is perceived as a figure of deference and attention compared to those in less advantageous positions (Hanneman & Riddle, 2005). An individual that holds a structurally advantageous position within a social network, otherwise known as high centrality, will have the

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tendency to receive information more often and control benefits (Burt, 1992). Power stemming from individuals within a social network will vary from person to person based on organizational characteristics such as size, the number of interpersonal connections, and the intensity of those relationships (Hanneman & Riddle, 2005). There are three variations of centrality measurements which include closeness centrality, betweenness centrality, and in/out degree centrality (Wasserman & Faust, 1994).

There are multiple ways of calculating centrality, one being closeness centrality. Centrality based on closeness focuses on the proximity of an individual node relative to the rest of the network. The closeness centrality measure is accomplished through analyzing the distance of a particular node to another with the inclusion of indirect (third party ties) links (Hanneman & Riddle, 2005). Closeness centrality is typically utilized on undirected graphs (Wasserman & Faust, 1994).

The betweenness centrality measure is used to determine geodesic distances between non-adjacent nodes or nodes that are not linked together. Calculating betweenness centrality between paired individuals involving one geodesic connection is simple (Freeman, 1978). However, once multiple geodesic connections establish ties between pairs, determining centrality becomes more complicated (Freeman, 1978). Betweenness centrality is best suited for non-directed graph analysis (Wasserman & Faust, 1994)

The most common centrality measure is degree centrality which can be further categorized as: (a) out-degree; and (b) in-degree. Out-degree centrality measures one's perception of the total number of ties and the level of intensity of such ties he or she holds with other members in that particular group. Conversely, in-degree centrality

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measures the perceived number of ties and level of intensity from a particular group towards an individual group member (Hanneman & Riddle, 2005). Prior research has shown that people generally tend to perceive themselves to be more central within a social network than what they truly are (Kumbasar, Romney, & Batchelder, 1994). One reason for the misleading levels of out-degree centrality is that individuals prefer to see their relationships with others as reciprocated when in fact this may not always be the case (Balkundi & Kilduff, 2005). Due to individual tendencies to view themselves having elevated levels of popularity (Kumbasar et al., 1994), out-degree measurements would seemingly be more prone to error.

In-degree centrality is the ratio of the relationship (tie) intensity one has with others in his or her group to the maximum level of tie intensity for that group. For instance, in figure 1, the tie intensity level for in-degree centrality ranges from one to five. For individual A, has a in-degree total of six (3+2+1=6) and the highest possible total is 15 (5*(4-1)=15). The in-degree for individual A is the individual total score divided by the maximum allowable. In this example, six divided by 15, or a .4 level of in-degree centrality.
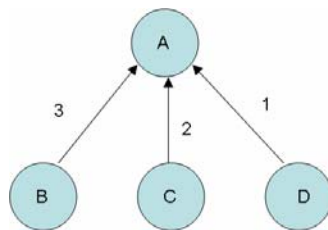
Figure 1: In-degree Calculation Example (Individual A's in-degree = .4)

When deciding whether to utilize in-degree or out-degree centrality, researchers are often faced with issues concerning common method variance (Podsakoff, 1986). A

frequent method variance issue when dealing with multiple self-assessment measures such as out-degree centrality, is consistency motif (Podsakoff, 1986). Consistency motif suggests that individuals desire to present a consistent trend when responding to questions thus producing misleading relationships (Campbell & Fiske, 1959). For example, an individual providing a self assessment on their level of satisfaction as "very high" may also provide a positive assessment on the number of out-degrees just to appear consistent. Due to the risks of common method variance, a non-self assessment measure of in-degree centrality was utilized.

One of the most common ways to analyze a social network size is to utilize a ratio based measure termed density. Social network density can be defined as a ratio of established ties between group members in relation to the maximum possible number of such ties (Balkundi, 2006). Social network density is often utilized as a reflection of the level of interrelatedness or reticulation between all possible social ties (Scott, 2000). The number of social ties can be equated as $(n(n-1)/2)$ with the variable "n" representing the organizational size. As the network size increases, the number of possible social ties increases aggressively. As the size of an organization steadily rises, the social network density decreases assuming that individuals can only maintain a certain number of ties. For instance, a leader who is central in a social network would experience a burden to maintain too many close relationship ties which would ultimately reduce task productivity (Boyd & Taylor, 1998). Close relationship ties are often referred to as "in-degree" ties which drain a centrally positioned individual not only from their own resources due to the laborious maintenance, but due to role demands of that position (Mayhew & Levinger, 1976).

A decreasing level of social network density may elevate the level of difficulty in maintaining the closure required for effective norms and sanctions (Coleman, 1988) along with levels of trust required for fulfilling organizational obligations and expectations (Brass & Labianca, 1999). A resulting consequence of larger network sizes could possibly lead to increasing fragmentation where individuals form sub-groups (Shaw, 1971). Increasing interaction within sub-groups would strengthen existing relationships resulting in the forming of densely connected in-group ties. When each member is a part of a sub-group reciprocating these exclusive ties, this creates what researchers refer to as cliques (Doreian, 1979). The increasing levels of dense ties amongst sub-groups may decrease an organization's ability to facilitate stronger and more positive connections across all groups (Brass & Labianca, 1999). The exclusiveness between sub-groups could promote positive in-group biases and negative out-group biases producing undesirable social outputs such as inter-group conflict and stereotypes (Coser, 1956; see Pruitt & Rubin, 1986 for review; Simmel, 1955; Tajfel & Turner, 1985).

One of the most common ways to analyze a social network size is to utilize a ratio based measure called density. Social network density can be defined as "the ratio of existing ties between team members relative to the maximum possible number of such ties" (Balkundi, 2006). Social network density is often utilized as a reflection of the level of interrelatedness or reticulation between all possible social ties (Scott, 2000).

Task Centrality and Satisfaction

Within every organization, individuals are a part of multiple social networks that are often overlapping. The social interactions within a specific network may consist of

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various interactions to include information, affect, influence, material goods, and psychosocial support (Cross & Parker, 2004). Depending on the type of social tie (friendship or task related) between individuals, will ultimately define the type of network established. For instance, two individuals that enjoy informal activities outside of work may establish a friendship-based network. However, beyond the friendship tie, both individuals may belong to different work, church, and academic affiliation networks.

Research suggests that functional task-based networks are important to employees within an effective organization (e.g., Rogers, 1979). Rogers (1979) and Coleman, Katz, and Menzel (1967) have all emphasized the importance of personal networks and how they play a vital role in the diffusion of critical information within an organization and society as a whole (Baldwin, 1997). For the purpose of this study, task based relationships serve as purely instrumental ties as opposed to friendship or expressive ties. Previous organizational studies have shown that centrality in task-based social networks have been commonly associated with perceptions of power (Burkhardt & Brass, 1990), adoptions of innovations (Ibarra & Andrews, 1993), and the ability to access critical information (Krackhardt, 1990; Rogers, 1979). In many ways, task based communication processes occurring in an organization are applicable to the educational environment. For instance, a student that is highly embedded in a task-based social network may enhance the ability to "[learn] the quirks of certain professors, keeping abreast of changes in assignments, and generally being well informed about the multitude of details involved in successfully performing and surviving in a competitive environment" (Baldwin, 1997, p.1373). Based on the referenced studies (Baldwin, 1997; Burkhardt & Brass, 1990) , we would expect that centrality in a task-based social network

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would enhance one's ability to access greater amounts of quality information. In terms of AET, the day-to-day task related occurrences such as sharing of information or helpful conversations involving work could accumulate over time. This accumulation of quality information would reduce the levels of stress, ambiguity, and uncertainty derived from tasks, but most importantly, increases one's satisfaction (Ganster & Schaubroek, 1991). Thus, the following test hypothesis was developed:

> Hypothesis 1a. Individual degree centrality in a task-based social network will positively affect levels of work group satisfaction.

Friendship Centrality and Satisfaction

An individual who is highly positioned within a friendship-based social network would have a greater access to a multitude of resources that is essential to succeed in many organizations (Baldwin, 1997). Being a part of a positive social relationship, or friendship, serves as a source of psychosocial support (e.g., Ibarra, 1995) that could possibly be used to combat the effects of stress and strain while negotiating difficult tasks. One of the greater contributions friendship centrality plays on an individual is the provisions of accessibility to the indirect and direct social environments. Individuals who hold an extensive base of psychosocial and social resources are more likely to perceive a greater sense of enjoyment in any situation (Baldwin, 1997). In terms of AET, the day-to-day friendship related occurrences of psychosocial support could accumulate over time. Intuitively, one would expect that an individual with a high degree of friendship-based support would be related to elevated levels of work group satisfaction. Thus, the following test hypothesis was developed:

> Hypothesis 1b. Individual degree centrality in a friendship-based social network will positively affect levels of work group satisfaction.

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Avoidance Centrality and Satisfaction

Within every organization, not all interpersonal interactions are positive and may experience negative interactions that can exacerbate intergroup conflict (e.g., Ben-Ari & Amir, 1988). Individuals who are not direct recipients of negative relationships can ultimately be influenced by the mere perceptions of intergroup conflict as this can limit the frequency and quality of interpersonal interaction between group members (Labianca & Brass, 1999). Individuals who are affiliated with an avoidance network are often faced with organizational constraints such as required interactions due to vital workflow exchanges or hierarchical supervisory relationships. A study by Nelson (1989) examined the overall conflict level in 20 different organizations. His suggested showed that organizations faced with high levels of conflict had fewer strong relationships between groups compared to an organization with low levels of perceived conflict (Labianca & Brass, 1999). Nelson's findings were relatively consistent with a study performed by Coser (1956), where he suggested that as conflict between groups increased, the level of group differentiation increased (Forsyth, 1990). In terms of AET, the day-to-day negative occurrences such as avoidance could accumulate over time. Intuitively, as an individual becomes cumulatively more central in an avoidance network, would sever a greater number of social ties. The reduction of social ties would suggest a lower level of social support. This lack of positive social interaction could possibly explain why network conflict is commonly associated with reduced levels of productivity and most importantly, satisfaction (Gladstein, 1984; Wall & Nolan, 1986). Thus, the following test hypothesis was developed:

> Hypothesis 1c. Individual degree centrality in a avoidance-based social network will negatively affect levels of work group satisfaction.
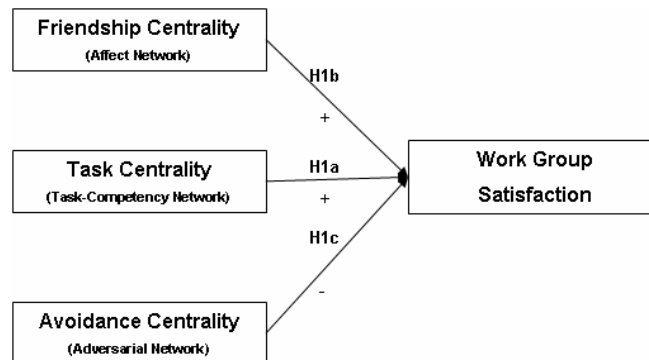
Figure 2 represents the model summary of the three test hypotheses developed for this study. Note, of the three hypotheses, only avoidance centrality is expected to negatively effect work group satisfaction.

Figure 2: Model Summary

Methodology

Sample

This field study's population consisted of active duty military students enrolled in a leadership development course. The course is a 6 ½ week long training course attended primarily by enlisted personnel ranging in pay grade of E-7 to E-9. The development program is a professional military education program directed towards preparing senior military enlisted members for key leadership positions in their particular career field (or equivalent allied nations members).

Structure/Organization

During the time that the field study was conducted, the student body consisted of 412 students who were divided into 28 groups consisting of anywhere between 12 to 16 students. Each flight was assigned a specific academic instructor who is skilled, certified, and a knowledgeable military professional.

Demographics

Ages ranged from 32 to 55 with an average age of 40 years. Of the 412 students, 87% of the student body was male while the remaining 13% were female. The ethnic backgrounds of the students consisted of 74% Caucasian, 16% African American, 3% Asian, and 6% other. The educational background of the sample consisted of 52% of students having an associate's degree, 22% had a bachelor's degree, 14% having had some college, and 8% had a master's degree. The majority of the sample represented U.S. Air Force Active Duty with 85.1% followed by the Air Force Reserve and National Guard representing 8%. The remainder consisted of U.S. Army, U.S. Navy, U.S. Coast Guard, and foreign military personnel. Students were randomly placed in groups but

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were structured to ensure similar career field and demographic diversity across the groups.

Procedure

The collection of network and personality data was accomplished using self-report paper-based questionnaires. Demographic data were made available through the questionnaire. The first survey was administered on day two with six additional surveys at weekly intervals thereafter. A total of seven surveys were administered over 6 ½ weeks. The first survey administered on day two served as a baseline to identify any pre-existing relationships between group members prior to the start of training. Each week, respondents were asked to complete a social network instrument. At each weekly interval, surveys were administered by the researcher to each group's leader to disseminate amongst their designated group members. Upon completion, all surveys were sealed in envelopes by groups as originally administered by the researcher. Respondents were made aware that the survey was completely voluntary and could opt to decline to respond to any if all questions. Three of the 28 groups decided not to respond to surveys six (T_6) and seven (T_7) as these groups of cases were automatically eliminated from analysis due to incomplete data. This reduced the original sample size of 412 students from 28 groups to 320 individuals in 25 groups.

Measures

Work Group Satisfaction

The dependent variable in this study was individual work group satisfaction. Utilizing the instrument originally implemented by LePine and Van Dyne (1998), incorporates a 5-item, 7-point face scale. The face scales itself were pictorial

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representations of levels of satisfaction first developed by Smith, Kendall, and Hulin (1969). At the time, the graphic faces were representative of the male gender only, which was later modified into a gender-neutral face as used by Kunin (1955). The Cronbach's alpha for reliability for this scale is .82 (Halverson, 2005).

Social Networks Centrality

At each time interval (T_x), a social network instrument measuring friendship, task competency, and avoidance relationships was administered through a roster method. Each respondent received a list of names of people within his or her group and was asked to respond to statements to determine the strength of their relationship with each individual during the past week. Responses would indicate frequency of contact in different social situations. Participants were instructed to provide a response ranging from 1 = "Not at all," 2 = "Once in a while," 3 = "Sometimes," 4 = "Fairly Often," and 5 = "Frequently."

The friendship social network was assessed using the following questions: (a) "I spend time in social-oriented activities with this person (dining out, movies, sports, etc);" and (b) "I hang out with this person." The task network was assessed using another set of questions: (a) "I spend time on work-related tasks with this person (projects, studying, etc.);" and (b) "I go to this person for work-oriented advice." Taking the raw data provided by each person concerning relationships with other members in the group, the ratings for both questions were averaged to construct a friendship and a task network adjacency matrix. Most social network studies (e.g., Casciaro & Lobo 2005) rely on one question to construct the network. This study in particular utilized an additional question per friendship and task network to allow the calculation of the internal consistencies of

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the measures. The Cronbach's alpha for the instrument used to measure friendship centrality was .72. Similarly, the Cronbach's alpha for the instrument used to measure task centrality was .74.

The avoidance social network was assessed using the following question, "I have difficulty working with this person." In order to calculate reliability for any instrument would require a minimum of two cases to have responded to at least two items (Helms, 2007). The instrument used to measure avoidance only incorporated one item; thus a estimate was not computed.

Centrality Calculations

After all the network data were complied, each flight member was assigned a score based on the summation of the in-degree values provided by his or her flight mates. Once the total number of in-degrees is measured per flight member, a centrality value could be designated for any flight member via using the following equation:

Individual Centrality (Flight with *n* members):

Social Network Density Calculations

An additional calculation derived from individual centrality values was group density. Density can be a useful comparison tool to contrast between the 28 flights as to which flights have higher levels of friendship and or competency social network relationships within their groups. Based on the friendship or task competency centrality values for each individual, a corresponding group density value could be calculated using the following equation:

Group Density (Flight with *n* members): $\dfrac{\sum_{i=1}^{n} Centrality_i}{n}$

Although seven weekly surveys were administered, only the last six surveys provided individual competency based centrality values in the social network. At time one, only the friendship relationships were evaluated to identify any pre-existing relationships between flight members.

Positive and Negative Affect

Since the levels of centrality were highly dependent on the intensity of social interaction among group members, controls for dominant personality factors of extraversion and introversion were put in place. Research performed by Watson and Clark (1988) suggested that an individual's emotional disposition is composed of two factors; positive affectivity (PA) and negative affectivity (NA) (Judge & Larsen, 2001). A high level of positive affectivity refers to individual feelings of high energy, alertness, enthusiasm, and pleasurable engagement (Watson & Tellegen, 1988). In contrast, high levels of negative affectivity can be characterized by individual feelings of distress, unpleasurable engagement, anger, contempt, guilt, fear, and nervousness (Judge & Larson, 2001). Individual levels of positive and negative affectivity serve as predictors of dominant personality factors of extraversion and anxiety/neuroticism (Tellegen, 1985; Watson & Clark, 1984). This would suggest that levels of low positive affectivity and high levels of negative affectivity would roughly correspond to feelings of depression and anxiety (Tellegen, 1985).

In their study of hospital employees, Agho, Mueller, and Price (1993) found that both positive and negative affectivity were significantly correlated to levels of job satisfaction ($r = .44$, $p<.01$ and $r =-.27$, $p<.01$), respectively. More specifically, Necowitz and Roznowski (1994) isolated three facets of satisfaction to be negatively

correlated to NA; work (r = -.29, p<.05), supervision (r = -.22, p<.05), and co-work relations (r = -.20, p<.05). To reaffirm the social basis for PA/NA, a study performed by Watson (1988) showed that PA was positively correlated to levels of social interaction and satisfaction (Beiser, 1974; Bradburn, 1969; Clark & Watson, 1986, 1988). There is an overwhelming level of agreement within the research community, as presented by Connolly and Viswesvaran's (2000) meta-analysis of 27 articles concerning the correlation between PA/NA to job satisfaction, that PA and NA are strongly related to job satisfaction.

To evaluate individual level of positive and negative affectivity, the PANAS Scale developed by Watson, Clark, and Tellegen (1988) was used. The PANAS Scale is based on a 5-point Likert-Type response scale ranging from 1 = Very slight or not at all, 2 = "A Little," 3 = "Moderately," 4 = "Quite a bit," and 5 = "Extremely." To evaluate an individual's level of positive and negative affectivity at the present moment, a series of 20 descriptors were provided. To measure levels of positive affectivity, 10 positive descriptor scales were given as; attentive, interested, alert, excited, enthusiastic, inspired, proud, determined, strong, and active. The 10 descriptor scales to measure negative affectivity included; distressed, upset, hostile, irritable, scared, afraid, ashamed, guilty, nervous, and jittery. Based on these 20 descriptors, an individual was to rate each word using the 5-point Likert scale based on his current mood. The Cronbach's alpha for positive affectivity (PA) and negative affectivity (NA) were found to be .85 (n = 375) and .93 (n = 375). respectively.

Response Rate

The response rates for the seven surveys measuring network relationships were: 91% (T_1); 92% (T_2); 97% (T_3); 89% (T_4); 86% (T_5); 79% (T_6); and 75% (T_7). Prior research indicated that an 80% response rate was ideal for this type of social network research (Wasserman & Faust, 1994), and all but T_6 and T_7 met this requirement.

Analysis

In this sample, two levels were utilized to model this particular social network apparatus; level-one references to the individual while level-two references the group. Due to the multi-level nature of the data collected, hierarchical linear modeling (HLM) was used for hypothesis testing. Multi-level modeling, including hierarchical linear modeling (Raudenbush & Bryk, 2002) or random coefficient modeling, demonstrates the ability of hierarchical regression analysis. Incorporating HLM facilitated the ability to control for the nested structure of the data that influenced the within-group effects. Controlling for the nested structure enabled the researcher to evaluate how individuals may act differently around group orientated activities. To initially utilize HLM as apart of the analysis process, a series of estimated regression equations for the dependent measure (satisfaction) was created. The dependent variable was an individual's work group satisfaction at the group level while each individual's unique centralities (friendship, task, and avoidance), positive/negative affectivity contributed to the first level effects. The corresponding centrality densities (friendship, task, and avoidance) were applied to the second level to capture the nested within-group effects. In order to test the hypotheses, a generic first level equation was initially developed to assist in modeling a multitude of variations to centrality (the predictor variable):

$$\text{Level 1:} \quad Y_N = B_0 + B_1(Centrality) + B_2(PA) + B_3(NA) + R$$

The variable Y was the normalized level of satisfaction of a student within his or her group; B_0 (the intercept) represented the mean satisfaction of the group; β_1 represented the regression coefficient for an individual's centrality; B_2 represented the regression coefficient for an individual's positive affectivity; B_3 represented the regression coefficient for an individual's negative affectivity; and R represented the individual error term or the deviation of a member from his or her group score.

In the second-level model (i.e., group-level mode), the influence on the group level effects of density on an individual's satisfaction score was tested. The dependent variable serves as the intercept and slop for the level-one model, while the variable of density served as the independent variable. In order to facilitate the group level effects of density, a generic second level equation was initially developed to assist in modeling a multitude of variations to centrality densities:

$$\text{Level 2:} \quad \begin{aligned} B_0 &= \gamma_{00} + \mu_0 \\ B_1 &= \gamma_{10} + \gamma_{11}(Density) + \mu_1 \\ B_2 &= \gamma_{20} + \mu_2 \\ B_3 &= \gamma_{30} + \mu_3 \end{aligned}$$

From the generic layout of the level two equations, effects were not added for the intercept, PA, and NA therefore, the terms γ_{00}, γ_{20}, and γ_{30} were equivalent to their corresponding B values for the intercept, PA, and NA, respectively. The only variables to be added to the model to control for the level two effects that could influence the relationship between centrality and satisfaction were density (task and friendship). The variable γ_{11} accounted for variation in centrality density. Density refers to the mean level of interaction an individual has with other group members of the group (Sparrow et al.,

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2001). In essence, a group that has fewer social barriers and a high level of social interaction will have a greater density. Variables represented in the generic model were as follows: γ_{00} (level-2 intercept) represented the grand mean normalized satisfaction; μ_0 presented the level-2 random error that captured the deviation of B_0 (mean group satisfaction) from the grand mean normalized satisfaction; γ_{10} represented the grand mean normalized centrality; γ_{11} accounted for variation in centrality density; U_1 represented the level-2 random error that captured the deviation of the mean level of centrality (B_1) from its corresponding grand mean normalized centrality.

Due to instrument scaling, the HLM coefficients must be standardized by converting these coefficients to standard deviation units. Standardizing the HLM coefficients can be accomplished by multiplying the HLM coefficients by the standard deviation of each predictor variable and then dividing by the standard deviation of the outcome variable (Hox, 2002).

Results and Analysis

Introduction

Prior to running a bi-variate correlation analysis, the data set was tested for normality. Based on these results, the data set represented an approximately normal distribution. The mean, standard deviations, minimum, maximums, reliabilities, and bi-variate correlations among the measures are presented in table 1. Both task and friendship centralities were significantly related to work group satisfaction at various time periods. All work group satisfaction scores were significantly, positively correlated at each time period. The correlation results between friendship and task centrality across all time periods displayed relatively high correlation coefficients. Since both types of centrality were used as predictors, these high correlations (some as high as .80) introduced the possibility of multicollinearity. Although a multicollinearity test was performed, and the results indicated no signs of multicollinearity (Tolerance $\approx$ 1; VIF $\approx$ 2; Eigenvalues > 0), there was still a concern about the high correlations between predictor variables when used in the same model (Williams, 1979).

Table 1: Descriptive Statistics Among the Measures

	Variable	n	Mean	s.d.	Min	Max	1	2	3	4	5	6	7	8	9	10
1	Positive Affectivity	342	3.53	0.73	1.00	5.00	(.85)									
2	Negative Affectivity	342	1.49	0.52	1.00	4.00	-0.23**	(.93)								
3	Task Centrality Time 2	362	1.55	0.32	1.00	2.73	0.07	0.01								
4	Task Centrality Time 3	361	2.45	0.38	1.00	3.54	0.10*	0.00	0.54**							
5	Task Centrality Time 4	360	2.51	0.41	1.39	3.42	0.08	-0.05	0.56**	0.65**						
6	Task Centrality Time 5	359	2.6	0.48	1.18	3.71	0.12*	-0.04	0.46**	0.43**	0.77**					
7	Task Centrality Time 6	360	2.56	0.54	1.00	3.50	0.10	-0.07	0.35**	0.42**	0.78**	0.80**				
8	Task Centrality Time 7	391	2.54	0.6	1.08	3.95	0.03	0.02	0.26**	0.48**	0.57**	0.46**	0.59**			
9	Friendship Centrality Time 1	374	1.1	0.34	1.00	3.07	0.03	-0.06	0.13*	0.20**	0.11*	0.03	0.02	0.10*		
10	Friendship Centrality Time 2	360	1.9	0.34	1.23	3.00	0.05	-0.08	0.46**	0.36**	0.35**	0.20**	0.24**	0.23**	0.09	
11	Friendship Centrality Time 3	361	2.41	0.36	1.29	3.54	0.17*	-0.10	0.38**	0.56**	0.48**	0.41**	0.35**	0.28**	0.05	0.53**
12	Friendship Centrality Time 4	360	2.62	0.44	1.43	3.71	0.07	-0.06	0.38**	0.44**	0.76**	0.62**	0.63**	0.51**	0.10*	0.50**
13	Friendship Centrality Time 5	359	2.63	0.48	1.35	3.64	0.12*	-0.06	0.37**	0.34**	0.65**	0.80**	0.70**	0.45**	0.05	0.32**
14	Friendship Centrality Time 6	360	2.7	0.43	1.33	3.65	0.06	-0.10	0.26**	0.29**	0.65**	0.75**	0.72**	0.40**	-0.02	0.32**
15	Friendship Centrality Time 7	391	2.56	0.59	1.00	4.00	-0.04	-0.01	0.21**	0.48**	0.60**	0.47**	0.58**	0.75**	0.04	0.35**
16	Satisfaction Time 1	375	5.89	0.83	3.20	7.00	0.30**	-0.12*	0.05	0.19**	0.15**	0.15**	0.14**	0.17**	0.09	0.13**
17	Satisafction Time 2	370	5.74	0.84	3.20	7.00	0.41**	-0.21**	0.13**	0.12**	0.12*	0.14**	0.09	0.01	0.10*	0.08
18	Satisfaction Time 3	367	5.84	0.77	3.40	7.00	0.43	-0.23**	0.08	0.14**	0.16**	0.19**	0.16**	0.11*	0.10*	0.06
19	Satisfaction Time 4	353	5.63	0.88	3.00	7.00	0.42**	-0.25**	0.11*	0.12*	0.18**	0.21**	0.15**	0.13*	0.07	0.12*
20	Satisfaction Time 5	346	5.77	0.92	1.00	7.00	0.51**	-0.26**	0.09	0.08	0.13*	0.21**	0.18**	0.09	0.03	0.01
21	Satisfaction Time 6	338	5.72	0.97	1.00	7.00	0.42**	-0.19**	0.05	0.08	0.09	0.15**	0.13*	0.10	-0.02	0.02
22	Satisfaction Time 7	320	5.99	0.91	2.20	7.00	0.44**	-0.20**	0.07	0.10	0.20**	0.26**	0.25**	0.21**	0.00	0.05
23	Avoidance Centrality Time 2	391	1.02	0.05	1.00	1.27	0.03	0.03	051**	0.19**	0.27**	0.25**	0.17**	0.28**	-0.07	0.20**
24	Avoidance Centrality Time 3	391	1.07	0.11	1.00	1.64	0.01	0.00	0.13**	-0.01	-0.05	0.08	-0.11*	-0.23**	-0.04	0.00
25	Avoidance Centrality Time 4	390	1.08	0.11	1.00	1.64	0.06	-0.05	0.019**	-0.02	0.11*	0.16**	0.09	0.00	-0.11*	0.04
26	Avoidance Centrality Time 5	389	1.07	0.11	1.00	1.67	0.01	-0.01	0.11*	0.06	0.01	-0.15**	-0.13**	-0.08	-0.05	0.06
27	Avoidance Centrality Time 6	392	1.11	0.17	1.00	2.00	-0.03	-0.02	0.01	-0.04	-0.02	0.02	-0.10	-0.12*	-0.02	-0.03
28	Avoidance Centrality Time 7	391	1.10	0.21	1.00	2.00	-0.03	0.04	0.09	0.24**	0.20**	0.18**	0.26**	0.37**	0.06	0.03

Note: Reliabilities for PA and NA appear in parentheses on the diagonal.
*: p<.05, **:p<.01;

Table 1 continued: Descriptive Statistics Among the Measures

Variable	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
1																		
2																		
3																		
4																		
5																		
6																		
7																		
8																		
9																		
10																		
11																		
12	0.62**																	
13	0.57**	0.80**																
14	0.48**	0.77**	0.84**															
15	0.41**	0.63**	0.55**	0.59**														
16	0.21**	0.17**	0.14**	0.15**	0.13**													
17	0.12*	0.11**	0.14**	0.12**	0.02	0.60**												
18	0.15**	0.18**	0.19**	0.16**	0.07	0.51**	0.66**											
19	0.15**	0.21**	0.22**	0.20**	0.07	0.45**	0.51**	0.59**										
20	0.10*	0.13*	0.21**	0.16**	0.01	0.38**	0.48**	0.58**	0.61**									
21	0.08	0.13*	0.18**	0.19**	0.09	0.36**	0.42**	0.51**	0.54**	0.79**								
22	0.13*	0.24**	0.32**	0.24**	0.15**	0.32**	0.43**	0.58**	0.61**	0.72**	0.77**							
23	0.23**	0.18**	0.22*	0.09	0.21**	0.00	-0.06	0.01	-0.02	0.00	0.01	0.03						
24	0.05	-0.05	0.04	-0.13**	-0.20**	-0.05	0.02	0.03	-0.03	-0.01	-0.09	-0.09	-0.16**					
25	0.07	0.14**	0.15**	0.08	0.01	0.03	0.08	0.13**	0.05	0.03	-0.04	-0.06	-0.19**	0.58**				
26	-0.06	0.01	-0.18**	-0.12*	-0.04	-0.01	-0.04	0.00	-0.01	-0.08	-0.08	-0.16**	-0.03	0.27**	0.45**			
27	0.03	-0.01	-0.10*	-0.13**	-0.11*	-0.03	-0.07	-0.01	-0.11*	-0.18**	-0.26**	-0.27**	0.13**	0.56**	0.56**	0.69**		
28	0.15**	0.21**	0.18**	0.18**	-0.36**	0.10*	0.04	0.10	0.06	0.00	0.06	0.09	0.16**	0.074	0.24**	0.27**	0.14**	

Note: Reliabilities for PA and NA appear in parentheses on the diagonal.
*: p<.05, **:p<.01;

A major concern when dealing with any level of multicollinearity is the ability to interpret the HLM regression coefficients. When an HLM model utilizes more than one predictor variable, the corresponding beta coefficients are generally referred to as partial beta coefficients (Shieh & Fouladi, 2003).   Multicollinear predictor variables would attenuate the magnitude of the corresponding partial beta coefficients (Chatterjee, Hadi, & Price, 2000; Morrow-Howell, 1994); hence making it extremely difficult to identify any unique contribution by the predictor variables (Cohen & Cohen, 1983). On the other hand, the absence of multicollinearity does not suggest multiple correlation and regression necessarily (Schwab, 2005). Even with the presence of multicollinearity, standard errors still remain valid (though often inflated) in addition to the hypothesis test and confidence intervals (Schwab, 2005).

Individual Level Analysis

Hypothesis 1a

It was hypothesized that task centrality would be positively related to levels of work group satisfaction. The analysis performed using HLM indicates that task centrality was negatively related to levels of work group satisfaction at only T_6 with a standardized HLM coefficient of -.33 ($p<.05$) (Refer to Table 2). Considering that only one (T_6) of seven time periods was significant, little support for hypothesis 1a was found. The second level density term, γ_{31}, which was a group level control variable, was positive and significant in two (T_3 and T_6) of the seven time periods.

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Table 2: Two-level Model of the Influence of Task Centrality and Density on Normalized Work Group Satisfaction, Hypothesis 1a.

	Work Group Satisfaction											
	Time 2		Time 3		Time 4		Time 5		Time 6		Time 7	
	Raw Coefficients	Standardized Coefficients	Raw Coefficients	Standardized Coefficients	Raw Coefficients	Standardized Coefficients	Raw Coefficients	Standardized Coefficients	Raw Coefficients	Standardized Coefficients	Raw Coefficients	Standardized Coefficients
1. Intercept, γ_{00}	4.07** (0.52)	--	4.82** (0.63)	--	3.94** (0.46)	--	3.38** (0.45)	--	4.63** (0.39)	--	4.42** (0.40)	--
2. Positive Affectivity, γ_{10}	0.44** (0.07)	0.38	0.43** (0.06)	0.41	0.43** (0.07)	0.36	0.59** (0.06)	0.47	0.44** (0.07)	0.33	0.50** (0.07)	0.40
3. Negative Affectivity, γ_{20}	-0.17* (0.08)	-0.11	-0.17* (0.07)	-0.11	-0.21 (0.11)		-0.20 (0.10)		-0.13 (0.13)		-0.18 (0.10)	
4. Task Centrality, γ_{30}	0.25 (0.32)		-0.64 (0.41)		-0.19 (0.37)		0.07 (0.24)		-0.60* (0.23)	-0.33	-0.29 (0.32)	
5. Task Density, γ_{31}	-0.01 (0.08)		0.21* (0.09)	0.09	0.150 (0.09)		0.060 (0.06)		0.18** (0.06)	0.08	0.120 (0.07)	

Note: **$p<.01$, *$p<.05$. Raw refers to raw HLM coefficients. Standard errors are in parenthesis.

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Hypothesis 1b

It was originally hypothesized that friendship centrality would be positively related to levels of work group satisfaction. The analysis performed using HLM showed that friendship centrality was negatively related to levels of work group satisfaction at T_2 and T_3 with standardized HLM coefficients of -.36 (p<.05) and -.46 (p<.05) (Refer to table 3). Though only T_2 and T_3 were significant, times four through seven showed negative HLM coefficients. The second level density term, γ_{31}, which was a group level control variable, was positive and significant at times two through six.

Table 3: Two-level model of the influence of Friendship centrality and Density on Normalized Work Group Satisfaction, Hypothesis 1b.

| | Work Group Satisfaction | | | | | | | | | | | | | |
| | Time 1 | | Time 2 | | Time 3 | | Time 4 | | Time 5 | | Time 6 | | Time 7 | |
	Raw Coefficients	Standardized Coefficients	Raw Coefficients	Standardized Coefficients	Raw Coefficients	Standardized Coefficients	Raw Coefficients	Standardized Coefficients	Raw Coefficients	Standardized Coefficients	Raw Coefficients	Standardized Coefficients	Raw Coefficients	Standardized Coefficients
1. Intercept, γ_{00}	4.49**	--	4.92**	--	5.23**	--	4.05**	--	3.82**	--	4.22**	--	4.67**	--
	(0.30)		(0.56)		(0.71)		(0.53)		(0.44)		(0.51)		(0.54)	
2. Positive Affectivity, γ_{10}	0.35**	0.30	0.45**	0.39	0.43**	0.41	0.43**	0.35	0.59**	0.47	0.46**	0.35	0.47**	0.37
	(0.07)		(0.07)		(0.06)		(0.07)		(0.06)		(0.07)		(0.07)	
3. Negative Affectivity, γ_{20}	-0.03		-0.17*	-0.11	-0.19*	-0.13	-0.21*	-0.13	-0.19		-0.11		-0.22	
	(0.06)		(0.06)		(0.07)		(0.10)		(0.11)		(0.13)		(0.11)	
4. Friendship Centrality, γ_{30}	0.24		-0.90*	-0.36	-0.99*	-0.46	-0.23		-0.36		-0.46		-0.11	
	(0.14)		(0.36)		(0.47)		(0.26)		(0.22)		(0.29)		(0.29)	
5. Friendship Density, γ_{31}	-0.01		0.34**	0.13	0.30**	0.11	0.15*	0.06	0.15**	0.07	0.18*	0.06	0.040	
	(0.04)		(0.10)		(0.10)		(0.06)		(0.05)		(0.06)		(0.07)	

<u>Note:</u>   **$p<.01$, *$p<.05$. Raw refers to raw HLM coefficients. Standard errors are in parenthesis.

Hypothesis 1c

It was hypothesized that avoidance centrality would be negatively related to levels of work group satisfaction. The results indicated that avoidance centrality was also negatively related to levels of work group satisfaction at T_2 and T_7 with standardized HLM coefficient of -.49 (p<.01) and -.44 (p<.01) (Refer to table 5). The second level density term, γ_{31}, which was a group level control variable, was positive and significant in two (T_2 and $T_{7)}$ of the seven time periods.

Table 4: Two-level model of the influence of Avoidance Centrality and Density on Normalized Work Group Satisfaction, Hypothesis 1c.

	Work Group Satisfaction											
	Time 2		Time 3		Time 4		Time 5		Time 6		Time 7	
	Raw Coefficients	Standardized Coefficients	Raw Coefficients	Standardized Coefficients	Raw Coefficients	Standardized Coefficients	Raw Coefficients	Standardized Coefficients	Raw Coefficients	Standardized Coefficients	Raw Coefficients	Standardized Coefficients
1. Intercept, γ_{00}	8.60**	--	4.63**	--	4.59**	--	4.87**	--	5.34**	--	5.45**	--
	(1.13)		(0.50)		(0.69)		(0.73)		(0.68)		(0.48)	
2. Positive Affectivity, γ_{10}	0.42**	0.37	0.43**	0.41	0.43**	0.36	0.59**	0.47	0.48**	0.36	0.50**	0.40
	(0.06)		(0.06)		(0.06)		(0.06)		(0.07)		(0.08)	
3. Negative Affectivity, γ_{20}	-0.18**	-0.11	-0.18*	-0.12	-0.29**	-0.17	-0.22*	-0.12	-0.15		-0.20*	-0.11
	(0.06)		(0.07)		(0.09)		(0.11)		(0.12)		(0.10)	
4. Avoidance Centrality, γ_{30}	-8.20**	-0.49	-0.33		-0.06		-0.17		-0.41		-1.92**	-0.44
	(2.48)		(0.58)		(1.22)		(1.30)		(0.90)		(0.42)	
5. Avoidance Density, γ_{31}	4.15*	0.20	0.290		0.00		-0.59		-0.49		0.93**	0.19
	(1.68)		(0.22)		(0.76)		(0.81)		(0.49)		(0.12)	

Note: **$p<.01$, *$p<.05$. Raw refers to raw HLM coefficients. Standard errors are in parenthesis.

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Dual Predictors

When both task and friendship centrality predictors were placed within the level-one model, it was hypothesized that both variables would be positively related to work group satisfaction. The HLM results (Refer to table 5) indicated that when both predictor variables were inserted into the level-one model, both hypotheses 1a and 1b were not supported. The HLM results in table 2 indicated that friendship centrality was negatively related to the levels of work group satisfaction at time two ($\gamma_{30} = -.41$, $p < .001$). Task centrality was shown to be positively related to levels of work satisfaction at T_2 ($\gamma_{40} = .20$, $p < .001$) but negatively related at T_6 ($\gamma_{40} = -.62$, $p < .001$). The HLM analysis results indicated a degree of significance between the predictor variables and the dependent variable of work group satisfaction. Due to concerns of multicollinearity between the predictor variables as stated earlier, the final hypothesis testing will be based on the individual affects of task and friendship centrality on work group satisfaction.

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Table 5: Two-level model of the influence of Task & Friendship Centrality (simultaneously) on Normalized Work Group Satisfaction, Hypothesis 1a and 1b.
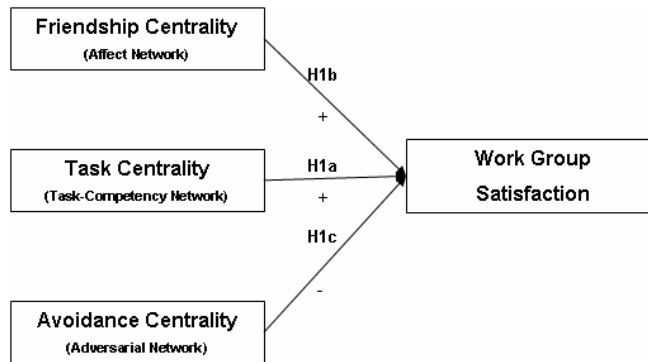
	Work Group Satisfaction													
	Time 1		Time 2		Time 3		Time 4		Time 5		Time 6		Time 7	
	Raw Coefficients	Standardized Coefficients	Raw Coefficients	Standardized Coefficients	Raw Coefficients	Standardized Coefficients	Raw Coefficients	Standardized Coefficients	Raw Coefficients	Standardized Coefficients	Raw Coefficients	Standardized Coefficients	Raw Coefficients	Standardized Coefficients
1. Intercept, γ_{00}	4.49**	--	4.61**	--	5.04**	--	4.13**	--	4.16**	--	4.68**	--	4.56**	--
	(0.27)		(0.66)		(0.65)		(0.50)		(0.50)		(0.50)		(0.53)	
2. Positive Affectivity, γ_{10}	0.36**	0.32	0.45**	0.39	0.43**	0.41	0.42**	0.35	0.46**	0.37	0.36**	0.27	0.46**	0.37
	(0.06)		(0.07)		(0.07)		(0.08)		(0.06)		(0.07)		(0.08)	
3. Negative Affectivity, γ_{20}	-0.07		-0.21**	-0.13	-0.20**	-0.14	-0.23		-0.30*	-0.17	-0.21		-0.25*	-0.14
	(0.07)		(0.06)		(0.07)		(0.12)		(0.14)		(0.14)		(0.11)	
4. Task Centrality, γ_{30}	--		0.53**	0.20	-0.25		-0.26		0.48		-1.11**	-0.62	-0.85	
	--		(0.15)		(0.39)		(0.57)		(0.53)		(0.35)		(0.65)	
5. Task Density, γ_{31}	--		-0.08		0.11		0.10		0.09		0.28*	0.12	0.32	
	--		(0.05)		(0.10)		(0.12)		(0.13)		(0.10)		(0.20)	
6. Friendship Centrality, γ_{40}	0.29		-1.02**	-0.41	-0.58		-0.11		-0.65		-0.60		-0.77	
	(0.17)		(0.35)		(0.45)		(0.44)		(0.37)		(0.39)		(0.65)	
7. Friendship Density, γ_{41}	-0.05		0.32**	0.13	0.150		0.10*	0.04	0.21*	0.09	0.080		0.270	
	(0.05)		(0.10)		(0.11)		(0.09)		(0.09)		(0.11)		(0.20)	

Note: **p<.01, *p<.05. Raw refers to raw HLM coefficients. Standard errors are in parenthesis.

Discussion

The purpose of this research was to explore the relationships between various social networks and an individual's work group satisfaction. Though current studies on social network development have a strong foothold in behavioral science literature, this study focused on the dynamic nature of attitudes that have, to date, received minimal attention. In an effort to address the weaknesses in the current behavioral science literature, this study tested several models in which social network position was predicted to effect work group satisfaction. The research model summary provided a basis for three research hypotheses.

Figure 3: The Research Model Summary

Task Centrality

Brass (1981) suggested that individuals who experienced greater levels of task-based social support from co-workers would display signs of elevated performance and work group satisfaction. The research model proposed in this study predicted that individual's level of task centrality would be related to work group satisfaction. Surprisingly, results obtained did not exhibit support for this hypothesis. In fact, at T_6, the relationship was negative between task centrality and work group satisfaction. These

results suggested as individuals developed increasing number of instrumental relationships, the level of work group satisfaction decreased.

Such results, as explained by Boyd and Taylor (1998), suggested that individuals that are centrally positioned within a task-based social network may consider it a burden to maintain too many close relationship ties which could reduce task productivity. In application to this study, the setting involved obligatory study groups, which may have been considered burdensome by some students, especially given the individual nature of academic evaluations. Though study groups were not mandatory activities, participating in such group activities conformed to the cooperative and social interaction expected of the students.

Similar to the friendship social network, the longitudinal effects of task centrality were not supported over the seven evaluation periods, as no discernable pattern emerged. One reason for this result may be attributed to the fact that participants of this study have attended years of professional military education and are usually well informed of what the expectations and requirements are. Essentially, students know that their overall performance is highly based on individual academic assessment therefore did not find the need to develop instrumental ties. In many instances, a student could easily gage the level of task related social interaction depending on academic requirements. In the case of this particular professional military education course, required very little group orientated work.

Friendship Centrality

Ibarra (1993) suggested that friendship (expressive) ties served as a conduit for social support and values which would result in elevated levels of overall [work group]

satisfaction (Ducharme & Martin, 2000). The research model proposed in this study predicted that individual levels of friendship centrality are related to work group satisfaction. Surprisingly, results obtained did not exhibit support for this hypothesis. In fact as at times two and three the relationship was negative between friendship centrality and work group satisfaction. These results would indicate as individuals developed increasing numbers of expressive relationships, this would cause the level of work group satisfaction to decrease.

The results, as explained by Mayhew & Levinger (1976), are suggestive of the "draining" effect on a centrally positioned individual due to the labor and effort required to preserve such relationships. In a study performed by Duxbury and Higgins (1998) showed that individuals who were confronted with constant demands for attention from others experienced burnout or the "draining effect." Outcomes associated with the "draining effect" are strongly correlated with unfavorable organizational behavior such as reduced job satisfaction and increased job conflict (Duxbury & Higgins, 1998). Due to the fact that students would be evaluated based on peer ratings, it would be imperative to develop expressive ties with as many classmates as possible. Maintaining such relationship, even those individuals that are disliked, would be very tedious, and at times, stressful.

On a more surprising note, the HLM results showed that friendship density was significantly, positively related to work group satisfaction at time periods two through seven. Even though friendship centrality was shown to be negatively related to individual work group satisfaction, the significance of friendship density states that satisfaction levels would increase in relation to the number of friendship ties within the

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group. Essentially, an individual's satisfaction would decrease if he or she developed more friendship ties however satisfaction would increase if group members co-existed harmoniously.

From a longitudinal perspective, Ashkanasy, Hartel, and Daus (2002) suggested that over time, moods and emotions could accumulate to persuade a more sustainable work attitude such as satisfaction. In terms of friendship centrality, the seven time periods showed no discernable pattern in correspondence to the Affective Events Theory. Reason behind why the results failed to show support towards any longitudinal effect may be due to the lack of time provided for the students to interact with one another. The accelerated pace of the course could have hindered the development of expressive ties.

Avoidance Centrality

Jehn (1995) suggested that individuals that experienced elevated levels of interpersonal incompatibilities from co-workers would ultimately lead to lowered work group satisfaction. The research model proposed in this study predicted that individual's level of avoidance centrality is related to overall work group satisfaction. Results obtained did show support for this hypothesis. In fact, at times one and seven the relationship was negative between avoidance centrality and work group satisfaction. These results would indicate as individuals developed increasing number of avoidance ties, this would cause the level of work group satisfaction to decrease as originally predicted. Being centrally positioned in an avoidance network would signify the presence of relationship conflicts producing feelings of tension, animosity, and annoyance (Jehn, 1995). Such feelings would ultimately result in psychological and physical withdrawal from the situation (Peterson, 1983; Ross, 1989) making it extremely

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difficult to experience any degree of social support. The lack of social support at the workplace would serve as a deterrent factor in the development of work group satisfaction.

In application to this study, Tuckman's five stages of development would best explain what was seen in the data results. Note that only at time periods one and seven was there a significantly, negative correlation between avoidance centrality and work group satisfaction. Tuckman's theory suggests that at time two would be classified as the "forming" stage of the group where individuals tend to behavior independently, roles and responsibilities are unclear, and boundaries are tested (Tuckman & Jensen, 1977). Individuals would generally not be inclined to form immediate relationships with classmates until he or she is familiarized with their surroundings. Immediately following the forming stage, time periods three through six showed no signs of significant correlations. Only until time seven, which Tuckman refers to as the "adjourning" stage, individuals realize that there is no longer a need to be apart of the group and break away. At time period seven, students were in the final stages of evaluation in preparation for departure back to their home duty station. Due to the professional development program coming to a close, would be an explanation why time seven developed a significantly, negative correlation between avoidance centrality and work group satisfaction. At time seven, group members no longer felt the need to maintain their current group member relationships therefore would not be inclined to invest any more time.

The longitudinal effects of avoidance centrality were not supported over the seven evaluation periods as there was no discernable pattern. One reason for this result can be attributed to the fact that members of the armed forces, especially those selected for

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senior level professional development, are usually inclined to follow typical social norms of the military. Expressive, instrumental, and more commonly, avoidance ties could have been easily suppressed within a military environment saturated with customs, courtesies, and mannerisms.

Limitations

Out of 28 groups with 440 initial participants in this study, the lack of response in the latter surveys (times six and seven) resulted in a reduction of size to 25 flights with a minimum of 320 participants. Each week, students were asked to provide social network data on their fellow group members. However, knowing that the surveys were completely voluntary, many opted not to respond to some of the questions or disregarded the survey entirely. Those individuals that did take the time to fill out the surveys completely posed the issue of response acquiescence. In many of the responses, individuals tended to agree with "attitude statements regardless of its content" (Winkler, Kanouse & Ware, 1982). Many items appeared to be worded similarly but were conceptually unrelated. For instance, an individual may have rated his or her peers the maximum possible score for friendship ties but also rated them the maximum score for avoidance ties.

A second limitation to this study was the lack of a reliability when measuring avoidance centrality. Unlike the friendship and task centrality instruments, the avoidance centrality network only incorporated one item when measuring the intensity of avoidance ties. Due to the lack of reliability in measuring the avoidance centrality, makes any significant result questionable. However, one must realize that it is extremely difficult to collect data concerning avoidance relationships due to the lack of social desirability to

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divulge that sort of information (Podsakoff, MacKensize, and Lee, 2003). Individuals tend to present themselves in a positive light despite any cynical feelings concerning the subject matter (Podsakoff, 2003). This natural human tendency generates response bias that may conceal any true relationship between variables (Ganster, Hennessey & Luthans, 1983).

Nonetheless, Marsden (1990) discovered that network indexes utilizing a roster method are largely reliable regardless of a single item instrument (Labianca, Brass, & Gray, 1998). In fact, in a re-analysis of the Bernard, Killworth, and Sailer studies (1980, 1982) noted that individuals were able to report interaction frequency (as measured in this study) accurately. Thought it may have been ideal if multiple items were utilized for the avoidance instrument, a single item may serve just as effective.

Suggestions for Future Research

Though this particular study examined the research model summary, several improvements could be made for future iterations of this research. This study was conducted in a training environment attended by students who didn't know each other, however would be classified as a "strong setting." Characteristics of a "strong setting" includes the sample population having been already familiarized or holding pre-conceived knowledge of the environment of which they were placed in.

In addition to sample population recommendations, improvements in the nature of which the surveys were administered could have bolstered a higher response rate. This study utilized seven successive survey packets over a six and a half week course. Due to the short intervals of time between each survey may have caused the students to become

disinterested in the latter surveys. Instead of incorporating seven surveys, four or five evaluations may have created a better balance in longitudinal data points.

Lastly, future research may want to extend the timeline associated with measuring centrality development over time. A longer timeline would contribute a greater number of data points to portray a more realistic development of relationship ties. In many cases, to properly measure the longitudinal effects would require a greater amount of time to allow for the interpersonal relationships to fully develop.

Conclusion

This research studied how individual social network centrality values could serve as predictors to overall work group satisfaction. Statistical analysis showed support for the only one out of the three hypotheses offered. Though the hypotheses dealing with task and friendship centrality were unsupported, the possible context explanations discussed in this study such as peer evaluations and individual academic assessments could have easily been responsible for the unexpected results. Again, the results may have been skewed due to the uniqueness of the environment and sample population. None the less, organizational leaders could use these findings and techniques to better serve in identifying employees who serve as negative actors within a social network. More specifically, when organizational leadership selects an individual to lead important projects, it would be in their best interest to assign an individual that is highly central in friendship and task networks. On a subordinate level, co-workers could also benefit from incorporating the concepts expressed in this study by recognizing social-behavioral patterns that may influence their level of centrality. Although personality factors may

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prohibit an individual from becoming a centralized figurehead in an organization, altering one's behavior may produce elevated levels of centrality.

Appendix A: Social Network Survey

Survey

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: _____

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					

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DIRECTIONS: The following questions ask about *satisfaction*. Fill in the blank space next to each statement to indicate which of the following faces (1-7) best represents how you feel about your **experiences as a member of your flight during the past week**.

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
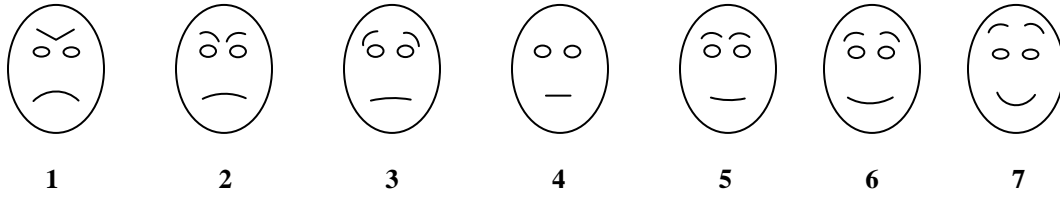
Consider your flight during the past week. Select the number which best expresses how you feel about your flight.	
Consider the other members of your flight during the past week. Select the number which best expresses how you feel about the other members of your flight.	
Consider the quality of interaction among flight members during the past week. Select the number which best expresses how you feel about the quality of interaction among flight members.	
Consider the information that you get about things that are relevant to your flight during the past week. Select the number which best expresses how you feel about the information you get.	
Consider the influence that you have in your flight during the past week. Select the number which best expresses how you feel about the influence that you have.	

DIRECTIONS: This scale consists of a number of words that describe different feelings and emotions. Fill in each block with a number to indicate to what extent you generally feel this way, that is, **how you feel 'on average'** using this scale:

Very slightly, or not at all	A little	Moderately	Quite a bit	Very Much
1	2	3	4	5

Interested		Irritable	
Distressed		Alert	
Excited		Ashamed	
Upset		Inspired	
Strong		Nervous	
Guilty		Determined	
Scared		Attentive	
Hostile		Jittery	
Enthusiastic		Active	
Proud		Afraid	

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Vita

First Lieutenant Peter M. Choi graduated from New Trier Township High School in Winnetka, Illinois. He entered the Virginia Military Institute where he graduated with a Bachelor of Science in Electrical Engineering in May 2003. After graduation he was commissioned as an Air Force Civil Engineering officer through AFROTC. His first assignment was at Malmstrom AFB where he worked in construction management and the readiness flight. In August 2005 he entered the Graduate School of Engineering and Management at the Air Force Institute of Technology. Upon graduation, he will be assigned to Kunsan ABS, Republic of Korea.

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14. ABSTRACT
The purpose of this research was to identify how various social network centralities affect a person's satisfaction level. Simple degree centrality has been utilized to specify an individual's location in a network by measuring the number of direct links with other members in the organization (Brass & Burkhardt, 1992, 1993). This study examines how location in friendship, task, and avoidance networks affect an individual's satisfaction with the group. To determine the relationship between social network centrality and work group satisfaction, a longitudinal field study was conducted on 440 active duty enlisted military members in a leadership development training course. While most research has indicated a positive relationship between task or friendship network centrality and satisfaction (Kilduff, Krachardt, 1993), other research suggests otherwise (Brass, 1981). The results of this study are similarly inconclusive. Task centrality only predicted work group satisfaction in one of six time periods, however the relationship was negative. Similarly, friendship network centrality predicted satisfaction in two time period, with a negative relationship. Avoidance network centrality negatively predicted work group satisfaction in two periods. These inconsistent results suggest that the relationship between network position and attitudes such as satisfaction are dynamic. This paper proposes that researchers must not neglect the dynamic nature of social networks as well as the dynamic nature of attitudes, and how they interact to influence individuals within social networks.

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