HIGH PERFORMING TEAMS: THE MODERATING EFFECTS OF COMMUNICATION CHANNELS

THESIS

Edgard I. Zamora, Capt, USAF
AFIT/GIR/ENV/08-M27

DEPARTMENT OF THE AIR FORCE
AIR UNIVERSITY

AIR FORCE INSTITUTE OF TECHNOLOGY

Wright-Patterson Air Force Base, Ohio

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THESIS

Presented to the Faculty

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 Information Resource Management

Edgard I. Zamora

Captain, USAF

March 2008

AFIT/GIR/ENV/08-M27

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Edgard I. Zamora

Captain, USAF

Approved:

//Signed//	11 Mar 08
Jason M. Turner, Maj, USAF (Chairman)	Date
//Signed//	11 Mar 08
Alexander J. Barelka, Lt Col, USAF (Member)	Date

ABSTRACT

The purpose of this study is to support the Air Force's goal of improving team performance by bringing visibility to several overlapping areas of study where little comprehensive research has been conducted. Specifically, an officer's ability to successfully complete his or her mission has been complicated in recent years by the emergence of new communication technologies. For example, communication networks now make it possible for pilots to fly Unmanned Arial Vehicles (UAVs) who sit on one continent while the aircraft and mission planners are on another and, although they may not see each other, their physical separation does not negate the need for effective team performance. It is important organizations have a clear understanding of the impact that communication technologies have on team and individual behaviors. Knowing these effects may mean the difference between successfully completing a mission or not.

ACKNOWLEDGMENTS

I wish to thank the members of my committee, Maj Jason Turner and Maj Alexander Barelka for their participation, interest, and valuable guidance during the course of this research. I'd like to give a special thanks to my supervisor and committee chair, Maj Jason Turner. He challenged me when I needed to be challenged and was a patient mentor throughout my entire master's program; I can only hope that I may one day return the favor by mentoring those who need it.

Most importantly, I want to thank my wife for her unwavering commitment to me as I spent many long days working on my research. She understood that this process would be time consuming and was patient with me nonetheless.

Edgard I. Zamora

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CHAPTER 1

INTRODUCTION

Background

We live in an age of rapidly changing technologies and globalization (Hegstad & Wentling, 2004), and the business world in which our parents worked is not the one in which we currently find ourselves. For example, it is increasingly common for work to be accomplished in collaborative environments such as teams (Northhouse, 2007; Wilson, 1999). One of the key ingredients to making such teams perform well is getting people in those teams to communicate effectively.

In extreme cases, a team's ability to communicate may mean the difference between life and death. For instance, in 1996, a Mt. Everest expedition went horribly wrong because of the inability of climbing team members to communicate effectively (Houston, 2003). Consisting of year-round inclement weather, climbing Mt. Everest requires that people work in teams to accomplish the goal of reaching the mountain summit and returning home alive. This particular expedition was fraught with many issues, the most important of which was a lack of communication between team members. For example, because team leaders did not communicate and coordinate with the rest of the expedition to ensure new ropes had been in place ahead of time, only tattered rope remains from previous expeditions were available. As such, climbers were forced to waste precious time by laying down new rope during their ascent. Furthermore,

communication problems were compounded by poor radio equipment and a lack of equitable radio distribution (Houston, 2003). These issues culminated on May 11, 1996, with the unnecessary and very likely preventable deaths of eight climbers.

The U.S. military has also witnessed many such tragedies as a result of team communication issues. One such example is the 1993 "Black Hawk Down" incident which resulted in the loss of 18 soldiers. Initially designed to capture two persons of interest in Mogadishu, Somalia, Operation GOTHIC SERPENT quickly ran into several complications before turning into a rescue operation (Bowden, 1999). For instance, during the raid, there was a breakdown in communication between the ground convoy and the assault team causing a needless waste of 20 minutes, ultimately resulting in the downing of an unprotected MH-60 Black Hawk helicopter by enemy forces. This incident, and many others like it, was at least partially the result of breakdowns in effective communication. By improving the ways in which we communicate in teams, we may be able to improve overall team performance and perhaps limit future such tragedies.

In addition to the critical communication issues noted above, an Air Force officer's ability to successfully complete his or her mission has been complicated in recent years by the emergence of new communication technologies. For example, communication networks now make it possible for pilots who sit on one continent to fly Unmanned Arial Vehicles (UAVs) while the aircraft maintainers and mission planners may sit on another. Although those involved in such missions may not see each other, the importance of their mission requires that their physical separation not get in the way of effective team performance and communication. Because we often use technology to mediate communication in team-based environments, or to bridge physical distances

between widely dispersed team members, it is important that we have a clear understanding of the potential impact communication technologies can have on team performance and team communication. Awareness and possible mitigation of these effects may ultimately mean the difference between successfully completing a mission or not.

Research Focus

The purpose of this study is to advance and support the Air Force's overarching interest in improving team performance. Through improved communications, high performing teams may be more likely to accomplish their missions. In the following sections, various concepts related to team performance will be discussed. Performance itself will be examined relative to both individual team members as well as the team as a whole. Finally, the effects of communication technologies on various aspects of team performance will be discussed in the course of outlining the specific research framework and model used for this study. Ultimately, this research will attempt to answer the following fundamental question:

- What impact do communication technologies have on verbal team member communication and team performance?

CHAPTER 2

LITERATURE REVIEW

Collaborative Environments

Because communication can play such a critical role in team performance, it is important to first identify an appropriate context in which to consider such communication. There are several perspectives from which interpersonal communication can be considered: whole societies, entire organizations, discursive formations, small groups, and dyads (Poole, 1998). Poole asserts that the first three contexts are not appropriate for *studying* social phenomena as a researcher because they are too complex to pick out the characteristics of individuals and, as a result, omit the importance of individuals and their actions in collaborative environments. Thus, we are left with two collaborative environments suitable for studying the communicative process; small groups and dyads.

A dyad refers to a grouping of two individuals (Northouse, 2007). Poole (1998) suggests that small groups and dyads are the only units of analysis that allow for comprehensive study of interpersonal communication. For example, both dyads and small groups allow researchers to witness message production and reception processes (Poole, 1998). In addition, Poole argues that both units of analysis are simple enough to enable the study of cognitive and affective processes. However, dyads begin to lose their attractiveness because the grouping may in fact be *too* small. According to Poole, including only one other person "does not adequately capture the complex nature of

social situations" (p. 96). Furthermore, if one member of the dyad leaves, the collaborative environment ceases to exist. Such is not the case for small groups.

Unlike dyads, if a member leaves a small group, the social and collaborative structures of the group itself will continue to exist, if only changed or altered somewhat by that departure. Because small groups therefore have some degree of permanence or enduring nature, and because they are small enough to study the impact of each individual member, they are therefore ideal units of analysis for studying communication and developing communication theories (Poole, 1998). But, how can we determine how "small" a small group should be? According to Wilson (1999) and Robbins & Judge (2007), a small group consists of three or more individuals who interact to work on a common problem and have influence over one another. Poole adds that because there are limits to human processing capacity, no more than ten people can be individually considered by group members at one time. As such, small groups are limited herein to between three to ten people (Poole; Wilson).

Group vs. Team

It is not uncommon to hear the terms "group" and "team" used interchangeably. Although they are similar, they do not actually refer to the same concept. A group is a collaboration of individuals who work together to share information and to make decisions that help each member better perform their duties (Robbins & Judge, 2007). A team, on the other hand, is considered a subset of a group (Wilson, 1999). Specifically, a team is a mature grouping of individuals that generates synergistic effects through a coordination of its members' efforts (Robbins & Judge, 2007; Wilson, 1999). In addition, Wilson states that teams interact on an ongoing basis, provide their own leadership, and

exert mutual influence over each other. The present study focuses more on the team concept, as opposed to the group concept, because it is more typical of Air Force collaborative environments where a coordination of efforts is often necessary for mission accomplishment.

Team Performance

In today's operational and business environment, change is a constant (Hammer & Champy, 2003). Thriving in such an environment requires that people do more than simply work in teams; organizations require high performing teams. For example, the Air Force cares about high performing teams because a team's performance and success are often the keys to mission accomplishment. But, how do we (or how should we) conceptualize performance?

According to Campbell, Dunnette, and Lawler (1970), there are three dimensions of performance. The first method focuses on traits. The term "traits" refers to people's general characteristics such as their patterns of behavior, motives, and capacities (Kirkpatrick & Locke, 1991; Robbins & Judge, 2007). For example, human virtues such as assertiveness, honesty, competitiveness, dedication, intelligence, and alertness may be considered traits (Campbell et al., 1970). Performance in this light might be conceptualized in terms of intelligent or honest team members.

The trait-based approach has garnered support partially because it has a century of research to back it up; no other theory can boast this claim (Northouse, 2007). The trait approach can also serve as a benchmark or guideline for the kind of people we want to

have in our teams (Northouse). Furthermore, people may be informed as to the traits they are lacking and can work toward changing certain aspects of themselves.

Nevertheless, there are several criticisms to the trait-based approach. First, researchers assert that it is difficult to define and observe traits (Kirkpatrick & Locke, 1991). Although there have been many studies that attempt to define lists of desirable individual traits, these studies are often ambiguous in their implications or recommendations (Northouse, 2007). For example, trait-based studies have produced long lists of "desirable" traits that often do not coincide with one another. Second, trait-based studies have also been inconclusive in identifying how particular traits affect team members and their work (Northouse). According to Kirkpatrick & Locke, although certain traits assist in creating high performing teams, individual traits alone do not guarantee team performance. Finally, critics assert that the trait-based approach is not very useful in terms of training and development because traits are largely fixed; therefore, additional training and development to expand or alter individual traits could yield limited results (Northouse).

The second approach to conceptualizing performance focuses on behavior. Specifically, Campbell et al. (1970) focused on workers' job-related behavior as opposed to their personal qualities. Examples of job-related behaviors include the ability to plan and organize effectively, set realistic goals, communicate effectively, and cooperate with others. Such a behavioral approach is intuitively appealing because behavior is modifiable and therefore trainable (Kirkpatrick & Locke, 1991; Northouse, 2007). Behavior is also observable and can therefore be easily recorded for research purposes

(Campbell et al.). Finally, behavior is related to organizational outcomes and can therefore be used to hold people accountable for their actions (Campbell at al.).

Still, the behavioral approach is not without its own criticisms. First, research has been inconclusive as to whether certain behaviors are associated with performance outcomes (Northouse, 2007); thus, it is unclear which behaviors or sets of behaviors will necessarily lead to high performance in different situations. Second, similar to the trait-based approach, critics note there is no universal list of behaviors that would or should lead to high performing teams in every situation; behavioral studies have therefore produced long lists of behaviors that often do not coincide with one another.

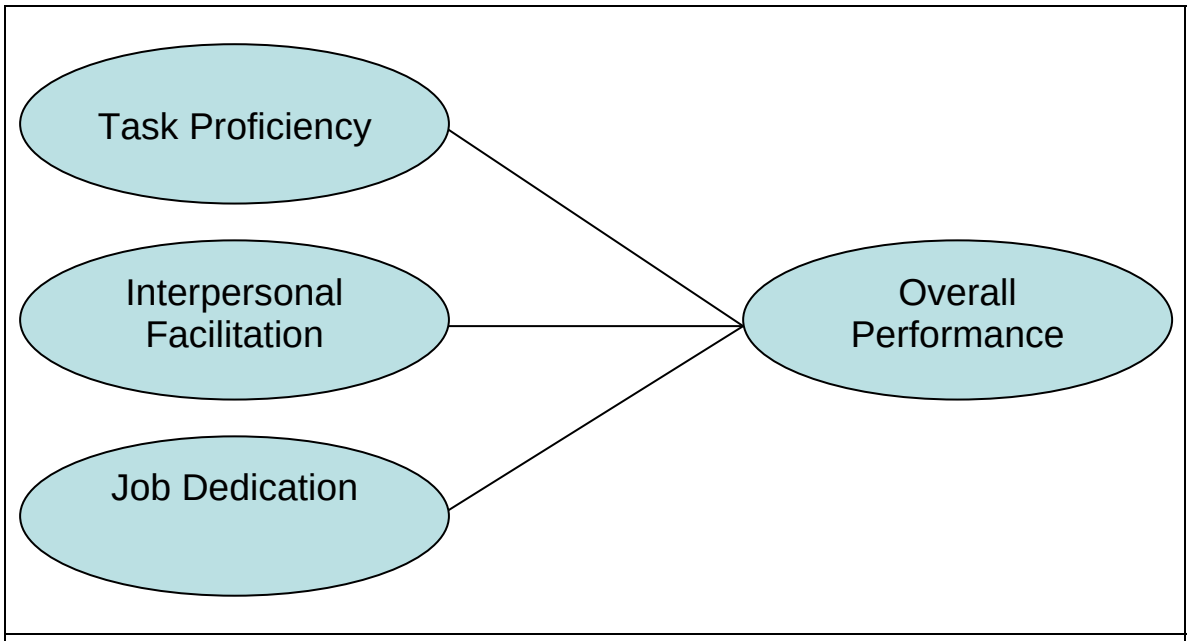
The final approach to conceptualizing performance is related to the end product (Campbell et al., 1970; Kirkpatrick & Locke, 1991). This approach focuses on what is accomplished as the end result of one's actions. For example, according to Robbins & Judge (2007) and Wilson (1999), we might measure the end product by money costs, team cohesiveness, team satisfaction, number and quality of ideas, social pressure, and potential for interpersonal conflict. Proponents of this approach maintain that *results* are what matters at the end of the day (Campbell et al.). In addition, proponents state that this approach is appropriate for study because the end product is measurable and can be influenced by individuals (Kirkpatrick & Locke, 1991). At the same time, at least one critic notes that there is no clear link between achieving the expected results and the overall success of an organization (Thomas, 1994). In other words, the achievement of one thing does not necessarily result in the achievement of another. We are therefore cautioned to be mindful of the end product we seek or the one we choose to study as researchers.

Individual Performance

We should not forget the fact that teams are made up of individuals and the performance of individuals can affect the entire team. But what does individual performance mean? According to Van Scotter (1994), individual performance consists of behaviors that can be controlled by the individual and are relevant to the individual's organizational goals. Van Scotter maintains that individuals who perform their jobs well are more effective, exceed performance standards, and contribute significantly to an organization while the opposite is true for low performers. Due to the primacy of behaviors in relation to individual performance, the following sections will also focus on the behavioral aspects of individual performance, specifically as described by two individual performance models that have emerged from Air Force-related research on team effectiveness and individual performance.

Three Factor Performance Model

The Three Factor Performance Model (see Figure 1), developed by Van Scotter (1994), uses the behavioral approach to determine individual performance. Van Scotter found that three sets of behaviors contributed to the performance of Air Force maintenance technicians. These sets of behavior consisted of task proficiency, interpersonal facilitation, and job dedication behaviors.



Source: Van Scotter (1994)

Figure 1: Three Factor Performance Model

Task Proficiency

Task proficiency is defined as the proficiency with which an individual performs duties related to his or her job (Borman & Motowidlo, 1993; Van Scotter, 1994). Van Scotter maintained that task proficiency behaviors contribute both directly and indirectly to an organization (Table 1 contains a list of task proficiency behaviors). For example, if a computer network technician can do his job proficiently, his work will have a positive and direct impact on the computer network for which he is in charge. Further, by properly maintaining the computer network, the computer network technician may indirectly affect the productivity of his coworkers. The emphasis of task proficiency behaviors should be on the ability of individuals to perform their particular duties rather than proficiency at any task at all (Campbell, McHenry, & Wise, 1990). For instance, an aircraft maintainer's abilities differentiate him from a pilot while a help desk computer technician's skills differentiate him from an Information Systems Flight commander.

• Performing routine and specialized tasks efficiently [1,2] • Solving urgent, unexpected problems expertly [1] • Using equipment, tools, and computers proficiently [2] • Writing clearly and concisely [2] • Providing others with current technical information [1,2] • Anticipating future issues [1,2] • Communicating task information effectively [2] • Planning and organizing work well [1,2] • Troubleshooting expertly [1,2] • Collecting and accurately interpreting information [1,2] • Keeping up with latest technology [1,2] • Performing safely [1] • Using technical material effectively [1,2]
Sources: [1]Van Scotter (1994), and [2]Borman & Brush (1993).

Table 1: Task Proficiency Behaviors

Interpersonal Facilitation

In addition to task proficiency behaviors, Van Scotter (1994) suggests that interpersonal facilitation behaviors must be considered as well. Interpersonal facilitation consists of conflict resolution, being cooperative, consideration for others, and encouraging others to perform well (Robbins & Judge, 2007; Van Scotter). These types of behaviors (an expanded list can be found in Table 2) help establish a positive work environment; individuals lacking these types of behaviors detract from work performance.

According to Van Scotter (1994), individuals lacking interpersonal facilitation behaviors may, "disagree vocally, act aggressively, or pick fights; tell lies or spread rumors about others; manipulate others; compete with coworkers; act selfishly; avoid associating with coworkers during breaks; and complain about working conditions" (p. 21-22). The negative behaviors exhibited by such individuals can bring down morale for

others and detract from overall performance. Therefore, it can be safely concluded that, for everyone's benefit, organizations should discourage such practices.

• Supporting or encouraging a coworker [1,2] • Talking to others before taking actions that affect them [1,2] • Treating others fairly [2] • Helping someone without being asked [1,2] • Developing and maintaining good working relationships [2] • Showing concern for others [3] • Coordinating actions with others [1,3] • Displaying respect for others [2,3] • Encouraging others to work together [1] • Cooperating with others effectively [1,2] • Having a cheerful, confident outlook [2] • Considering others' needs before acting [1,2] • Warning the supervisor about issues [2] • Helping others with their work [1,2] • Praising others' good work [2] • Listening to others' ideas about getting work done [1,2] • Advice others about how to do their jobs [1,2]
Sources: [1]Borman & Motowidlo (1983), [2]Van Scotter (1994), [3]Borman & Brush (1993)

Table 2: Interpersonal Facilitation Behaviors

Job Dedication

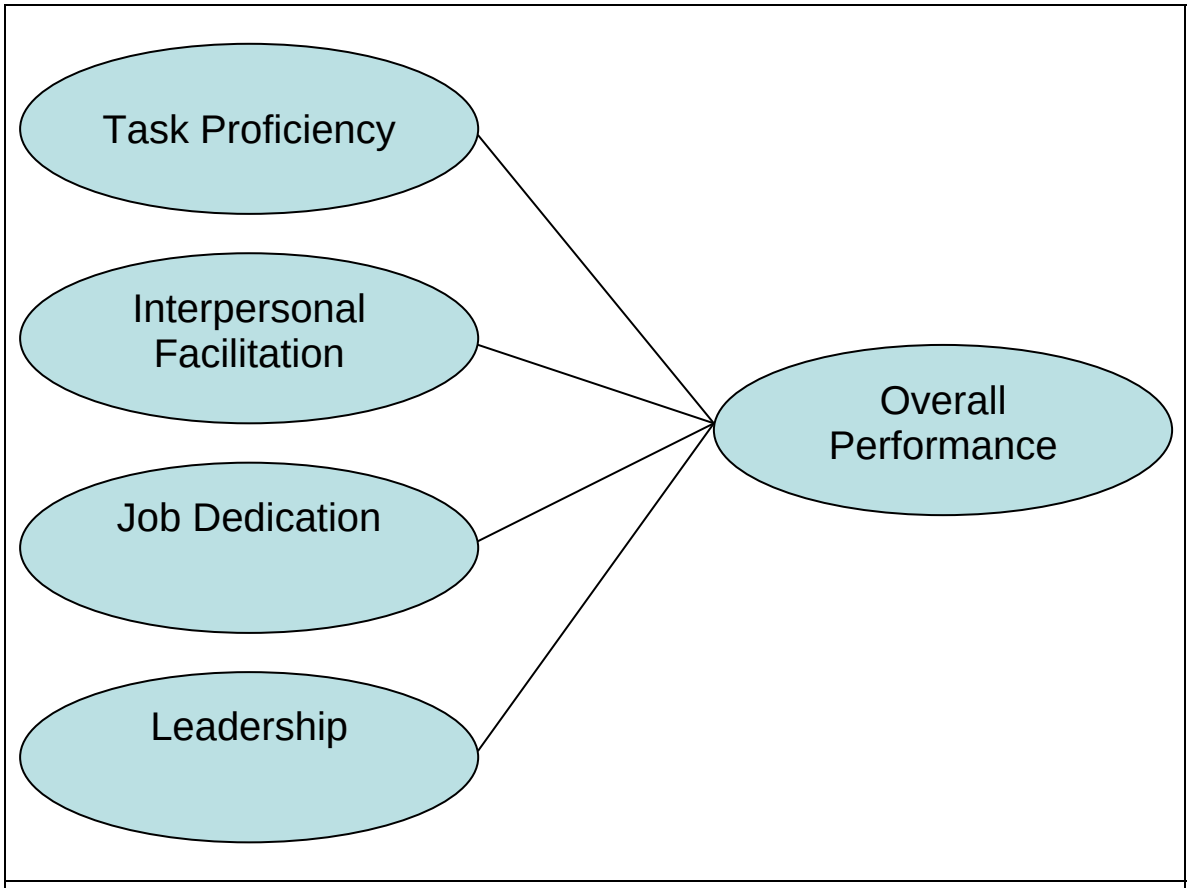
Individual performance also requires that people's job attitudes are "in the right place". More specifically, Van Scotter (1994) identifies job dedication as another important set of behaviors that contribute directly to performance in an organization. Borman and Motowidlo (1993) add that job dedication "…transcends job involvement and motivation to perform the specific tasks that comprise the job and connotes a sense of loyalty to the organization as a whole and a desire to fulfill more general role requirements that come with organizational membership" (p. 78). To summarize, individuals who exhibit job dedication behaviors (Table 3 contains a list of these behaviors) contribute to the performance of an organization while those who lack such behaviors do not (Van Scotter).

• Paying attention to important details [1,2] • Taking initiative to solve a work problem [1,2] • Overcoming obstacles to complete a task [2,3] • Performing a difficult work assignment enthusiastically [1,2,3] • Seeking excellence [2] • Making sure work is done properly [2] • Performing reliably and consistently [2] • Doing your job even when you are not supervised [1,2] • Seeking additional duties [1,2] • Working overtime to finish on time [2] • Defending the supervisor's decisions [2] • Working hard [2]
Sources: [1]Borman & Motowidlo (1993), [2]Van Scotter (1994), and [3]Borman & Brush (1993).

Table 3: Job Dedication Behaviors

Four Factor Performance Model

Hurry (1995) took Van Scotter's model one step further by introducing a new set of individual performance behaviors into the performance model: leadership. Similar to Van Scotter's approach, Hurry's Four Factor Performance Model (see Figure 2) also used the behavioral method to determine individual performance. Hurry's research indicated that leadership behaviors contributed as much (if not more) to overall performance as task proficiency, interpersonal facilitation, and job dedication behaviors.



Source: Hurry (1995)

Figure 2: Four Factor Performance Model

Leadership

"Leadership is the art and science of influencing and directing people to accomplish the assigned mission" (Department of the Air Force, 2006, p. 1). Organizations have much to gain when its members display good leadership behaviors (see Table 4 for a more complete list of such behaviors). Conger and Kanungo (1989) noted that leaders have been found to increase organizational and unit performance. In addition, it is important to consider that leadership necessarily occurs in the context of others, including team environments (Bass & Stogdill, 1990; Department of the Air Force, 2006; Northouse, 2007; Robbins & Judge, 2007). Therefore, it is reasonable to

consider additional factors that extend our consideration of performance beyond the individual behavioral factors at play to that of the team.

• Behaving consistently [3,4] • Assigning subordinates duties consistent with their abilities [4] • Using good judgment [1] • Recognizing and encouraging high performance [3,4] • Encouraging cooperation among others [1,4] • Reconciling conflicting organization demands [3,4] • Maintaining high visibility on or off job [3] • Supporting subordinates [1,2,3,4] • Speaking effectively [3] • Avoiding trespassing on others' duties [3] • Making tough decisions quickly and confidently [1] • Providing feedback to subordinates [1,2,3,4] • Taking a stance on controversial issues [2] • Resolving conflicts between members [3,4] • Coordinating subordinates' efforts [1,3,4] • Monitoring status of work [1]
Sources: [1]Borman & Motowidlo (1993), [2]Department of the Air Force (2006), [3]Conger & Kanungo (1989), [4]Borman & Brush (1993)

Table 4: Leadership Behaviors

Team Effectiveness Behaviors

Any member of the team can display task proficiency, interpersonal facilitation, job dedication, and even leadership behaviors (Bass & Stogdill, 1990). However, some behaviors may only be meaningful in the context of a team. Team effectiveness behaviors are a set of team-specific behaviors that assist teams in improving their performance (see Table 5 for a list of representative behaviors). In the Air Force, high team performance is important because it is often the key to mission accomplishment. For example, a pilot often cannot perform his or her mission without the assistance of a mission planner, an air traffic controller, an aircraft maintainer, or an aircraft refueler. Introducing team effectiveness behaviors into the performance models discussed in the sections above may

give us a clearer perspective and more complete picture of the many behavioral factors that can lead to high team performance.

• Having a clear and elevating goal [1,2] • Establishing a results-driven structure [1,2] • Displaying unified commitment [1,2] • Encouraging a collaborative environment [1,2] • Building standards of excellence [1,2]
Source: [1]Northouse (2007), [2]Wilson (1999)

Table 5: Team Effectiveness Behaviors

Communication Media Effects

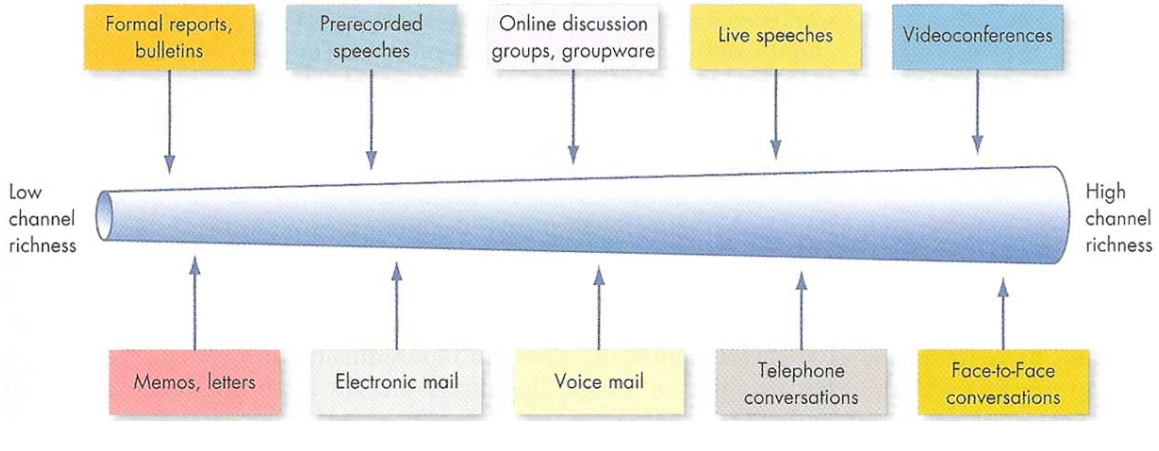
Teams cannot and do not work and perform in a vacuum. There are many external factors that may also affect a team's ability to complete its tasks. One such factor that can impact team performance is how team members communicate. The process of communicating a message from one person to another can be broken down into several parts. According to Robbins & Judge (2007), the key parts to communication are: the sender, encoding, the message, the channel, decoding, the receiver, noise, and feedback. Of these eight parts, the sender, the receiver, and the channel are of particular importance to this study because it is people that illustrate behaviors through particular channels. The sender is the person who initiates communication; the receiver is the person who receives it (Robbins & Judge). In between the sender and receiver lies the communication channel; this is the medium through which communication travels (Robbins & Judge).

There are many media through which people may communicate with one another. Within the Air Force, media such as memos, emails, phone calls, bulletin boards, and video teleconferencing are quite common. But how do we know which media might best communicate our message? One answer to this question may lie in the understanding of

the capacity of a particular medium to convey that message and the information it contains.

Media Richness Theory

Media richness theory suggests that communications media differ in their capacity to convey information (Daft & Lengel, 1986; Kellerman, 1992; Lengel & Daft, 1988; Robbins & Judge, 2007, Timmerman, 2002). To illustrate a medium's capacity, media richness theory arranges communication media on a continuum (see Figure 3) from low to high richness (Daft & Lengel, 1986; Lengel & Daft, 1988). The more information that a particular communication medium can convey, the "richer" it is. According to Lengel and Daft (1988), there are three characteristics used to determine where communication media fall on the richness continuum: (1) the ability to handle multiple cues simultaneously, (2) the ability to facilitate rapid feedback, and (3) the ability to establish a personal focus. Selecting the best media to use to communicate a message is a function of the fit between the capacity of the medium and the nature of the information itself.



Source: Lengel & Daft (1988), Robbins and Judge (2007)

Figure 3: Media Richness Channels

Face-to-face communication is the richest medium. It has the capacity to handle multiple information cues such as body language, tone of voice, and natural language to convey information (Daft & Lengel, 1986). In addition, face-to-face communication has the capacity for immediate feedback (so that information can be checked or validated) and the ability to establish a personal focus (Daft & Lengel, 1986).

Near the middle of the richness continuum we find various communication technologies such as voice mail, email and the telephone. Such communication technologies allow for team members to communicate even when they are miles apart. For example, mission commanders in a fixed-base environment can lead the efforts of troops performing a mission "outside the wire" using a combination of voice and text-based messaging technologies. In addition, commanders may use "old fashioned" methods such as reports or memos to communicate information.

Despite its intuitive appeal and a lengthy history of empirical study, not all research has supported the basic premises of media richness theory. For example, El Shannawy & Markus (1998) found that that voice mail was not necessarily preferred over email for complex messages. Yet, despite some such equivocal evidence regarding how well the theory actually accounts for media selection decisions, media richness theory remains a long-standing foundational perspective from which to study communication and technology effects (Timmerman, 2002).

Indeed, much research and study has shown that certain communication technologies tend to impact the way people feel or perform in a team. For example, the use of communication technology such as teleconferencing may reduce social pressures common to face-to-face communication (Sproull & Keisler, 1986); as such, a shy person

may have an easier time participating in team activities when they do not have to work face-to face with their team members. Similarly, research has also demonstrated that technology may influence the way people participate in teams. For example, team members using groupware have been observed to participate more equally than they would face-to-face (Scott, 1999). Muchi-Faina, Maass, and Volpato (1991) also noted that communication technologies tend to equalize the contributions of team members and may spur an increase in diverging and original ideas. Because communication technologies have been demonstrated to impact individual team members both perceptually and behaviorally, it is also likely that communication technology could impact team performance.

Constructing the Research Framework

According to Poole (1998), small groups are the optimal unit of analysis to allow for a comprehensive study of communication exchanges. Because teams have been defined as a special subset of groups and an overriding interest in teams has already been established, this study will therefore focus on small team environments. With respect to conceptualizing team performance, three approaches were discussed: traits, behaviors, and the end product (Campbell et al., 1970). Traits cannot be easily changed, and teaching Airmen to exhibit or develop new traits would be a difficult and time-consuming process. As noted in the research reported above, the behavioral approach is intuitively appealing because behavior is modifiable and therefore trainable (Kirkpatrick & Locke, 1991; Northouse, 2007). In addition, behavior is observable and can therefore be recorded for research purposes (Campbell et al.). Furthermore, behavior is related to

organizational outcomes and can therefore be used to hold people accountable for their actions (Campbell at al.). It is for these reasons that a behavioral approach was thus selected as the perspective for studying elements of team performance, and will also be used as a foundation to conceptualize individual performance.

In addition, the end product approach will be used because the Air Force, like any large organization, is ultimately interested in results. Although we may define the end product in terms of concepts such as team cohesiveness, quality of ideas, social pressure, and potential for interpersonal conflict, such constructs are often subjective and difficult for an outsider to objectively observe and measure. Nor will this study pursue a money cost approach, primarily because it is exceedingly difficult to tie the behaviors and performance factors of interest to specific dollar cost estimates (the basis of such cost estimates occur at such high levels of abstraction in an organization like the Air Force that they are ultimately impractical to use relative to the behavioral emphasis of this study). Instead, this study will conceptualize the end product in terms of satisfaction (as reported by the participants themselves) and objective measures that do not depend upon the subjective assessments of an outside party; the specifics of how the end product will be measured are discussed in depth in the next chapter.

Finally, it has been suggested that communication technology may impact behaviors. Therefore, the present study will incorporate various forms of communication technologies to examine the potential moderating effects those technologies may have on the relationships between behaviors and the end product. The following diagram represents the integrated research model built upon the literature and theories cited to this point.

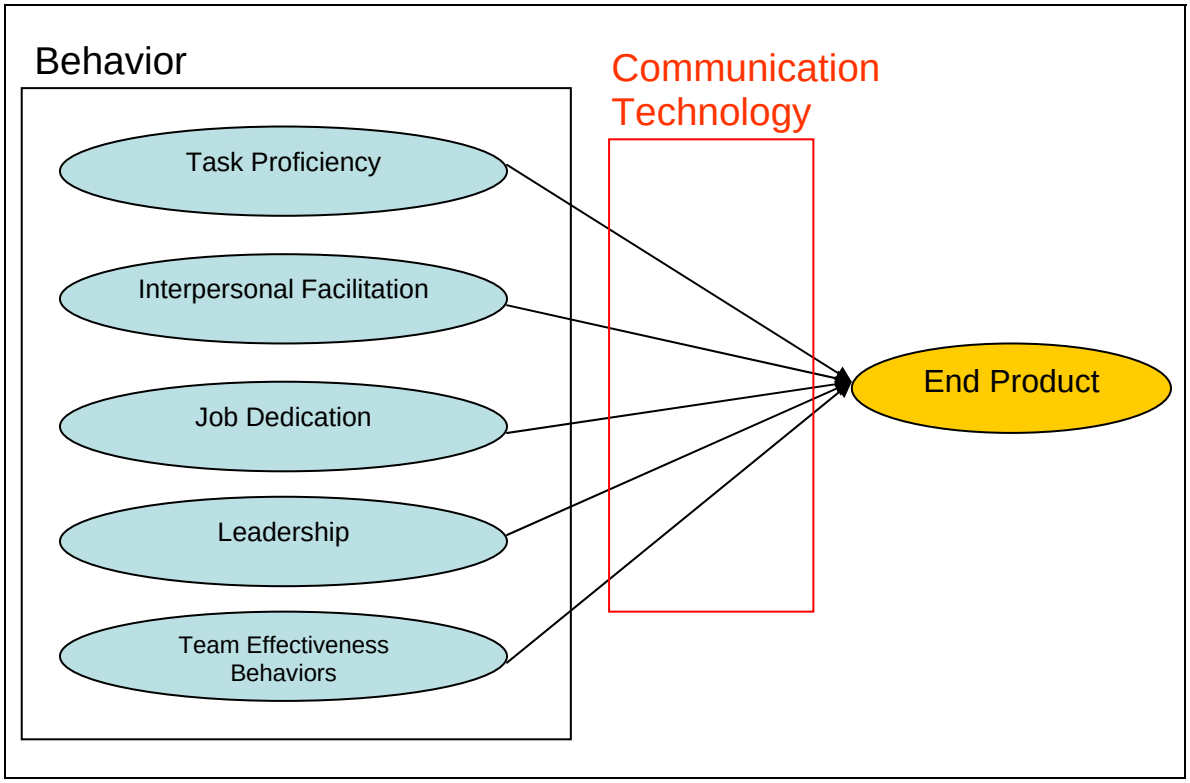


Figure 4: Team Performance Research Model

The Team Performance Research Model is designed to illustrate the many factors that have been demonstrated to contribute to high performing teams. The first four sets of behaviors focus on the team's individuals; the last set of behaviors, team effectiveness behaviors, focuses on those behaviors that are meaningful and relevant only in context of the team's effort as a whole. Based upon this model, the following specific research questions will be investigated:

- Question 1: What are the effects of leadership behaviors on team performance and how is this relationship impacted by communication technologies?

- Question 2: What are the effects of task proficiency behaviors on team performance and how is this relationship impacted by communication technologies?
- Question 3: What are the effects of interpersonal facilitation behaviors on team performance and how is this relationship impacted by communication technologies?
- Question 4: What are the effects of job dedication behaviors on team performance and how is this relationship impacted by communication technologies?
- Question 5: What are the effects of team effectiveness behaviors on team performance and how is this relationship impacted by communication technologies?

The answers to these questions may provide information or strategies used to help the Air Force create better teams or manage them more effectively. The obtained results could also help pave the way for future training programs and initiatives that focus on the various behaviors necessary to foster high-performing teams. Using the Team Performance Research Model as a foundation, the following chapter will detail the specific methodology and procedures used in the current investigation before moving to a discussion of the obtained results and their implications.

CHAPTER 3

METHODOLOGY

Baseline Study

This study is based on a secondary data set from a similar investigation performed by Barelka (2007) which examined the interactions between team structure, leadership style, and task complexity on team performance. The following sections will detail the particulars of Barelka's study to provide a full understanding of the nature of the original data set, and the methods by which that data was collected, before moving to a discussion of the methods and analysis that were ultimately used in the current investigation.

Participants

Participants consisted of 344 undergraduate students enrolled in an upper-level management course at a large Midwestern university. The sample was 56.6% male and the mean age was 21.74 years. Participants signed up for a research session at their discretion and were randomly assigned to 4-member teams. Each participant was given course credit for their participation.

Task Description

Participants played a networked computer simulation based on a military command and control context. This simulation was a modified version of the Distributed Dynamic Decision-making (DDD) simulation developed for the Department of Defense for research and training purposes (Miller, Young, Kleinman, & Serfaty, 1998). The simulation in this experiment was developed for use by 4-member teams with little or no military experience.

The simulation playing area was comprised of a 20x20 grid that was further broken down into four quadrants each with 10x10 regions. Each region had a base located in the middle. The purpose of the simulation was for players to monitor the ground and air space around the bases and keep enemy targets out of the region which had been assigned to them. To perform this function, each player was assigned assets (such as AWACS planes, tanks, helicopters, and jets) allocated to their base that could be directed towards and prosecute targets.

The simulation was programmed to present the players a fixed radar representation only of the region a specific player had been assigned; any target outside the radar range of an individual's base was usually invisible to them. However, each assigned asset had the ability to detect and identify targets outside of the displayed region. As a result, team members could determine the nature of a target outside their base's radar display by working together and asking their teammates to share information, or by launching a vehicle on their own and moving it near the target.

Typically, the assets for each team were comprised of AWACS planes, tanks, helicopters and jets. Each of these vehicles varied in its capacities on four different dimensions: (a) range of vision, (b) speed of movement, (c) duration of operability, and (d) weapons capacity. For this study, AWACS (an aircraft system designed to carry out surveillance, command and control, and battle management functions) were assigned to the team leader to ensure that they were given an informational advantage over the other team members; specifically, the AWACS allowed the leaders to see all the targets on the entire 20x20 grid.

There were eight types of "standard targets," each with specific characteristics: air

or ground, friendly or unfriendly, and the three levels of firepower necessary to disable unfriendly targets. There were also four types of unidentified ground targets– these were targets that could not be identified even after they had been picked up by radar. Familiarization with all of these characteristics was provided for by a training session prior to the start of the simulation. During the course of the simulation, players had to determine how to find, identify, and coordinate their attack on each of these targets to perform well as a team.

During the simulations, participants were presented with a number of different episodes or scenarios to complete. Each episode may be considered a different task which relates to a larger problem. These episodes typically consisted of a number of enemy targets that simultaneously attacked the team's various bases. In order to score well on the simulation, the team members needed to focus diligently on their assigned regions and leaders needed to manage the entire battlespace effectively.

Experimental Design

Barelka's (2007) study consisted of a 3 (team structure) x 2 (leadership style) x 2 (task complexity) mixed factorial design. The three different types of structure (collocated, virtual, and reachback) were crossed with the two different types of leadership styles (transformational and transactional) which were crossed with a high and low complexity environment.

Team structure was manipulated by having all the participants in the same room if they were in a collocated team, or in different rooms if they were in a virtual or reachback team. For the collocated condition, all team members were assigned to the same room and arranged such that they could see and hear each other. For the virtual team,

participants where assigned to stations in separate rooms after their initial training. In the reachback teams, only the leader was assigned to a station in a different room, the reaming three members stayed together in a separate room.

Leadership style was manipulated by training assigned leaders to behave in either transactional or transformational manners. According to Northhouse (2007), transactional leaders are only interested in the exchanges between themselves and their followers. In contrast, transformational leaders are interested in engaging with their followers to create a connection that raises the level of motivation for the entire group.

Finally, task complexity was characterized as either high or low by a combination of structure, team learning, and level of uncertainty. The structure was manipulated by changing the number of vehicle types to which each team member had access. For example, in a divisional structure, each team member had access to all three vehicle types. The level of team learning was modified by changing the number of unknown targets; as more unknown targets are "discovered", more team learning was thought to occur. In addition, the level of uncertainty was manipulated by changing the location where the targets appeared on the screen (as opposed to having them come from the same place every time). As such, a low task complexity environment was characterized by a functional structure, low team learning, and a low level of uncertainty. Similarly, a high-complexity environment was characterized by a divisional structure, high team learning, and a high level of uncertainty.

Procedures

Two separate simulations were run during each experimental session. Prior to running the simulation, participants were asked to wait in a waiting room until all other

participants arrived. Random assignment to teams was then made and the team members were directed into one of two rooms for training.

Once the participants were seated, they were asked to complete a consent form and a pre-training survey. The entire team was then given a 20 minute electronic slide show presentation which included a pre-recorded audio track on how to operate the simulation. Once the training was completed, one team member from each of the two teams was randomly selected and designated as the leader for their particular team.

Leaders were then provided training in a separate room from their team members in the hopes that by physically removing the leader from the group, their roles as leaders would be more salient to the rest of the team members during the simulation. The leadership training focused on teaching individuals how to behave in either a transformational or transactional manner; specifically, how to exhibit behaviors associated with a transformational or transactional leadership style. During the leader training, the remaining team members where given additional hands-on training using the simulation as administered by qualified research staff members. Leaders were not provided this hands-on training because they were not given any vehicles to control in the simulation (AWACS simply functioned on autopilot).

Following the leader and team member training sessions, all participants were assigned to their proper stations and prepared to play the simulation. Each team worked through two 30-minute simulations, a low-complexity and a high-complexity simulation, presented in random order. Audio recordings of each team working through their simulations were made. Between simulations, players were allowed to speak to each other but were given only a few minutes break before continuing to the second

simulation. After the first simulation was completed, the participants were also electronically administered a number of perceptual instruments (in the same room) to be detailed in the following section. The instruments were administered again at the conclusion of the second simulation. Once both simulations and instruments had been administered, the participants were debriefed and thanked for their time.

Measures

Barelka (2007) used several measures to examine the impact of the various combinations of team structural configurations, leadership style, and task complexity on team performance. These measures consisted of:

- Communication Quantity: a measure conceptualized as the amount of communication within a team. It was measured by summing the temporal length of all comments made by all members of the team during a 30-minute simulation.
- Communication Quality: a measure of the quality of the interaction between persons in a team based setting. This construct was measured using a 12-item communication competence instrument developed by Monge, Backman, Dillard, & Eisenberg (1994).
- Leader Centrality: a measure that reflects the extent to which interactions are concentrated in certain individuals rather than distributed equally among all members. This construct was measured by using an instrument developed by Sparrowe, Liden, Wayne, and Kraimer (2001).
- Objective Performance: a composite measure of objective performance comprised of both a speed and accuracy measure. Speed was measured by

recording the final team defensive score while accuracy was measured by recording the final team offensive score; both of these scoring methods were high in construct validity (Barelka, 2007). The final composite score was created by standardizing the data within measure (game not complexity) and taking the mean of team offense and defense score.

- Leader Satisfaction: a series of post-simulation survey measurements indicating the level of satisfaction of the team with the leader. The measure consisted of a 14-item satisfaction scale originally developed by Scarpello and Vanderberg (1987).
- Team Satisfaction: measured the level of satisfaction of the team members with the team itself. This measure was assessed using Wageman, Hackman, and Lehman's (2005) four-item quality of team interaction and three-item satisfaction with team relationships measures.

Current Investigation

The following sections detail the nature of the current investigation. Specifically, an overview of the methods used to examine the various data sources produced during Barelka's (2007) original study will be presented. In addition, rationale will be provided for certain methodological decisions and concessions made regarding the use and, more importantly, the exclusion of certain elements of the data set and measures.

Data Collection Strategy

Because the overriding goal of this study is to inform and improve the nature of team performance and communication in Air Force contexts, various elements of

Barelka's (2007) study were selected. For example, Barelka placed teams in collocated, partially collocated, and virtual team environments. Given that this study was looking for the greatest variance in its findings, this study focused on the teams assigned to the collocated and virtual conditions. Although this approach may seem simplistic, it gives one the capability to clearly observe any differences (McClelland, 1997).

Barelka (2007) also trained team leaders to behave as either transactional or transformational leaders. According to Northouse (2007), transformational leadership is a key leadership paradigm because it meets the needs of today's teams and those who want to be inspired and empowered to succeed in these uncertain times. Because transformational leadership is the more dominant leadership style in literature today, only teams with transformational leaders were selected for study.

Each team worked through two 30-minute simulations, one designed to be low in task complexity and one designed to be high in task complexity. Air Force teams routinely work in complex environments executing complex operational tasks. As such, this study focused on team performance in high complexity settings.

In sum, the final data set used for this study consisted of the audio recordings of 28 4-member transformational teams. Of the 28 total teams, 14 worked in collocated environments while the remaining 14 worked in virtual environments. Finally, only the audio recordings of each team working though high complexity situations were retained for analysis.

Nine minutes of each audio recording were then transcribed verbatim. The first 3 minutes of conversation prior to the start of the simulations were selected because studies have indicated that performance-relevant perceptions of other people are established

within the first 4 or 5 minutes (Robbins & Judge, 2007). Jarvenpaa and Leidner (1999) also found that high-performing virtual teams establish trust quickly, thus allowing them to begin working together right away. Therefore, these initial 3 minutes seemed theoretically relevant to the kinds of behaviors to be investigated in this study. In addition, 3 minutes from the second episode and 3 minutes from the sixth episode of the simulation were transcribed as well. These episodes were selected because they were complex and captured team behavior near both the beginning and the end of the simulation.

Two independent coders then searched the transcripts for behaviors indicative of task proficiency (tk), interpersonal facilitation (int), job dedication (jd), leadership (ld), or team effectiveness (tm) (see Appendix A for description of behaviors). When behaviors were observed in a particular sentence of the transcript, coders marked the dominant behavior. For example, if a particular sentence contained a leadership behavior, coders marked the beginning of the sentence with "ld".

Coders initially worked together on three sample transcripts to minimize the disparity between their coding. Once the coders came to a common understanding on how data would be interpreted and coded, they began and completed independent coding of the actual transcripts in one sitting. At the conclusion of each coded transcript review, the coders discussed and compared their responses to gain further insight into the other's thoughts regarding their respective coding decisions. Post-hoc agreement between both coders about the expression of particular behavior types was noted (further details available in the next chapter); however, only independent coding agreement was used for the reliability estimate.

Performance Measures

In an effort to relate the participant behaviors (task proficiency, interpersonal facilitation, leadership, job dedication, team effectiveness) to team performance outcomes, three of Barelka's (2007) measures were used: Objective Performance, Leader Satisfaction, and Team Satisfaction. Objective Performance measured the speed and the accuracy of teams as they worked through the simulation. Speed was measured by recording the final team defensive score. This was a very visible indicator of performance to all members of the team throughout the game and was considered to have high construct validity because how quickly individuals and teams were able to destroy incoming targets was directly related to their performance within the context of the simulation (Barelka, 2007). Speed is a good way of measuring end product because task completion in itself is not the only aspect of team performance worth consideration (Campbell, Dunnette, and Lawler, 1970); the time it takes for a team to complete a task should be considered as well because of its relevance to the operational context in which Air Force teams operate—specifically, the Air Force performs many time sensitive missions.

Similarly, tasks must be completed accurately as many missions the Air Force performs leave little margin for error. For this study, accuracy of performance was measured by recording the final team offensive score. This was also a very visible score to all members of the team throughout the game and was considered to have a good degree of construct validity because how precisely the team attacked only enemy targets was directly reflected in their offensive performance score. Similar to Barelka's (2007)

study, a final composite performance score was then created by taking the mean of a team's standardized offensive and defensive score.

Barelka's (2007) study also employed two self-reported measures of satisfaction: team satisfaction and leader satisfaction. Both were appropriate for use in this study because satisfaction can have an impact on team performance (Kozlowski and Bell, 2003). According to Kozlowski and Bell, satisfaction is important because it directly contributes to a team's ability to remain viable and keep making high quality decisions over an extended period of time. In other words, if the team is not satisfied with the experience, there is little chance that team members will continue to perform. The following diagram represents an overlay of the research model from this study with the various manipulations and measures selected from Barelka's experimental sessions. Results of the data collection and analysis will be presented in the next chapter.

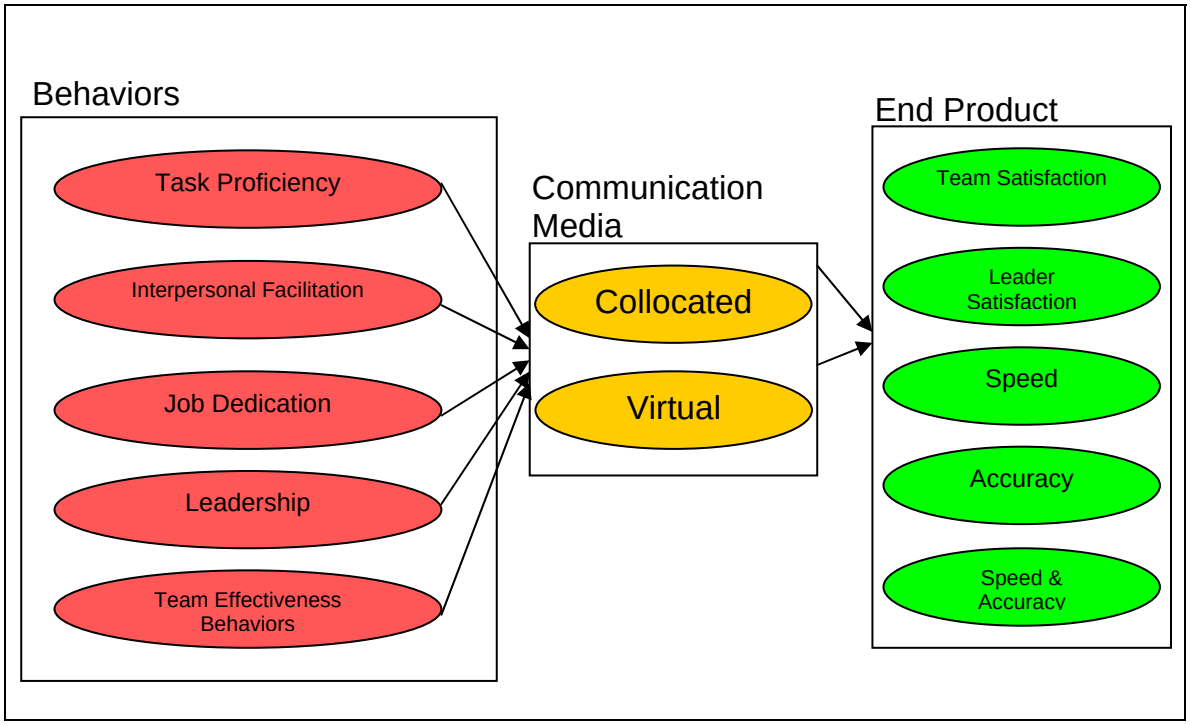


Figure 5: Team Performance Research Model (ovelayed)

CHAPTER 4

RESULTS

Coding and Reliability

This portion of the analysis is modeled closely after Turner's (2006) design for coding and reliability estimates of categorical data. Coders were given three practice transcripts to become accustomed to each other's coding styles. Once they were comfortable, they coded all of the final transcripts separately. The order in which transcripts were coded was randomly selected. After coding each individual transcript, the coders compared their responses to gain further insight into the other's reasoning behind their respective coding decisions. Post-hoc agreement between both coders about the expression of particular behaviors was noted; however, only independent coding agreement was used for the reliability estimate. Using the Cohen's Kappa estimate of reliability for two-person ratings of categorical data, inter-rater reliability was computed as K = 0.552 (Table 6), indicating moderate reliability (0.60 to 0.80 is considered substantial, 0.81 and higher is outstanding; Landis & Koch, 1977).

			Coder 1 Behavior Set #							
			Tk	Int	Jd	Ld	Tm	bk	Σ Row	(Σ Row * Σ Column)/n
Coder 2 Behavior Set #		Tk	997	150	2	172	3	4	1328	737.778
		Int	40	221	0	12	13	1	287	53.148
		Jd	0	0	0	0	0	0	0	0.000
		Ld	98	2	0	96	0	2	198	27.619
		Tm	17	9	0	8	213	3	250	28.499
		bk	3	3	0	2	8		16	0.077
	Σ Column		1155	385	2	290	237	10	1527 (Σ Diagonal)	

a=	1527	(total agreement, Σ diagonal cells)
n=	2079	(total observations)
e = Σ cells on diagonal for each ((Σ Row * Σ Column) / n) =	847.121	(expected agreement on diagonal)
Kappa = (a - e) / (n - e) =	**0.552**	(ratio of surplus of agreements over expected agreements)

Table 6: Cohen's Kappa Estimation of Inter-Rater Reliability for Categorical Data

The column and row headings (Tk, Int, Jd, Ld, and Tm) in Table 1 correspond to one of each of the five behaviors: task proficiency, interpersonal facilitation, job dedication, leadership, and team effectiveness behaviors. The sixth heading is a dummy variable for those instances where one coder identified the occurrence of a particular behavior while the other identified none existed. Numbers along the diagonal (shaded in gray) indicate cases where both coders agreed on the type of behavior expressed in a particular line of the transcript. Differences of opinion are noted off-axis, such as one coder identifying a passage as behavior type Tk and the other type Int.

Despite the apparent differences of opinion, nearly all of these discrepancies were reconciled during the post-coding discussions; of the 2,079 observations only 56 codes remained in question between coders once all coding was complete. Therefore, given the moderate degree of reliability (as estimated by Cohen's Kappa) and high degree of inter-rater agreement (evidenced during the post-coding reconciliation), final coding decisions

were based on the agreed-upon ratings from both sets of coder reviews—one independent, the other post-hoc—thereby reducing overall error variance for the five measures. This coding convention resulted in a combined inter-rater agreement of 0.97 with 1,527 individual instances of the five behaviors recorded over 127 pages text.

Findings

Intercorrelation Profiles

Intercorrelations of behaviors and performance measures obtained from the 28 teams studied are shown in Table 7 below. The table does not show job dedication behaviors because such behaviors were not observed during the course of the simulations. Further, the table shows that all observed behaviors, with exception to task proficiency behaviors, were independent from each other. As such, it is not likely problems associated with multicollinearity would affect the results.

	Mean	SD	1	2	3	4	5	6	7	8	9	10
1. Collocated (Dummy 1) [a]	.5	.51	1									
2. Task Proficiency Behaviors	.00	1.00	-.03	1								
3. Interpersonal Facilitation Behaviors	.00	1.00	-.48**	-.42*	1							
4. Leadership Behaviors	.00	1.00	.43*	-.62**	.06	1						
5. Team Effectiveness Behaviors	.00	1.00	.04	-.35	-.26	-.08	1					
6. Offensive Score	-.02	.94	.37	-.22	-.11	.27	.02	1				
7. Defensive Score	.24	1.13	.55**	.22	-.32	.12	-.25	.58**	1			
8. Objective Score	.11	.92	.52**	.03	-.25	.21	-.15	.87**	.91**	1		
9. Leader Satisfaction	4.02	.38	.01	.13	-.14	-.19	.03	.40*	.15	.29	1	
10. Team Satisfaction	3.98	.49	.11	.02	-.05	.06	-.09	.46*	.23	.38	.60**	1

N= 27 to 28

*p<.05; **p<.01

[a] Dummy coded: collocated vs. virtual (1= collocated)

Table 7: Intercorrelations Among Behaviors and Performance Measures

Direct Effects

The first objective of this study was to identify any direct effects between behavior and performance. Though several linear regression analysis tests were performed, no direct effects were discovered (see Appendix B for detailed findings).

Task Proficiency Behaviors

The second objective of this study was to identify any moderation effects of communication media on the relationship between behaviors and performance. Results indicated that communication media moderated a team's offensive score ($\Delta R^2 = .041$, $p < .05$; ß = .816, $p < .05$). Figure 6 illustrates the nature of the moderation: an increase in task proficiency behaviors in a collocated environment had little to no effect on a team's offensive score; in a virtual environment, an increase in task proficiency behaviors decreased a team's offensive score.

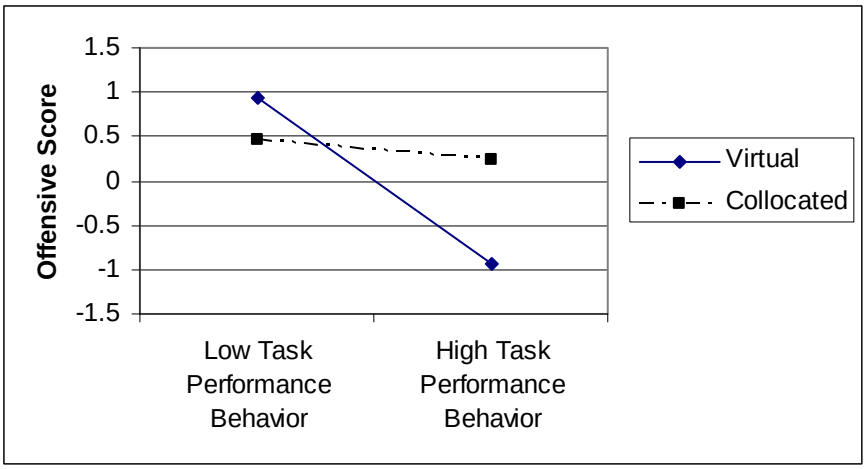


Figure 6: Moderation Effect of Technology on Task Proficiency Behaviors and Offensive Score

Analysis also indicated that communication media can moderate a team's defensive score ($\Delta R^2 = .132$, $p < .05$; ß = .794, $p < .05$). Figure 7 illustrates that an increase in task proficiency behaviors in a collocated environment increased a team's

defensive score. But, in a virtual environment, an increase in task proficiency behaviors in turn decreased a team's defensive score.

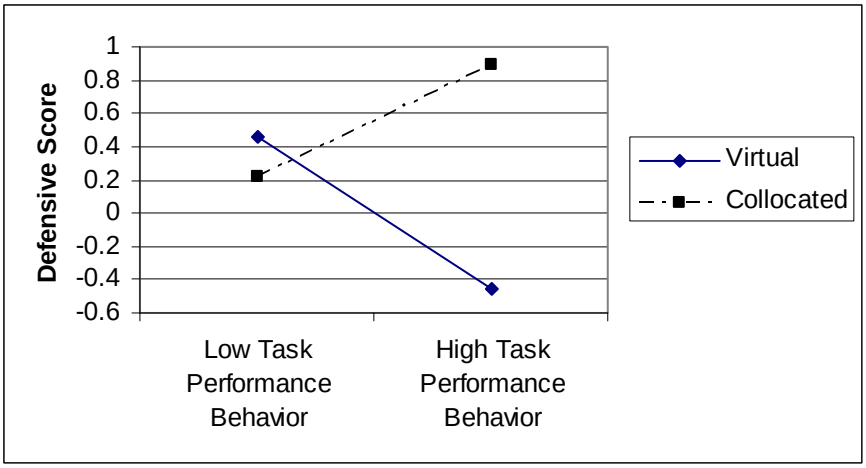


Figure 7: Moderation Effect of Technology on Task Proficiency Behaviors and Defensive Score

Communication media also moderated a team's overall score ($\Delta R^2 = .171$, $p < .05$; ß = .902, $p < .05$). Figure 8 illustrates that an increase in task proficiency behaviors in a collocated environment had little to no effect a team's overall score. In a virtual environment, however, an increase in task proficiency behaviors decreased a team's overall score.

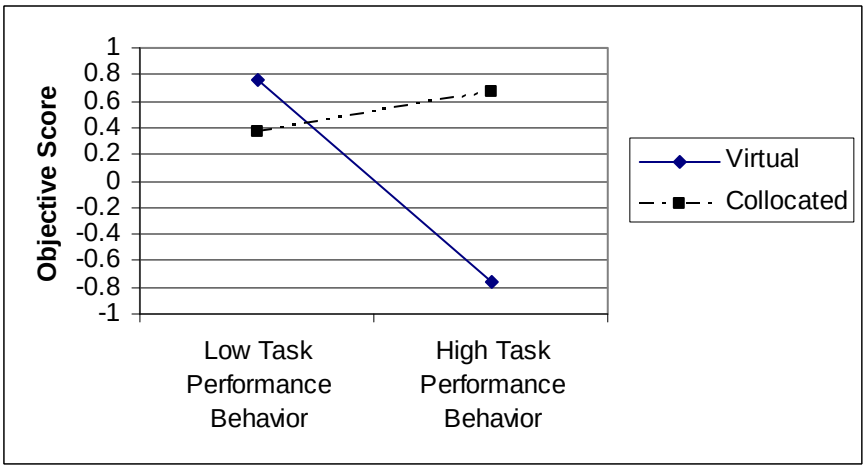


Figure 8: Moderation Effect of Technology on Task Proficiency Behaviors and Overall Score

Interpersonal Facilitation Behaviors

Linear regression studies indicated communication media had one moderation effect on interpersonal facilitation behaviors. Analysis indicated that different media can moderate a team's defensive score ($\Delta R^2 = .087$, $p < .10$; ß = -.391, $p < .10$). It is worth noting that although the standard for this study thus far has been to report on findings at an alpha of .05, this moderation was theoretically interesting at the .10 significance level. As illustrated by Figure 9, an increase in interpersonal facilitation behaviors in a collocated environment decreased a team's defensive score. But, in a virtual environment, an increase in interpersonal facilitation behaviors also increased a team's defensive score.

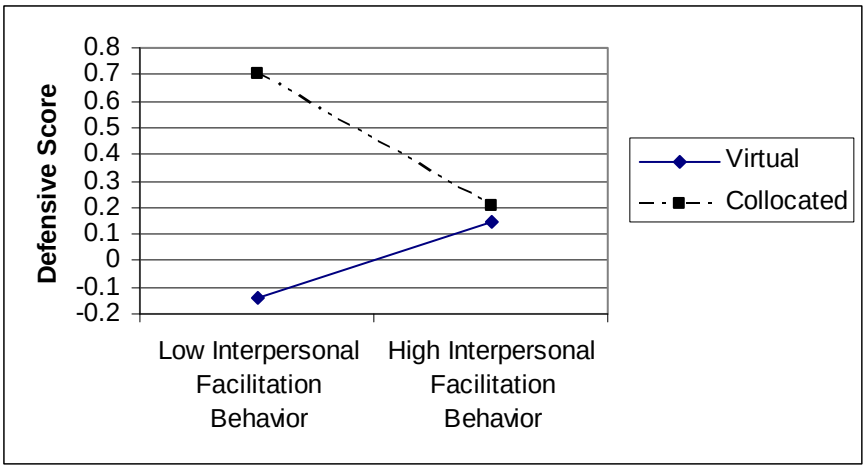


Figure 9: Moderation Effect of Technology on Interpersonal Facilitation Behaviors and Defensive Score

Leadership Behaviors

Further linear regression studies also indicated communication media had two moderation effects on leadership behaviors. Analysis indicated that technology can moderate a team's defensive score ($\Delta R^2 = .136$, $p < .05$; ß = -.790, $p < .05$). Figure 10 demonstrates that an increase in leadership behaviors in a collocated environment slightly

decreased a team's defensive score. But, in a virtual environment, an increase in leadership behaviors heavily increased a team's defensive score.

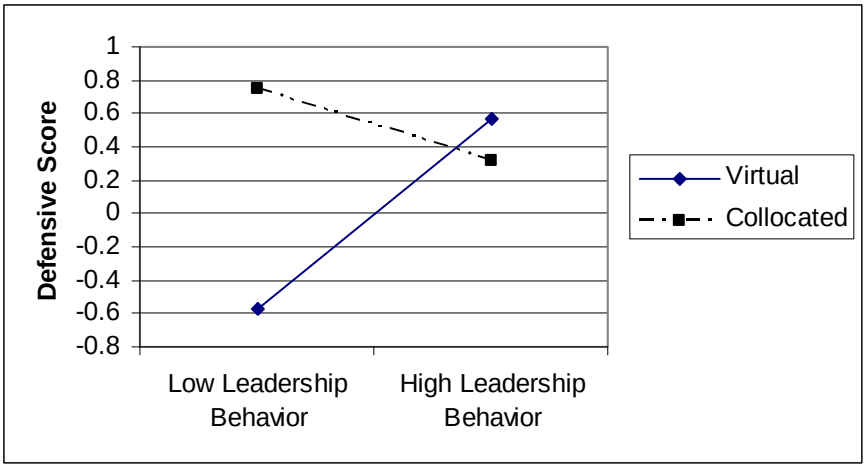


Figure 10: Moderation Effect of Technology on Leadership Behaviors and Defensive Score

In addition, analysis also indicated that communication media can moderate a team's overall score ($\Delta R^2 = .135$, $p < .05$; ß = -.787, $p < .05$). Further analyses of these results (see Figure 11) demonstrated that an increase in leadership behaviors in a collocated environment had little to no effect on a team's overall score. But, in a virtual environment, an increase in leadership behaviors heavily increased a team's overall score.

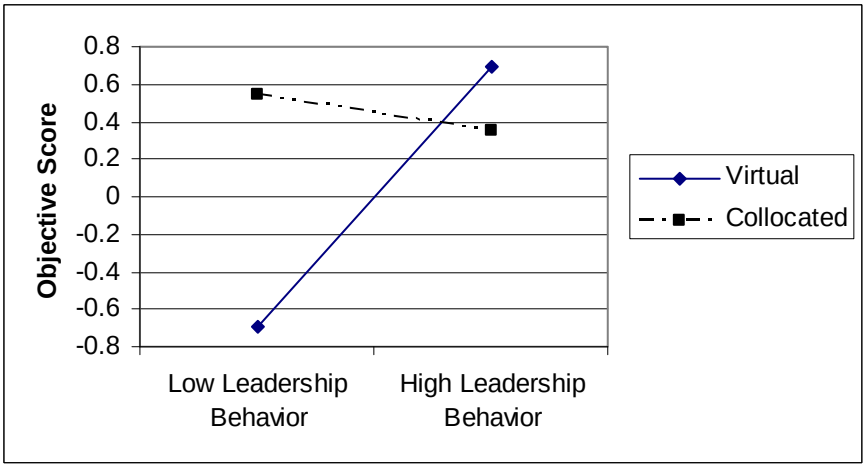


Figure 11: Moderation Effect of Technology on Leadership Behaviors and Overall Score

Team Effectiveness Behaviors

This portion of research was meant to identify any moderation effects introduced by communication media when linking Team effectiveness behaviors to performance measures. Several linear regression tests indicated no moderation is present. A detailed analysis can be found in Appendix B.

Behaviors and Satisfaction

It is worth noting that linear regression tests did not indicate any link between behaviors and satisfaction. Specifically, there was no apparent link between any of the behaviors and Leader Satisfaction. Similarly, there was no link between behaviors and Team Satisfaction.

Updated Team Performance Model

The following diagrams represent an updated overlay of the research model from this study with the various manipulations and measures selected from Barelka's (2007) experimental sessions. Figures 12 and 13 illustrate the six moderation effects of communication media on the relationships between various group behaviors and the performance measures. Specifically, Figure 12 illustrates the type of moderation that occurred in collocated environments; Figure 13 demonstrates the type of moderation observed in the virtual environments.

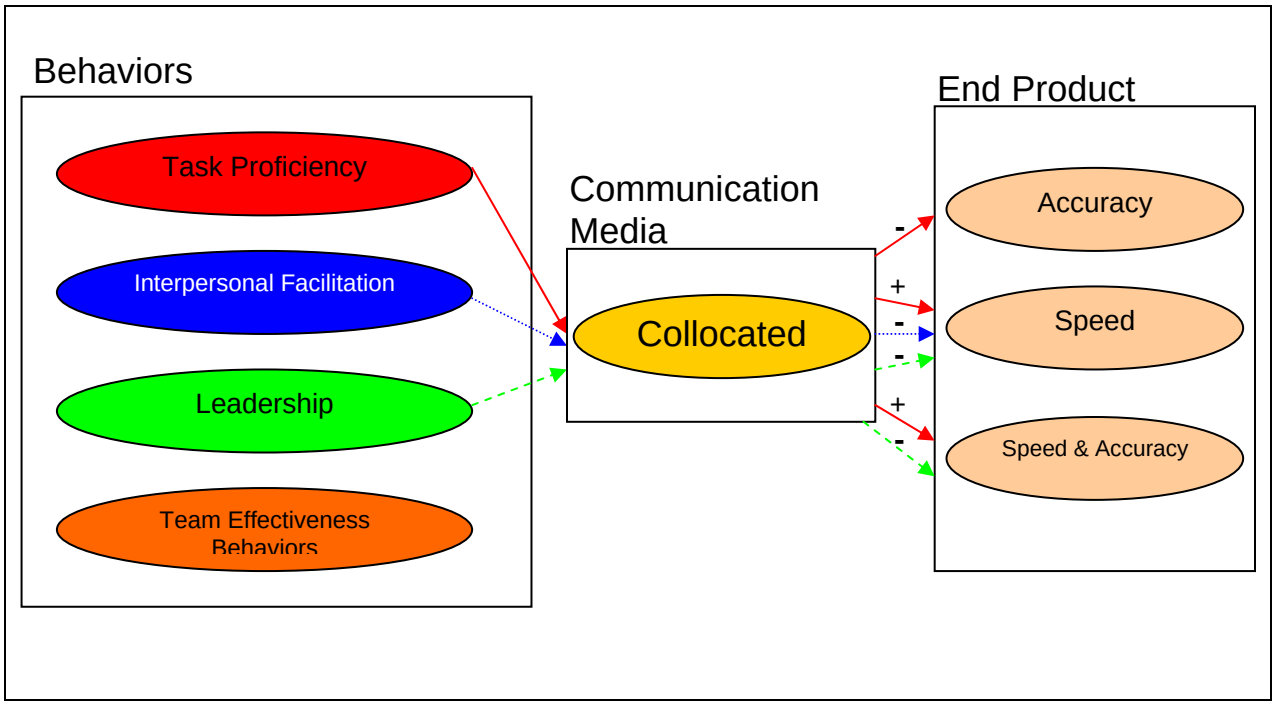


Figure 12: Updated Team Performance Research Model (Collocated View)

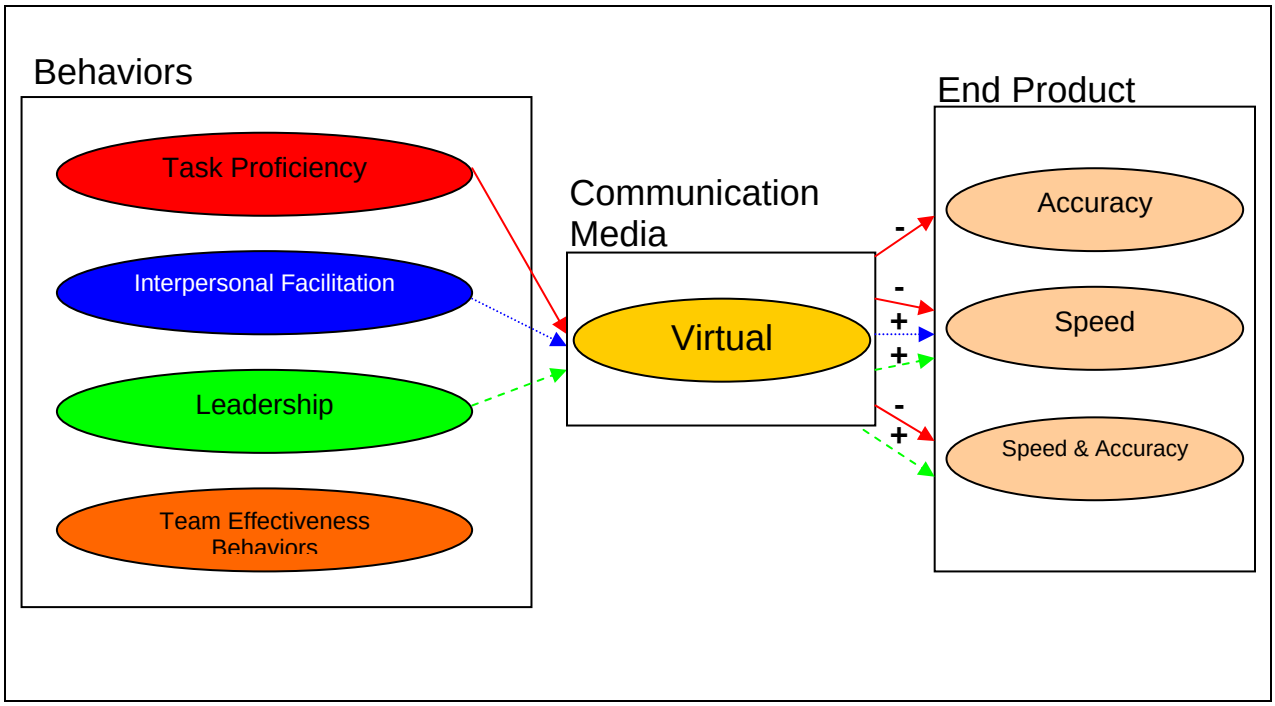


Figure 13: Updated Team Performance Research Model (Virtual View)

CHAPTER 5

DISCUSSION

The results of this study did not suggest any direct effects between the five behaviors and team performance. Although this result appears to refute this study's underlying model, statistical tests hinted at several direct effects that may have been manifest simply for want of a larger sample size (see the Limitations portion of this chapter for additional information on this topic). Still, communication technology was demonstrated to moderate the effect of various behaviors on team performance measures. In light of these findings, the following analysis will examine the five major research questions with respect to moderation effects.

Analysis

Q1: What are the effects of leadership behaviors on team performance and how is this relationship impacted by communication technologies?

Results indicated that communication media may moderate the effects of leadership behaviors on performance. In virtual environments, increased expressions of leadership behaviors were associated with increases in a team's speed and accuracy. These findings were similar to those of Sproull & Keisler (1986). Using email communication technology, they found that decreasing social context cues tended to make it easier for people to communicate by reducing self-absorption tendencies, equalizing team member status, and increasing uninhibited behavior. Thus, in virtual environments, it is possible that leaders may have conveyed information that may have been omitted in a face-to-face environment. Such reduction in social pressures may have

caused team leaders to lead more effectively, thus increasing their team's speed and accuracy.

Alternatively, results indicated that when team members were face-to-face, leadership behaviors had little effect on the team's speed and accuracy. These findings were contrary to those of Conger and Kanungo (1989)— their results indicated that leadership behaviors have a positive impact on team performance. However, even though Conger and Kanungo found such behaviors to be significant, it is apparent that leadership behaviors do not occur in a vacuum. Specifically, Conger and Kanungo discussed leadership from the perspective of the charismatic leader. They defined charismatic leaders as leaders who had an aura of charisma and had an optimistic view. On the other hand, this study was based on a designed experiment which randomly selected team members to lead the team. As such, this study was not designed to ensure that the selected team members were charismatic. In addition, as noted above, Sproull & Keisler (1986) found that because of increased communication cues, face-to-face environments were associated with greater social pressures. Such environments tended to increase self-absorption tendencies, amplify team member status, and decrease uninhibited behavior. Thus, this increase in social pressures may have reduced the leader's effectiveness, and limited the leader's influence on their team's speed and accuracy.

Q2: What are the effects of task proficiency behaviors on team performance and how is this relationship impacted by communication technologies?

In virtual environments, we see once more the moderating effects of communication technology on the relationship between behaviors and performance. Specifically, task proficiency behaviors decreased a team's speed and accuracy. These

results were contrary to those of Van Scotter (1994) who indicated that task proficiency behaviors had a positive impact on team performance. It is worth noting that Van Scotter's study was designed around people working face-to-face— not in a virtual environment. Further, communication media typically used to simulate virtual environments (such as chat, email, teleconference) are limited in their ability handle multiple communication cues, allow for rapid feedback, and be personal (Robbins & Judge, 2007). This limitation in media channel richness may have reduced the effectiveness of task proficiency behaviors on team performance.

Alternatively, in collocated environments, task proficiency behaviors generally increased a team's speed and accuracy. These findings hold face validity because one might expect teams that exhibit proficiency in the performance of their tasks to complete those tasks faster than teams lacking proficiency. These results are also similar to those of Borman & Motowidlo (1993) as well as Van Scotter (1994); they found that task proficiency behaviors positively contributed to organizations.

Q3: What are the effects of interpersonal behaviors on team performance and how is this relationship impacted by communication technologies?

Environment also had an impact on interpersonal facilitation behaviors. In a virtual environment, such behaviors increased a team's speed. This finding is consistent with Van Scotter's (1994) model, suggesting that interpersonal facilitation behaviors improved team performance. Furthermore, because virtual environments tend to have less social pressures associated with it, this environment may have allowed team members to display more encouraging type behaviors.

Alternatively, when teams were face-to-face, interpersonal facilitation behaviors decreased a team's speed. This result was contrary to that of Van Scotter's (1994) study; he reported that interpersonal facilitation behaviors positively impacted team performance. This difference in findings may be the result of design incongruence. Van Scotter's study employed surveys to establish whether behaviors such as interpersonal facilitation behaviors contributed organizational effectiveness. This study, on the other hand, employed an experimental design to objectively measure a team's speed. Therefore, both studies are valid because they measure performance differently.

Q4: What are the effects of job dedication behaviors on team performance and how is this relationship impacted by communication technologies?

Van Scotter (1994) identified job dedication behaviors as an important set of behaviors that contribute directly to performance in an organization. Results of this study were inconclusive regarding this relationship because no job dedication behaviors were observed during the experimental trials. It is likely that no behaviors were observed because this study was not designed to reward team loyalty. Instead, teams were judged on their ability to complete their tasks quickly and accurately. As such, teams placed all their emphasis on behaviors they felt would help them increase their speed and accuracy. Once a team completed its tasks, team members were free to disband and had no future motives to work together again.

Q5: What are the effects of team effectiveness behaviors on team performance and how is this relationship impacted by communication technologies?

Results from this study did not indicate whether communication media moderated the effects of team effectiveness behaviors on team performance. It is possible that

behaviors such as having a clear and elevating goal and setting high standards of excellence are unaffected by media channel richness. For example, setting standards of excellence via audio conferencing may be just as effective as doing so face-to-face. This may be so because setting standards may not require multiple information cues, immediate feedback and a personal touch. Specifically, one does not need to be in a face-to-face environment to be told that they need to live up to certain standards of excellence. Instead, through the use of any communication media, one just needs to know that standards of excellence exist and what those standards are. Thus, displaying such behaviors face-to-face or via technology would yield similar results.

Implications

Theoretical Analysis

Overall, the theories and models used as the foundation for this study were useful in helping better understand what behaviors lead to team performance and how communication technology can moderate these effects. For example, media richness theory proved to be very useful in analyzing moderation effects. As noted throughout this study, communication media vary in their ability to convey multiple information cues, immediate feedback, and add a personal touch. These factors often helped to account for the differences in findings from collocated to virtual environments. Still, it is possible that incorporating additional theories such as social influence theory (proposes that media selection is influenced by subjective perceptions of users and information from other users in the organization) may have added further insight to this study (Timmerman, 2002).

Communication Strategies for Team Performance

Although this study focused on five behavior sets (task proficiency, interpersonal facilitation, leadership, job dedication, and team effectiveness), the basic premise of the situational leadership approach seems to apply equally across all five behaviors. Specifically, situational leadership theory states that no one leadership approach is appropriate for all situations (Northhouse, 2007). Similarly, the results from this study indicate that the value of the performance-enhancing behaviors of study may vary with the situation in which they are used.

Communication Strategies when Working Face-to-Face

Working face-to-face remains the richest form of communication; it conveys the largest amount of information. Such environments allow for the most information cues, the fastest feedback, and clearly the most personal touch (Robbins & Judge, 2007). The value of the five behaviors studied, in terms of impacting performance, seems to vary depending on how performance is measured. When the mission demands speed and accuracy, focus should be given to exhibiting more task proficiency behaviors. Thus, it is reasonable to conclude that the following behaviors, whether trained or naturally occurring, should improve performance under time-sensitive conditions:

- Perform routine and specialized tasks more efficiently
- Use equipment, tools, and computers more proficiently
- Anticipate future issues
- Communicate task information clearly

Contending with Communication Technology

The value of the five behaviors studied varies depending on how performance is measured *and* the communication media used. Specifically, this study found that communication technology has an impact on team performance. This finding is not meant to suggest that we should limit our use of communication technology, rather, it is meant to point out that certain behaviors that yield positive results in face-to-face environments do not necessarily have the same impact in virtual environments. This is especially important in our modern Air Force as we become increasingly dependent on technology. The findings in this study suggest that when the mission requires teams working in virtual environments to work quickly and accurately, more emphasis should be placed on leadership and interpersonal facilitation behaviors. Leadership behaviors consist of:

- Recognizing and encouraging high performance
- Making tough decisions quickly and confidently
- Providing feedback to subordinates
- Coordinating subordinates' efforts

Furthermore, interpersonal facilitation behaviors such as the following should be emphasized:

- Supporting or encouraging a colleague
- Treating others fairly
- Showing concern for others
- Having a cheerful and confident outlook

It is worth noting that the Air Force has been making many of the right decisions all along. Through accession criteria, basic training, tech school, PMEs, and on-the-job

training, the Air Force has done an outstanding job at improving task proficiency behaviors, encouraging interpersonal facilitation behaviors, training leadership behaviors, fostering job dedication behaviors through esprit de corps, and improving team effectiveness behaviors by setting standards of excellence. What needs to be improved upon is training Airmen that the value of exhibiting these behaviors differs depending on how performance is measured *and* the communication media used.

Limitations and Directions for Future Research

There are several limitations worth noting. First, this study was conducted using secondary data. As a result, this study was limited because one could not go back and modify the experimental design to allow for all five behaviors of interest to be expressed more freely. This issue may well have been responsible for the fact that no job dedication behaviors were observed. Given that the participants knew that their teams would disband upon the conclusion of simulation and that team loyalty was not a measure they were being scored on, they had no reason to display job dedication behaviors.

Furthermore, it is possible that a larger sample size would have yielded additional results (statistical power in this study ranged from .3967 to .8604). Smaller sample sizes have lower statistical power than larger sample sizes; as statistical power is increased,, so is the likelihood of rejecting the null hypothesis when it is false (Norusis, 2006). Thus, the higher power associated with a larger sample would have improved the likelihood of finding additional relationships or moderation effects where this study found none of statistical significance.

In addition, this study was limited to teams with transformational leaders, it did not account for teams with transactional leaders. Transformational leaders are interested in engaging with their followers to create a connection that raises the level of motivation for the entire group. Alternatively, transactional leaders focus only in the exchanges between themselves and their followers (Northhouse, 2007). Although Northhouse suggests that the transformational leadership style has been the preferred style in recent times, one can conceive that teams with transactional leaders may have performed better in this study because the experiment was designed to reward teams that completed their tasks quickly and accurately. As such, teams may have limited their behaviors to those that would allow them to attain the highest possible scores (these behaviors tended to be more transactional in nature).

Another limitation of concern was that only one "level" of technology was manipulated via the study's design. Communication technologies differ in their capacity to convey multiple information cues, provide immediate feedback, and add a personal touch (Robbins & Judge, 2007). While this study used voice chat technology, other technologies may have also been used to mediate virtual environments including: text chat, video chat, telephone, and video teleconferencing. The use of additional technologies may have resulted in different findings. For example, video teleconferencing, which contains higher channel richness (more information cues, higher capacity for immediate feedback, and a more personal touch) than voice chat technology, may have yielded results similar to those one would expect in a collocated environment.

Conclusion

There is no *one* right way to communicate with your troops. Behaviors that yield positive results in one environment may have a negative impact in others, or have no impact at all. The Air Force's dependence on technology to mediate the environments in which we work makes this statement especially important. As we look to educate the leaders of tomorrow, we should remember that there is no "one size fits all" approach to getting the job done. Though some combination of methods and circumstances may clearly be more suitable to the task than others; we should therefore inform Airmen of these differences through education programs such as professional military education or on-the-job training.

APPENDIX A. BEHAVIOR EXPLANATION LIST

- **Task Proficiency**
  - **Definition**: the proficiency with which individuals perform duties related to their job
  - **Examples**
    - Performing routine and specialized tasks efficiently
    - Solving urgent, unexpected problems expertly
    - Using equipment, tools, and computers proficiently
    - Anticipating future issues
    - Communicating task information effectively
    - Planning and organizing work well
- **Interpersonal Facilitation**
  - **Definition**: encouraging behavior such as conflict resolution, being cooperative, consideration for others, and encouraging others to perform well
  - **Examples**
    - Supporting or encouraging a coworker
    - Treating others fairly
    - Helping someone without being asked
    - Showing concern for others
    - Having a cheerful, confident outlook
    - Praising others' good work
- **Job Dedication**
  - **Definition**: perform the tasks that comprise the job and connotes a sense of loyalty to the organization as a whole and a desire to fulfill more general role requirements that come with organizational membership
  - **Examples**
    - Taking initiative
    - Seeking excellence
    - Performing reliably and consistently
    - Seeking additional duties
    - Working hard
- **Leadership**
  - **Definition**: the art and science of influencing and directing people to accomplish the assigned mission
  - **Examples**:
    - Recognizing and encouraging high performance
    - Encouraging cooperation among others
    - Supporting subordinates
    - Making tough decisions quickly and confidently
    - Providing feedback to subordinates
    - Coordinating subordinates' efforts
- **Team Effectiveness**
  - **Definition**: team-specific behaviors that assist teams in improving their performance
  - **Examples**
    - Having a clear and elevating goal
    - Establishing a results-driven structure
    - Displaying unified commitment
    - Encouraging a collaborative environment
    - Building standards of excellence

APPENDIX B. SUPPLEMENTAL TABLES

Table 8: Direct Effects between ZOffScr and all behaviors

	Unstandardized B	Beta	ΔR^2
Constant	-.336		*.207*
ZTk_per	-.506	-.549	
ZInt_per	-.211	-.227	
ZLd_per	-.238	-.256	
ZTm_per	-.244	-.265	
ZTk_per x Collocated	1.326	1.279	*.209*
ZInt_per x Collocated	.700	.406	
ZLd_per x Collocated	-.337	-.295	
ZTm_per x Collocated	*.381*	*.299*	

N= 27 teams; *p<.1 **p<.05

Collocated (Dummy coded): collocated vs. reachback (1=collocated)

Table 9: Direct Effects between ZDefScr and all behaviors

	Unstandardized B	Beta	ΔR^2
Constant	-.378		*.417***
ZTk_per	-.087	-.078	
ZInt_per	-.179	-.160	
ZLd_per	-.242	-.216	
ZTm_per	-.393*	-.354	
ZTk_per x Collocated	.097	.077	*.153*
ZInt_per x Collocated	-.648	-.312	
ZLd_per x Collocated	-.987	-.716	
ZTm_per x Collocated	*-.361*	*-.235*	

N= 27 teams; *p<.1 **p<.05

Collocated (Dummy coded): collocated vs. reachback (1=collocated)

Table 10: Direct Effects between ObjScr and all behaviors

	Unstandardized B	Beta	ΔR^2
Constant	-.358*		*.327**
ZTk_per	-.295	-.326	
ZInt_per	-.194	-.212	
ZLd_per	-.239	-.262	
ZTm_per	-.317	-.351	
ZTk_per x Collocated	.707	.695	*.203*
ZInt_per x Collocated	.021	.013	
ZLd_per x Collocated	-.664	-.592	
ZTm_per x Collocated	*.009*	*.007*	

N= 27 teams; *p<.1 **p<.05

Collocated (Dummy coded): collocated vs. reachback (1=collocated)

Table 11: Direct Effects between LdrSat and all behaviors

	Unstandardized B	Beta	ΔR^2
Constant	3.997**		*.067*
ZTk_per	-.092	-.242	
ZInt_per	-.085	-.223	
ZLd_per	-.140	-.368	
ZTm_per	-.053	-.140	
ZTk_per x Collocated	.506	1.180	*.149*
ZInt_per x Collocated	.338	.482	
ZLd_per x Collocated	.404	.873	
ZTm_per x Collocated	*.549**	*1.042*	

N= 28 teams; *p<.1 **p<.05

Collocated (Dummy coded): collocated vs. reachback (1=collocated)

Table 12: Direct Effects between TmSat and all behaviors

	Unstandardized B	Beta	ΔR^2
Constant	3.933**		*.025*
ZTk_per	-.052	-.105	
ZInt_per	-.043	-.088	
ZLd_per	-.029	-.059	
ZTm_per	-.079	-.160	
ZTk_per x Collocated	1.191**	2.144	*.283*
ZInt_per x Collocated	1.126**	1.241	
ZLd_per x Collocated	.700	1.166	
ZTm_per x Collocated	*.967***	*1.416*	

N= 28 teams; *p<.1 **p<.05
Collocated (Dummy coded): collocated vs. reachback (1=collocated)

Table 13: Regression results between ZOffScr and Task Proficiency behaviors with moderation

	Unstandardized B	Beta	ΔR^2
Constant	-.335*		*.099***
ZTk_per	-.188	-.204	
ZTk_per x Collocated	*.846***	*.816*	*.041***

N= teams; *p<.1 **p<.05
Collocated (Dummy coded): collocated vs. reachback (1=collocated)

Table 14: Regression results between ZDefScr and Task Proficiency behaviors with moderation

	Unstandardized B	Beta	ΔR^2
Constant	-.356*		*.363***
ZTk_per	.272*	.245	
ZTk_per x Collocated	*.993***	*.794*	*.132***

N= 27 teams; *p<.1 **p<.05
Collocated (Dummy coded): collocated vs. reachback (1=collocated)

Table 15: Regression results between ObjScr and Task Proficiency behaviors with moderation

	Unstandardized B	Beta	ΔR^2
Constant	-.346*		*.277***
ZTk_per	.042	.047	
ZTk_per x Collocated	*.919***	*.902*	*.171***

N= teams; *p<.1 **p<.05
Collocated (Dummy coded): collocated vs. reachback (1=collocated)

Table 16: Regression results between LdrSat and Task Proficiency behaviors with moderation

	Unstandardized B	Beta	ΔR^2
Constant	4.014**		*.016*
ZTk_per	.049	.127	
ZTk_per x Collocated	*.021*	*.049*	*.000*

N= 28 teams; *p<.1 **p<.05
Collocated (Dummy coded): collocated vs. reachback (1=collocated)

Table 17: Regression results between TmSat and Task Proficiency behaviors with moderation

	Unstandardized B	Beta	ΔR^2
Constant	3.927*		*.013*
ZTk_per	.012	.024	
ZTk_per x Collocated	*-.017*	*-.031*	*.000*

N= 28 teams; *p<.1 **p<.05
Collocated (Dummy coded): collocated vs. reachback (1=collocated)

Table 18: Regression results between ZOffScr and Interpersonal Facilitation behaviors with moderation

	Unstandardized B	Beta	ΔR^2
Constant	-.373*		*.138**
ZInt_per	.070	.075	
ZInt_per x Collocated	*-.032*	*-.019*	*.000*

N= 27 teams; *p<.1 **p<.05
Collocated (Dummy coded): collocated vs. reachback (1=collocated)

Table 19: Regression results between ZDefScr and Interpersonal Facilitation behaviors with moderation

	Unstandardized B	Beta	ΔR^2
Constant	-.306		*.308***
ZInt_per	-.089	-.079	
ZInt_per x Collocated	*-.813**	*-.391*	*.087**

N= 27 teams; *p<.1 **p<.05
Collocated (Dummy coded): collocated vs. reachback (1=collocated)

Table 20: Regression results between ObjScr and Interpersonal Facilitation behaviors with moderation

	Unstandardized B	Beta	ΔR^2
Constant	-.341*		*.275***
ZInt_per	-.009	-.010	
ZInt_per x Collocated	*-.425*	*-.251*	*.036*

N= 27 teams; *p<.1 **p<.05
Collocated (Dummy coded): collocated vs. reachback (1=collocated)

Table 21: Regression results between LdrSat and Interpersonal Facilitation behaviors with moderation

	Unstandardized B	Beta	ΔR^2
Constant	4.046**		*.022*
ZInt_per	-.065	-.170	
ZInt_per x Collocated	*-.081*	*-.116*	*.007*

N= 28 teams; *p<.1 **p<.05
Collocated (Dummy coded): collocated vs. reachback (1=collocated)

Table 22: Regression results between TmSat and Interpersonal Facilitation behaviors with moderation

	Unstandardized B	Beta	ΔR^2
Constant	3.927**		*.012*
ZInt_per	.000	.001	
ZInt_per x Collocated	*.190*	*.209*	*.024*

N= 28 teams; *p<.1 **p<.05
Collocated (Dummy coded): collocated vs. reachback (1=collocated)

Table 23: Regression results between ZOffScr and Leadership behaviors with moderation

	Unstandardized B	Beta	ΔR^2
Constant	-.293		*.145**
ZLd_per	.114	.123	
ZLd_per x Collocated	*-.675*	*-.591*	*.076*

N= 27 teams; *p<.1 **p<.05
Collocated (Dummy coded): collocated vs. reachback (1=collocated)

Table 24: Regression results between ZDefScr and Leadership behaviors with moderation

	Unstandardized B	Beta	ΔR^2
Constant	-.427*		*.325***
ZLd_per	-.188	-.168	
ZLd_per x Collocated	*-1.089***	*-.790*	*.136***

N= 27 teams; *p<.1 **p<.05
Collocated (Dummy coded): collocated vs. reachback (1=collocated)

Table 25: Regression results between ObjScr and Leadership behaviors with moderation

	Unstandardized B	Beta	ΔR^2
Constant	-.360*		*.276***
ZLd_per	-.037	-.040	
ZLd_per x Collocated	*-.882***	*-.787*	*.135***

N= 27 teams; *p<.1 **p<.05
Collocated (Dummy coded): collocated vs. reachback (1=collocated)

Table 26: Regression results between LdrSat and Leadership behaviors with moderation

	Unstandardized B	Beta	ΔR^2
Constant	3.977**		*.049*
ZLd_per	-.093	-.243	
ZLd_per x Collocated	*.005*	*.012*	*.000*

N= 28 teams; *p<.1 **p<.05
Collocated (Dummy coded): collocated vs. reachback (1=collocated)

Table 27: Regression results between TmSat and Leadership behaviors with moderation

	Unstandardized B	Beta	ΔR^2
Constant	3.929**		*.012*
ZLd_per	.005	.010	
ZLd_per x Collocated	*-.074*	*-.124*	*.003*

N= 28 teams; *p<.1 **p<.05
Collocated (Dummy coded): collocated vs. reachback (1=collocated)

Table 28: Regression results between ZOffScr and Team Effectiveness behaviors with moderation

	Unstandardized B	Beta	ΔR^2
Constant	-.340*		*.134**
ZTm_per	.003	.003	
ZTm_per x Collocated	*.169*	*.133*	*.008*

N= 27 teams; *p<.1 **p<.05
Collocated (Dummy coded): collocated vs. reachback (1=collocated)

Table 29: Regression results between ZDefScr and Team Effectiveness behaviors with moderation

	Unstandardized B	Beta	ΔR^2
Constant	-.360*		*.375***
ZTm_per	-.299*	-.269	
ZTm_per x Collocated	*-.063*	*-.041*	*.001*

N= 27 teams; *p<.1 **p<.05
Collocated (Dummy coded): collocated vs. reachback (1=collocated)

Table 30: Regression results between ObjScr and Team Effectiveness behaviors with moderation

	Unstandardized B	Beta	ΔR^2
Constant	-.351*		*.301***
ZTm_per	-.147	-.163	
ZTm_per x Collocated	*.054*	*.043*	*.001*

N= 27 teams; *p<.1 **p<.05
Collocated (Dummy coded): collocated vs. reachback (1=collocated)

Table 31: Regression results between LdrSat and Team Effectiveness behaviors with moderation

	Unstandardized B	Beta	ΔR^2
Constant	4.016**		*.001*
ZTm_per	.012	.033	
ZTm_per x Collocated	*.172*	*.326*	*.050*

N= 28 teams; *p<.1 **p<.05
Collocated (Dummy coded): collocated vs. reachback (1=collocated)

Table 32: Regression results between TmSat and Team Effectiveness behaviors with moderation

	Unstandardized B	Beta	ΔR^2
Constant	3.925**		*.022*
ZTm_per	-.048	-.097	
ZTm_per x Collocated	*.197*	*.289*	*.040*

N= 28 teams; *p<.1 **p<.05
Collocated (Dummy coded): collocated vs. reachback (1=collocated)

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VITA

Capt Edgard I. Zamora graduated from Lowell High School in San Francisco, California in June 1997. He continued his education at the University of the Pacific in Stockton, California. In May 2001, Capt Zamora earned a Bachelor of Science degree in Computer Science, graduating with Cum Laude honors.

Upon graduation, Capt Zamora accepted an IT Specialist position with Hewlett Packard. In December 2002, Capt Zamora was accepted to Air Force Officer Training School. He was commissioned as a Communications officer in May of 2003. His first assignment as a commissioned officer was at Travis Air Force Base, California. There he spent the next three years as a Network Administration OIC, Network Infrastructure OIC, and Executive Officer. In August 2006, he entered the Graduate School of Engineering and Management, at the Air Force Institute of Technology to pursue a MS degree in Information Resource Management. Upon graduating, he will be assigned to the Air Force Communication Agency at Scott Air Force base, Illinois.

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 074-0188

1. REPORT DATE *(DD-MM-YYYY)*	2. REPORT TYPE	3. DATES COVERED *(From – To)*
27-03-2008	Master's Thesis	March 2007 – March 2008

4. TITLE AND SUBTITLE

High Performing Teams: The Moderating Effects of Communication Channels

5a. CONTRACT NUMBER

5b. GRANT NUMBER

5c. PROGRAM ELEMENT NUMBER

6. AUTHOR(S)

Edgard I. Zamora, Capt, 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, Building 640
WPAFB OH 45433

8. PERFORMING ORGANIZATION REPORT NUMBER

AFIT/GIR/ENV/08-M27

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

Intentionally left blank

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 purpose of this study is to support the Air Force's goal of improving team performance by bringing visibility to several overlapping areas of study where little comprehensive research has been conducted. Specifically, an officer's ability to successfully complete his or her mission has been complicated in recent years by the emergence of new communication technologies. For example, communication networks now make it possible for pilots to fly Unmanned Arial Vehicles (UAVs) who sit on one continent while the aircraft and mission planners are on another and, although they may not see each other, their physical separation does not negate the need for effective team performance. It is important organizations have a clear understanding of the impact that communication technologies have on team and individual behaviors. Knowing these effects may mean the difference between successfully completing a mission or not.

15. SUBJECT TERMS

Performance (Human), Behavior, Teams (Personnel)

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			Jason M. Turner, Maj, USAF
U	U	U	UU	79	19b. TELEPHONE NUMBER *(Include area code)* (937) 255-3636, ext 7407 (jason.turner@afit.edu)

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