ABSTRACT

Title of Thesis: VIRTUALLY A LEADER: MITIGATING PROCESS LOSSES THROUGH SHARED TEAM STATES

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Research on virtual teams reveals that virtual teams do not operate in the same way as non-virtual teams. Despite increasing interest in this field, virtuality's impact on teams through an integrated IPO framework has yet to be assessed. The current study addresses this limitation by examining how virtuality impacts shared team states, and, subsequently, how shared team states impact communication, and how communication impacts outcomes. Further, this study investigated the role leadership plays in reducing process losses encountered by virtual teams. Results indicate that virtuality impacts the formation of shared team states, and leadership moderates this relationship, but in an unexpected direction. Shared team states were not found to contribute to communication, and communication did not predict outcomes. However, virtuality was found to directly affect communication, and the interaction between virtuality and leadership affected outcomes. Implications for research and practice are discussed.

VIRTUALLY A LEADER: MITIGATING PROCESS LOSSES THROUGH SHARED TEAM STATES

by

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Virtually a Leader: Mitigating Process Losses through Shared Team States

In the face of today's multi-cultural, globalized—indeed, almost boundary-less—world, the nature of the workplace is changing rapidly. Organizations seek to address the challenges these changes create by implementing technologies to promote access of expert knowledge and allow the creation of teams composed of talented, geographically dispersed, employees (Bell & Kozlowski, 2002). Businesses are increasingly turning to these virtual teams in order to remain competitive. Virtual teams are used by a number of areas and disciplines. Government agencies, military organizations, and research groups (e.g., Hanges, Lyon, & Dorfman, 2005) all use virtual teams to accomplish a variety of tasks. Even hospitals have adopted technologies that allow doctors to collaborate with Emergency Medical Technicians in the field to provide medical care to trauma patients (Pattichis et al., 2002). While virtual teams are clearly being used with increasing frequency in the business world, business organizations are not unique in implementing such teams. At this time, many groups, including research teams and organizations such as Al Qaeda, use technology to help their members communicate and organize.

Unfortunately, while virtual teams have many benefits they also suffer numerous drawbacks. For instance, research indicates that the potential for social isolation of virtual workers can lead to anti-social behavior (Siegel, Dubrovsky, Kiesler, & McGuire, 1986; Sproull & Kiesler, 1985; 1992) and difficulty forming relationships (Chidambaram, 1996; Grinter, Herbsleb, & Perry, 1999). Further, the lack of visual and/or emotional cues increases potential miscommunication between team members (DeRosa, Hantula, Kock, & D'Arcy, 2004).

While the severity of the issues faced by virtual teams diminishes over time (Chidambaram 1996), it has been noted that speed is frequently an imperative in the completion of virtual team tasks (Zigurs, 2003). As such, these teams do not have the luxury of time to improve their communication and performance. Consequently, organizations need these teams to be effective as quickly as possible. Clearly, then, it is imperative to understand how to mitigate the consequences of virtual work. One factor that might lessen the difficulties associated with the use of communication media in completing work tasks is leadership (Balthazard , Waldman, Howell, & Atwater, 2004; Chen, Kirkman, Kanfer, Allen, & Rosen, 2007; Zaccaro & Bader, 2003; Zigurs, 2003). Indeed, leadership has been proposed as a contributor to the reduction of process losses, especially in *ad hoc* teams. Unfortunately, leadership as a moderator between communication media and process loss within virtual teams has not been adequately addressed by the prior empirical literature. One purpose of the present study was to address this limitation. Specifically, I explored whether leadership style can moderate the initial difficulties faced by virtual teams. Further, research to date has not addressed the complexities how virtuality can affect team properties and processes. In other words, prior research has largely ignored the extent that virtuality has affected the development of important team characteristics, such as collective efficacy, group empowerment, and interpersonal cohesion (some notable exceptions: Chen et al., 2007; Kirkman, Tesluk, Rosen, & Gibson, 2004; Wang & Lin, 2007; Warkentin, Sayeed, & Hightower,1997). Thus, a second goal for the present study was to address this limitation by assessing the impact of virtuality on these team characteristics. However, before the present study can be reviewed in detail, I begin with a discussion of what makes a team "virtual."

Definition of Virtuality

Definitions of what constitutes a virtual environment vary throughout the literature. While specific elements are differentially endorsed by researchers, the primary theme that emerges from this literature is that geographical dispersion and time differences (Warkentin et al. 1997; Kirkman et al. 2002; Hinds & Bailey, 2003; Zigurs, 2003; Zaccaro & Bader, 2003; Lee-Kelley 2002; Cascio & Shurygailo, 2003) are primary aspects of virtual teams. There is, however, variation within the literature over the specific elements that measure geographical and temporal dispersion. For instance, some definitions discuss organizational boundary-spanning as a type of geographical dispersion (Kirkman, Rosen, Gibson, Tesluk, & McPherson, 2002; Zigurs, 2003). Likewise, cultural variation (Zigurs, 2003) is also an aspect of virtual teamwork associated with geographic dispersion.

However, while the prior literature has used criteria connected to the physical or temporal dispersion of teams to define virtuality, these definitions do not provide any conceptual rationale for why these characteristics determine virtuality. Indeed, physical and temporal dispersion may be issues related to virtuality, but are not, independently, determinants of its existence. Further, these criteria do not permit the possibility that teams, despite being separated by equal distances, might vary in their level of virtuality. Thus, I argue that physical and temporal dispersion criteria are only proxy variables for what truly makes a team virtual. Specifically, all virtual teams rely on communication technology to overcome the lack of physical (or temporal) proximity of their group members. I argue that it is the nature of the communication technology (e.g., email, instant messaging, phone call, video conferencing) that determines the degree of

virtuality experienced by team members. Indeed, when examining the prior literature, the inclusion of physical or temporal criteria in defining virtuality differed across studies, whereas communication technology used by team members consistently appeared in all "virtuality" definitions. Thus, virtuality in this study is assessed through the team's use of certain types of communication media. Such a definition necessitates the application of a metric to determine exactly how "virtual" specific types of communication media truly are. In the current study, a team's communication media is considered more or less virtual, depending on its degree of "richness", as outlined in Media Richness Theory (Daft & Lengel, 1986).

Daft and Lengel (1986) developed Media Richness Theory (MRT) to classify communication media by level of richness. According to MRT, a communication medium is considered rich to the extent that it a) enables synchronicity of communication (e.g., feedback during the communication), b) allows users to communicate through several cues and channels (e.g. visually, verbally, etc.), and c) allows users to be "personal" (e.g. facilitates the informal communication and relationship development) between communication partners. Degree of virtuality is thus conceptualized as the opposite of the "richness" of communication media. According to MRT, face to face is considered non-virtual while an example of a virtual communication medium would be instant messaging.

In summary, I have argued that the primary distinguishing feature between virtual teams and their FTF counterparts is use of virtual communication media. Degree of virtuality can be considered a continuum along which communication media are ranked based on three factors. Media Richness theory (Daft & Lengel, 1986) provides a useful

classification of virtuality, which is employed in this study. In the next section, I explore how virtuality affects team processes and outcomes, and how these effects may be mitigated through leadership.

Virtuality and Leadership.

How does virtuality affect team processes and outcomes, and, further, how are these effects differentially impacted by leadership in comparison to their face-to-face counterparts? Despite the call in the literature to investigate leadership as a lever in mitigating process losses , research on this topic is limited. Moreover, beyond a general question addressing the efficacy of leadership in the virtual environment, an imperative issue in this area is which leadership style might be most effective in such an environment. Many theories of leadership have been proposed over the years (e.g. trait: Stogdill, 1974; behavioral: Halpin & Winer, 1957; contingency: Fiedler, 1964; Leader-Member Exchange: Dansereau, Graen, & Haga, 1975; Transformational/Transactional Leadership: Bass, 1985). These theories differ in the extent to which they include the leader, the follower, and/or the environment. One leadership theory, Path-Goal Theory (House, 1971), is unique in that it focuses on all of these components. Additionally, path-goal theory is unique in that it claims that leadership behavior can be adapted to different situations. Path-goal theory states that leaders can clear "obstacles" from followers' paths by examining the situation and choosing certain actions.

According to path-goal theory (House, 1971), a leader must clear the path for and motivate their followers by enacting one of four leadership styles: directiveness, supportiveness, participation, and achievement-orientation. Directive leadership behavior involves increasing task structure. Directive leaders engage in behaviors to increase

rewards and decrease ambiguity. Supportiveness refers to a focus on group morale and relationships—supportive leaders seek to enhance employee self-esteem and increase the attractiveness of a given task. Participative leadership involves the leader in the task, such that the leader acts as a member of the group and not as an external director. Participative leaders consult followers before implementing solutions or making decisions. Achievement-oriented leadership behaviors include setting high goals and expectations.

Depending on situational factors, including subordinate and task characteristics, leaders may emphasize certain behaviors to be most effective. Directive leadership should enhance satisfaction and performance by reducing ambiguity in unstructured tasks. When subordinates have a high need for clarity (Keller, 1989), when tasks are time sensitive (Tschan, Semmer, & Gautschi, 2006), or when tasks are risky or teams are inexperienced (Yun, Faraj, & Sims, 2005), directive leadership enhances performance.

Participative leadership, alternatively, should increase team satisfaction, especially with stressful tasks. For example, unstructured tasks may be particularly stressful. Consistent with this proposition, participative leadership has been found to be effective when employees are working on unstructured tasks (Carew, Parisi-Carew, Blanchard, 1986). The idea that participative leadership should be generally satisfactory to team members has also been supported (Bliss & Fallon, 2003).

There have been mixed results on overall assessments of path-goal theory. Some studies have found support (Fry, Kerr, & Lee, 1986; Schriesheim & DeNisi, 1981), while others have found either no (Schriesheim & Schriesheim, 1980) or limited support (Al-Gattan, 1985) for House's (1971) claims. Meta-analyses of path goal leadership indicate

support for path-goal theory (Indvik, 1986), although the effects of leadership on outcomes might be moderated by situational variables (Wofford & Liska, 1993). House (1996) addressed the issue of mixed results in the literature, claiming that errors in measurement led to these mixed and unsupportive results.

In summary, path-goal theory emphasizes the role of the leader in facilitating subordinate accomplishment through clearing obstacles from the employee's "path". The leader does this by reducing ambiguity or by providing support to employees. How, then, might path-goal leadership apply in the virtual environment? Next, I review how the four leadership styles delineated and discussed in path-goal theory may apply, or not apply, to teams working virtually.

First, directive leadership is intended, as discussed, to provide structure in an ambiguous environment. The virtual environment is often touted as highly ambiguous, resulting in frequent miscommunication and misinterpretation (DeRosa et al., 2004). As such, directive leadership should be particularly useful in mitigating process losses stemming from the ambiguity of the virtual environment. Likewise, participative leadership aims to get members of the team involved in contributing and making decisions. The prior literature reveals that virtual communication is, in fact, associated with perceptions of social isolation (Siegel et al., 1986; Sproull & Kiesler, 1985; 1992). Clearly, then, participative leadership should be useful in mitigating process losses stemming from the isolating effects of working virtually.

While participative leadership and directive leadership appear to be especially relevant in a virtual setting, achievement orientation and supportive leadership are not as compelling to study in such an environment. Achievement orientation (e.g. setting high

goals) does not address needs more relevant to virtual teams than non-virtual teams. That is, while directive and participative leadership appear to be particularly relevant in the virtual environment relative to the non-virtual environment, there is no effect of virtuality that calls for the special attention of a leader focused on achievement orientation. Conversely, supportive leadership seems at first blush to be relevant to certain process losses induced by working virtually. That is, as discussed, virtual team members often have difficulty forming relationships relative to their non-virtual counterparts (Chidambaram, 1996; Grinter et al., 1999). While supportive leadership may be expected to address this need, research reveals that relationally-oriented and emotionally-rich communication is difficult to send and interpret over virtual communication media (Kato, Kato & Akahori, 2007). Consequently, while the goal of the supportive leader may fit a need relevant to virtual teams, the execution of such a goal would not meet this need.

In sum, directive and participative leadership styles clearly address concerns particularly relevant to virtual teamwork. In contrast, achievement orientation is not more necessary in virtual teams relative to non-virtual teams, and supportive leadership would be almost impossible to convey over virtual communication media. Despite the potential impact of directive and participative leadership on virtual team success, the vast majority of path-goal leadership research has been conducted in face to face teams. Therefore, it is important to consider the extent to which path-goal leadership theory explains the moderating role of leadership in virtual team situations.

While research on leadership in virtual teams is lacking, a set of key studies investigating this issue has been conducted by Kahai and colleagues (Kahai, Sosik, & Avolio, 1997; 2003; 2004; Sosik, Avolio, & Kahai, 1997; Sosik, Kahai, & Avolio, 1998;

1999). Specifically, Kahai and his colleagues have explored the effects of path-goal and transformational leadership on virtual teams. In their research on the latter, Kahai et al. (2003) and Sosik et al. (1997; 1998; 1999) addressed the role of rewards, anonymity, and transformational/transactional leadership on virtual team efficacy, flow, potency, satisfaction, and outcomes whereas Kahai et al (1997; 2004) examined path-goal leadership in virtual teams. Transformational/transactional leadership has received some attention in the broader virtual teams literature beyond the work by Kahai and colleagues (Hambley, O'Neill, & Kline, 2007; Hoyt & Blascovich, 2003; Kahai et al., 2003; Sosik et al., 1997;1998;1999). However, path-goal leadership, while a compelling leadership style potentially well-suited for the virtual environment, has not received nearly as much attention.

Only two articles, as discussed, began exploring these issues (Kahai, Sosik, & Avolio, 1997; 2004). Specifically, these authors explored how task structure and two types of path goal leadership styles (House, 1971) affect the team processes, productivity, and satisfaction of virtual teams. Kahai et al. (1997) found that participative leadership enhanced processes and that task structure increased solution proposals. Additionally, they found that participative leadership increased solutions in a more structured task, while directive leadership led to more solutions in a less structured task, in support of House's theory. Finally, a greater number of solution proposals led to greater group productivity and satisfaction.

A second study (Kahai et al., 2004) explored perceptions of path-goal leadership in the electronic meeting system (EMS) environment. This study addressed structure, perceived participative and directive leadership styles, satisfaction, participation, and

effectiveness in an electronic meeting system environment. The difference between this study and the previous study was emphasis on perceptions of leadership. As before, leadership style was manipulated and controlled through scripted comments presented to *ad hoc* teams of four participants.

Kahai et al. (2004) found that directive and participative leadership enhanced group performance in the less structured task. Additionally, in the more structured task, the participative leadership inhibited performance. Finally, they found that perceptions of directive and participative behaviors directly and positively affected satisfaction.

While somewhat helpful, the Kahai et al (1997, 2004) studies only begin to address the aforementioned questions regarding how virtuality impacts group states, processes, and outcomes. I extended the work of Kahai et al (1997, 2004) in my study to more completely address these questions. Specifically, I first focused on the leadership dimension manipulated by Kahai et al. As indicated above, these authors only tested for differences between participative and directive leaders with virtual teams. One conclusion that could be drawn from their study is that participative leadership is not effective with virtual teams. However, this might be an incorrect conclusion. It is possible that while directive leadership produced optimal effects for virtual teams, particularly in unstructured tasks, participative leaders might still yield some benefit for virtual teams. Thus, I included a laissez-faire leadership condition in my study along with a participative and a directive leadership condition.

It should also be noted that Kahai et al. (1997, 2004) only included virtual teams in their studies. That is, they did not examine how virtual teams reacted to the two leadership styles compared to non-virtual (i.e., face to face) teams. It is possible that,

given the ambiguity of the experimental task that participants were working on in the Kahai et al. (1997; 2004) studies, directive leaders would always be more effective than participative leaders, regardless of whether the teams were virtual or not. Thus, I included two levels of virtuality in my study: a) face to face - nonvirtual; and b) instant messaging - moderately virtual. These two conditions enabled an unambiguous assessment of the extent to which virtuality and leadership style affect team processes and outcomes.

While I added to the manipulations used in the Kahai et al. (1997, 2004) studies in several ways, I also eliminated one of the variables they tested. That is, in favor of a more in-depth exploration of the effects of leadership and virtuality, a manipulation of task structure was not included in the current study. Of the two tasks Kahai et al. (1997, 2004) used to assess task structure, I implemented only the most unstructured task in my study. I chose to use only the most unstructured task for several reasons. First, given that I expanded upon Kahai et al.'s (1997;2004) framework by introducing an additional leadership condition as well as an additional dimension of virtuality, I already have a large number of "cells" in which to collect data. If I included both tasks, it would be difficult to collect enough data to perform meaningful analyses. Further, structured and unstructured tasks may have dramatically different effects in a virtual, and thus inherently unstructured, environment. The latter exacerbates the lack of structure in a virtual environment, while the former may remove some uncertainty. As such, I chose to implement the task that would be the most challenging to address virtually. In sum, I used the unstructured task in order to best assess leadership in a doubly ambiguous—that is, virtual and unstructured—setting.

Finally, I explored how virtuality affects processes and outcomes in my study. While Kahai et al. (1997, 2004) examined virtual teams, since they did not manipulate virtuality itself, no conclusions regarding the effect of virtuality on processes and outcomes can be drawn. In order to assess the impact of virtuality on processes and outcomes, I have developed a model based upon the classic Input-Output-Process (IPO) team framework which incorporates leadership and virtuality. Before the full model can be explicated, it imperative that the IPO framework is explained. To this end, I will review the IPO framework next.

Virtuality and Team Performance

To understand the disruption of team processes in virtual teams, it is imperative to first review the basic framework that is believed to capture the machinery of team work.

The Input-Process-Output Team Framework

In an attempt to understand how to improve organizational effectiveness, researchers have generated numerous team models. A seminal team model is the IPO framework (McGrath, 1964). Many team models generated thereafter followed the same basic framework as McGrath's initial model, with a few modifications (e.g. Gladstein, 1984; Hackman, 1987).

In the IPO framework, inputs are individual, group, and environment level factors that affect team processes (e.g. team diversity, roles, and the task itself). Processes in the IPO framework are defined as the manner in which a group performs its task (Jex, 2002). Examples include communication and conflict management. These processes directly affect group output. Finally, output has social and performance elements. First, outcomes are measured in terms of productivity, which is output that an independent

observer might assess. Second, outcomes are measured in terms of team members' satisfaction with the group. A depiction of McGrath's original IPO model is provided in Figure 1.1.

Insert Figure 1.1

While the basic IPO model provides an adequate way to begin understanding team effectiveness, there are additional non-input, non-process factors which affect outcomes and should thus be included in the team framework. Some of these factors are characteristics of the team, or affect regarding the team. These factors are considered emergent states, or "properties of the team that are typically dynamic in nature and vary as a function of team context, inputs, processes, and outcomes" (Marks, Mathieu, & Zaccaro, 2001, p. 357). Marks et al. (2001) include emergent states as mediators along with processes in their revision of the traditional IPO framework.

The current research addresses the effects of virtual leadership on output within a revised IPO framework (Marks et al., 2001). However, in order to understand how leadership impacts output in virtual teams, relevant inputs, shared or emergent states, and processes must be included. Variables in each of these categories considered pertinent to the virtual environment will be addressed in the following sections. Certain aspects of this model have been adapted from the Kahai et al. (1997, 2004) studies, such as the inclusion of aspects of communication and outcomes. Additional elements of this model are included in the current study due to the importance of particular shared states and off-task communication in virtual teamwork. A depiction of the model that drove this study

is shown in Figure 1.2. The part of the model explored previously by Kahai et al. (1997, 2004) is shown in black in this figure. The contribution of my study to testing this model is shown in red.

Insert Figure 1.2 Here

Virtuality

Virtuality, in this study, is defined by the communication media used by a team, which is likewise classified by degree of virtuality through MRT. Therefore, virtuality is an "environmental level" input in McGrath's IPO framework (1964). Virtuality is thus expected to affect emergent states (as per Marks et al., 2001) through its consequences on users' cognitions, affect, and behavior. The effects of virtuality on the cognition, affect, and behavior of those using communication media have been well-documented in the current literature (Dyer, Green, Pitts & Millward, 1995; Hinds & Bailey, 2003; Kato, Kato & Akahori, 2007; Kiesler, Siegel, & McGuire, 1984; McGuire, Kiesler, & Siegel, 1987; Siegel et al., 1986, Sproull & Kiesler, 1985; 1992; Warkentin et al., 1997).

Prior literature indicates that the use of virtual communication technology by teams has a number of consequences on cognition, affect, and behavior of team members. Specifically, teams working over virtual communication technologies perceive their work environment differently than teams working face to face. That is, these virtual teams develop affective bonds less readily, and behave differently than their face to face counterparts. With regard to cognitive consequences of virtual communication, virtual team members experience their work environment as more socially isolating, and

therefore perceive themselves as having more anonymity than their face to face counterparts (Kiesler et al., 1984). Additionally, in terms of affective consequences, people communicating over virtual communication technologies tend to interpret messages more negatively than they were intended, especially when contextual cues are limited (Kato et al., 2007). Further, people communicating over virtual media tend to express more negative emotions (Dyer, et al., 1995; McGuire, et al., 1987). As a result, teams working over virtual communication technologies tend to experience more affective conflict (Hinds & Bailey, 2003), and have more difficulty forming relational and affective links (Warkentin et al., 1997). Finally, with regard to behavioral consequences, users of virtual communication technologies have been found to act in more anti-normative and anti-social ways than their face to face counterparts (Siegel et al., 1986, Sproull & Kiesler, 1985; 1992).

Clearly, the use of virtual media by a team creates a unique environment with which virtual team members must cope. The prior literature has documented the numerous effects virtuality has on ***individual*** team members. What has not been explored in the previous literature, however, is if the cognitive, affective, and behavioral consequences of using virtual media negatively impact the formation of shared team states in virtual teams. Specifically, the shared states of collective efficacy, team empowerment, and interpersonal cohesion may not form as strongly or as readily in virtual as opposed to face-to-face teams. Further, while the prior literature documents the effects of virtuality on separate shared team states and processes, no attempt has been made at using the IPO framework to integrate and extend these findings, as is done in the current study.

Collective efficacy is a group-level construct that reflects a shared belief amongst group members in the group's ability to organize and complete processes needed to attain goals, analogous to the individual-level construct of self-efficacy (Bandura, 1997). Not only has a meta-analysis on collective efficacy identified a strong positive association between collective efficacy and performance in face to face teams (Gully, Incalaterra, Joshi & Beaubien, 2002), but collective efficacy has been found to lead to better communication and performance in virtual learning groups as well (Wang & Lin, 2007). Thus, collective efficacy is clearly an important shared state in both virtual and face to face environments.

While collective efficacy is important for the success of virtual teams, previous research has not looked at the extent to which the cognitive effects of using virtual communication media may damage the ability of a team to form a sense of collective efficacy. One specific effect of virtuality, the perception of anonymity creates conditions that are ripe for social loafing (Paulus & Dzindolet, 1993; Sanna, 1992). Indeed, some research shows that electronic brainstorming can be improved through the encouragement of social comparison, suggesting that conditions of anonymity, and thus, social loafing, are present in the virtual working environment (Shepherd, Briggs, Reinig, Yen, & Nunamaker, 1996). Such non-participatory behavior can damage team members' sense of collective efficacy (Kahai, Sosik, & Avolio, 2003).

Another important process variable that could be affected is cohesion. Cohesion reflects the attraction of team members to their group. Further, cohesion is often considered a multi-dimensional construct comprised of task and interpersonal aspects (Gross & Martin, 1952; Zaccaro 1991). Interpersonal cohesion refers to relationships and

friendships amongst team members (Lott & Lott, 1965), whereas task cohesion is defined as individual members' task-based attraction to the group (Hackman, 1976). The current study focuses on interpersonal cohesion, as it is more likely that interpersonal cohesion will be affected and applicable in the virtual environment, as virtual teams have greater difficulty with relational development than task orientation, especially at their initiation (Chidambaram, 1996).

Studies have shown that cohesion form at a lower level in virtual, as opposed to face to face, teams (Balthazard et al., 2004; DeRosa et al., 2004; Driskell, Radtke, & Salas 2003; Zaccaro & Bader, 2003). It is likely that the negative affect expressed through virtual communication media may result in personal dislike among team members. Further, research shows that virtual teams have greater difficulty developing relational bonds amongst team members (Jarvenpaa & Leidner, 1999; Warkentin et al., 1997). Without these relational bonds, cohesion will form at a lower level—if indeed it forms at all. Additionally, given that these relational bonds are most directly related to the formation of interpersonal cohesion, it is likely that interpersonal cohesion is more affected by this issue relative to task cohesion. Indeed, it is reasonable to hypothesize that team member dislike of one another, and team members' inability to develop relational bonds, will inhibit the team's ability to develop a high level of interpersonal cohesion.

Finally, team empowerment is another important group-level process variable which may form at a lower level in virtual teams. Team empowerment has been conceptualized as a multi-dimensional construct, comprised of the following aspects: a.) potency - the collective belief of a team that it can be effective; b.) meaningfulness - the

perceived importance and value of a team's tasks; c.) autonomy - the degree to which team members experience freedom, independence, and discretion in their work; and d.) impact - the teams' perception of their ability to contribute significantly to the organization (Chen et al., 2007; Kirkman & Rosen, 1999; Kirkman et al., 2004). Team empowerment has been linked both to process (Mathieu, Gilson, & Ruddy, 2006) and team productivity (Chen et al., 2007; Kirkman & Rosen, 1999) in face to face teams. Additionally, Kirkman et al., 2004 found that team empowerment is more important to process and productivity improvement in virtual, as opposed to face-to-face teams. Thus, team empowerment is clearly an important variable to consider in the current study.

While team empowerment appears to be more important in a virtual environment relative to a non-virtual environment, the very nature of the virtual environment may damage a team's ability to develop this shared state at a high level. Specifically, both Kirkman & Rosen (1999) and Mathieu et al. (2006) found that a good social structure, where team members feel that communication can be safe and open, strongly contributes to team empowerment. In a virtual environment, individuals are more likely to act in anti-normative and anti-social ways (Siegel et al., 1986, Sproull & Kiesler, 1985; 1992). Such anti-social and anti-normative behavior may damage team members' perception of a safe social structure, thus damaging level of team empowerment. In sum, based on Figure 1.2 and the aforementioned literature, I hypothesize the following:

Hypothesis 1a: Virtuality results in lower levels of shared team states, such as collective efficacy, interpersonal cohesion, and team empowerment.

While the assessment of the level of interpersonal cohesion, collective efficacy, and team empowerment will provide some idea of the extent to which virtuality is

expected to impact the formation of shared team states, it does not address the whole picture. Next, I turn to the levels literature to further explicate how virtuality may affect these shared states. Specifically, cues from the levels literature reveal a second imperative: team members must not only feel that their teams are highly cohesive, empowered, and efficacious—they must also share these perceptions. This corresponds to the distinction within the levels literature between the "mean" and the "dispersion" of shared team state development (Chan, 1998; Zohar & Luria, 2005). The mean of a particular aggregate property is developed through the additive model, in correspondence with Chan's (1998) framework. Through this model, the shared team state is viewed as the aggregate of individual responses, regardless of variance amongst these individuals. While the mean, or level, of shared team states is an important variable to address, it does ignore a fundamental aspect of shared team states. That is, shared team states by definition must be shared.

In order to address the "shared" property of these shared team states, I must then also assess the level of agreement amongst team members on the strength of these states. This corresponds to the model labeled by Chan (1998) as the "dispersion" model. In this model, the amount of agreement (or disagreement) amongst individuals within a team is a meaningful variable itself. Indeed, Kozlowski & Klein (2000) specifically address the importance of dispersion in assessing shared team properties—by definition, these properties are achieved through consensus amongst individual team members. If a team disagrees on the strength of these states, then they cannot be said to operate on a team level. Instead, they could only be thought of as individual perceptions of their team

(James, 1982). Thus, to fully assess the extent to which virtuality impacts team shared states, I also hypothesize that:

Hypothesis 1b: Virtuality will be negatively associated with the degree of sharedness for the shared team states (e.g. collective efficacy, interpersonal cohesion, and team empowerment).

Shared or Emergent States

Prior literature indicates that shared team states affect team processes (collective efficacy: Kahai et al. 2003; interpersonal cohesion: Hart & McLeod, 2003; team empowerment: Kirkman et al., 2004). As depicted in Figure 1.2, I hypothesize that these shared team states will directly affect particular communication processes, such as evaluative (critical and supportive) remarks, solution proposals, and off-task remarks. Critical remarks can be thought of as comments targeted at criticizing other's ideas. Conversely, supportive remarks reflect positive, supportive comments provided to indicate agreement with others. Both of these remarks are clearly "evaluative", as they are used to provide feedback to other team members about the quality of their ideas. Proposed solutions naturally reflect solutions posed by group members to solve the team task. Requests for clarification, then, are offered when team members do not understand what someone else in their team has said. Finally, off-task remarks are comments that do not relate to the problem at hand, and often are social or personal in nature.

Collective Efficacy

As discussed previously, Bandura (1997) defines collective efficacy as a shared belief amongst group members in the group's ability to organize and complete processes needed to attain goals. Collective efficacy level has been linked to a number of positive

outcomes at the team level. For instance, collective efficacy is linked to performance in sports teams (Watson, Chemers, & Preiser, 2001), decision-making groups (Jung & Sosik, 2003), long term effectiveness (Pescosolido, 2003), and even work groups abroad (Jung & Sosik, 2002). Further, collective efficacy has also been linked to satisfaction in a group chat environment (van Dolen, Ruyter, & Carman, 2006).

Unfortunately, however, there is limited research on how collective efficacy might impact communication. Only one study was found that empirically examined the relationship between collective efficacy and communication. Specifically, Wang & Lin (2007) found that collective efficacy enhances communication in virtual groups. Another paper that addresses the linkage between collective efficacy and communication provides a theoretical model delineating the development of collective efficacy (Gibson & Earley, 2007). This model alludes to communication in the context of interaction and cooperation. However, according to Gibson & Earley (2007), cooperation is an antecedent of collective efficacy, not an outcome. While this latter proposition is inconsistent with my model, a hint about how to untangle this apparent contradiction in the literature comes from Marks et al. (2001). Marks et al. (2001) distinguish between processes and emergent states. According to Marks et al. (2001), emergent states are dynamic properties of the team that both influence, and are influenced by, inputs, processes, and outputs. As such, emergent states can be either antecedents or consequences of processes. In the current paper, I address collective efficacy as an emergent state. That is, collective efficacy is seen as dynamic. Thus, while communication may help develop collective efficacy (Gibson & Earley, 2007), it is also likely that collective efficacy improves and enhances communication (Wang & Lin,

2007). In the current paper, I focus on collective efficacy as an antecedent of communication, as the former is likely directly impacted by the use of communication technology.

While literature on the linkage between collective efficacy and communication is scarce, studies show that agreement on perceptions of collective efficacy does increase over time (Jung & Sosik, 2003), as do levels of self-efficacy (Baker, 2001). Clearly, then, something is happening over time—perhaps increased interaction and communication—that helps build collective efficacy. In sum, it appears that an increased sense of collective efficacy should bolster confidence in the team and interest in the task. Thus, I hypothesize that collective efficacy will enhance task related communication, leading to more solution proposals, evaluative remarks, and less off-task discourse.

Interpersonal Cohesion

Interpersonal cohesion refers to relationships and friendships amongst team members (Lott & Lott, 1965). Cohesion has been linked consistently to team performance (Carron, Colman, & Wheeler, 2002; Wolfe & Box, 1988; Michalisin, Karau, & Tanpong, 2004). While cohesion affects outcomes, McGrath (1964) does not include it in the original IPO framework. Curşeu (2006), however, identifies it as an emergent state, which allocates cohesion to a position within Mark et al.'s (2001) revised IPO model.

Research on interpersonal cohesion and communication has left the exact relationship between cohesion and communication uncertain. Some studies have looked at communication as an antecedent of cohesion (Anderson & Martin, 1999), or have addressed the two as occurring simultaneously (Driskell et al., 2003; Ivancevich, 1974).

However, some early research shows that initial cohesion levels predict the use of an information system, which required communication with a gatekeeper to access (O'Keefe, Kernaghan, Rubenstein, 1975). Further, research by Lott & Lott (1961) shows that cohesiveness is positively related to communication within groups. Marks et al. (2001) provide a way for us to understand this apparent ambiguity—cohesion, as an emergent state, is dynamic, and should both contribute to and be enhanced by communication. In the current study, I viewed cohesion as an antecedent of communication, given that cohesion should be directly impacted by communication technology (Burke, Aytes, & Chidambaram, 2001). Thus, I extended the literature by specifying which aspects of communication should be particularly affected by interpersonal cohesion.

Interpersonal cohesion (e.g. the relational ties between team members) promotes positive feelings about team members' experiences. Therefore, interpersonal cohesion should have the greatest impact on aspects of communication that are targeted at relationship development and maintenance. Thus, given that teams with high interpersonal cohesion should also have strong relational bonds, they are likely to engage in non-task, relationally-oriented communication. Specifically, high interpersonal cohesion should lead to an increased number of off-task remarks. Further, teams with high interpersonal cohesion are also hypothesized to be more supportive and less critical of each others' suggestions, as they will be mindful of the relational links within the team and the need to maintain cohesion.

Team Empowerment

As previously discussed, team empowerment is conceptualized as a multi-dimensional construct, comprised of potency, meaningfulness, autonomy, and impact (Chen et al., 2007; Kirkman & Rosen, 1999; Kirkman et al., 2004). Team empowerment has been linked both to process (Mathieu et al., 2006) and team productivity (Chen et al., 2007; Kirkman & Rosen, 1999) in face to face teams. Additionally, Kirkman et al., 2004 found that team empowerment is more important to process and productivity improvement in virtual, as opposed to face-to-face teams. Beyond its contribution to process and effectiveness in general, some research shows that the meaning facet of team empowerment is related to extensive communication within a team (Özaralli, 2003). Research by Kirkman and Rosen (1999) also indicates that highly empowered teams are more likely to engage in proactive behaviors and communication, while work by Hyatt & Ruddy (1997) shows that such team are innovative, and are more likely to seek continuous improvement. In sum, current research on team empowerment strongly supports the idea that empowered teams are proactive, innovative, and communicate frequently.

Based on theory and empirical findings on team empowerment, I hypothesize that highly empowered teams will be more likely to participate and focus communication on task related issues. Thus, it is hypothesized that team empowerment will lead to more solution proposals. Further, given the tendency for empowered teams to seek continuous improvement, team empowerment should lead to more critical and supportive remarks, as it will encourage frank and open discussion of task-related issues. Finally, as team

empowerment is focused on task issues, it should lead to lessened off-task discourse. In sum, I hypothesize the following:

Hypothesis 2: Shared team states affect communication.

2a. Collective efficacy will positively affect solution proposals and evaluative remarks, and negatively affect off-task discourse.

2b. Interpersonal cohesion will positively affect supportive remarks and off-task discourse and negatively affect critical remarks.

2c. Team empowerment will positively affect solution proposals and evaluative remarks, and negatively affect off-task discourse.

Given the importance of these shared states to processes and productivity, I will include measures of these shared states to test these proposed mechanism by which virtuality affects teams. Next, I discuss how the process of communication was hypothesized to affect outcomes.

Communication

A process particularly salient in the virtual environment is communication. Research on virtual teams consistently highlights difficulties teams encounter due to their reliance on communication technology (DeRosa et al., 2004, Driskell et al., 2003, Martins, Gilson, & Maynard., 2004). Clearly, then, communication warrants investigation in the proposed study.

Several key studies on the effects of leadership on virtual team effectiveness (Kahai et al.; 1997; 2004) address communication. For instance, Kahai et al. (1997; 2004) assessed aspects of participation. The variables used to do so were also aspects of communication: critical remarks, supportive remarks, proposed solutions, and requests

for clarification, as previously discussed and defined. This schema to assess participation through communication has been used in past virtual team studies (Connolly, Jessup, & Valacich, 1990). Since virtual teams generally lack informal communication (DeRosa et al., Martins et al., 2004), I also include off-task remarks in as a measure of communication in the current study.

Solution proposals, entailing potential ways to solve a given problem, should thus directly affect productivity (Kahai et al., 1997; 2004). Further, as in Kahai et al. (1997;2004), solution proposals should also make team members feel more satisfied with their experience as part of their team. That is, as team members propose a greater quantity of solutions, they should also feel more positively about their team and their team's performance. With respect to the two kinds of evaluative remarks (supportive and critical), supportive remarks should encourage teammates, leading to greater productivity and satisfaction. Critical remarks, on the other hand, should enhance team productivity by inspiring brainstorming about the task. However, critical remarks should also inspire dissent amongst team members, thus damaging satisfaction. Finally, off-task remarks, being unrelated to the task, but aimed at sharing personal information with team members, should only improve satisfaction, and not productivity. Hypotheses are not made about requests for clarification, as these are not expected to be directly linked to either productivity or satisfaction.

Hypothesis 3: Communication affects outcomes

3a. Solution proposals and supportive remarks positively affect satisfaction and productivity

3b. Critical remarks will positively affect productivity and negatively affect satisfaction

3c. Off-task remarks will positively affect satisfaction.

Leadership as a Moderator

While in a virtual setting, the use of communication technology may impede the formation of a functioning team, leadership may be able to overcome these difficulties. Specifically, as discussed earlier, directive leadership can provide structure and guidance in the ambiguous virtual environment. Thus, team members will experience less ambiguity when working on their assigned task. This reduction in ambiguity should enhance the virtual team's collective efficacy as well as team empowerment. Alternatively, because participative leadership incorporates the opinions of group members, it should reduce perceptions of social isolation, and therefore facilitate team members developing stronger interpersonal cohesion and collective efficacy. In contrast to these two leadership styles, having laissez-faire leadership should result in virtual team members having to navigate the ambiguous, socially isolating, affect-absent virtual environment alone. Thus, the absence of leadership should be particularly deleterious in a virtual context.

Hypothesis 4: Leadership enhances the ability of virtual team members to develop team shared states.

4a. Directive leadership will be more effective than participative and laissez-faire leadership conditions

4b. Participative will be more effective than the laissez-faire leadership condition

4c.The negative effect of virtuality on shared team states will be mitigated by leadership, such that directive leadership mitigates the effects of virtuality more than participative or laissez-faire leadership, and participative leadership mitigates the effects of virtuality more than laissez-faire leadership.

In sum, the model tested in the current study incorporates a number of theoretical and empirical findings to more fully address the role of leadership in mitigating the negative effects of virtuality on the formation of emergent states, and through these states, processes and outcomes. While Kahai et al. (1997; 2004) provide initial support for the moderating impact of leadership in a virtual environment, the current study built upon these results in several ways. First, unlike the work of Kahai and his colleagues, the current study directly investigated the impact of virtuality on certain shared team states. Second, while the Kahai et al. (1997; 2004) studies were the first to address path-goal leadership approaches through the team framework, neither of their studies addressed virtuality, shared states, and communication through the IPO framework, as was done in the current study. Finally, neither of the Kahai et al studies addressed the difference in effect of these leadership behaviors between virtual and FTF teams. My research addressed these issues using Media Richness Theory.

Method

Participants

A power analysis revealed that a minimum of 10 teams per condition would be needed to have 80% power to detect a large effect. Based on this analysis, I collected 60 four-member teams. Thus, a total of 240 participants were involved in the current experiment. Participants were undergraduates attending the University of Maryland in College Park. They were recruited by using the Department of Psychology's SONA system as well as by gaining permission from upper level psychology course professors to recruit their students. One credit hour of extra credit and entry into a lottery for several prizes were offered as incentive to participate in the research.

Participants were, on average, 19.9 years old (range = 17-36). The majority of the sample (64.9%) was female and majored in psychology (50%). The second most frequent major cited (4.2%) was kinesiology. All other majors had fewer than 10 participants self-identifying themselves (i.e., less than 4.2%). The majority of the participants were white (55.4%), followed by African Americans (14.2%), Asians (11.3%), bi-racial individuals (6.7%), and Indians (2.1%). Fewer than 5 participants identified themselves in any of the remaining ethnicities (i.e. less than 2.1%). Finally, 30.5% of participants were sophomores, 24.7% were juniors, 23.4% were freshmen, and 21.4% were seniors

Experimental Design

The current study employed a 2 (virtuality manipulation) x 3 (leadership style manipulation) between-groups experimental design. Groups of four participants were randomly assigned to one of the two virtuality conditions (i.e., instant messaging (IM) vs. face-to-face meeting) and one of three leadership style conditions. With respect to the

virtuality manipulation, the groups assigned to the IM condition were in the more virtual (i.e., less rich) environment whereas groups assigned to the face-to-face meeting were in the non-virtual condition.

With regard to the three leadership style conditions (i.e., participative; directive; laissez-faire leadership), I followed the work of Kahai et al. (1997; 2004) by having each group led by a confederate displaying one of these three different leadership styles. Specifically, leadership was manipulated by having the confederates carefully follow memorized scripts (see Appendices A, B, and C) either by entering the script text when in the virtuality condition or by enacting the script in the non-virtual condition.

The scripts for participative and directive leadership (Appendix A and B, respectively) were adapted from Kahai et al. (1997; 2004). Specifically, the participative leaders consulted participants for their suggestions. They also offered, but did not impose, directions, and they encouraged participants to contribute to the group process. Directive leaders, on the other hand, asserted that they were in charge and provided explicit direction to participants. A third script was developed to convey laissez-faire leadership. In this condition, the confederate simply gave the teams their assigned task and did not speak further until the study was complete (see Appendix C).

Two additional issues should be noted about the experimental manipulations. First, all scripted comments for the leadership manipulations in the IM condition were not capitalized to more accurately replicate the way people typically communicate over IM. This lack of capitalization was done to make the comments seem more realistic and less scripted. Second, participants in the IM condition were asked not to surf the internet while completing the study.

Experimental Task

Each group was asked to complete a 23 minute task. I used one of the tasks from the studies by Kahai et al (1997, 2004). Specifically, I used the more unstructured of the two tasks employed in these studies. The task required the groups to identify ways to improve the prestige of the university. More specifically, the group members had to first generate alternative ways to improve the university's prestige, and then the group had to identify the most appropriate solutions. Kahai et al. (1997, 2004) established that this task was perceived as unstructured by their participants.

Procedure

None of the members of my teams were explicitly introduced to each other or to their "leader" before the task began. After the task was assigned, the leader provided initial comments. The groups were then allowed to conduct their work. Following completion of the task, interpersonal cohesion, collective efficacy, team empowerment, and satisfaction were measured via questionnaire. In addition to these measures, manipulation checks of both leadership and task structure were also administered. To assess communication during the study, virtual team members' IM conversations were saved, and face to face team members' verbal conversations were audio and video recorded. These recordings were then transcribed and coded to identify comments.

Measures

Interpersonal Cohesion: I used two measures of interpersonal cohesion. It was measured through a semantic differential scale assessing interpersonal attraction (Zaccaro & McCoy, 1988) as well as through a measure of cohesion developed by Craig & Kelly (1999). The Zaccaro & McCoy (1988) scale assessed group members perception of their

groups using a set of six bipolar items. Following the work of González, Burke, Santuzzi, & Bradley, (2003), I changed the Zaccaro & McCoy (1988) measure to a 7 point scale. This scale is available in Appendix D.

A maximum likelihood factor analysis was conducted at both the individual and team level using SPSS to explore the structure of this scale. Only one factor emerged with an eigenvalue greater than 1 at both levels of analysis. All items loaded on this factor at both the individual and team levels.[1] The factor loadings for the items are shown in Table 1. The loadings for all the items are acceptable, regardless of level of analysis and the internal consistency reliability for this scale at the group level of analysis was .88.

The Craig & Kelly (1999) measure of cohesion is in Appendix E. In this measure, group members responded to four cohesion questions using a 7 point scale. Maximum likelihood factor analysis was conducted at both the individual and team level to explore the structure of this scale. Again, only one factor emerged with an eigenvalue greater than one at both levels of analysis. All items loaded on this factor at both the individual and team levels. The factor loadings for each item are displayed in Table 1. In this study, the internal consistency reliability for this scale at the group level of analysis was .78. Both of these measures showed acceptable levels of reliability (Nunnally & Bernstein, 1994).

To explore the extent to which these two scales address the same underlying construct, the scale averages were correlated at both the individual and team level. These analyses reveal a significant correlation between these two factors at the individual ($r(235) = .45$, $p < .01$) and team ($r(60) = .53$, $p < .01$) levels. Given the magnitude of

these correlations, it is reasonable to assert that both scales measure the same higher-level construct of interpersonal cohesion. Since both were measured on 7 point scales, an overall interpersonal cohesion scale was generated by averaging responses to the items from these two scales together. The reliability of this linear combination at the group level of analysis is .90 (Nunnally & Bernstein, 1994). This overall scale was used in for the remainder of the analyses in the current study.

Insert Table 1

Collective Efficacy: I used two measures of this construct in the current study. First, I used the measure developed by Salanova, Llorens, Cifre, Martinez & Schaufeli (2003). Salanova et al. (2003) adapted four items from Schwarzer & Jerusalem's (1995) Generalized Self-Efficacy Assessment to measure group-level, as opposed to individual-level, efficacy. This measure is shown in Appendix F. To assess the structure of this scale, maximum likelihood factor analyses were conducted at the individual and team level. At first, two factors with eigenvalues greater than 1 emerged at both levels of analysis. A one-factor structure was then forced on the data. All items loaded on this factor at the individual and the team levels at or above .4. The factor loadings for each item are displayed in Table 2. Given these results, and the historic use of this measure as a single factor, I used this measure as a single-factor scale in the current study. In my study, the Cronbach's alpha of the Salanova et al. (2003) scale at the group level was .90.

Second, I measured collective efficacy by using an adaptation from Bandura's (1997) self efficacy measure. This adaptation is fairly common in the literature, and has been used in numerous studies examining collective efficacy (Earley, 1999; Katz-Navon & Erez, 2005; Prussia & Kinicki, 1996). Specifically, this collective efficacy scale measures the extent that individuals feel their team can generate a certain number of solutions within a given time frame. Generally, as noted by Prussia & Kinicki (1996), the number of solutions used as the target of these questions ranges from 40% below the normed performance to 40% above the normed performance. Since there is no normative information available for this task, I simply adapted the measure to levels that seemed reasonable given the 23 minute time limit imposed on the groups. The second measure of collective efficacy is in Appendix G. I assessed the structure of this scale using a maximum likelihood exploratory factor analyses at the individual and team level. Only one factor emerged with an eigenvalue greater than 1 at both levels of analysis. All items loaded on this factor at the individual and the team levels. The factor loadings for each item are displayed in Table 2. This team level Bandura scale had a Cronbach's alpha of .97 at the group level. The Cronbach's alphas of the two collective efficacy scales reflect very strong reliability.

Insert Table 2

To assess whether or not these scales could be combined into a single collective efficacy measure, I ran correlations between the measures at both the individual and team levels. The scales were significantly correlated with each other at both the individual

($r(238) = .49$, $p < .01$) and the team ($r(60) = .54$, $p < .01$) level. Given the magnitude of the correlation between the two scales, they are both likely tapping into the same higher order construct of collective efficacy, and could thus be combined to form a composite collective efficacy score. Since the two scales used different scale anchors, the scale scores had to be standardized before they could be averaged together. The z-scores resulting from this standardization were then averaged together to create the second-order factor. The reliability of the linear combination at the team level was .97 (Nunnally & Bernstein, 1994).

Team Empowerment: The 12-item version of Kirkman & Rosen's (1999) team empowerment questionnaire was used in the current study. This version is a shortened version of the original scale. However, the shortened version has previously been used by Kirkman et al (2004) to assess team empowerment and they found that the shortened measure adequately addresses all aspects of team empowerment. Specifically, the measure has three questions that assess potency, three questions that assess meaningfulness, three questions that capture feelings of autonomy, and three questions that assess perceptions of impact. Appendix H displays the team empowerment measure used in the current study. As with the previous two team shared states, I conducted a maximum likelihood factor analysis at both the individual and team level to assess the structure of this scale. Only one factor emerged with an eigenvalue greater than 1 at both levels of analysis. The twelve items loaded onto this factor at both the individual and the team level. The factor loadings for these items are displayed in Table 3. The Cronbach's alpha for this measure at the team level was .93.

Insert Table 3

Communication: The communication categories were coded from transcripts of the team conversations by independent sources. Six raters were trained on the coding schema. These six raters were undergraduate research assistants who volunteered or were earning course credit for their assistance with coding and data preparation for this project. The six raters were split into three groups and the three groups were randomly distributed a portion of the 60 conversations to code. Discrepancies between members in a coding dyad were discussed and resolved with the help of a mediator.

The coding scheme required the raters to first assess overall amount of communication in terms of number of unique comments made by participants. Further, the coding scheme required the raters to measure four different communication properties of the groups (i.e., solution proposals, supportive remarks, critical remarks, and off-task remarks). Coding was conducted at the individual level of analysis, and aggregated to represent team-level communication. Six of the 60 total conversations, one from each of the six conditions, were assigned to all six raters to code. A measure of inter-rater reliability specifically designed for more than 2 raters coding categorical variables, Fleiss' Kappa (Fleiss, 1971), was employed to assess agreement between raters. Fleiss' Kappa is calculated by dividing the actual agreement achieved by the maximum potential agreement attainable above chance. Specifically, the equation for Fleiss' Kappa is as follows:

$$\kappa = \frac{\frac{1}{Nn(n-1)}\left(\sum_{j=1}^{N} n \sum_{i=1}^{k} 2_{ij} - Nn\right) - \left(\sum_{j=1}^{k}\left(\frac{1}{Nn}\sum_{i=1}^{N} nij\right)^{2}\right)}{1 - \left(\sum_{j=1}^{k}\left(\frac{1}{Nn}\sum_{i=1}^{N} nij\right)^{2}\right)} \quad (1)$$

Where n represents the number of raters, k the number of categories comments were assigned to, and N the total number of comments that were rated. Comments are indexed i = 1, . . . N, while categories are indexed j = 1, . . . k. Fleiss' Kappa in the current study was .49. Landis and Kock (1977) provide a six category guide for interpreting Fleiss' Kappa (i.e., a.) < 0 poor agreement, b.) 0.0 – 0.20 slight agreement, c.) 0.21 – 0.40 fair agreement, d.) 0.41 – 0.60 moderate agreement, e.) 0.61 – 0.80 substantial agreement, and f.) 0.81 – 1.00 almost perfect agreement). Given the observed kappa of .49, there appears to be a moderate level of inter-rater agreement.

For actual analyses conducted with this variable, however, I decided to convert these frequency counts into percentage scores because it is possible that some groups simply talk more than others and this talking frequency could bias the raw frequency information across groups. I tested for between group differences on overall communication by teams by conducting a one-way ANOVA. The results indicated significant differences in overall amount of communication between groups ($F(59, 180) = 3.34$, $p < .01$). Based on these results, I computed the percentage of each type of communication by dividing the frequency in each coded category by the overall communication of that group. In this way, I assess a meaningful measure of communication that is not confounded by overall communication differences between groups.

More specifically, the team-level solution proposals were calculated from the number of statements in which participants proposed solutions over the total number of comments. A measure of team-level supportive remarks was calculated from the number of statements in which participants supported a proposed solution over the total number of comments. A measure of team-level critical remarks was calculated from the number of statements in which participants criticized a proposed solution over the total number of comments. A measure of team-level off-task remarks was calculated from the number of statements in which participants exchanged relational or personal non-task communication over the total number of comments.

Satisfaction: I used the Kahai et al. (1997, 2004) measure of satisfaction. Specifically, satisfaction with outcome, group process, and discussion was assessed. An overall satisfaction measure was created by averaging individual responses to these items. The satisfaction questionnaire is shown in Appendix I. The Cronbach's alpha of this satisfaction measure was .90 indicating high reliability.

Performance: Performance was independently coded by the same six raters who coded communication. Following the same procedure used in assessing communication, the six raters were randomly separated into three groups to code team performance.

I used the same coding process used by Kahai et al. (1997, 2004) to assess performance. Specifically, team performance was computed by counting the number of unique solutions generated by each team. Independent raters coded proposed solutions as either unique or repeated. Performance was measured in two different ways: proportion of unique solutions over overall solutions and proportion of solutions that involve the synthesis of earlier ideas over overall number of solutions.

These two measurements are related to Guilford's (1950) conceptualization of creativity. Divergent creativity is the extent to which individuals can draw on different ideas and generate multiple answers to a given problem. In the current study, the proportion of solutions that are new, or extend upon other solutions, was used as a measure of divergent creativity. Convergent creativity is the extent to which individuals can take different ideas or concepts and draw a single solution from them. In the current study, synthesized proposals were used as a measure of convergent creativity. Definitions of communication categories, including types of proposals, are available in Appendix L.

With regard to rater accuracy, all six raters coded performance from six conversations, one from each of the six experimental conditions. Fleiss's Kappa for performance ratings was .25, indicating fair agreement. Discrepancies in coding between the pairs were resolved through discussion with a mediator.

Task Manipulation Check: I employed one item used in Kahai et al. (1997; 2004) to assess task ambiguity. The task manipulation check is available in Appendix J.

Leadership Manipulation Check: As in the Kahai et al. (1997, 2004) studies, the manipulation check of leadership was composed of five questions that assessed the extent to which leaders displayed either participative (three items) or directive (two items) behaviors. Further, I added one item that asked participants to choose one of three descriptions (participative, directive, or uninvolved) that best described their facilitator's behavior. The leadership manipulation check is available in Appendix J. The reliability of the three-item participative measure was .69, while the reliability of the two-item directive measure was .66. While I expected these two types of leadership scales to be negatively related, in the current sample they were significantly positively correlated

($r(240) = .30$, $p < .05$). This may initially seem counter-intuitive, however, this result is actually reasonably consistent with path-goal leadership theory (House, 1971), in which leaders are proposed to be able to display more than one leadership style at any given time. Given these results, in the current study, I regard these scales as distinct scales of participativeness and directiveness, as opposed to a single scale that captures both.

Results

Manipulation Checks

Task Manipulation Check. As previously discussed, I employed one of two tasks originally used in the Kahai et al. (1997; 2004) studies. In particular, I selected the more unstructured of the two tasks used by Kahai et al (1997; 2004). This task asked students to brainstorm ways to improve the university's prestige. Immediately after completing the task, participants in my study rated their perceptions of task ambiguity on a 5 point scale. The mean for the task ambiguity check was 3.02 (95% CI: 2.88-3.15), which falls right around the center of the scale. As such, the current task can be seen as moderately ambiguous. Interestingly, these results are comparable to results reported in Kahai et al. (1997; 2004) for this task (mean = 2.98).

Leadership Manipulation Check. Analyses were conducted to see if the leadership manipulation was effective. To assess the leadership manipulation, One-Way ANOVAs were conducted to examine differences in participants' responses to both the participative and directive leadership manipulation checks. If the manipulation worked, participative leaders should be rated more highly on the participative leadership scale than directive leaders, who in turn should be rated more highly than the laissez-faire leaders. Likewise, directive leaders should be rated higher than participative leaders on the directive leadership scale, who in turn should be rated higher than laissez-faire leaders.

A One Way ANOVA on the participative leadership scale revealed significant differences overall ($\eta^2 = .13$, $F(2,237) = 17.53$, $p < .01$). Since I had a-priori hypotheses regarding the nature of the expected differences in leadership perceptions between conditions, I ran t-tests between participative, directive, and laissez-faire leadership

conditions. There were significant differences in perceptions of leader participativeness between the participative (M = 4.47) and laissez-faire leadership conditions (M = 3.88), with participative leaders being perceived as more participative than non-leaders ($t(158) = 4.43$, $p < .01$). There was also a significant differences in perceptions of leader participativeness between directive (M = 4.55) and laissez-faire leadership conditions ($t(158) = 5.13$, $p < .01$), with directive leaders being perceived as more participative than non-leaders. However, contrary to expectations, there was no difference in perceptions of leader participativeness between directive and participative leadership conditions ($t(158) = .79$, $p > .05$).

A one-way ANOVA was also run to assess differences in perceptions of directive leadership between conditions. Overall significant differences in perception of directive leadership behavior between conditions were found ($\eta^2 = .05$, $F(2,237) = 5.53$, $p < .01$). As before, since I had a-priori hypotheses regarding the nature of the expected differences in leadership perceptions between conditions, I ran t-tests between participative, directive, and laissez-faire leadership conditions. Again, there were significant differences in perceptions of leader directiveness between the participative (M = 3.73) and laissez-faire leadership conditions (M = 3.33), with participative leaders being perceived as more directive than non-leaders ($t(158) = 2.02$, $p < .05$). There was also a significant differences in perceptions of leader directiveness between directive (M = 3.94) and laissez-faire leadership conditions ($t(158) = 3.32$, $p < .01$), with directive leaders being perceived as more directive than non-leaders. However, contrary to expectations, there was no difference in perceptions of leader directiveness between directive and participative leadership conditions ($t(158) = 1.18$, $p > .05$). In sum, neither

manipulation checks revealed the expected results. Indeed, while participants appear to be able to distinguish between leaders and non-leaders, they do not appear to be able to distinguish between the two types of leaders.

While these prior analyses address how participants perceived their leaders' participative and directive leadership behavior, they do not provide analyses for the entire leadership manipulation check. Thus, one additional question was included as a part of this manipulation check: participants were asked to identify one, and only one, of three leadership descriptors as the one that applied most to the leader of their team. These descriptors portrayed a participative, a directive, and a non-leader. Thus, as a final test of the leadership manipulation, an overall χ^2 test of homogeneity was run to see if individuals within different conditions could correctly identify their leader through this single descriptor. The overall χ^2 was significant ($\chi^2(4) = 57.15$, $p < .01$), indicating non-homogeneity. Further, the Cramer's V coefficient, a measure of association between non-binary nominal variables, for this overall test is significant ($\varphi = .35$, $p < .01$). While this Cramer's V is significant, coefficients between .3 and .7 represent only a weak association between the two variables. Thus, while responses generally appear to fall along the diagonal, they do not always conform to this pattern. Essentially, since the diagonal of this χ^2 test represents "correct" responses, it appears that participants were only somewhat able to correctly identify their leader.

Additional χ^2 tests were conducted with two conditions examined at a time, to understand if participants were able to distinguish between any two pairs of leaders more accurately than other pairs. First, whether or not participants could discriminate between participative and directive leaders was explored. The χ^2 was significant ($\varphi = .28$; $\chi^2(1) =$

8.75, $p < .01$,). Since the φ coefficient was less than .3, there is no association between these two variables. That is, participants could not correctly discriminate between participative and directive leaders. Next, a χ^2 test comparing perceptions of participative and non-leaders was conducted. This test was also significant ($\varphi = .41$; $\chi^2(1) = 25.10$, $p < .01$). Since the φ coefficient is greater than .3, there is an apparent weak association between these two variables, such that participants appear to be somewhat able to differentiate between participative and non-leaders. Finally, a χ^2 test comparing perceptions of directive versus laissez-faire leadership was conducted. This test was significant ($\varphi = .53$; $\chi^2(1) = 28.03$, $p < .01$). The phi coefficient, again, is between .3 and .7, indicating a weak association between these two variables. That is, participants are able to somewhat differentiate between directive and non-leaders.

The results of both leadership manipulation checks are consistent. In sum, while participants can differentiate between leadership and laissez-faire leadership, they cannot differentiate between the two types of leadership. Given that the manipulation failed, it is important to interpret results corresponding to differences in leadership styles with caution.

Hypothesis Tests

Correlations between variables at the individual and team level are in Table 4 and Table 5, respectively. Hypothesis 1a and 1b predicted that teams working over instant messaging would report lower levels and greater dispersion of team shared states. Since these shared states are theoretically linked, highly correlated in the dataset (see Tables 4 and 5), and predicted to be influenced equally and in the same direction by virtuality, multivariate analyses were run to determine the influence of virtuality on all shared team

states. I first ran a multivariate ANOVA to assess the relationship between virtuality and dispersion of shared states. This can be done without any providing evidence of aggregation because the dispersion construct (i.e., standard deviation) only exists at the team level of analysis. The multivariate ANOVA (Wilk's lambda= .86, η^2 = .14, F(1,56) = 2.95, p <.05) was significant. This means that for some or all of the scales, teams working over instant messaging had significantly different dispersion levels on the shared team state variables than those teams working face to face.

To determine the direction of these relationships as well as to determine which shared team states were significant, I ran a series of one-way ANOVAs. The effects of virtuality on dispersion of shared states were significant for collective efficacy (η^2 = .13, F(1,58) = 8.58, p < .01, IM sd mean = .81, FtF sd mean = .52) and interpersonal cohesion (η^2 = .07, F(1,58) = 4.12, p < .05, IM sd mean = .93, FtF sd mean = .74), but not for team empowerment (η^2 = .05, F(1,58) = 2.94, p < .10, IM sd mean = .89, FtF sd mean = .84). Consistent with my hypotheses, virtuality negatively affected the amount of agreement between team members for collective efficacy and interpersonal cohesion. Inconsistent with my hypotheses, however, virtuality did not affect the amount of agreement between team members on team empowerment.

I next analyzed the extent to which virtuality affected the level of shared team states. However, when testing the level effects, it is imperative to account for variation both within and between teams. Random Coefficient Modeling (RCM) is an analysis technique that allows for the simultaneous assessment of effects on the team and individual level. More importantly, RCM allows for the assessment of data when the homogeneity of variance cannot be assumed (Raudenbush, 1988). As discussed

previously, the variance of shared team states statistically differed between virtual and face to face teams. In other words, the homogeneity of variance assumption is violated in the current study, and the use of RCM is required to deal with this violation.

Thus, I used HLM 6.06 to conduct a multivariate RCM to assess the main effect of virtuality on the formation of level of shared team states. In this analysis, a multivariate dependent variable is constructed as a function of all three states. Given my hypotheses, I did not enter any predictors at the individual (i.e., level 1) level of analysis but entered virtuality as a dichotomous predictor at the between team (i.e., level 2) level of analysis. The equations for this multivariate analysis are as follows:

Level 1 Model:

$$Y^* = CE * Y1^* + IC * Y2^* + TE * Y3^* \quad (2)$$

$$Y^* = P_0 + e \quad (3)$$

Level 2 Model:

$$P_0 = B_{00} + B_{01}(V) \quad (4)$$

In Equation 1, CE represents Collective Efficacy, IC and TE represent interpersonal cohesion and Team Empowerment, respectively. In Equation 3, V represents the virtuality manipulation (i.e., 1 = IM; 2 = face to face).

Results indicate that virtuality significantly predicted differences in the formation of shared team states at the team level (unstandardized B = .32, $p < .01$, $\beta = .19$). Additional single RCMs were conducted to investigate which team state effects were driving this relationship. Each state was regressed separately onto virtuality. Results of these analyses reveal that the measure of collective efficacy (unstandardized B = .38, $p < .05$, $\beta = .22$) appeared to be driving the multivariate results. Results of analyses conclude

that virtuality exhibited a trend on the level of interpersonal cohesion (unstandardized B = .28, $p > .05$, $\beta = .14$) and team empowerment (unstandardized B= .24, $p > .05$, $\beta = .12$). In sum, with regard to collective efficacy and interpersonal cohesion, Hypotheses 1a was supported. That is, people in the face to face condition had more agreement on collective efficacy and interpersonal cohesion than did people in the IM condition. Hypothesis 1b was supported for all three shared team states.

Hypotheses 4a and b predicted that leadership would have a main effect on shared team states. In particular, directive leadership was predicted to be more effective in forming shared team states than participative leadership and laissez-faire leadership, and that participative leadership would be more effective than laissez-faire leadership. To test these hypotheses on dispersion of shared team states, a multivariate ANOVA was run to gauge dispersion of shared team states by leadership. The results of this multivariate test were non-significant (Wilk's lambda = .91, $\eta^2 = .05$, $F(6,110) = .94$, $p > .05$). Given that the multivariate test was non-significant, no further analyses exploring the effect of leadership on dispersion were performed.

I next tested whether leadership had an effect on the level of shared team states. To do this, I ran a multivariate RCM. To test my hypotheses with this multivariate analysis, I had to create orthogonal leadership variables. Specifically, Hypothesis 4a states that directive leadership should be better than both participative and laissez-faire leadership. Thus, the first orthogonal comparison was created by assigning teams with directive leaders a score of "2", and teams with participative or no-leaders as score of "-1". Hypothesis 4b states that participative leadership should be better than laissez-faire leadership. Thus, the second orthogonal comparison was created by assigning teams with

directive leaders a score of "0", teams with participative leaders a score of "1", and teams with no leaders as score of "-1". The level 1 RCM equations for this analysis were identical to those used previously (i.e., Equations 1 and 2). The difference between the present analysis and previous RCM multivariate analysis is that in the present analysis the level 2 RCM equation includes the two orthogonally coded leadership variables instead of the dichotomous virtuality variable.

Results of the multivariate RCM indicated that leadership did not have a significant main effect on the level of shared team states for either the first (unstandardized B = -.02, $p > .05$, $\beta = -.01$), or second orthogonally-coded leadership variable (unstandardized B = .04, $p > .05$, $\beta = .01$). In sum, there is no support for Hypotheses 4a and b either for dispersion or level of shared team states.

Hypotheses 4c predicted that differences in leadership effectiveness would be more extreme in virtual as opposed to face to face settings. To test this hypothesis, a multivariate ANOVA was first run to assess whether there was a significant leadership by virtuality interaction on shared team state dispersion. In contrast to this hypothesis, however, the interaction was non-significant (Wilk's lambda = .82, $\eta^2 = .10$, $F(6,104) = 1.85$, $p > .05$).

I next tested Hypothesis 4c by examining whether there was a significant leadership by shared team state level interaction on the overall level of shared team states. The multivariate RCM consisted of the two orthogonally-coded leadership variables, the virtuality variable, and the interactions of these variables at level 2. The specific equations used in this analysis are:

Level 1 Model:

$$Y^* = CE * Y1^* + IC * Y2^* + TE * Y3^* \quad (5)$$

$$Y^* = P_0 + e \quad (6)$$

Level 2 Model:

$$P_0 = B_{00} + B_{01}(V) + B_{02}(LO(1)) + B_{03}(LO(2)) + B_{04}(IVL(1)) + B_{05}(IVL(2)) \quad (7)$$

In Equation 6, V, LO(1), LO(2), IVL(1), IVL(2) represent the virtuality manipulation, the first orthogonally-coded leadership variable, the second orthogonally-coded leadership variable and the first and second interaction terms, respectively.

Results indicated a significant interaction (Interaction 1: unstandardized B = .18, $p < .05$, $\beta = .15$; Interaction 2: unstandardized B = -.10, $p < .05$, $\beta = .05$). Unfortunately, while significant, this interaction was not in the hypothesized direction. Specifically, directive leadership enhanced shared team states in face to face teams relative to virtual teams. Participative leadership had no effect on shared team states compared to the laissez-faire leadership condition.

Additional RCMs were conducted to investigate which team state variables were influenced by the interaction of leadership and virtuality. Each state was then separately regressed onto virtuality, leadership, and the interaction of virtuality and leadership. Results of these analyses reveal a significant interaction of leadership and virtuality on team empowerment (Interaction 1: unstandardized B = .24, $p < .05$, $\beta = .64$, Interaction 2: unstandardized B = .11, $p > .05$, $\beta = .14$) but not collective efficacy (Interaction 1: unstandardized B = .13, $p > .05$, $\beta = -.60$, Interaction 2: unstandardized B = -.21, $p > .05$, $\beta = -.32$), or interpersonal cohesion (Interaction 1: unstandardized B = .16, $p < .10$, $\beta =$

.41, Interaction 2: unstandardized B = -.02, $p > .05$, $\beta = -.02$). Thus, the effects of the leadership by virtuality interaction appear to be driven by team empowerment.

In summary, while there is a significant interaction between virtuality and leadership, it was in the opposite direction than predicted. Specifically, directive leadership enhanced the formation of shared team states in face to face teams only. As such, there is no support for Hypothesis 4c. Results for the effects of virtuality, leadership, and the interaction of leadership and virtuality on the level of shared team states are summarized in Table 6.

Insert Table 6

Hypothesis 2 predicted that shared states would affect communication. Given that shared team states do not form to the same degree within virtual teams as they do in non-virtual teams, it is important to assess this hypothesis with RCM. To test this hypothesis, I first tested the significant of shared team states on each communication outcome. An illustrative set of equations associated with one of the communication variables are as follows:

Level-1 Model:

$$P_0 = B_0 + B_1(CE) + R \quad (8)$$

Level-2 Model:

$$B_0 = G_{00} + G_{01}(CEG) + U_0 \quad (9)$$

$$B_1 = G_{10} + U_1 \quad (10)$$

In Equation 7, P represents a particular communication variable (e.g., proportion of solution proposals) and CE represents the grand-mean centered collective efficacy at the individual level. In Equation 8, CEG represents collective efficacy aggregated to the group level of analysis.

Hypotheses 2a states that collective efficacy should enhance solution proposals and evaluative remarks and decrease off task discourse. Results indicate that collective efficacy was not related to proportion of supportive remarks at either the individual or group level (unstandardized $B_1 = .00$, $p > .05$, $\beta_1 = .00$, unstandardized $G_{01} = .01$, $p > .05$, $\gamma_{01} = .06$), proportion of solution proposals at either the individual or group level (unstandardized $B_0 = -.01$, $p > .05$, $\beta_1 = -.09$, unstandardized $G_{01} = -.00$, $p > .05$, $\gamma_{01} = -.03$, respectively), proportion of off task remarks at either the individual or group level (unstandardized $B_1 = .00$, $p > .05$, $\beta_1 = .00$, unstandardized $G_{01} = .01$, $p > .05$, $\gamma_{01} = .05$, respectively), or proportion of critical remarks at the individual (unstandardized $B_1 = .00$, $p > .05$, $\beta_1 = .01$) or group levels$_1$ (unstandardized $G_{01} = -.01$, $p > .05$, $\gamma_{01} = .-.05$). In other words, there was no support for Hypothesis 2a.

Hypothesis 2b states that interpersonal cohesion would positively affect supportive remarks and off-task remarks, and decrease critical remarks. Results indicate that the interpersonal cohesion measure was largely unrelated to communication at either the individual or group levels of analysis. Specifically, this measure was unrelated to proportion of supportive remarks at both levels (individual: unstandardized $B_1 = .02$, $p > .05$, $\beta_1 = .13$; group: unstandardized $G_{01} = .01$, $p > .05$, $\gamma_{01} = .02$), proportion of critical remarks at both levels (individual: unstandardized $B_1 = -.00$, $p > .05$, $\beta_1 = -.01$; group: unstandardized $G_{01} = .00$, $p > .05$, $\gamma_{01} = .00$), proportion of solution proposals on the both

levels (individual: unstandardized B_1 = -.01, $p > .05$, β_1 = -.14; group: unstandardized G_{01} = -.04, $p < .05$, γ_{01} = -.38), and proportion of off-task remarks on both levels (individual: unstandardized B_1 = -.00, $p > .05$, β_1 = -.04; group: unstandardized G_{01} = .01, $p > .05$, γ_{01} = .08). In summary, there was no support for Hypothesis 2b.

Hypotheses 2c states that team empowerment should enhance solution proposals and evaluative remarks and decrease off task discourse. Analyses on the extent to which team empowerment affects communication reveal that there is no relationship between team empowerment and communication on either level of analysis. Specifically, team empowerment is not related to proportion of supportive remarks at the individual or group level (unstandardized B_1 = .00, $p > .05$, β_1 = .02, unstandardized G_{01} = .02, $p > .05$, γ_{01} = .08, respectively), proportion of solution proposals at the individual or group level (unstandardized B_1 = -.00, $p > .05$, β_1 = -.02, unstandardized G_{01} = -.01, $p > .05$, γ_{01} = -.06, respectively), proportion of off task remarks at the individual or group level (unstandardized B_1 = .01, $p > .05$, β_1 = .07; unstandardized G_{01} = -.01, $p > .05$, γ_{01} = -.03, respectively), or proportion of critical remarks at the individual or group level (unstandardized B_1 = -.00, $p > .05$, β_1 = -.01; unstandardized G_{01} = -0.01, $p > .05$, γ_{01} = -.03, respectively). In sum, there is no support for Hypothesis 2c. Results of the main effects analyses are summarized in Table 7.

Insert Table 7

Hypothesis 3 predicted that team communication would affect team outcomes. To test this hypothesis, I again employed RCM. Each outcome was independently

regressed onto each relevant aspect of communication on the individual and group levels. An example set of equations is as follows:

Level-1 Model:

$$P_0 = B_0 + B_1 * (PSP) + R \qquad (11)$$

Level-2 Model:

$$B_0 = G_{00} + G_{01} * (PSPG) + U_0 \qquad (12)$$

$$B_1 = G_{10} + U_1 \qquad (13)$$

In equation 16, P represents an outcome of interest, while PSP represents the grand mean centered proportion of solution proposals on the individual level. In equation 17, PSPG represents proportion of solution proposals aggregated to the group level.

Hypothesis 3a predicted that solution proposals and supportive remarks would affect both satisfaction and productivity positively. The RCM results revealed that proportion of solution proposals were not related to task satisfaction at either the individual or group levels (unstandardized $B_1 =$ -.03, $p > .05$, $\beta_1 =$ -.00; unstandardized $G_{01} =$ -.05, $p > .05$, $\gamma_{01} =$ -.00, respectively), or proportion of convergent solutions at either the individual or the group level (unstandardized $B_1 =$ .01, $p > .05$, $\beta_1 = .01$; unstandardized $G_{01} = .06$, $p > .05$, $\gamma_{01} = .07$, respectively). However, proportion of solution proposals was negatively related to the proportion of divergent solutions at the individual and positively related to the proportion of divergent solutions at the group level (unstandardized $B_1 =$ -.33, $p < .05$, $\beta_1 =$ -.20; unstandardized $G_{01} = .59$, $p < .05$, $\gamma_{01} = .24$, respectively)

Analysis of the relationship between the proportion of supportive remarks and outcomes reveals that the proportion of supportive remarks was not related to task

satisfaction on either the individual or group level (unstandardized B_1 = .05, $p > .05$, β_1 = .01; unstandardized G_{01} = .94, $p > .05$, γ_{01} = .05, respectively), or to proportion of divergent and convergent solutions on the individual level (divergent: unstandardized B_1 = .21, $p > .05$, β_1 = .14; convergent: unstandardized B_1 = -.03, $p > .05$, β_1 =-.06). However, there appears to be a trend such that proportion of supportive remarks may be related to proportion of divergent and convergent solutions on the group level (divergent: unstandardized G_{01} = -.48, $p < .1$, standardized γ_{01} = -.17; convergent: unstandardized G_{01} = .16, $p < .1$, γ_{01} = .16). In sum, there is limited support for Hypothesis 3a.

Hypothesis 3b states that critical remarks will enhance productivity and decrease satisfaction. The RCM indicated that the proportion of critical remarks was not related to task satisfaction on either the individual to group level (unstandardized B_1 = 2.54, $p > .05$, β_1 = .13; unstandardized G_{01} = -3.52, $p > .05$, γ_{01} = -.12, respectively), proportion of convergent solutions on either the individual or group levels (unstandardized B_1 = .17, $p > .05$, β_1 =.15; unstandardized G_{01} = .08, $p > .05$, γ_{01} = .05, respectively), or proportion of divergent solutions on either the individual or group levels (unstandardized B_1 = .25, $p > .05$, β_1 = .07; unstandardized G_{01} = .10, $p > .05$, γ_{01} = .02, respectively). Thus, Hypothesis 3b was not supported.

Hypothesis 3c predicted that off-task remarks would enhance satisfaction. Analysis of this hypothesis reveals that, consistent with expectations, off topic remarks are unrelated to either proportion of convergent or proportion of divergent solutions on the individual or group levels (convergent, individual level: unstandardized B_1 = -.10, $p > .05$, β_1 = -.15; convergent, group level: unstandardized G_{01} = .15, $p > .05$, γ_{01} = .18; divergent, individual level: unstandardized B_1 = -.13, $p > .05$, β_1 = -.07; divergent, group

level: unstandardized G_{01} = -.16, p > .05, γ_{01} = -.06). However, off-task remarks are also not related to satisfaction on either the individual or group level (unstandardized B_1 = -1.21, p > .05, β_1 = -.11; unstandardized G_{01} = 2.21, p > .05, γ_{01} = .16, respectively). Thus, there is no support for Hypothesis 3c. A summary of the main effects results is in Table 8.

Insert Table 8

Post-Hoc Analyses

Post-hoc analyses were conducted to investigate the disappointing lack of results for Hypotheses 2 and 3. Specifically, given the powerful effect of virtuality on the formation of shared team states, I first tested if virtuality affected communication and outcomes directly. Indeed, virtuality directly impacted percentage of solution proposals (unstandardized B_1 = -.06, p < .05, β_1 = -.27) and critical remarks (unstandardized B_1 = -.03, p < .05, β_1 = -.23), such that teams working virtually had a greater percentage of communication taken up by solution proposals and critical remarks. Further, virtuality affected percentage of off-task remarks (unstandardized B_1 = .05, p < .05, β_1 = .25), with non-virtual teams exhibiting a higher percentage of off-task remarks relative to virtual teams. Virtuality did not, however, affect percentage of supportive remarks (unstandardized B_1 = -.03, p > .05, β_1 = -.10), divergent solutions (unstandardized B_1 = .01, p > .05, β_1 = .02), convergent solutions (unstandardized B_1 = -.01, p > .05, β_1 = -.08), or satisfaction (unstandardized B_1 = .17, p > .05, β_1 = .07). In sum, virtuality appears to

have directly affected communication, but not outcomes. Results of these analyses are summarized in Table 9.

Insert Table 9

Additional post-hoc tests were conducted to see if leadership directly impacted communication or outcomes. Directive leadership, relative to participative and laissez-faire leadership, did not significantly affect any of the communication variables (solution proposals: unstandardized $B_1 = .01$, $p < .10$, $\beta_1 = .18$, supportive remarks: unstandardized $B_1 = -.00$, $p > .05$, $\beta_1 = -.02$, critical remarks: unstandardized $B_1 = -.00$, $p < .10$, $\beta_1 = -.03$, off-topic remarks: unstandardized $B_1 = .01$, $p > .05$, $\beta_1 = .17$). Likewise, participative leadership relative to laissez-faire leadership did not significantly affect any of the communication variables (solution proposals: unstandardized $B_1 = -.01$, $p > .05$, $\beta_1 = -.06$, supportive remarks: unstandardized $B_1 = -.00$, $p > .05$, $\beta_1 = -.02$, critical remarks: unstandardized $B_1 = .01$, $p > .05$, $\beta_1 = .09$, off-topic remarks: unstandardized $B_1 = .00$, $p > .05$, $\beta_1 = .01$). Finally, neither contrast was significantly related to outcomes: percentage of divergent solutions (L1: unstandardized $B_1 = .01$, $p > .05$, $\beta_1 = .06$, L2: unstandardized $B_1 = .01$, $p > .05$, $\beta_1 = .04$), convergent solutions (L1: unstandardized $B_1 = .01$, $p > .05$, $\beta_1 = .12$, L2: unstandardized $B_1 = -.01$, $p > .05$, $\beta_1 = -.08$), or satisfaction (L1: unstandardized $B_1 = .04$, $p > .05$, $\beta_1 = .05$, L2: unstandardized $B_1 = .05$, $p > .05$, $\beta_1 = .04$). In sum, leadership does not directly impact communication or outcomes. Results of these analyses are summarized in Table 10.

Insert Table 10

A final set of post-hoc analyses were conducted to determine whether leadership and virtuality interact in influencing communication or outcomes. Leadership and virtuality did not significantly interact with regard to solution proposals (Interaction 1: unstandardized $B_1 = -.00$, $p > .05$, $\beta_1 = -.07$; Interaction 2: unstandardized $B_1 = .01$, $p > .05$, $\beta_1 = .11$), critical comments (Interaction 1: unstandardized $B_1 = -.00$, $p > .05$, $\beta_1 = -.12$; Interaction 2: unstandardized $B_1 = .02$, $p > .05$, $\beta_1 = .37$), or off-task remarks (unstandardized $B_1 = -.00$, $p > .05$, $\beta_1 = -.05$; Interaction 2: unstandardized $B_1 = -.01$, $p > .05$, $\beta_1 = -.14$). However, there was a significant interaction for supportive comments (Interaction 1: unstandardized $B_1 = 0.04$, $p < .05$, $\beta_1 = -.67$; Interaction 2: unstandardized $B_1 = -.05$, $p > .05$, $\beta_1 = -.49$). This interaction is shown in Figure 2.1. As can be seen in this figure, non-directive leadership increases the percentage of supportive comments in face to face teams, but directive leadership does not affect the percentage of supportive comments in virtual teams.

With regard to outcomes, leadership and virtuality did not significantly interact for the convergent solutions (Interaction 1: unstandardized $B_1 = .01$, $p > .05$, $\beta_1 = .45$; Interaction 2: unstandardized $B_1 = .00$, $p > .05$, $\beta_1 = .00$). However, there is evidence for an interaction for divergent solution proposals (Interaction 1: unstandardized $B_1 = -.05$, $p < .05$, $\beta_1 = -.55$; Interaction 2: unstandardized $B_1 = .03$, $p > .05$, $\beta_1 = .19$). This interaction is shown in Figure 2.2. Directive leadership is more detrimental in the virtual relative to the non-virtual environment. Specifically, teams working with directive

leaders using the IM media proposed a smaller proportion of divergent solutions relative to those teams using IM but with participative or Laissez-faire leaders. However, teams with directive leaders in the face to face condition proposed a larger proportion of divergent solutions relative to teams with participative or laissez-faire leaders.

Finally, I found evidence for a leader by virtuality interaction on satisfaction (Interaction 1: unstandardized $B_1 = .29$, $p < .05$, $\beta_1 = .54$; Interaction 2: unstandardized $B_1 = .05$, $p > .05$, $\beta_1 = .06$). This interaction is shown in Figure 2.3. Face to face teams working under directive leaders were more satisfied than teams working with either participative or laissez-faire leaders. No difference is evidence in the IM condition. In sum, these analyses reveal that there is virtuality and leadership interact in predicting outcomes. A summary of the results of these analyses is provided in Table 11.

Insert Table 11

Discussion

In today's increasingly globalized world, organizations are seeking ways to expand their boundaries, whether through the deployment of expatriates, establishment of multinational corporations, or through the implementation of virtual teams. These so-called "virtual" teams provide a number of opportunities and challenges for those who choose to employ them. Indeed, virtual teams provide businesses and other organizations with access to remote talent (Bell & Kozlowski, 2002). However, research indicates that virtual teams suffer from what are known as "process losses". A large majority of these process losses have been traced to the effects of such teams' reliance on communication media. Specifically, individuals interacting over virtual communication technology tend to be more anti-social in behavior (Siegel et al., 1986; Sproull & Kiesler, 1985; 1992), have more difficulty forming relational bonds (Chidambaram, 1996; Grinter et al., 1999), and perceive themselves more anonymously, and as more isolated, than their face to face counterparts (Kiesler et al., 1984).

While research shows that these process losses diminish over time (Chidambaram, 1996), it is imperative that such teams be effective immediately. One way through which these process losses may be counteracted is through leadership (Balthazard et al., 2004; Chen et al., 2007; Zaccaro & Bader, 2003; Zigurs, 2003). However, while the effects of leadership in virtual teams have been oft-touted, they have not yet been rigorously empirically tested. The current study was designed to address some of these issues. Specifically, it was designed to test whether leadership could counteract the negative effects of communication media on the performance of *ad hoc* teams.

More specifically, I explored whether participative and directive leadership styles might mitigate process losses teams experience due to virturality. I choose these two styles of leadership because of their prominence in the Path-Goal leadership (House, 1971) theory. I also contrasted these two leadership styles were laissez-faire leadership to provide a comprehensive test of how, and when, leadership may be effective in overcoming the hypothesized effects of communication media.

My first hypothesis stated that virtual teams would have more difficulty forming shared team states than face to face teams. This hypothesis was supported, both with respect to the level of the shared team state (e.g. the mean) and with respect to the level of agreement within each team. These results suggest that shared team states do not form as quickly, and possibly may form with less strength, in virtual as opposed to face to face teams. Thus, consistent with the existing literature, my results demonstrate that virtuality affects the extent to which groups of individuals can be truly called teams. Further, while existing literature has shown that virtual teams do not form shared team states at the same level as their non-virtual counterparts, this study is the first to empirically show that virtual teams exhibit greater dispersion in their perceptions of shared team states relative to non-virtual teams.

If organizations are going to continue to rely on virtual communication technology to solve their problems and to capitalize on talent across the globe, then some intervention (e.g., team-building, relational-oriented exercises) is needed to counteract the negative effect of virtual communication. Without any intervention, my findings indicate that virtual teams will either not form collective cognitions or will not form them as readily as those working non-virtually.

I also expected that the kind of leadership used for virtual teams would be an effective intervention to mitigate the harmful effects of virtuality on team formation. Specifically, I hypothesized that directive leadership would be more effective than participative leadership or laissez-faire leadership with regard to the development of shared team states in the virtual teams. Further, I predicted that participative leadership would be better than lassiez-faire leadership with regard to the development of shared team states in the virtual teams. Unfortunately, there was no support for any of these leadership hypotheses. Path-Goal leadership (House, 1971), as measured in the current study appears to have some effect on the formation of shared states, but this effect appears to occur in face to face teams, not in virtual teams as I expected. However, it is possible that Path-Goal leadership may still be an effective intervention in virtual teams. That is, in the current study, it appeared that participants were only able to distinguish between leadership and non-leadership, not between the two styles of leadership. Given this limitation, the findings from the current study may not reflect a true test of the effects of Path-Goal leadership.

Other hypotheses examined how specific shared team states were related to the communication styles in teams. Specifically, collective efficacy and team empowerment were predicted to lead to a greater proportion of solution proposals, supportive remarks, and critical remarks. Interpersonal cohesion was predicted to leader to a greater proportion of supportive remarks and off-task remarks, and fewer critical remarks. Unfortunately, my results were not supportive of these relationships. One explanation may be that the type of task employed in the current study, and the duration of this task, were not suited for proper examination of the relationship between shared team states and

communication. That is, such a relationship may only exist for teams who work on an integrative task over a longer period of time. Indeed, some Aiello and Kolb (1995) also found that cohesiveness did not lead to greater productivity in virtual team members working on a simple task.

I also hypothesized that communication style would affect team outcomes. Specifically, supportive comments and solution proposals were both expected to predict productivity and satisfaction. Critical comments were hypothesized to positively affect productivity and negatively affect satisfaction and off-topic remarks were expected to affect satisfaction. Overall, I found no support for these hypotheses. While there was a positive trend between percentage of supportive comments and both divergent and convergent solutions proposed, no results reached significance. No significant relationships were found between either percentage of critical remarks or percentage of off-task remarks on any outcome. Together, the results for this set of hypotheses provide no support for the connection between communication style and outcomes.

While initial tests of the second and third hypotheses have no support, post-hoc tests on the direct effects of virtuality, leadership, and the effects of the interaction of virtuality and leadership on communication and outcomes reveal provoking findings. Specifically, virtuality directly impacts communication. Teams working virtually provide more solution proposals, more critical remarks, and fewer off-task remarks relative to teams working non-virtually. This is consistent with previous research findings indicating that individuals working virtually provide a greater quantity of ideas (Kerr, & Murthy, 2004), voice disagreement (McLeod, Baron, Marti & Yoon, 1997), and communicate in a more task-oriented manner than their non-virtual counterparts (Hiltz,

Johnson, & Turoff, 1986). Further, post-hoc tests reveal that virtuality and leadership interact in predicting outcomes. Specifically, directive leadership results in lower satisfaction in non-virtual teams only, while directive leadership results in a greater number of divergent solutions proposed in virtual teams. Thus, while there was no support for the hypotheses pertaining to the relationships between shared team states and communication, or between communication and outcomes, virtuality and leadership do impact communication and outcomes through a more direct means. Thus, while leadership was not found to leverage the formation of shared team states in the current study, it may still be an important intervention for short-term virtual teams whose highest priority is quantity of production.

Practical and Research Implications

The results of the current study have a number of implications for both researchers and practitioners. First, it is apparent that shared team states do not form as readily or as with as great strength in virtual, as opposed to face to face teams. While the current study did not find support for the influence of shared team states on communication, and thus, outcomes, it is time that researchers take the issue of shared team states in the virtual team literature seriously. As discussed, Aiello and Kolb (1995) also found no impact of shared team states on outcomes. However, this may be a function of task type, and time required to complete the task. Thus, researchers should focus on three major issues relevant to the study of shared team states: a) level of shared team states, b.) dispersion of shared team states, and c.) specific shared team states. That is, not only have levels of shared states been shown to impact outcomes in virtual teams in general (e.g. Chen et al., 2007; Jung & Sosik, 2003; Kirkman & Rosen, 1999;

Michalisin, et al., 2004), but, as discussed earlier, some shared states have been shown to be particularly important to success in virtual teams (Kirkman et al., 2004). Further, researchers have left an area completely unexplored, thus far, in virtual team research: dispersion of shared team states perceptions. Researchers should thus concentrate on finding the most effective shared team states for long-term virtual team success, and then seeing to what extent level versus dispersion matters in predicting relevant outcomes. That is, instead of concentrating on the direct effect of virtuality on outcomes, researchers should study mediated models to better understand the contingencies of virtual team success. Perhaps for certain types of tasks, high agreement of shared states may be imperative, whereas in other tasks, level may be more important. By pursuing research of mediated models, virtual teams researchers will not only align themselves better with teams research in general, they will also be able to inform their studies with information gleaned from the levels literature.

While integration with the levels and teams literature is encouraged, it should also be noted that virtuality exerted a main effect not only on shared team state formation, but also on communication. In plain terms, virtual teams are not like non-virtual teams. Thus, while informing virtual team studies with lessons learned in the broader literature, virtual teams researchers should be cautious. Specifically, theory and research need to focus on determining how virtual teams operate and how to make them effective, without making assumptions that they operate as face to face teams do.

An additional implication of this study is that Path-Goal leadership (House, 1971) may not necessarily be the most effective leadership for the virtual environment. There were no differences found on leadership's impact on the formation of shared team states

in virtual teams, while in face to face teams, path-goal directive leadership aided in the formation of these shared team states. There was, however, limited impact of directive leadership on divergent solution proposals in virtual teams. While these results might appear discouraging in terms of path-goal leadership's potential effectiveness in the virtual environment, recall that the manipulation check for the leadership manipulation failed. Thus, Path-Goal leadership may indeed be effective in virtual teams. More research is needed to assess the potential contribution of path-goal leadership to effectiveness in virtual teams.

Finally, the current study has a number of implications for practitioners as well. Practitioners should be aware that their virtual teams may not readily form as a team—indeed, they may simply exist and work as a compilation of individuals. Thus, the effectiveness of a virtual team may hinge on getting the team to actually think of itself as such, or to give the team tasks that can be driven by individuals. Specifically, in line with current theory, task complexity may be a critical issue in the formation and deployment of virtual teams, especially early in their development (Bell & Kozlowski, 2002). The current study used a brainstorming task, which is not an intensive, or fully integrated task—it is not, then, as complex as other tasks. As such, organizations implementing virtual teams should strive toward a strong match between their task type, composition of the team, and type of leadership employed.

Limitations

Despite the many contributions of the current study, there are also several limitations. The first consideration is that the current study employed a lab-based design. As such, generalizability outside of this sample may be difficult. This is particularly true

in the case of business-implemented virtual teams, which will rarely work entirely over one particular communication media. Thus, while the current study provided a rigorous test of the implications of leadership over particular communication media, it may not capture the entirety of the complexity of "real life" virtual teams. An additional concern related to the sample is that the number of teams is low (10 per condition). As such, power is only great enough to detect large effects. Thus, if the effects of leadership on virtual team performance are more subtle, the current study design lacks the power to detect these effects.

Additional limitations exist with regard to the measurement of shared states and the nature of the leadership manipulation. With regard to the former, recall that Marks et al. (2001) define emergent states as dynamic properties, such that they are affected by inputs, processes, and outcomes, and feed back into these as well. In the current study, I relied on a one-time, static measure to capture these dynamic states. As such, this measure may not have been the most accurate reflection of reality. Throughout the course of the task, the shared team states likely impacted communication, which probably reciprocally impacted the shared states. Thus, it is possible that the measures employed in the current study do not capture the full complexity of these states.

There were also a few limitations related to the leadership manipulation. As noted several times, the leadership manipulation did not work. Specifically, participants were not able to distinguish between participative and directive leaders. As such, it is difficult to distill any firm conclusions regarding the effects of leadership in virtual teams from the current study. Part of the failure of the leadership manipulation may be attributed to the subtlety through which leadership was manipulated in the scripts.

Additionally, the confederates who acted as leaders for participants in this study may not have portrayed the scripts accurately. A final limitation is that the scripted leadership comments entail leaving team members without guidance for a large majority of the task. Therefore, participants likely emerged as leaders independently within teams. Without having a measure of emergent leadership, it is conceivable that any emergent leadership within the teams confounded the instituted leadership conditions, thus rendering conclusions drawn from these conditions moot.

Future Directions

Despite the increasing implementation of virtual teams, there is limited conclusive evidence in favor of factors that help such teams succeed. Given the growing interest in the research of virtual teams, several specific future research directions may be of particular interest. First, Bell & Kozlowski (2002) delineate a typology of virtual teams that specifies the importance of task complexity in design and selection of leadership for these teams. Future research should investigate virtual team performance on tasks beyond the traditional brainstorming assignments. It may be that the model tested in the current study is more applicable in more complex tasks, and that certain types of leadership are important for different types of tasks.

Additionally, future research should investigate the operation of shared team states more fully. Perhaps a study could employ a more dynamic measurement of these states and more fully analyze how they feed into, and are affected by, inputs, processes, and outcomes. Additionally, researchers may wish to adapt the view proposed by Marks et al. (2001) on the stages of teamwork. If such a longitudinal view were applied to

research in the virtual environment, a better understanding of how virtual teams approach team processes and stages relative to face to face teams could be developed.

Finally, as noted several times, path-goal leadership (House, 1971) was unrelated to the formation of shared team states in virtual teams in the current study, and related only to divergent solution proposals in virtual teams. While this may appear to indicate that path-goal leadership is not useful in the virtual environment, it is likely that the null results were due to the failed leadership manipulation. Thus, more research on path-goal leadership in virtual teams is necessary to ascertain its potential usefulness in the virtual environment.

Conclusion

With the ever-increasing implementation of virtual teams, an understanding of how they operate and how to help them succeed is imperative. While researchers are becoming increasingly interested in the topic of virtual teams, to the author's knowledge, the current study is the first to examine virtual teams through the traditional IPO framework (McGrath, 1964). The results of this study indicate that virtual teams do not operate in the same way as face to face teams, and thus, may have different predictors of performance. Specifically, shared team states do no form as readily, or to as great a level, in virtual as opposed to face to face teams. Ideally, results of the current study will contribute to a broader understanding of, and a greater interest in, the study of the mechanics of virtual teams and the formation of shared team states therein.

Appendix A

Participative Leadership Script

Introduction:

Good ____. Today you all will be completing a group task and then filling out several surveys regarding this task.

During this task, feel free to take notes on the paper provided. Before you get started, I would like to clarify my role in this task. First, I will introduce the task to you. I will provide guidance as you work on this task, but I will otherwise not be contributing to its completion. I cannot answer any questions or concerns you have. If you have questions, address them to your group members.

Are you all ready to get started?

Participative Leader Script

1. We are expected to perform a task together by generating as many ideas concerning ways to improve the prestige of the university as possible.
2. We can work together to provide input to determine the best ideas concerning ways to improve the prestige of the university.
3. We can work together to determine the team's best ideas concerning ways to improve the prestige of the university.
4. We might each consider spreading the first 8 minutes generating ideas concerning ways to improve the prestige of the university and the last 15 minutes providing input to

determine the best ideas concerning ways to improve the prestige of the university. However, I'm interested in your input concerning how we should go about performing our task, that is, what do you feel we need to consider?

5. It might help our team if we all remember the guidelines for brainstorming:

(A) no idea can be criticized

(B) each idea presented belongs to the group, not to the person stating it

(C) no idea is too ridiculous

6. Let's discuss how to improve the prestige of the university together. Each of us can think of ways to improve the prestige of the university . I would appreciate us all attending to each of the ideas we come up with.

7. We'll work together in order to think of more ideas. If you need help, you can always refer to the previous comments of your team members to help you think of more ways to improve the prestige of the university.

8. Now we need to provide input to determine the best ideas concerning ways to improve the prestige of the university.

9. Some ideas we might consider are: _____. What do you think about these ideas?

10. Why don't we try to continue discussing the ideas we've all identified? They should help us come up with a solution to our problem.

11. We have only 8 minutes left to determine how to improve the prestige of the university.

12. I feel we should make a decision now

13. We should all agree on the best way to make a final decision. We could consider our

ideas about _____

14. What do you think?

15. Let's see what we've jointly agreed upon

16. We've decided that the best way to improve the prestige of the university is

_____. Look's like we've accomplished our task!

Appendix B

Directive Leadership Script

Introduction:

Good ____. Today you all will be completing a group task and then filling out several surveys regarding this task.

During this task, feel free to take notes on the paper provided. Before you get started, I would like to clarify my role in this task. First, I will introduce the task to you. I will provide guidance as you work on this task, but I will otherwise not be contributing to its completion. I cannot answer any questions or concerns you have. If you have questions, address them to your group members.

Are you all ready to get started?

Directive Leader Script

1. We are expected to generate as many ideas concerning ways to improve the prestige of the university as possible.
2. Our team is also expected to provide input to determine the best ideas concerning ways to improve the prestige of the university.
3. I'll determine the team's best ideas concerning ways to improve the prestige of the university.
4. Our team should spend the next 8 minutes generating ideas concerning ways to improve the prestige of the university and the last 15 minutes providing input to

determine the best ideas concerning ways to improve the prestige of the university. We should follow this work schedule

5. Keep in mind that our team should follow the traditional standard brainstorming rules:

(A) no idea can be criticized

(B) each idea presented belongs to the group, not to the person stating it

(C) no idea is too ridiculous

6. Everyone on our team should now be thinking of ways to improve the prestige of the university.

7. Keep on thinking of more ideas. Look at the ideas of others on our team to help you think of more ways to improve the prestige of the university.

8. Now, it's time for our team to provide input to determine the best ideas concerning ways to improve the prestige of the university . Remember to stick to the schedule

9. There are the ideas we need to consider: _____.We need to think about just these ideas.

10. Keep on discussing the ideas I've identified. They should help us come up with a solution to our problem.

11. There are only 8 minutes left to determine how to improve the prestige of the university.

12. It's time to make a decision

13. In my judgment, the best way now to make a final decision is to consider our ideas about _____

14. We have been directed to come up with as many ideas as we can.

15. I feel that the best ideas about ways to improve the prestige of the university are

_____

16. We should improve the prestige of the university by

_____. This is what needs to be done.

Look's like we've accomplished the task

Appendix C

Laissez-faire leadership Script

Introduction:

Good ____. Today you all will be completing a group task and then filling out several surveys regarding this task.

During this task, feel free to take notes on the paper provided. Before you get started, I would like to clarify my role in this task. I will only introduce the task to you, but will otherwise not be involved in the task.

Are you all ready to get started?

No Leader Script

1. You are expected to generate as many ideas concerning ways to improve the prestige of the university as possible.

2. You are also expected to provide input to determine the best ideas concerning ways to improve the prestige of the university.

3. You have 23 minutes to complete these two tasks. I will tell you when time is up, but you will have to keep time yourselves during the task.

4. Okay, time is up.

Appendix D

Interpersonal Cohesion (Zaccaro & McCoy, 1988)

The following questions address your feelings toward the group you have been working with. Please read each question carefully, and answer considering your opinions about the group as a whole.

On a scale of one to seven, how would you rate your group with respect to the following characteristics?

Cold	1	2	3	4	5	6	7	Warm
Pleasant	1	2	3	4	5	6	7	Unpleasant
Dislikable	1	2	3	4	5	6	7	Likable
Courteous	1	2	3	4	5	6	7	Discourteous
Undependable	1	2	3	4	5	6	7	Dependable
Friendly	1	2	3	4	5	6	7	Unfriendly

Appendix E

Interpersonal Cohesion (Craig & Kelly, 1999)

On a scale of one to seven, please rate the extent to which you agree or disagree with the following statements.

1 Strongly Disagree	2 Moderately Disagree	3 Slightly Disagree	4 Neither Agree nor Disagree	5 Slightly Agree	6 Moderately Agree	7 Strongly Agree

1. _____I like my group members
2. _____I anticipate liking my group members in the future
3. _____I feel that I am similar to other members in my group
4. _____I feel that socializing was an important part of this session

Appendix F

Collective Efficacy (Salanova et al., 2003)

On a scale of one to seven, please rate the extent to which you agree or disagree with the following statements.

1 Strongly Disagree	2 Moderately Disagree	3 Slightly Disagree	4 Neither Agree nor Disagree	5 Slightly Agree	6 Moderately Agree	7 Strongly Agree

1. _____I feel confident about the capability of my group to perform tasks very well
2. _____My group would be able to solve difficult tasks if we invest the necessary effort
3. _____I feel confident that my group would be able to manage effectively unexpected troubles
4. _____My group is totally competent to solve assigned tasks

Appendix G

Collective Efficacy (adapted from Bandura, 1977)

Please indicate the extent to which you feel confident of your team's abilities to come up with the following numbers of creative solutions a similar problem in 15 minutes.

1 Not Confident at All	2 Slightly Confident	3 Somewhat Confident	4 Moderately Confident	5 Very Confident

1. _____My team could generate 16 unique solutions to a similar problem in 15 minutes
2. _____My team could generate 18 unique solutions to a similar problem in 15 minutes
3. _____My team could generate 20 unique solutions to a similar problem in 15 minutes
4. _____My team could generate 22 unique solutions to a similar problem in 15 minutes
5. _____My team could generate 24 unique solutions to a similar problem in 15 minutes
6. _____My team could generate 26 unique solutions to a similar problem in 15 minutes
7. _____My team could generate 28 unique solutions to a similar problem in 15 minutes
8. _____My team could generate 30 unique solutions to a similar problem in 15 minutes

Appendix H

Team Empowerment

On a scale of one to seven, please rate the extent to which you agree or disagree with the following statements.

1 Strongly Disagree	2 Moderately Disagree	3 Slightly Disagree	4 Neither Agree nor Disagree	5 Slightly Agree	6 Moderately Agree	7 Strongly Agree

1. _____My team has confidence in itself.
2. _____My team can get a lot done when it works hard.
3. _____My team believes that it can be very productive.
4. _____My team believes that its projects are significant.
5. _____My team feels that its tasks are worthwhile.
6. _____My team feels that its work is meaningful.
7. _____My team can select different ways to do the team's work.
8. _____My team determines as a team how things are done in the team.
9. _____My team makes its own choices without being told by the leader.
10. _____My team has a positive impact on the university.
11. _____My team performs tasks that matter to the university.
12. _____My team makes a difference in this university.

Appendix I

Satisfaction

The following questions address how satisfied you are with different aspects of this experience. Please read each statement carefully, and assess the extent to which you agree or disagree with each of the following statements.

1 Strongly Disagree	2 Moderately Disagree	3 Slightly Disagree	4 Neither Agree nor Disagree	5 Slightly Agree	6 Moderately Agree	7 Strongly Agree

1. _____I am satisfied with the outcome of this task
2. _____I am satisfied with the discussion of my group
3. _____I am satisfied with my group's process
4. _____I am satisfied with the [online chat/face to face] environment
5. _____I feel that 23 minutes was enough time to address this problem
6. _____I would have liked to have more opportunity to get to know my group members before starting the task

Appendix J

Manipulation Checks

The following questions are about your task. On a five point scale, please indicate the extent to which you agree or disagree to the following statements regarding your task:

1 Strongly Disagree	2 Disagree	3 Neither Agree nor Disagree	4 Agree	5 Strongly Agree

1. _____The task was ambiguous

Leadership Manipulation Check

The following questions are about your group's facilitator. On a five point scale, please indicate the extent to which you agree or disagree to the following statements regarding your facilitator's behavior during the session:

1 Strongly Disagree	2 Disagree	3 Neither Agree nor Disagree	4 Agree	5 Strongly Agree

2. _____The facilitator incorporated group member suggestions into the group's solution
3. _____The facilitator treated group members are equals
4. _____The facilitator allowed group members to have equal input as him/herself
5. _____The facilitator told group members to follow specific rules
6. _____The facilitator told members how to accomplish the task

Select from the following three statements the one that <u>BEST</u> described your facilitator's behavior during the session. You may only choose <u>ONE</u> statement:

1. _____The facilitator emphasized group members' input with regards to how rules and decisions were made and incorporated group member suggestions into the group's final solution.
2. _____The facilitator emphasized that group members should follow specific rules and told members that he/she would determine the final solution to the problem.
3. _____The facilitator was completely uninvolved in the brainstorming and decision making process.

Appendix K

Coding Scheme

Solution proposals (New): A proposal for how to improve university prestige that has not been mentioned in any form previously

Solution proposals (Extension): A proposal for how to improve university prestige that elaborates upon or adds further details to an already mentioned idea

Solution proposals (Synthesis): A proposal for how to improve university prestige that combines two or more unique ideas previously mentioned into one idea.

Solution proposals (Repeat): A proposal for how to improve university prestige that is an unelaborated, unsynthesized repeat of a previously mentioned solution.

Critical comments: Statements made by group members to other group members to indicate disagreement with their proposed solutions.

Supportive comments: Statements made by group members to other group members to indicate support of their proposed solutions.

Problem clarifications: Statements by group members explaining or further clarifying what the problem means or entails (ways to improve university prestige)

Solution clarifications: Statements by group members explaining or further clarifying their proposed solutions.

Problem queries: Questions to group members asking for clarification of the problem (ways to improve university prestige)

Solution queries: Questions to group members asking for clarification of the proposed solutions.

Comments about the group process: Comments about how the group is solving the task

Table 1
Individual and Team Level Interpersonal Cohesion EFA Factor Loadings

Item	*Factor 1*
Individual Level	
1-1) Cold-Warm	0.52
1-2) Pleasant-Unpleasant	0.81
1-3) Dislikable-Likable	0.71
1-4) Courteous-Discourteous	0.74
1-5) Undependable-Dependable	0.50
1-6) Friendly-Unfriendly	0.81
Team Level	
1-1) Cold-Warm	0.56
1-2) Pleasant-Unpleasant	0.84
1-3) Dislikable-Likable	0.73
1-4) Courteous-Discourteous	0.87
1-5) Undependable-Dependable	0.57
1-6) Friendly-Unfriendly	0.86
Individual Level	
2-1) I like my group members	0.87
2-2) I anticipate liking my group members in the future	0.85
2-3) I feel that I am similar to other members in my group	0.78
2-4) I feel that socializing was an important part of this session	0.66
Team Level	
2-1) I like my group members	0.93
2-2) I anticipate liking my group members in the future	0.78
2-3) I feel that I am similar to other members in my group	0.61
2-4) I feel that socializing was an important part of this session	0.51

Table 2
Individual and Team Level Collective Efficacy EFA Factor Loadings

Item	Factor 1
Individual Level	
1-1) My team could generate 16 unique solutions to a similar problem in 15 minutes	0.81
1-2) My team could generate 18 unique solutions to a similar problem in 15 minutes	0.89
1-3) My team could generate 20 unique solutions to a similar problem in 15 minutes	0.94
1-4) My team could generate 22 unique solutions to a similar problem in 15 minutes	0.96
1-5) My team could generate 24 unique solutions to a similar problem in 15 minutes	0.95
1-6) My team could generate 26 unique solutions to a similar problem in 15 minutes	0.88
1-7) My team could generate 28 unique solutions to a similar problem in 15 minutes	0.81
1-8) My team could generate 30 unique solutions to a similar problem in 15 minutes	0.72
Team Level	
1-1) My team could generate 16 unique solutions to a similar problem in 15 minutes	0.89
1-2) My team could generate 18 unique solutions to a similar problem in 15 minutes	0.94
1-3) My team could generate 20 unique solutions to a similar problem in 15 minutes	0.97
1-4) My team could generate 22 unique solutions to a similar problem in 15 minutes	0.98
1-5) My team could generate 24 unique solutions to a similar problem in 15 minutes	0.97
1-6) My team could generate 26 unique solutions to a similar problem in 15 minutes	0.89
1-7) My team could generate 28 unique solutions to a similar problem in 15 minutes	0.83
1-8) My team could generate 30 unique solutions to a similar problem in 15 minutes	0.78

Table 2, Cont.
Individual and Team Level Collective Efficacy EFA Factor Loadings

Item	*Factor 1*
Individual Level	
2-1) I feel confident about the capability of my group to perform tasks very well	0.81
2-2) My group would be able to solve difficult tasks if we invest the necessary effort	0.81
2-3) I feel confident that my group would be able to manage effectively unexpected troubles	0.87
2-4) My group is totally competent to solve assigned tasks	0.87
Team Level	
2-1) I feel confident about the capability of my group to perform tasks very well	0.87
2-2) My group would be able to solve difficult tasks if we invest the necessary effort	0.84
2-3) I feel confident that my group would be able to manage effectively unexpected troubles	0.87
2-4) My group is totally competent to solve assigned tasks	0.93

Table 3
Individual and Team Level Team Empowerment EFA Factor Loadings

Item	*Factor 1*
Individual Level	
1) My team has confidence in itself.	0.73
2) My team can get a lot done when it works hard.	0.76
3) My team believes that it can be very productive.	0.72
4) My team believes that its projects are significant.	0.82
5) My team feels that its tasks are worthwhile.	0.82
6) My team feels that its work is meaningful.	0.80
7) My team can select different ways to do the team's work.	0.59
8) My team determines as a team how things are done in the team.	0.64
9) My team makes its own choices without being told by the leader.	0.57
10) My team has a positive impact on the university.	0.74
11) My team performs tasks that matter to the university.	0.71
12) My team makes a difference in this university.	0.72
Team Level	
1) My team has confidence in itself.	0.73
2) My team can get a lot done when it works hard.	0.74
3) My team believes that it can be very productive.	0.74
4) My team believes that its projects are significant.	0.87
5) My team feels that its tasks are worthwhile.	0.83
6) My team feels that its work is meaningful.	0.85
7) My team can select different ways to do the team's work.	0.56
8) My team determines as a team how things are done in the team.	0.60
9) My team makes its own choices without being told by the leader.	0.64
10) My team has a positive impact on the university.	0.70
11) My team performs tasks that matter to the university.	0.71
12) My team makes a difference in this university.	0.78

Table 4

Descriptive Statistics and Intercorrelations for Individual Level Variables

	M	SD	1	2	3	4	5	6	7	8	9	10	11	12	13	
1. Participative Leadership Check	4.30	.83	(.69)													
2. Directive Leadership Check	3.67	1.19	.30**	(.66)												
3. Task Ambiguity Check	2.71	.72	-.12	-.19**	(.85)											
4. Gender[a]	1.65	.48	-.02	.00	-.06	-										
5. Collective Efficacy[b]	.00	.86	.26**	.10	-.39**	.09	(.94)									
6. Interpersonal Cohesion	5.48	.97	.27**	.14*	-.19**	-.06	.53**	(.85)								
7. Team Empowerment	5.45	.98	.30**	.24**	-.37**	.06	.60**	.59**	(.93)							
8. Proportion of Comments: Supportive	.20	.13	.11	.08	-.06	-.05	.01	.12	.05	-						
9. Proportion of Comments: Critical	.04	.06	-.02	-.05	-.01	-.13*	-.05	.01	-.05	-.08	-					
10. Proportion of Comments: Proposals	.21	.12	-.01	.13*	-.04	-.02	-.06	-.18**	-.03	-.20**	-.12	-				
11. Proportion of Comments: Off Topic	.07	.11	.08	-.12	-.06	.11	.02	-.01	.04	-.15*	-.05	-.33**	-			
12. Proportion of Divergent Solutions	.78	.20	-.04	-.07	.17**	-.02	-.08	-.03	.01	.01	.06	-.02	-.10	-		
13. Proportion of Convergent Solutions	.03	.07	.09	.03	-.05	-.01	-.01	.04	-.03	.05	.14*	.09	.00	-.35**	-	
14. Satisfaction	5.68	1.20	.30**	.20**	-.42**	.01	.67**	.61**	.73**	.04	.06	-.01	-.04	-.11		0.10

N = 240

[a] Male = 1, Female = 2

[b] This scale is standardized

Note . * p < .05. ** p < .01

Table 5

Descriptive Statistics and Intercorrelations for Team Level Variables

	M	SD	1	2	3	4	5	6	7	8	9	10	11
1. Collective Efficacy [a]	.00	.88	(.95)										
2. Interpersonal Cohesion	5.47	.57	.57**	(.88)									
3. Team Empowerment	5.45	.54	.67**	.62**	(.93)								
4. Standard Deviation CE	.66	.39	-.23	-.12	-.16	-							
5. Standard Deviation IC	.84	.37	-.24	-.24	-.11	.58**	-						
6. Standard Deviation TE	.87	.38	-.22	-.15	-.28*	.55**	.49**	-					
7. Proportion of Comments: Supportive	.19	.07	.02	.10	.07	-.15	-.17	-.07	-				
8. Proportion of Comments: Critical	.04	.04	-.17	-.06	-.12	.38**	.26*	.18*	-.04	-			
9. Proportion of Comments: Proposals	.21	.08	-.15	-.32*	-.08	.00	.10	-.04	.01	.12	-		
10. Proportion of Comments: Off Topic	.07	.08	.14	.18	.09	-.10	-.04	-.04	-.07	-.20	-.42**	-	
11. Proportion of Divergent Solutions	.77	.13	-.01	-.07	.00	-.11	.03	.16	-.17	.01	.16	-.17	-
12. Proportion of Convergent Solutions	.04	.04	-.06	-.07	-.12	-.05	-.01	-.07	.29*	.23	.14	.11	-.43**

[a] This scale is standardized

Note . * p < .05. ** p < .01

Table 6
HLM results for Hypotheses 1 and 4

Variable	*Coefficient*	*SE*	*t*
Main Effects: Multivariate HLM			
Virtuality			
B0 (Intercept, Team)	0.19	0.10	3.29*
Leadership[a]			
$B0_1$ (Intercept, Team)	-0.01	0.04	-0.44
$B0_2$ (Intercept, Team)	0.01	0.06	0.70
Interaction: Multivariate HLM			
Virtuality			
B0 (Intercept, Team)	0.19	0. 10	3.34*
Leadership			
$B0_1$ (Intercept, Team)	-0.15	0.11	-2.70*
$B0_2$ (Intercept, Team)	0.06	0.19	1.01
Interaction			
$B0_1$ (Intercept, Team)	0.15	0.07	2.70*
$B0_2$ (Intercept, Team)	-0.05	0.12	-0.82
Main Effects: Virtuality on Individual Shared Team States			
Collective Efficacy			
B0 (Intercept, Team)	0.22	0.14	2.81*
Interpersonal Cohesion			
B0 (Intercept, Team)	0.14	0.14	1.97†
Team Empowerment			
B0 (Intercept, Team)	0.12	0.14	1.72†

Note: N = 60
[a] Leadership is effects-coded
* $p < .05$, † $p < .10$

Table 6, Cont.
HLM results for Hypotheses 1 and 4

Variable	*Coefficient*	*SE*	*t*
Interaction: Virtuality and Leadership on Individual Shared Team States			
Collective Efficacy			
B0 (Virtuality, Team)	0.22	0.13	2.83*
B0 (Leadership 1, Team)	-0.40	0.15	-1.59
B0 (Leadership 2, Team)	0.36	0.26	1.45
B0 (Interaction 1, Team)	0.41	0.09	1.64
B0 (Interaction 2, Team)	-0.32	0.16	-1.28
Interpersonal Cohesion			
B0 (Virtuality, Team)	0.14	0.14	2.00†
B0 (Leadership 1, Team)	-0.52	0.16	-2.26*
B0 (Leadership 2, Team)	0.00	0.27	0.02
B0 (Interaction 1, Team)	0.46	0.10	2.00†
B0 (Interaction 2, Team)	-0.02	0.17	-0.09
Team Empowerment			
B0 (Virtuality, Team)	0.14	0.13	1.79†
B0 (Leadership 1, Team)	-0.58	0.15	-2.37*
B0 (Leadership 2, Team)	-0.04	0.26	-0.17
B0 (Interaction 1, Team)	0.64	0.09	2.63*
B0 (Interaction 2, Team)	0.14	0.16	0.56

Note: N = 60
[a] Leadership is effects-coded
* $p < .05$, † $p < .10$

Table 7
Main Effects of Shared Team States on Communication

Variable	*Coefficient*	*SE*	*t*
On Solution Proposals			
Collective Efficacy			
B1 (Slope, Individual)	-0.03	0.01	-0.23
B0 (Intercept, Team)	-0.09	0.01	-0.44
Interpersonal Cohesion			
B1 (Slope, Individual)	-0.14	0.01	-1.05
B0 (Intercept, Team)	-0.38	0.02	-1.97†
Team Empowerment			
B1 (Slope, Individual)	-0.02	0.01	-0.20
B0 (Intercept, Team)	-0.06	0.02	-0.27
On Supportive Comments			
Collective Efficacy			
B1 (Slope, Individual)	-0.00	0.01	-0.03
B0 (Intercept, Team)	0.06	0.01	0.63
Interpersonal Cohesion			
B1 (Slope, Individual)	0.13	0.01	1.58
B0 (Intercept, Team)	0.02	0.02	0.27
Team Empowerment			
B1 (Slope, Individual)	0.02	0.01	0.30
B0 (Intercept, Team)	0.08	0.02	0.88
On Critical Comments			
Collective Efficacy			
B1 (Slope, Individual)	0.01	0.01	0.10
B0 (Intercept, Team)	-0.05	0.01	-1.02
Interpersonal Cohesion			
B1 (Slope, Individual)	-0.01	0.00	-0.28
B0 (Intercept, Team)	0.00	0.01	0.02
Team Empowerment			
B1 (Slope, Individual)	-0.01	0.00	-0.24
B0 (Intercept, Team)	-0.03	0.01	-0.73
On Off-Task Remarks			
Collective Efficacy			
B1 (Slope, Individual)	-0.00	0.01	-0.04
B0 (Intercept, Team)	0.05	0.01	0.48
Interpersonal Cohesion			
B1 (Slope, Individual)	-0.04	0.01	-.67
B0 (Intercept, Team)	0.08	0.02	.74
Team Empowerment			
B1 (Slope, Individual)	0.07	0.01	1.12
B0 (Intercept, Team)	-0.03	0.02	-0.31

Note: N = 60
* p < .05, † p <.10

Table 8
Main Effects of Communication on Outcomes

Variable	*Coefficient*	*SE*	*t*
On Divergent Solutions			
Proportion of Proposals			
B1 (Slope, Individual)	-0.20	0.16	-2.13*
B0 (Intercept, Team)	0.24	0.24	2.41*
Proportion of Supportive Comments			
B1 (Slope, Individual)	0.14	0.17	1.27
B0 (Intercept, Team)	-0.17	0.26	-1.83†
Proportion of Critical Comments			
B1 (Slope, Individual)	0.07	0.29	0.86
B0 (Intercept, Team)	0.02	0.53	0.20
Proportion of Off-Task Remarks			
B1 (Slope, Individual)	-0.07	0.25	-0.54
B0 (Intercept, Team)	-0.06	0.31	-0.51
On Convergent solutions			
Proportion of Proposals			
B1 (Slope, Individual)	0.01	0.06	0.98
B0 (Intercept, Team)	0.07	0.09	0.09
Proportion of Supportive Comments			
B1 (Slope, Individual)	-0.06	0.05	-0.65
B0 (Intercept, Team)	0.16	0.09	-1.77†
Proportion of Critical Comments			
B1 (Slope, Individual)	0.15	0.14	1.30
B0 (Intercept, Team)	0.05	0.16	0.52
Proportion of Off-Task Remarks			
B1 (Slope, Individual)	-0.15	0.09	-1.12
B0 (Intercept, Team)	0.18	0.11	1.36

Note: N = 60
* $p < .05$, † $p < .10$

Table 8, Cont.
Main Effects of Communication on Outcomes

Variable	*Coefficient*	*SE*	*t*
On Satisfaction			
Proportion of Proposals			
B1 (Slope, Individual)	-0.00	0.97	-0.03
B0 (Intercept, Team)	-0.00	1.45	-0.03
Proportion of Supportive Comments			
B1 (Slope, Individual)	0.01	0.73	0.08
B0 (Intercept, Team)	0.05	1.35	0.70
Proportion of Critical Comments			
B1 (Slope, Individual)	0.13	1.59	1.60
B0 (Intercept, Team)	-0.12	2.81	-1.25
Proportion of Off-Task Remarks			
B1 (Slope, Individual)	-0.11	1.11	-1.09
B0 (Intercept, Team)	0.15	1.60	1.38

Note: N = 60
* p < .05, † p <.10

Table 9
Post-Hoc Tests: Main Effects of Virtuality on Communication and Outcomes

Variable	*Coefficient*	*SE*	*t*
Main Effects: On Communication			
Solution Proposals			
B0 (Intercept, Team)	-0.27	0.02	-2.97*
Supportive Remarks			
B0 (Intercept, Team)	-0.10	0.02	-1.18
Critical Remarks			
B0 (Intercept, Team)	-0.23	0.01	-2.95*
Off Topic Remarks			
B0 (Intercept, Team)	0.24	0.02	2.56*
Main Effects: On Outcomes			
Divergent Solutions			
B0 (Intercept, Team)	0.02	0.03	0.27
Convergent Solutions			
B0 (Intercept, Team)	-0.08	0.01	-1.08
Satisfaction			
B0 (Intercept, Team)	0.07	0.18	0.97

Note: N = 60
[a] Leadership is effects-coded
* p < .05, † p <.10

Table 10
Post-Hoc Tests: Main Effects of Leadership on Communication and Outcomes

Variable	*Coefficient*	*SE*	*t*
Main Effects: On Communication			
Solution Proposals			
B_{01} (L1, Intercept, Team)	0.18	0.01	1.84†
B_{02} (L2, Intercept, Team)	-0.06	0.01	-0.64
Supportive Remarks			
B_{01} (L1, Intercept, Team)	-0.02	0.01	-0.21
B_{02} (L2, Intercept, Team)	-0.02	0.01	-0.19
Critical Remarks			
B_{01} (L1, Intercept, Team)	-0.03	0.00	-0.40
B_{02} (L2, Intercept, Team)	0.09	0.01	1.12
Off Topic Remarks			
B_{01} (L1, Intercept, Team)	0.17	0.01	1.75†
B_{02} (L2, Intercept, Team)	0.01	0.01	0.09
Main Effects: On Outcomes			
Divergent Solutions			
B_{01} (L1, Intercept, Team)	0.06	0.01	0.72
B_{02} (L2, Intercept, Team)	0.04	0.02	0.45
Convergent Solutions			
B_{01} (L1, Intercept, Team)	0.12	0.00	1.45
B_{02} (L2, Intercept, Team)	-0.08	0.01	-0.96
Satisfaction			
B_{01} (L1, Intercept, Team)	0.06	0.10	3.29*
B_{02} (L2, Intercept, Team)	0.12	0.14	1.72†

Note: N = 60
[a] Leadership is effects-coded
* p < .05, † p <.10

Table 11
Post-Hoc Tests: Interaction of Leadership and Virtuality on Communication and Outcomes

Variable	*Coefficient*	*SE*	*t*
Interaction: On Communication			
Solution Proposals			
B_{01} (Virtuality)	-0.27	0.02	-2.99*
B_{02} (Leadership 1)	0.24	0.02	0.84
B_{03} (Leadership 2)	-0.17	0.04	-0.58
B_{04} (Interaction 1)	-0.07	0.02	-0.24
B_{05} (Interaction 2)	0.11	0.03	0.34
Supportive Remarks			
B_{01} (Virtuality)	-0.10	0.02	-1,25
B_{02} (Leadership 1)	-0.65	0.02	-2.64*
B_{03} (Leadership 2)	0.45	0.04	1.83†
B_{04} (Interaction 1)	0.67	0.01	2.70*
B_{05} (Interaction 2)	-0.49	0.02	-2.00†
Critical Remarks			
B_{01} (Virtuality)	-0.23	0.01	-2.96*
B_{02} (Leadership 1)	0.09	0.01	0.35
B_{03} (Leadership 2)	-0.25	0.02	-1.03
B_{04} (Interaction 1)	-0.12	0.01	-0.51
B_{05} (Interaction 2)	0.37	0.01	1.49
Off Topic Remarks			
B_{01} (Virtuality)	0.24	0.02	2.55*
B_{02} (Leadership 1)	0.22	0.02	0.73
B_{03} (Leadership 2)	0.14	0.04	0.46
B_{04} (Interaction 1)	-0.05	0.01	-0.16
B_{05} (Interaction 2)	-0.14	0.03	-0.46

Note: N = 60
[a] Leadership is effects-coded
* p < .05, † p <.10

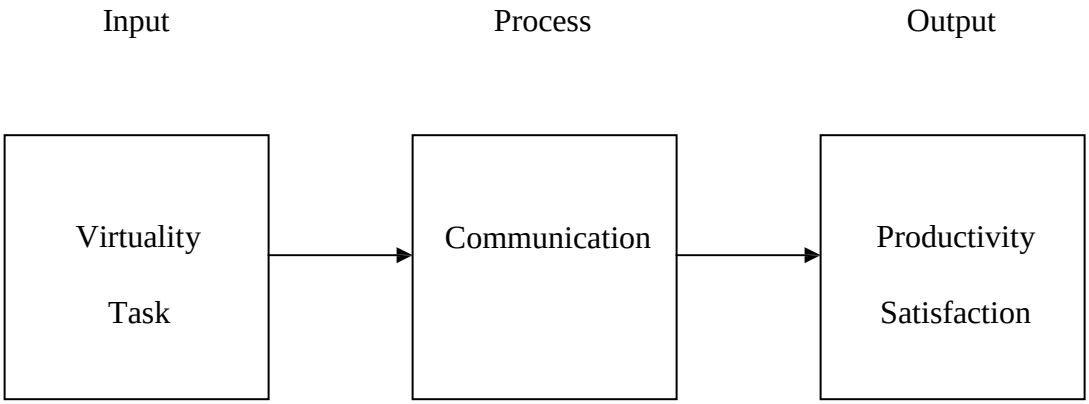
Table 11, Cont.
Post-Hoc Tests: Interaction of Leadership and Virtuality on Communication and Outcomes

Variable	*Coefficient*	*SE*	*t*
Interaction: On Outcomes			
Divergent Solutions			
B_{01} (Virtuality)	0.02	0.03	0.25
B_{02} (Leadership 1)	0.58	0.04	2.14*
B_{03} (Leadership 2)	-0.14	0.07	-0.54
B_{04} (Interaction 1)	-0.55	0.02	-2.02*
B_{05} (Interaction 2)	0.19	0.04	0.71
Convergent Solutions			
B_{01} (Virtuality)	-0.08	0.01	-1.10
B_{02} (Leadership 1)	-0.31	0.01	-1.26
B_{03} (Leadership 2)	-0.07	0.02	-0.30
B_{04} (Interaction 1)	0.45	0.01	1.82†
B_{05} (Interaction 2)	0.00	0.01	-0.01
Satisfaction			
B_{01} (Virtuality)	0.07	0.17	0.99
B_{02} (Leadership 1)	-0.47	0.19	-2.07*
B_{03} (Leadership 2)	-0.02	0.33	-0.09
B_{04} (Interaction 1)	0.54	0.12	2.40*
B_{05} (Interaction 2)	0.06	0.21	0.26

Note: N = 60
[a] Leadership is effects-coded
* $p < .05$, † $p < .10$

Figure 1.1

Traditional Input-Process-Output Model



Adopted from: McGrath, J. E. (1964). *Social Psychology: A brief introduction.* New York: Holt.

Figure 1.2

Hypothesized Model

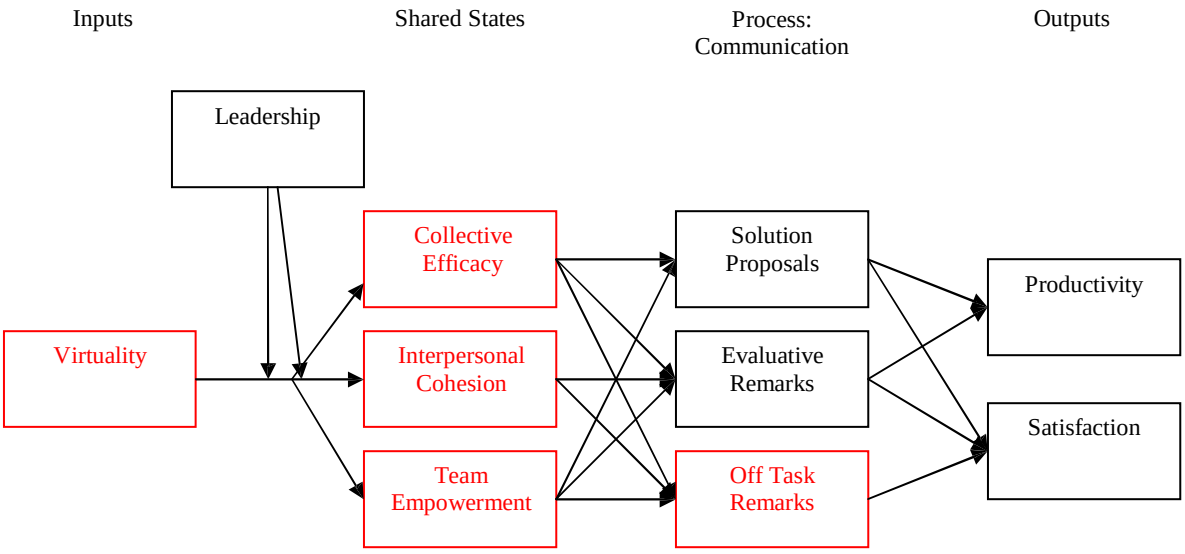


Figure 2.1

Interaction of Virtuality and Leadership on Percentage of Supportive Comments

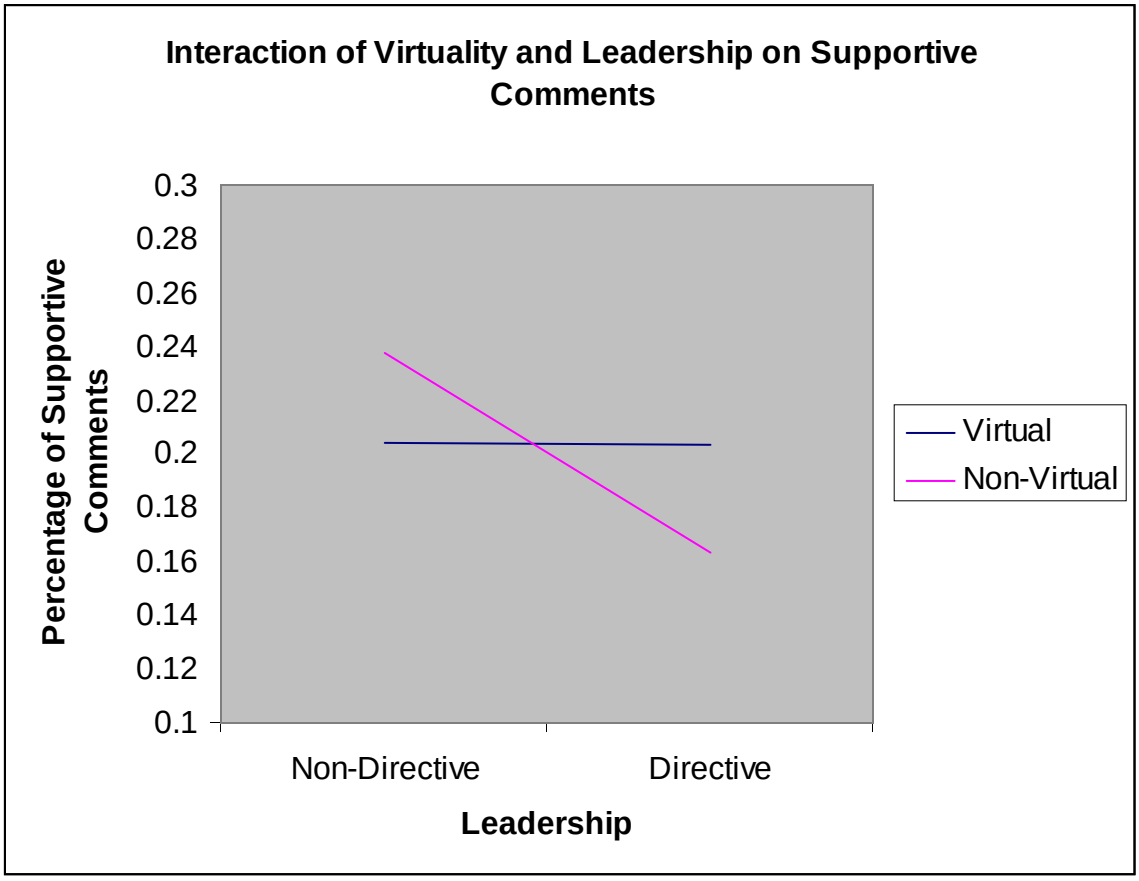


Figure 2.2

Interaction of Virtuality and Leadership on Divergent Solutions

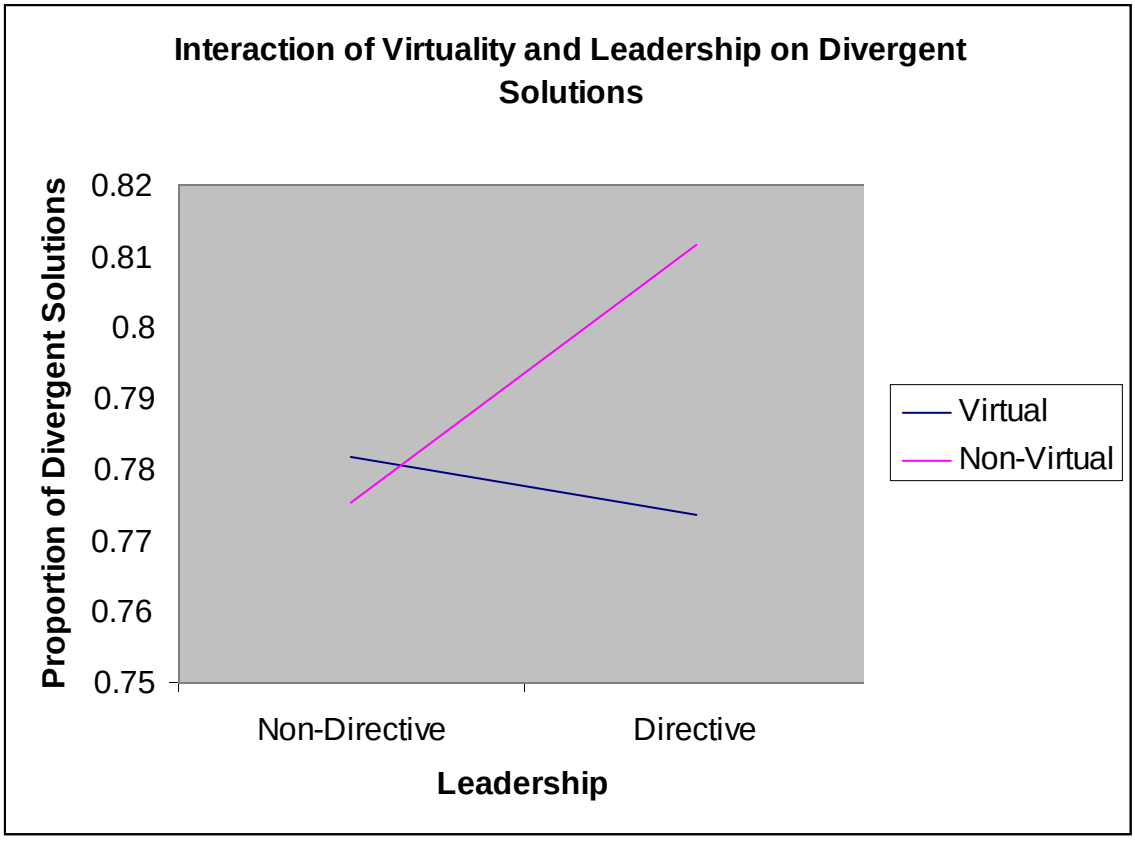
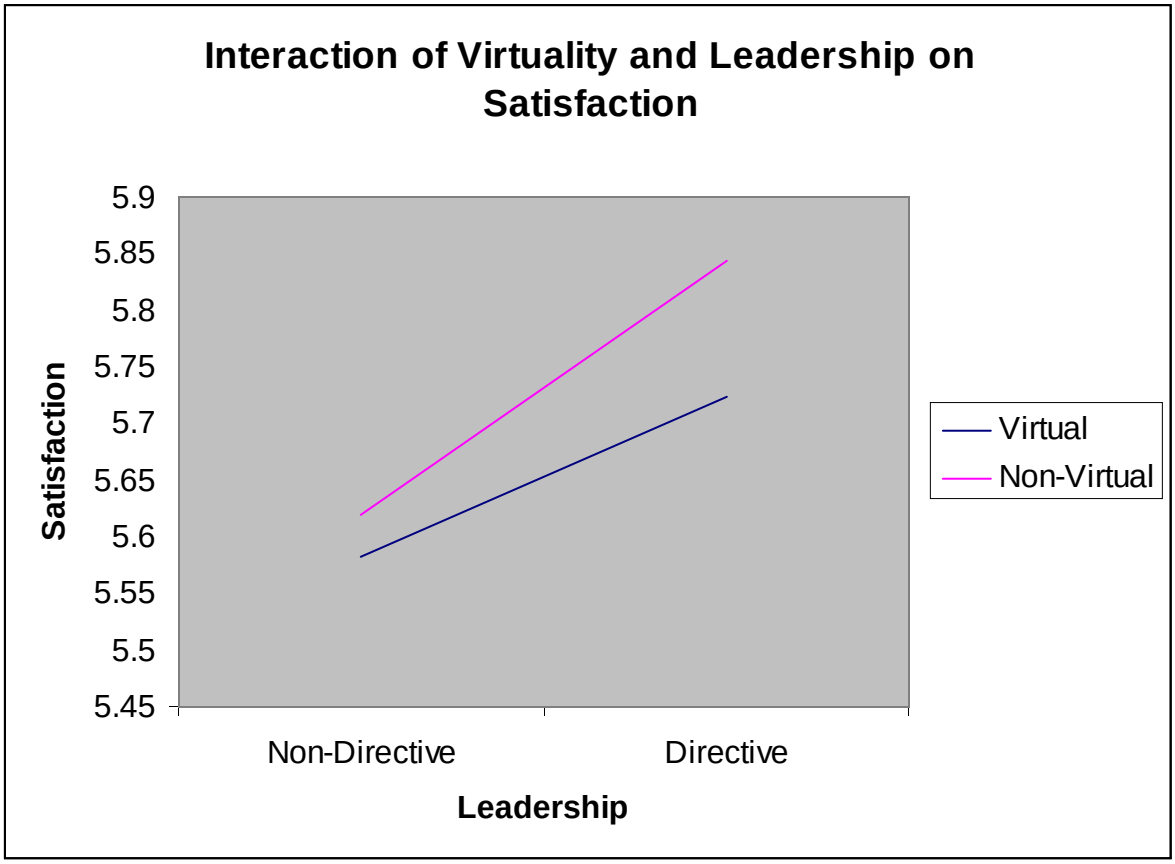


Figure 2.3

Interaction of Virtuality and Leadership on Satisfaction



Footnotes

1. Since vituality may effect the formation of shared team states, analyses were conducted at both levels to ensure equivalence of factor structure across levels.

2. As can be seen in Table 4, gender is related to critical remarks at the individual level, such that a greater percentage of male participants' communication is critical, relative to female participants. Thus, all hypotheses addressing critical remarks involved additional analyses wherein which gender was controlled. The results of these additional analyses, however, were no different from results of analyses without gender being controlled, and thus, are not reported.

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