DISSERTATION

TOWARDS A BETTER UNDERSTANDING OF VIRTUAL TEAM EFFECTIVENESS: AN INTEGRATION OF TRUST

Submitted by

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WE HEREBY RECOMMEND THAT THE DISSERTATION PREPARED UNDER OUR SUPERVISION BY VIRGINIA E. PITTS ENTITLED TOWARDS A BETTER UNDERSTANDING OF VIRTUAL TEAM EFFECTIVENESS: AN INTEGRATION OF TRUST BE ACCEPTED AS FULFILLING IN PART REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY.

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ABSTRACT OF DISSERTATION

TOWARDS A BETTER UNDERSTANDING OF VIRTUAL TEAM EFFECTIVENESS: AN INTEGRATION OF TRUST

The purpose of the current study was to expand the traditional input-process-output (IPO) models of team effectiveness to address the dynamic and distal work arrangements prevalent in the 21st century. Considering the critical role that trust plays in driving virtual team effectiveness, I proposed a model of virtual team effectiveness in which cognitive and affective trust dimensions mediate the relationships between team processes (action, transition, and interpersonal) and outcomes (team viability and performance). Participants were 191 undergraduate students who comprised 49 teams. Survey measures were completed following each of three interdependent tasks in which teams engaged. Multilevel structural equation modeling (MSEM), an innovative statistical technique that combines the benefits of multilevel modeling and structural equation modeling), was used to test hypotheses. The results of the analyses supported the mediational hypotheses at the individual level, but not at the team level of analysis.

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CHAPTER 1: INTRODUCTION

Changes to the work landscape, including the dissolution of traditional bureaucratic management and the increasing use of self-managed teams (Cascio, 2003; Kozlowski & Bell, 2003), have stimulated interest in organizational trust (Dirks & Ferrin, 2001; Kramer, 1999; Rousseau, Sitkin, Burt, & Camerer, 1998). In recent decades, the burgeoning use of technology in organizations has also facilitated the emergence of virtual work teams; teams in which members communicate across time, space, and boundaries using computer-mediated technology (Bell & Kozlowski, 2002; Martins, Gilson, & Maynard, 2004). Within the virtual team literature, a considerable amount of attention has been given to the unique role that trust plays in virtual team effectiveness (i.e., Aubert & Kelsey, 2003; Greenberg, Greenberg, & Antonucci, 2007; Jarvenpaa & Leidner, 1999; Jarvenpaa, Shaw, & Staples, 2004).

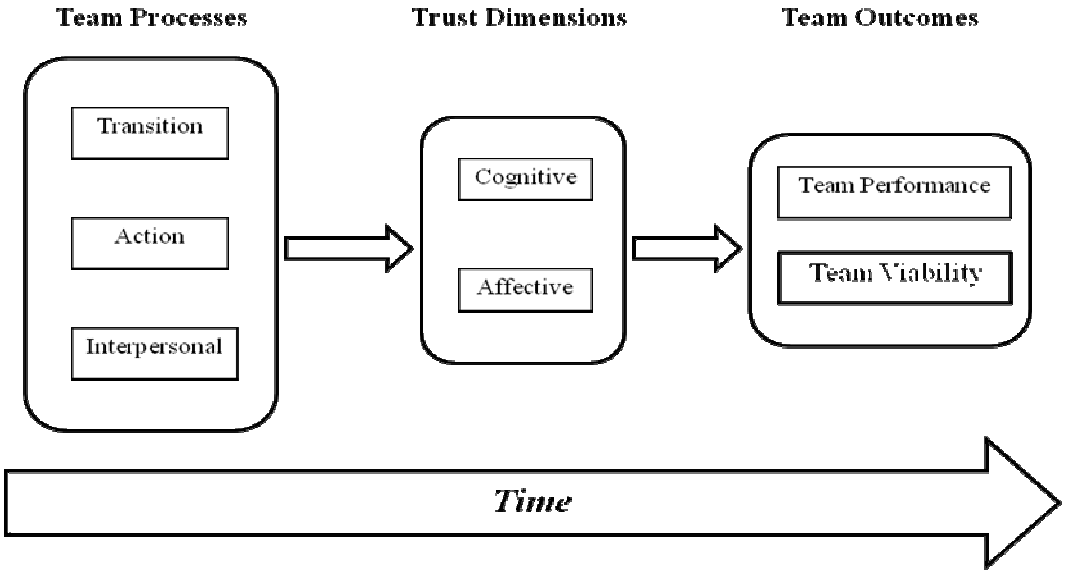
However, most studies have failed to examine the multidimensional nature of the trust construct in virtual teams (Greenberg et al., 2007), even though these teams are inherently multidimensional in nature (e.g., nested). Further, studies have neglected to explore the influence of team processes as predictors of trust development in virtual teams, despite the need to better understand antecedents of trust in such teams (Colquitt, Scott, & LePine, 2007; Furst, Blackburn, & Rosen, 1999). Given evidence that trust has important implications for virtual team performance and member well-being (Fiore,

Salas, Cuevas, & Bowers, 2003; Morris, Marshall, & Rainer, 2002; Kanawattanchai & Yoo, 2002), and that team processes are the primary mechanisms through which trust emerges (Jones & George, 1998; Panteli & Duncan, 2004), examination of the role of trust in explaining the relationship between team processes and outcomes is an important step in advancing our understanding of virtual team effectiveness. To this end, the current study addresses several critical gaps in the virtual team literature.

First, I create a new theoretical model by incorporating a multi-dimensional perspective of trust in virtual teams that examines cognitive and affective factors of trust. Although trust has received prominent attention as a predictor of virtual team effectiveness, the majority of studies have treated trust as a unidimensional construct (see Jarvenpaa, Knoll, & Leidner, 1998; Jarvenpaa et al., 2004). This focus on unidimensionality persists despite evidence that trust reflects cognitive and affective components (Greenberg et al., 2007; McAllister, 1995). Second, I examine team processes, which reflect the communication mechanisms through which team members interact, as antecedents of both cognitive and affective trust dimensions. To date, studies have neglected to explore team processes as predictors of trust development, despite their importance in understanding virtual team functioning (Martins et al., 2004). The present study makes a third contribution to the virtual team literature by clarifying our understanding of the "black box" of team process-outcome relationships in virtual teams. Because trust is arguably one of the most critical determinants of virtual team success (Greenberg et al., 2007; Jarvenpaa & Leidner, 1999; Jarvenpaa et al., 2004), I propose a model of virtual team effectiveness in which cognitive and affective trust serve as

mediators of the relationships between team processes and outcomes (i.e., objective performance and team viability; see Figure 1).

Figure 1



Because growing evidence suggests that traditional team effectiveness models do not adequately capture the challenges associated with modern-day work teams (Fiore et al., 2003; Graetz, Boyle, Kimble, Thompson, & Garloch, 1998; Johnson, Suriya, Yoon, Berrett, & LaFleur, 2002), especially those wherein virtual communication is frequent (Baltes, Dickson, Sherman, Bauer & LaGanke, 2002), this research provides modifications to existing team theory in light of important challenges faced by 21st-century teams. Furthermore, this study considers the role of time, as depicted in Figure 1, which represents an important yet neglected variable in the study of teams (Cohen & Bailey, 1997; Kozlowski & Bell, 2003; Marks, Mathieu, & Zaccaro, 2001). By measuring focal variables throughout the team's lifespan, the current study incorporates a

longitudinal perspective consistent with calls to abandon snap-shot, cross-sectional studies of team behavior (Ilgen, Hollenbeck, Johnson, & Jundt, 2005; Mathieu, DeShon, & Bergh, 2008; Maxwell & Cole, 2007).

In reviewing the literature on virtual team communication and effectiveness, my goal is to incorporate a variety of research domains that have addressed virtual communication. Specifically, I integrate research in communication science (i.e., Culnan & Markus, 1987; Daft & Lengel, 1986; Walther, 1992, 1997), information technology (i.e., Baker, 2002; Chidambaram, 1996; Potter & Balthazard, 2002), organizational behavior (i.e., Ahuja & Galvin, 2003; Foo, Sin, & Yiong, 2006), industrial and organizational psychology (i.e., Kozlowski & Bell, 2003; Kramer, 1999), and social psychology (i.e., Berger, 1979; Gersick, 1988). First, I define virtual teams, noting their benefits and challenges. Second, I describe methods of computer-mediated communication and provide evidence that the nature of interactions using this medium hinders the formation and maintenance of interpersonal relationships in virtual teams. Third, after summarizing the input-process-output (IPO) framework that dominates traditional models of team effectiveness (Gladstein, 1984; Hackman, 1987), I review evidence that these models fail to capture the unique environment in which modern-day teams interact. Accordingly, I discuss the central role that trust has assumed in explaining virtual team functioning and address the importance of treating trust as a multidimensional construct in the study of virtual teams. Finally, I propose a model of virtual team effectiveness in which cognitive and affective dimensions of trust serve as mediators of team process-outcome relationships.

Virtual Teams

Virtual teams are made up of individuals who work interdependently using computer-mediated communication technology to accomplish a shared organizational objective (Martins et al., 2004; Powell, Piccoli, & Ives, 2004; Warkentin & Beranek, 1999). Virtual teams share several common characteristics with other types of teams identified in the existing team literature. For example, like attributes of temporary teams (Meyerson, Weick & Kramer, 1996) and project teams (Sundstrom, McIntyre, Halfhill, & Richards, 2000), virtual teams have a finite lifespan, in which team members must interact to execute time-constrained tasks (Bell & Kozlowski, 2002; Martins et al., 2004; Warkentin & Beranek, 1999). Also like temporary and project teams, virtual team members are typically chosen for their expertise and they often disband once their collective task is complete (Bell & Kozlowski, 2002). Virtual teams differ from other teams in that their members communicate with one another across geographical distances using computer-mediated technology (i.e., e-mail, videoconferencing; Kirkman & Mathieu, 2005; Martins et al., 2004; Warkentin & Beranek, 1999). Thus, although virtual teams share features of other types of work teams, they represent a unique organizational form because their method of communication frequently lacks face-to-face cues that naturally occur in traditional team interactions.

Extensively used in today's organizations (Cascio, 2000; Cascio, 2003; Martins et al., 2004), virtual teams yield numerous benefits for both organizations and workers. Reducing real estate and travel expenses, accessing global markets, and increasing flexibility to remain competitive in a changing economy are a few of the mechanisms by

which virtual teams reduce costs and increase organizational effectiveness (Bell & Kozlowski, 2002; Cascio, 2000). Virtual teams also enable organizations to align their top talent by composing teams based on members' expertise rather than physical location (Kristof, Brown, Sims, & Smith, 1995; Warkentin & Beranek, 1999), further strengthening competitiveness in a global economy. Further, the implementation of virtual teams has benefits for employees, including reduced expenses and inconveniences associated with co-located work (e.g., commuting time, traffic) and increased worker flexibility (Lipnack & Stamps, 1997; Martins et al., 2004).

Despite the convincing business case for their implementation, virtual teams present critical obstacles for organizations. For example, virtual teams pose leadership challenges and managerial issues because of their autonomous nature (Bell & Kozlowski, 2002). Additionally, because virtual environments are void of physical interaction, team members may perceive greater isolation and lack trust in coworkers (Cascio, 2000; Kirkman, Rosen, Gibson, Tesluk, & McPherson, 2002; Powell et al., 2004). Indeed, an expanding volume of research suggests that trust is both more difficult to develop and more fragile in virtual teams as compared to their face-to-face counterparts (Jarvenpaa et al., 2004; Lu, Watson-Manheim, Chudoba, & Wynn, 2006; Wallace, 2004).

The challenge of developing trust is particularly noteworthy given evidence that trust is an essential ingredient of effective virtual team functioning (Kanawattanachai & Yoo, 2002; Lin, Standing, & Liu, 2008). Thus, in the current study, I propose and test a model of team effectiveness that accentuates the role of trust. An exploration of the nature of virtual team communication, and how it differs from traditional forms of team

interaction, illuminates the importance of considering the role of trust as a mechanism through which team processes exert influence on team outcomes in virtual teams.

Computer-Mediated Communication

Virtual teams may interact using a variety of computer-mediated communication mechanisms including teleconferencing, instant messaging, and e-mailing (Bell & Kozlowski, 2002; Martins et al., 2004). Media richness theory (Daft & Lengel, 1986) proposes that computer-mediated communication can be described along a continuum in terms of how much information is conveyed. Specifically, asynchronous communication (e.g., e-mail), which lacks paraverbal (e.g., voice tone and inflection, loudness) and nonverbal (e.g., hand gestures, head nods, facial expressions) information, is considered to be low on media richness. Synchronous (e.g., instant messaging) interaction, although still lacking nonverbal and paraverbal cues, allows individuals to communicate in real-time. Thus, synchronous communication is considered to be higher on media richness than asynchronous modes of communication because real-time interactions provide the opportunity for increased exchanges among team members (Culnan & Markus, 1987; Daft & Lengel, 1986; Warkentin & Beranek, 1999). Face-to-face communication reflects the highest point on the continuum because of its ability to simultaneously transmit paraverbal and nonverbal cues.

According to media richness theory (Daft & Lengel, 1986), the amount of information conveyed in computer-mediated groups is inherently less than that transferred in traditional face-to-face environments because the virtual environment lacks paraverbal and nonverbal cues, which convey a large portion of the meaning of

conversation in face-to-face exchanges (Graetz et al., 1998). Several researchers have proposed that this decreased flow of information impacts the development of interpersonal relationships (Chidambaram, 1996; Walther, 1992). As social information processing (SIP) theory posits (Walther, 1992), because the exchange of social information serves as the primary mechanism through which relationships develop, the nature of virtual interaction poses a threat to the formation and maintenance of meaningful personal relationships because it hinders team members' abilities to acquire social information (i.e., noverbal and paraverbal cues; Walther, 1992, 1997). SIP theory further proposes that although computer-mediated communication will initially attenuate relationship development, over time and with subsequent interactions the effect of this altered communication will diminish (Johnson et al., 2002; Lebie, Rhoades & McGrath, 1996; Walther, 1997). Thus, scholars have proposed that relationship development in virtual teams occurs at a slower rate than in traditional teams (Chidambaram, 1996; Johnson et al., 2002).

Empirical evidence supports propositions that computer-mediated groups demonstrate reduced interpersonal communication and slower relational development compared to face-to-face teams (Chidambaram, 1996; Lebie et al., 1996; Martins et al., 2004; Walther, 1997). For example, Lebie and colleagues found that compared to face-to-face teams virtual teams tended to share less personal information. Importantly, they also found that interpersonal interactions were an essential ingredient for effective task performance. Further research has demonstrated that virtual groups tend to be more task-focused than their face-to-face counterparts (Lebie et al., 1996; Lin et al., 2008; Martins

et al., 2004). Overall, these findings support the argument that the nature of virtual environments results in reduced social information that inhibits the development of interpersonal relationships.

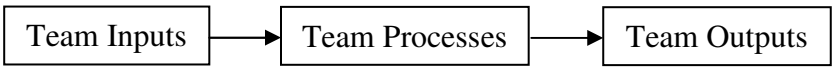
Given the noted differences between computer-mediated and face-to-face communication, as well as the increasing prevalence of virtual teams in organizations (Cascio, 2003; Sundstrom et al., 2000), it is not surprising that researchers have advocated modifying traditional team effectiveness models to address challenges faced by modern-day work groups (Ahuja & Galvin, 2003; Cascio, 2000; Driskell, Radtke, & Salas, 2003; Guzzo & Dickson, 1996; Lin et al., 2008; Lurey & Raisinghani, 2001). Because the development of social relationships between team members fosters group cohesion (a sense of togetherness among team members), which has positive organizational benefits (i.e., performance, team viability; see Kozlowski & Bell, 2003), a more thorough investigation of how different team processes drive the formation of interpersonal relationships in virtual teams is needed. To this end, the current study integrates the role of team processes and trust in virtual teams to inform changes to existing team effectiveness theory. The following sections highlight past, present, and future models of team effectiveness to provide context for the current study.

Team Effectiveness Models: The Past

Models of face-to-face team effectiveness, which are ubiquitous in the literature on team development and functioning within face-to-face teams (see Gersick, 1988; McGrath, 1964, 1991; Shea & Guzzo, 1987; Sundstrom et al., 1990; Tuckman, 1965), generally subscribe to the input-process-output (IPO) framework (e.g., McGrath, 1964;

Gladstein, 1984; Hackman, 1987; Kozlowski & Bell, 2003). Team inputs reflect antecedent factors that may contribute to or constrain team processes at multiple levels (Mathieu et al., 2008). Inputs, which include individual (e.g., personality characteristics, expertise), group (e.g., size, task), and organizational (e.g., rewards) factors, are hypothesized to exert influence on team processes, which represent members' interactions directed towards goal accomplishment (Marks et al., 2001). Within the IPO framework, team processes drive outputs including objective (e.g., task performance) and subjective (e.g., team member satisfaction, perceived effectiveness, team viability) outcomes (Guzzo & Dickson, 1996; Kozlowski & Bell, 2003; Mathieu, Maynard, Rapp, & Gilson, 2008). As Figure 2 depicts, IPO models assume a mediational process, whereby inputs impact team processes (e.g., communication, conflict), which subsequently impact team outcome variables (i.e., task performance, team member attitudes). Although an array of team input and outcome variables have been examined in the literature on traditional team effectiveness (see Mathieu et al., 2008), research on team processes has been relatively limited until recently (Marks et al., 2001; Mathieu et al., 2008).

Figure 2



Recent years have witnessed increased attention given to team processes in face-to-face teams, although the empirical study of team processes in face-to-face teams has been somewhat fragmented due to a lack of consensus regarding the core components of *team processes* (Marks et al., 2001). For example, despite suggestions that team

processes are multidimensional (Marks et al., 2001), many studies have measured team processes as a unidimensional construct (e.g., teamwork, coordination; see Foo et al., 2006; Tasa, Taggar, & Seijts, 2007). Across differing conceptualizations of team processes, scholars have found team processes to predict performance and positive work attitudes (although most of this research is based on face-to-face teams). For example, Stevens and Campion (1999) found that *teamwork behaviors* in face-to-face teams predicted overall job performance, as well as subjective ratings (both supervisor and peer ratings). Additionally, research has shown that *social cohesion* and *open communication*, as indicators of team processes, predict team viability (Barrick, Stewart, Neubert, & Mount, 1998; Foo et al., 2006), which is defined as team members' assessments of their ability to work together as a unit in the future (Barrick et al., 1998; Hackman, 1987; Kozlowski & Bell, 2003). Team member *cooperation* also shows positive relationships with performance (Zack & McKenney, 1995).

Although research supports the proposition that team processes serve as mechanisms that drive team outcome, the study of team processes themselves has advanced slowly due to the differing conceptualizations of team process variables. In an effort to provide an integrative framework from which to study team processes in face-to-face teams, Marks et al. (2001) proposed a model of team processes based on their comprehensive review of the existing team process literature. Their taxonomy of team-based processes reflects a viable framework from which to explore the study of team processes in virtual teams. Specifically, Marks et al.'s taxonomy, which has been validated in face-to-face teams (LePine, Piccollo, Jackson, Mathieu, & Saul, 2008),

classifies team processes into three main categories: transition processes, action processes, and interpersonal processes (shown in Figure 1).

Transition processes describe interactions between team members as they plan how to execute their task, and include goal specification (Dickinson & McIntyre, 1997) and strategy formulation (Gladstein, 1984) activities. Whereas transition processes typically occur between performance episodes as teams evaluate and reformulate their strategies for future work, action processes, which describe the *how* of teams (Weingart, 1997), occur when teams are engaged in activities directly related to goal accomplishment (Marks et al., 2001) Exemplars of action processes include monitoring progress towards goals (Cannon-Bowers, Tannenbaum, Salas, & Volpe, 1995) and task coordination (Brannick, Roach, & Salas, 1993). Lastly, interpersonal processes are focused on the development and maintenance of team member relationships. Interpersonal processes, defined as "activities that foster emotional balance, togetherness, and effective coping" (LePine et al., 2008, p. 277), include confidence building (Fleishman & Zaccaro, 1992) and conflict management (Cannon-Bowers et al., 1995). Thus, interpersonal processes reflect humanistic aspects of teamwork and are proposed to operate throughout the team's lifecycle (Marks et al., 2001).

In a recent meta-analysis, LePine et al. (2008) empirically tested the Marks et al. (2001) team process framework using studies of face-to-face teams. Their findings revealed that transition, action, and interpersonal processes represent unique constructs, each of which have positive and robust relationships with objective and subjective team effectiveness criteria (i.e., team performance and member satisfaction). Notably, the

magnitude of the relationships between transition, action, and interpersonal process dimensions and outcomes were roughly equivalent, indicating that each type of process makes an equally important contribution to explaining team outcomes in face-to-face teams. Overall, these results expand traditional IPO models of team effectiveness by showing the influence of action, transition, and interpersonal team process variables on important objective and subjective outcomes. However, to date studies have neglected to incorporate the Marks et al.'s taxonomy of team processes within virtual teams. Therefore, in an effort to better understand team processes and their effects on outcomes in virtual teams the current study contributes to extant literature by incorporating the validated framework offered by Marks and colleagues. Further, the current study answers continued calls to adapt traditional team effectiveness models to address modern work arrangements.

Team Effectiveness Models: Present & Future

Growing awareness that traditional IPO frameworks fail to capture the role of mediators in understanding team process-outcome relationships has promulgated revisions to existing team effectiveness models (see Ilgen et al., 2005; Marks et al., 2001). For example, Ilgen and colleagues proposed the IMO model of team effectiveness in which they substituted *mediators* for *processes* to denote the broader array of variables that may serve as mediators in explaining team functioning. Consistent with this idea of expanding traditional team effectiveness models, Marks et al. observed that a multitude of researchers have operationalized team processes using variables that reflect emergent states (i.e., situational awareness, potency, cohesion, trust), defined as "cognitive,

motivational, and affective states of teams, as opposed to the nature of their member interaction" (p. 357). Thus, emergent states do not describe team processes themselves, but serve as mechanisms through which team interaction influences team outcomes. Researchers have increasingly acknowledged the important role of emergent states in the study of team behavior, including team empowerment, safety climate, justice climate, and trust (Kozlowski & Bell, 2003; Kozlowski & Klein, 2000; Mathieu et al., 2008).

In addition to this expanded view of mediators in understanding virtual team effectiveness, widespread recognition that teams reflect dynamic and adaptive systems have led theorists to focus on the temporal nature of teams (Cohen & Bailey, 1997; Ilgen et al., 2005; Kozlowski & Bell, 2003; Kozlowski et al., 1999; Marks et al., 2001; McGrath, 1991). For example, Ilgen and colleagues invoked the role of time by proposing that teams experience continuous cyclical feedback in which outputs at one stage influence inputs at the next second stage of the team's lifecycle. Further, based on his time, interaction, and performance (TIP) theory, McGrath explained that because teams interact over time the nature of group interaction obviates the integration of time in the study of team functioning. However, researchers have generally conducted cross-sectional studies, which only capture a snapshot of behavior at a single moment in time (Ilgen et al., 2005; Marks et al., 2001; Mathieu et al., 2008). Because cross-sectional data fail to adequately model the dynamic and changing nature of teams, the extent that research findings based on these data generalize to team interaction and behavior across the team's lifespan is uncertain. Thus, studies that measure focal variables across the

team's lifespan provide a richer understanding of the dynamics of team interaction (Kozlowski & Bell, 2003; Mathieu et al., 2008; Mathieu & Taylor, 2007).

In light of the changing nature of work, further modifications to traditional team effectiveness models have been suggested (see Driskell et al., 2003; Furst et al., 1999; Graetz et al., 1998; Lebie et al., 1996; Lurey & Raisinghani, 2001; Martins et al., 2004). Scholars have proposed that existing team effectiveness models fail to address the distal work arrangements that typify 21st-century organizations. Specifically, because the vast majority of modern organizations employ work teams who invariably engage in virtual work to some extent (e.g., e-mail; Cascio, 2003), researchers have proposed that models of team effectiveness should consider the unique virtual environment in which modern teams interact. Empirical evidence that computer-mediated and face-to-face communication operate differently (Siegel, Dubrovsky, Kiesler, & McGuire, 1986; Walther, 1997), as well as changes to the nature of team-based work (e.g., autonomous work teams, increasing prevalence of virtual teams in organizations; Cascio, 2000, 2003; Sundstrom et al., 2000), support the need to make modifications to existing theory on team effectiveness.

Despite calls to reconsider team effectiveness theory in light of modern-day workgroups, little theoretical or empirical work has been conducted to integrate theory and research on virtual teams with traditional team effectiveness models. For example, although trust has assumed a central role in the virtual team literature as a primary driver of team effectiveness (both task and interpersonal; Jarvenpaa & Leidner, 1999; Jarvenpaa et al., 2004; Kanawattanachai & Yoo, 2002; Wallace, 2004; Wilson et al., 2006),

theoretical developments have not accentuated trust to the extent that empirical research supports its essential role in virtual team functioning. If theory and research on modern-day workgroups are to advance, a greater emphasis on the role of trust is needed (see Furst et al., 1999; Johnson et al., 2002; Peters & Karren, 2009).

To this end, the current study explores the "black box" of team process-outcome relationships by proposing that trust serves as a mechanism through which processes exert influences on outcomes (shown in Figure 1). Thus, I expand the processes-outcomes (P-O) component of the traditional IPO model by examining the role of trust dimensions as mediators of these relationships. By incorporating trust, I address recommendations that modifications to traditional IPO models are needed to capture the intricacies of modern team interaction (Ahuja & Galvin, 2003; Ilgen et al., 2005; Johnson et al., 2002). Because trust in virtual teams has important consequences for objective and subjective outcomes (Jarvenpaa & Leidner, 1999; Lin et al., 2008), the integration of trust provides a notable contribution to furthering our understanding virtual team effectiveness.

Trust

Researchers have converged on a definition of trust as a psychological construct reflecting one's willingness to be vulnerable to another (Rousseau et al., 1998). In this view, trust reflects a psychological experience that evokes behavioral acts (e.g., helping, counterproductive work behaviors; Colquitt et al., 2007; Lewicki, Tomlinson, & Gillespie, 2006). Research suggests that trust, which is conceptualized as an emergent construct (Mathieu et al., 2008), has numerous benefits for organizations at multiple

levels (i.e., individual, team, organizational). For example, trust positively predicts organizational helping, job satisfaction, intrinsic worker motivation, team satisfaction, organizational commitment, low levels of conflict and stress, and high performance (see Cook & Wall, 1980; Costa, 2003; Costa, Roe, & Tallieu, 2001; Colquitt et al., 2007; Dirks & Ferrin, 2001; Jones & George, 1998; McAllister, 1995). Additionally, Thau, Crossley, Bennett, and Sczesny (2007) found that both trust in senior management and trust in supervisor had negative relationships with antisocial behaviors, further supporting the important role that trust plays in understanding organizational behavior.

Although trust has frequently been measured as a unidimensional construct, the notion of trust as multidimensional has become increasingly accepted (see Costigan, Ilter, & Berman, 1998; Lewicki & Bunker, 1995; McAllister, 1995; Webber, 2008). In particular, the proposition that trust is composed of cognitive and affective dimensions has been acknowledged in models of interpersonal trust (Greenberg et al., 2007; Lewicki et al., 2006). Perceptions of cognitive-based trust denote that one perceives another as dependable and competent to perform his or her duties (McAllister, 1995). Whereas cognitive trust reflects a calculated or rational form of trust (Kramer, 1999), affective trust is based on an emotional bond and emerges from perceptions that another has genuine care and concern for others' (e.g., team members) well-being (McAllister, 1995; Young & Daniel, 2003). Thus, cognitive and affective trust arise through different mechanisms of interaction (McAllister, 1995). For example, cognitive trust evolves to the extent that another is consistent and reliable, whereas affective trust develops through

communication that establishes emotional rapport between two individuals (Greenberg et al., 2007).

McAllister's original delineation of cognitive and affective trust was specific to dyadic relationships, however scholars have extended this multidimensional view of trust to virtual teams (see Kanawattanachai & Yoo, 2002; Webber, 2008). This research suggests that not only are cognitive and affective trust distinct dimensions, but that they have differential relationships with other team-related variables (McAllister, 1995; Webber, 2008). For example, in a sample of face-to-face teams, Webber found that affective trust was related to citizenship behaviors within the team, whereas cognitive trust was not. Additionally, her results showed that affective trust was positively related to team performance, whereas cognitive trust was not related to performance. These findings underscore the unique influence that cognitive and affective trust have on outcomes. However, most research has examined trust in virtual teams examined trust from a unidimensional perspective (see Jarvenpaa et al., 1998; Jarvenpaa et al., 2004). Given findings that virtual team members tend to be more action-focused than relationship-focused (Martins et al., 2004), the separate examination of cognitive and affective trust serves to inform our understanding of the complex dynamics involved in virtual interaction (Peters & Karren, 2009).

Trust in Virtual Teams

Despite increasing recognition that trust reflects a multidimensional construct (Greenberg et al., 2007; McAllister, 1995), much of the research on trust in virtual teams has relied on Mayer, Davis, and Schoorman's (1995) model of trust, which treats trust as

a unidimensional construct (see Aubert & Kelsey, 2003; Jarvenpaa et al., 1998; Jarvenpaa et al., 2004). Specifically, Mayer and colleagues proposed that trust is driven by three factors of trustworthiness: ability (perceptions about team members' task competence), benevolence (perceptions about team members' emotional attachments) and integrity (perceptions about the appropriateness of team members' moral standards). Thus, though perceived trustworthiness of the trustee is modeled as a multidimensional construct that drives the trustor's perceptions, trust itself is conceptualized as a unidimensional construct. Explicitly, Mayer et al. explained that trustworthiness factors are "conditions that lead to trust" (Mayer et al., 1995, p.717). In testing the Mayer et al. (1995) model of trust in virtual teams, Jarvenpaa et al. (1998) concluded that perceptions of ability, benevolence, and integrity were predictive of trust, however their relative contributions differed across the team's lifespan. Although exploration of trust in virtual teams using Mayer et al.'s model adds to our understanding of antecedents of trust in virtual teams, their model fails to capture the multidimensional nature of trust.

The limited studies focusing on cognitive and affective dimensions of trust in virtual teams support that trust is composed of unique dimensions that reflect different attitudes, and that arise through different mechanisms. For example, Kanawattanchai and Yoo found that cognitive trust was higher than affective trust across the team's lifespan, supporting the hypothesis that virtual communication hinders the development of interpersonal relationships that drive affective trust (Walther, 1992, 1997). Further, they found that early levels of high cognitive trust in virtual teams were related to performance; however, early levels of affective trust were not. These findings contradict

those of Webber (2008), who found the opposite effect in a sample of face-to-face teams. Taken together, these findings highlight the unique, although equivocal, role of cognitive and affective trust in explaining different aspects of team functioning. Accordingly, Peters and Karren (2009) recently proposed that future research should consider trust dimensions in the study of virtual teams, including their differential antecedents and consequences. Given the increasing recognition that trust represents a multidimensional construct (Greenberg et al., 2007; McAllister, 1995), exploration of both cognitive and affective components of trust in virtual teams serves to expand virtual team theory and practice.

Research examining antecedents of a general trust dimension supports a critical link between communication and trust development in virtual teams (Jarvenpaa & Leidner, 1999; Jarvenpaa et al., 2004; Lu et al., 2006). Jarvenpaa and Leidner concluded that teams characterized by high levels of trust throughout the team's lifecycle engaged in more frequent communication, conveyed enthusiasm, and were more likely to inform fellow team members of anticipated absences, as compared to low trust teams who communicated infrequently and failed to display enthusiasm regarding the team's task. These findings suggest that team processes, as mechanisms of communication, predict trust among virtual team members. Although researchers recognize that the communication mechanisms through which virtual teams interact pose significant challenges to the development of trust (Greenberg et al., 2007; Jarvenpaa et al., 2004; Lin et al., 2008; Panteli & Duncan, 2004), to date researchers have failed to empirically explore the role of team processes in predicting trust. Particularly given evidence that

communication is a necessary condition for trust development (Gibson & Manuel, 2003; Jarvenpaa & Leidner, 1999; Panteli & Duncan, 2004), the influence of team processes, as mechanisms of communication, on the development of trust reflects a critical gap in the virtual team literature (Fiore et al., 2003; Lu et al., 2006; Lurey & Raisinghani, 2001; Warnkentin & Beranek, 1999).

Multilevel Considerations

Because individuals are nested in teams, the study of teams necessitates consideration of multilevel issues (Guzzo & Dickson, 1996; Kozlowski & Bell, 2003; Kozlowski & Klein, 2000; Rousseau, 1985). Multilevel modeling techniques have gained increasing theoretical and substantive attention in team research because they offer advantages over traditional methods of analyzing team data (e.g., aggregation; see Krull & MacKinnon, 2001; Kenny, Korchmaros, & Bolger, 2003; Luke, 2004; Moritz & Watson, 1998; Watson, Chemers, & Preiser, 2001). Specifically, multi-level modeling allows the researcher to simultaneously examine effects at multiple levels of analysis (e.g., individual and team levels) resulting in a more accurate model of the true multilevel phenomena (Krull & MacKinnon, 2001; Morgeson & Hofmann, 1999; Raudenbush & Bryk, 2002).

Prior to the development of multilevel modeling, researchers assessing relationships among higher-level units (e.g., teams) had limited options for analyzing these nested data (Ludtke et al., 2008; Preacher, Zyphur, & Zhang, in press). First, some researchers chose to analyze their data at the individual level, which causes problems with the level of inference (e.g., it is inappropriate to infer team-level relationships if

analyses are conducted at the individual-level; Kozlowski & Klein, 2000). Additionally, this method violates the statistical assumption of independence of observations and fails to capture contextual effects associated with group membership (Kenny et al., 2003).

A second method traditionally used by researchers is aggregation, whereby lower-level units are combined to reflect a higher-level of analysis and data are analyzed at the team-level of analysis (Chan, 1998; Dickinson & McIntyre, 1997; Tesluk, Mathieu, & Zaccaro, 1997; Kozlowski & Bell, 2003; Kozlowski & Klein, 2000). Although this method satisfies the assumption of independent observations, it precludes the researcher from simultaneously examining individual-level and higher-level relationships. Additionally, this traditional aggregation method assumes that the group mean is measured without error (e.g., the group mean is completely reliable; Ludtke, Trautwein, Kunter, & Baumert, 2006). Moreover, aggregation may result in researchers committing errors of inference, namely the ecological fallacy (Piantadosi, Byar, & Green, 1988), which occurs when relationships found at the higher-level are generalized to exist at the individual-level of analysis.

A more advanced statistical approach, multilevel structural equation modeling (MSEM; Preacher et al., in press), combines the benefits of structural equation modeling (e.g., use of manifest indicators to estimate latent variables) and multilevel modeling (e.g., ability to account for nested data). In essence, MSEM treats the group-level constructs as latent (unobserved) variables, taking into account the unreliability of the group mean when estimating group-level effects (Ludtke et al., 2008). Traditional multilevel modeling may produce biased effects when the aggregated variable is assumed

to be measured without error, particularly when there are a small number of individuals in each of the lower-level units (Ludtke et al., 2008). Further, the use of multilevel modeling to test mediational hypotheses is proposed to yield downwardly biased estimates of the indirect effects (Preacher et al., in press). MSEM accommodates multilevel data, with the same benefit of structural equation modeling, which accounts for measurement error in calculating effects and estimates model parameters simultaneously.

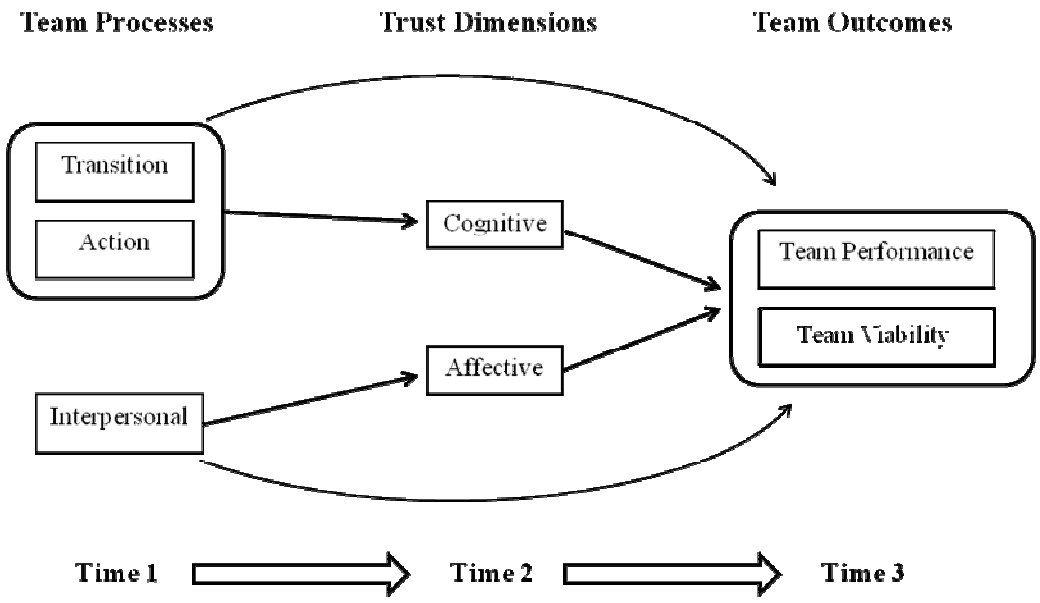
The Current Study

The purpose of the current study was to expand the "black box" of team process-outcome relationships in virtual teams by integrating trust. Thus, this study focused on expanding the P-O facet of the IPO model. Unlike traditional models of team effectiveness, which fail to accentuate the prominent role of trust in virtual teams, I suggest that trust as an emergent state serves as a mediator of team process-outcome relationships. Researchers have argued that trust develops via team member interactions (Jones & George, 1998; Panteli & Duncan, 2004); thus, communication within these interactions reflects the means through which trust develops. I propose a model of virtual team functioning in which trust cognitive and affective trust dimensions are given pronounced roles as mechanisms that drive team process-outcome relationships (see Figure 3).

Because action and transition processes reflect task-based activity associated with cognitive trust, I hypothesize that cognitive trust will mediate relationships between these types of team processes and outcomes. Accordingly, because interpersonal processes reflect social-based activity, which drive the development of affective trust (Greenberg et

al., 2007), I hypothesize that affective trust will mediate the relationships between interpersonal processes and outcomes. The current study incorporates a multidimensional perspective of team effectiveness by assessing both objective and subjective outcomes, consistent with traditional team effectiveness models (i.e., Gladstein, 1984; Hackman, 1987).

Figure 3



Further, the present study addresses the role of time by examining process, mediator, and outcomes at different points in the team's lifecycle, consistent with calls to abandon cross-sectional research when testing the mediational hypotheses (Mathieu et al., 2008). Scholars have advocated that research should align measurement of predictor, mediator, and outcome variables with the hypothesized temporal precedence (Mathieu & Taylor, 2007). That is, mediational inferences are strengthened when predictor, mediator,

and outcome variables are measured at different time points, consistent with the researcher's proposed causal sequence. Thus, I propose several multilevel mediation hypotheses (see Figure 3). All hypotheses are proposed to occur at the group-level, although individual level effects may be of substantive interest. As Mathieu and Taylor (2007) note, it is incumbent upon the researcher to state whether the mediator is proposed to fully or partially mediate predictor and criterion. Explicitly, I hypothesize (see Figure 3):

Hypotheses 1a & 1b: Cognitive trust (measured at Time 2) will partially mediate the relationships between transition processes (measured at Time 1) and team viability (1a) and team performance (1b), both measured at Time 3.

Hypotheses 2a & 2b: Cognitive trust (measured at Time 2) will partially mediate the relationships between action processes (measured at Time 1) and team viability (2a) and team performance (2b), both measured at Time 3.

Hypotheses 3a & 3b: Affective trust (measured at Time 2) will partially mediate the relationships between interpersonal processes (measured at Time 1) and team viability (3a) and team performance (3b), both measured at Time 3.

CHAPTER 2: METHOD

Sample and Procedure

The total sample consists of 232 undergraduate students, who comprised 58 four-person virtual teams. Of the 232 participants, 38.4% identified as male, 56.9% identified as female and 4.7% chose not to identify their gender. Of the sample, 79.7% identified themselves as Caucasian, 3% African-American, 3% Pacific Islander, 6.9% Hispanic, and 2.6% indicated "Other," with 4.7% choosing not to respond. The average age of participants was 19.07 years old (SD = 2.11). Subjects, who received course credit for participating in the research project, signed up to participate via a secured website that allowed them to read a description of the study and its requirements. The description explained that participation in the study would span 10 days, and would include: 1) an initial meeting with the researcher, 2) attendance at three online virtual team meetings, and 3) responding to online surveys collected after each virtual team meeting, hereafter labeled Time 1, Time 2, and Time 3 surveys. The website directed participants to arrive at a designated location on campus on the first day of their participation (for all participants, this was a Friday), in order to meet with the researcher, an undergraduate student trained by the author.

After participants arrived at the initial meeting with the researcher, they were given a more detailed account of what to expect as a participant in the study. First, the

researcher explained that the goal of this study was to better understand communication in virtual teams. Then participants were told that they would meet with three other individuals in an online chatroom to complete three decision-making tasks, using instant messaging (synchronous communication), on three separate occasions across one week. Participants were instructed to log into the chatroom from any convenient location to meet with their team members. Accommodations were offered to participants without internet access, although none of the participants requested such accommodations. Furthermore, participants were informed that each team member on the team would be designated to role-play a different vice president (VP) of a fictional movie production company. Based on their assigned VP role, team members would be sent important information unique to their specific role. Thus, successful decision-making on each task would require sharing information with other team members.

Once the study had been explained to them, participants were asked to provide the researcher with a pen name (pseudonym), which they would use to log into the chat room. Participants were also told they would use their pen name, as opposed to their real name or e-mail address, when they completed each of the online surveys. Pen names were used to enhance perceptions of confidentiality and anonymity, and to reduce the likelihood that participants would determine the personal identities of other team members. Secondly, participants were asked to provide an e-mail address so that they could receive instructions from the researcher throughout the study.

After pen name and email address information had been collected, participants were told about the individual and team incentives embedded in the study. In addition to

receiving course credit for their participation, participants were offered several tangible incentives, consistent with research showing the effectiveness of incentives for increasing participant response rates (Heerwegh, 2006; Singer, Groves, & Corning, 1999). Individual incentives included six $30 gift cards, which were raffled off to those who completed all requirements of the study (attended all online meetings and completed all online surveys). In addition to individual incentives, team incentives based on the team's performance were offered. At the end of the study, each member of the team with the highest profit score (based on the simulation algorithm, described below) received an iPod shuffle, purchased by the author.

The researcher ended the meeting by telling participants that they should check their e-mail within the next 24 hours for a link to the first online survey. They were also told that once they completed the initial survey, they would receive another e-mail with information about their first task to be completed with their team members. Immediately following the initial meeting with the researcher, a separate e-mail with the link to Survey 1 (which included demographic items) was sent to each participant. Once the participant completed Survey 1, he or she received an e-mail from the researcher providing information on the team's first task. For all teams, the online meetings (described below) occurred the following Monday, Wednesday, and Friday after the initial meeting with the researcher.

The simulation. The Tinsel Town Simulation (Devine, Habig, Martin, Bott, & Grayson, 2004) was used as the team project/role-play for the current study. Tinsel Town is a top management team simulation requiring team member interdependence and

distributed expertise, in which participants complete three separate tasks. The simulation was developed to address a critical problem in team development research: a lack of simulations that adequately mimic the real world, subsequently failing to engage participants. Thus, Tinsel Town was chosen for use in the current study for several important reasons: 1) appealing subject matter, 2) use of distributed expertise (which mirrors the individualized expertise associated with virtual teams), 3) it incorporates an objective performance metric, and 4) because it includes three unique yet interrelated tasks that enables the study of teams using multiple sessions over time.

Within the simulation, participants act as vice presidents of a fictional Hollywood movie studio. Each of the three tasks in the simulation (henceforth referred to as Task 1, Task 2, and Task 3) requires team members to share information with one another in order to make the most financially sound decisions about which movies should be produced by the company within the following year. For example, the Vice President of Talent Appraisal receives information regarding the quality of actors and directors, whereas the Vice President of Marketing receives information specific to marketing each of the movies from which the team must choose. For each task, the goal of the team is the same: to maximize profit for the company. Thus, the simulation creates interdependence, such that communication among team members is vital to making the most profitable decisions. Although the goal for each task is the same (to achieve the highest possible profit), each of the tasks differ because a unique movie list and corresponding descriptions are provided.

The simulation was originally created for use in face-to-face teams, therefore materials were adapted so that they could be e-mailed to participants. Participants were e-mailed the documents they needed to complete each task. Following completion of demographic items in an initial online survey, individual participants were sent materials related to Task 1 (i.e., a general memo about the assignment, movie lists for Task 1, and their unique information related to their individual VP role). On three separate occasions, members logged into a secure website where they used instant messaging to reach consensus about what movies should be produced by the company the following year. Participants were instructed that once a decision had been made by the team, one of the team's members should volunteer to e-mail the team's recommendations to the researcher.

Surveys. Following completion of each task, participants were e-mailed a link to an online survey that measured the focal constructs (team processes, trust dimensions, team viability). That is, following completion of Task 1, each participant on the team was e-mailed a link to the survey (Time 1) measuring team processes. Following Task 2, participants were e-mailed a link to a survey measuring trust (Time 2). After the completion of Task 3, participants were e-mailed the link to the final survey (Time 3) that assessed subjective outcomes (team viability). If any participant failed to attend any one of the online meetings, he or she was not sent a link to complete the corresponding survey. Thus, although absent members were not excluded from the remaining parts of the study (e.g., additional team meetings and surveys), they were not invited to submit responses to that particular online survey. Following the completion of each survey, team members were e-mailed their profit score for the task they had just completed. Thus,

teams did not have their profit score until after their surveys had been completed. Following completion of the entire study, participants were sent an e-mail, debriefing them as to the nature of the research question and indicating that no deception occurred.

Measures

Appendix A provides all survey measures.

Team processes. Transition, action, and interpersonal processes were measured at Time 1 (after completing the team's first online task) by asking respondents to indicate the extent that their team actively worked on specific activities. Using a 5-point Likert scale (from 1 = *Not at all* to 5 = *To a very great extent*), participants responded to 18 items (six items measuring each process) from Mathieu and Marks (2006), which asked them to rate the extent to which their team engaged in specific behaviors. Sample items for *action processes* ($\alpha = .87$) included: "Know whether your team was on pace for meeting your goals," and "Coordinate your activities with one another." *Transition processes* ($\alpha = .86$) were measured by items including "Set goals," and "Identify your main task." Sample items measuring *interpersonal processes* ($\alpha = .87$) were as follows: "Share a sense of togetherness and cohesion," and "Encourage each other to perform to the best of your abilities."

Trust dimensions. Trust dimensions were measured at Time 2 (after completing the team's second task). Cognitive and affective trust dimensions were measured using a scale developed by Kanawattanachai and Yoo (2002), who modified McAllister's original items (developed for dyads) to reflect perceptions about the team. *Cognitive trust* ($\alpha = .79$) and *affective trust* ($\alpha = .78$) were each measured using four items each, which asked

respondents to indicate the extent they agreed with each statement regarding their team (1 = *Strongly disagree* to 5 = *Strongly agree*). Sample items for cognitive trust included: "I see no reason to doubt my teammates' competence and preparation for the job" and "Most of my teammates can be relied upon to do as they say they will do." Sample items for affective trust included: "I would feel a sense of loss if one of my teammates was moved to another team" and "If I shared my problems with my team, I know that my teammates would respond constructively and caringly."

Team viability. Team viability (α = .81) was measured using nine items from Barrick, Stewart, Neubert, and Mount (1998), that ask participants to rate the extent that they agree with statements regarding their team (1 = *Strongly disagree* to 5 = *Strongly agree*). Sample items included: "This team is not capable of working together as a unit" (reverse-scored) and "This team accomplished what it set out to do."

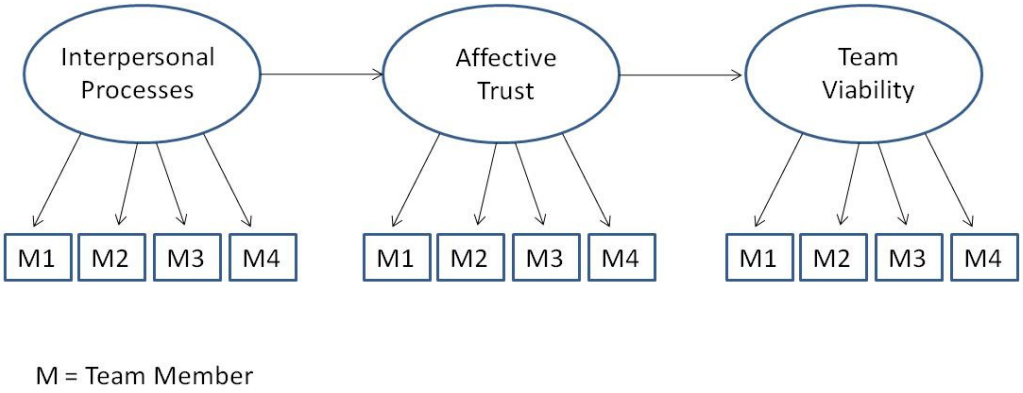
Team performance was operationalized as movie profit for Task 3. Using the simulation algorithm, profit was calculated as the difference between movie cost and movie revenue, where movie cost included production and marketing costs and movie revenue was determined by the number of viewers times the average ticket price (Devine et al., 2004). The maximum amount of profit a team could make for Task 3 was $527.88 million.

Data Analyses

Figure 4 depicts the multilevel structural equation modeling (MSEM) framework, in which the manifest (i.e., observed) constructs of lower-level units (e.g., individual team members) are modeled at the group-level as latent (unobserved) constructs (Ludtke,

Marsh, Robitzsch, Trautwein, Asparouhov, & Muthen, 2008; Muthen, 1997). Thus, these models take into account the unreliability of the group mean in estimating the group-level effects, providing more accurate parameter estimates (Ludtke et al., 2008). Note that Level 1 constructs are represented by squares to denote that they are observed, whereas Level 2 constructs are represented by circles to indicate that they are latent constructs. For the sake of simplicity, only a subset of focal constructs are depicted, although analogous relationships occur across variables in the model (see Figure 4).

Figure 4. *Multilevel structural equation modeling framework.*



Multilevel structural equation modeling (MSEM; Ludkte et al., 2008; Muthen, 1997), in which measurement error associated with individual-level responses is considered when estimating group-level effects, was used to test hypotheses. Figure 4 depicts the manner in which MSEM estimates the group-mean as a latent construct, using team member ratings as indicators. Thus, unlike traditional methods of aggregation used in multi-level modeling, MSEM does not require estimation of inter-rater agreement (r_{wg}; James, Demaree, & Wolf, 1993) to justify aggregation because MSEM does not employ traditional methods of aggregation (Ludtke et al., 2006, 2008). That is, MSEM provides

parameter estimates of the group effect assuming that an infinite number of raters were available, appropriately accounting for uncertainty in the group mean (Ludtke et al., 2008). Because the group mean is modeled as a latent variable informed by individual responses, this method yields more reliable estimates of the group-level effects than traditional multilevel modeling (Ludtke et al., 2008).

CHAPTER 3: RESULTS

Data were analyzed using MPlus 5.2 (Muthen & Muthen, 2007). Prior to analyses, a total of nine teams were removed from the data set. First, data for one team was removed because all four members were unable to log into the chat room for their first meeting due to technical difficulties. Data for five teams were removed because these teams failed to satisfy the requirement for inclusion: that at least three of the four team members were at *each* of the online team meetings. Because the current study sought to understand communication and trust in virtual teams, which may be affected by team member absenteeism, this rule was created to reduce this potential confound.

Three additional teams were removed because none of the participants in these teams completed the final survey, precluding the ability to include these teams in the between-level effects, because there were no manifest indicators with which to estimate team-level latent constructs (Ludtke et al., 2008). Because I wanted to ensure that the sample sizes across both within and between models were the same, these three teams were excluded. In addition to the nine teams (36 participants) that were removed, five participants were removed from the study data because they failed to complete Survey 1, which measured team processes. Mplus is able to accommodate missing data on endogenous variables in the model, however these estimations do not accommodate missing data on exogenous variables (team processes). In order to prevent loss of power

in estimating the effects, instead of deleting all five teams (20 participants) within which these individuals were members, only the five participants were removed. This resulted in a sample of 49 teams, comprised of five three-member teams, and 44 four-person teams (N = 191).

Of the 191 participants who completed the study and included in the analyses, the average age of participants was 19.16 (SD = 1.58). Of the participants in the study, 87% were between the ages of 17 and 20 years old. The sample was evenly balanced with regard to gender (males = 40%, females = 57%, 3% of the sample did not identify themselves as male or female). Participants in the sample identified their race as follows: 81% Caucasian, 3% African-American, 3% American Indian, 8% Hispanic, 2% indicated "other", and 3% did not report their race. Table 1 provides observed means, standard deviations, coefficient alphas, and correlations for all variables, both within and between teams.

The intraclass correlation (ICC) assesses the level of variance in the observed variable that is attributable to membership in its cluster, and is used to justify examining between-level effects. The values of the ICCs for the variables measured at Level 1 ranged from .05-.18, indicating that between 5-18% of the variance across individuals was accounted for by team membership. Three separate mediational models were tested in order to assess the full effects of action, transition, and interpersonal processes without adjusting for other relationships in the model. Because the observed correlations among action, transition, and interpersonal processes were highly correlated (consistent with previous findings; see Lepine et al., 2008), separate models were also run due to concerns

about multicollinearity. These three mediation models were fully saturated because there were as many parameter estimates as degrees of freedom; thus, each model yielded a perfect fit to the data.

Tables 2, 3 and 4 present standardized parameter estimates for within and between effects for each model. The *a* paths reflect the relationship between predictor and mediator, and the *b* paths reflect the relationships between mediator and outcomes. Note that performance was only measured at Level 2 (between effect); thus, there is no within effect for this outcome variable. As Table 2 depicts, cognitive trust was found to be a significant mediator of the relationship between transition processes and team viability at the within-level. However, at the between-level of analysis cognitive trust was neither a significant mediator of the transition processes-team viability relationship nor a significant mediator of the transition processes-performance relationship. Thus, Hypotheses 1a and 1b were not supported because the mediation effect was not found at the hypothesized level of analysis (team-level). Notably, there was a significant relationship between cognitive trust and team viability at the team-level (*b* path).

A second multilevel mediation was run to test Hypotheses 2a and 2b, that cognitive trust would mediate the relationships between action processes and team viability, and action processes and performance. Standardized parameter estimates are presented in Table 3. Consistent with the findings for Hypotheses 1a and 1b, cognitive trust served as a mediator between action processes and team viability at the within-team level, but did not mediate relationships between action processes and outcomes at the between-team level. Although the *b* path assessing the between effect for the cognitive

trust-team viability relationship was significant, the indirect effect was not significant. Thus, Hypotheses 2a and 2b were not supported.

Hypotheses 3a and 3b stated that affective trust would mediate the relationships between interpersonal processes and outcomes. Standardized parameter estimates for tests of this model are presented in Table 4. The results of these analyses showed that affective trust mediated the relationship between interpersonal processes and team viability at the within-level, but not at the between level. Additionally, affective trust did not mediate the relationship between interpersonal processes and performance at the team-level, consistent with the results for cognitive trust. Thus, Hypothesis 3a and 3b were unsupported. Overall, none of the hypotheses were supported at the team-level of analysis, although all hypotheses were supported at the within-level. Notably, however, standard errors for all between-level effects in all three models were extremely large, suggesting low power to detect an effect.

Table 1.

Means, Standard Deviations, Coefficient Alphas[a], and Correlations[b]

	Mean	SD	1	2	3	4	5	6	7
1. Transition processes	3.83	0.61	(.86)	**.91****	**.88****	**.44****	**.35***	**.49****	**.09**
2. Action processes	3.87	0.57	.90**	(.87)	**.88****	**.47****	**.52****	**.57****	**.02**
3. Interpersonal processes	3.79	0.60	.87**	.88**	(.87)	**.50****	**.50****	**.56****	**.04**
4. Cognitive trust	3.90	0.54	.42**	.45**	.48**	(.79)	**.55****	**.61****	**.14**
5. Affective trust	3.32	0.68	.34**	.50**	.49**	.54**	(.78)	**.63****	**-.08**
6. Team viability	3.76	0.51	.47**	.59**	.54**	.59**	.61**	(.81)	**.20**
7. Performance[c]	429.50	67.82	--	--	--	--	--	--	--

Note [a]: Means, standard deviations, and coefficient alphas were calculated across teams. Coefficient alphas are reported along the diagonal.

[b] Within team correlations are reported on the bottom of the correlation matrix. Between team correlations are reported in bold along the top of the correlation matrix.

[c]: Means and standard deviations for performance reflect millions of dollars, where maximum performance was $527.88 million.

*$p < .05$

**$p < .01$

Table 2. *Within & Between Effects For Cognitive Trust Mediates Transition Processes-Outcomes.*

	Team Viability				Performance			
	c' (S.E.)	*a* path (S.E.)	*b* path (S.E.)	Indirect Effect	*c'* (S.E.)	*a* path (S.E.)	*b* path (S.E.)	Indirect Effect
Within Effect								
TP → CT → outcomes	.22* (.09)	.54** (.06)	.46** (.09)	.25**				
Between Effect								
TP → CT → outcomes	.41 (.55)	.11 (.59)	.81* (.39)	.09	.19 (.26)	.11 (.59)	.18 (.24)	.02

Note. TP = transition processes; CT = cognitive trust *$p < .05$ **$p < .001$

Table 3. *Within & Between Effects For Cognitive Trust Mediates Action Processes-Outcomes.*

	Team Viability				Performance			
	c' (S.E.)	*a* path (S.E.)	*b* path (S.E.)	Indirect Effect	*c'* (S.E.)	*a* path (S.E.)	*b* path (S.E.)	Indirect Effect
Within Effect								
AP → CT → outcomes	.21* (.08)	.55** (.07)	.47** (.08)	.26**				
Between Effect								
AP → CT → outcomes	.58 (.32)	.28 (.37)	.55* (.27)	.15	-.02 (.21)	.28 (.37)	.20 (.24)	.06

Note. AP = action processes; CT = cognitive trust *$p < .05$, **$p < .001$

Table 4. *Within & Between Effects For Affective Trust Mediates Interpersonal Processes-Outcomes.*

	Team Viability				Performance			
	c' (S.E.)	*a* path (S.E.)	*b* path (S.E.)	Indirect Effect	*c'* (S.E.)	*a* path (S.E.)	*b* path (S.E.)	Indirect Effect
Within Effect								
IP → AT → outcomes	.31** (.08)	.48** (.07)	.33** (.06)	.16**				
Between Effect								
IP → AT → outcomes	.36 (.34)	.53 (.39)	.57 (.42)	.30	.26 (.28)	.53 (.39)	-.36 (.38)	-.19

Note. IP = interpersonal processes; AT = affective trust *$p < .05$, **$p < .001$

CHAPTER 4: DISCUSSION

The purpose of the current study was to expand the "black box" of team process-outcome relationships in virtual teams by proposing a new theoretical model of virtual team effectiveness that incorporates trust as a mediator between team processes and outcomes. Although trust is extensively recognized as an important ingredient of virtual team effectiveness (Greenberg et al., 2007; Jarvenpaa & Leidner, 1999; Jarvenpaa et al., 2004; Kanawattanachai & Yoo, 2007; Lin et al., 2008; Warkentin & Beranek, 1999), thus far research on virtual teams has failed to incorporate trust as a multidimensional construct and instead focused on trust as a unidimensional construct. Thus, my model integrated a multi-dimensional perspective of trust (examining cognitive and affective dimensions) with Marks et al.'s (2001) taxonomy of face-to-face team processes. Specifically, I investigated the extent that cognitive and affective trust dimensions served as mediators of the relationships between team processes (transition, action, and interpersonal) and outcomes (team viability and performance).

Overall, the results supported all hypotheses at the individual-level of analysis. That is, across participants, cognitive trust mediated the transition-team viability relationship, and the action-team viability relationship. Additionally, affective trust

mediated the relationship between interpersonal processes and team viability at the individual-level. Unfortunately, inferences from these findings are problematic because the survey items were written at the team-level (a referent-shift consensus model; Chan, 1998), rather than at the individual-level. Making inferences about relationships among individuals based on this team-level data commits the ecological fallacy, in which researchers make assumptions that higher-level (e.g., team-level) units can be generalized to lower-level units (e.g., individuals; Piantadosi et al., 1988). Although direct inferences cannot be made, the significant within-level effects suggest that team member opinions about the group's functioning may explain relationships between team processes and outcomes. That is, the findings that trust dimensions mediated all team processes-team viability relationships at the individual level of response suggests that individual-level perceptions of trust among team members may be driven by individual perceptions of team processes and subsequently influence individual team member attitudes about their team.

At the between-level of analysis, none of the hypotheses were supported, suggesting that neither cognitive nor affective trust served as mediators of the relationships between team processes and outcomes. However, at the team-level, cognitive trust was a significant predictor of team viability. The findings that team-level cognitive trust predicts team-level team viability is consistent with previous research demonstrating that high levels of cognitive trust in virtual teams are positively related to team-level outcomes (Kanawattanchai & Yoo, 2002). Further, evidence that teams may develop cognitive trust more quickly than affective trust in virtual teams may explain the

nonsignificant relationship between affective trust and team viability at the team level. That is, consistent with social information processing theory, interpersonal relationships may occur at a slower rate in virtual teams as compared to face-to-face teams (Warkentin & Beranek, 1999; Wilson et al., 2006). Thus teams in the current study may not have had adequate time to develop affective trust between team members.

Taken together, the between-level results for the current study contradict previous theory and research which suggests that the communication mechanisms through which virtual teams interact influence a team's perception of trust (Jarvenpaa et al., 2004; Lewicki et al., 2006), as well as team-level outcomes (e.g., collective efficacy, job satisfaction, performance; see Costa et al., 2001; Morris et al., 2002; Tasa, Taggar, & Seijts, 2007). However, given the large standard errors associated with the between-level effects, power to detect an effect at the between-level is a potential limitation of the current study, and a possible reason for the null results.

Overall, the findings of the current study suggest that further research is warranted. Although inferences from the individual-level to the team-level are precluded, the significant mediations at the individual-level of analysis (for all hypotheses) provide some support for the need to continue research in this area. Moreover, current theory and proposals for the expansion of traditional IPO frameworks (Fiore et al., 2003; Greenberg et al., 2007) support the need to integrate emergent states, particularly trust, into the P-O framework (Peters & Karren, 2009; Greenberg et al., 2007). Thus, despite the lack of significant findings at the hypothesized level of analysis (between-level), the current study makes a significant contribution to the study of virtual teams by integrating

previous theory with current empirical research. The proposed model is supported by extensive research suggesting that communication mechanisms drive trust perceptions, and that both communication and trust impact outcomes. By making an initial effort to integrate team processes and trust into a model of virtual team effectiveness, this study provides a viable framework for future research.

If future research demonstrates that trust plays a prominent role as a mediator between team processes and outcome relationships, this has implications for organizational practice and research. For example, in a meta-analytic study, Salas et al. (2008) found that across settings, tasks, and type of team, team training interventions significantly influenced teamwork processes, cognitive and affective outcomes, and performance. Their findings suggest that training directed towards teamwork (i.e., communication) processes may serve as a means through which teams are successful. Though their meta-analysis focused on face-to-face teams, as opposed to virtual teams, given the impersonal nature of virtual teams, communication training, especially training that focuses on interpersonal communication, may hold promise for enhancing virtual team functioning. Clearly more research is needed to better understand the team processes-outcome relationships within virtual teams, as well as how different interventions influence these relationships, either directly, or indirectly through emergent states (e.g., trust).

Strengths & Limitations

The current study has several strengths. First, I adopted a longitudinal approach, whereby predictor, mediator, and outcomes were measured according to the hypothesized

mediational sequence. Thus, consistent with calls to abandon snap-shot, cross-sectional studies of teams (Cohen & Bailey, 1997; Kozlowski & Bell, 2003), I considered the role of time in testing hypotheses. Given calls for researchers to investigate specific types of team processes within a single study (Mathieu et al., 2008), a second strength of the study was that I addressed all three of the team processes proposed by Mark et al. (2001). Additionally, the current study used a real-world simulation, in which participants could log on to the chat room from any internet connection. Unlike other studies that have utilized classroom samples (i.e., Jarvenpaa et al., 1998), the current study provided mundane realism to participants, making the results more generalizable to applied populations (e.g., employees in organizations). The current study also used an innovative statistical approach to the study of mediational relationships in nested data. To date, multilevel modeling is unable to account for measurement error and structural equation modeling is unable to account for nested data. Thus, the application of MSEM in the current study reflects an initial attempt at integrating multilevel modeling and structural equation modeling in the study of virtual teams.

The current study also has several limitations. Some would criticize the study because of its length (5 days), particularly because the focus was on trust, which arguably takes time to develop. However, some research suggests that virtual teams may exhibit high levels of early trust (Kanawattanachai & Yoo, 2002), labeled *swift trust* (Meyerson et al., 1996). For example, Kanawattanachai and Yoo found that some teams exhibited high levels of initial trust, despite team members' limited history working together. The theory of swift trust suggests that in situations of uncertainty, where limited information

with which to develop trust perceptions is available, team members assume trust as a means of facilitating goal accomplishment. In this way, trust frees up cognitive resources that would otherwise be spent monitoring fellow team members, resulting in enhanced performance (Meyerson et al., 1996). Therefore, temporary teams *can* develop trust. Thus, the findings of the current study are generalizable to temporary virtual teams, but the duration of the study limits the extent that the results can be generalized to long-term teams.

A second limitation of the current study is that only one type of computer-mediated communication was studied (synchronous communication). As Daft and Lengel (1986) explain, multiple modalities of communication are available for virtual interaction (i.e., e-mail, videoconferencing). Thus, the findings of the current study are only generalizable to virtual teams who utilize synchronous communication. Additionally, the current study used a sample of undergraduate students. Thus, although a real-world simulation was used, the results of the study may not generalize to the real-world organizations. Additionally, use of self-report data to measure team processes, trust dimensions, and team viability may have introduced common method bias (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). However, temporal separation of focal constructs should reduce this possibility (Podsakoff et al., 2003). Lastly, the most egregious limitation of the current study is the lack of power associated with detecting an effect for the mediational hypotheses. Preacher et al. (in press) recently noted that MSEM requires at least 50-100 clusters (e.g., teams) in order to have enough power to detect an effect.

Thus, the findings of the current study are limited because only 49 clusters were included in the analysis.

Future Research

In addition to further probing the hypothesized relationships in the current study using a larger sample size, future research should focus on antecedents of team processes in virtual teams (e.g., team orientation; Walther, 1997). Because relational development is frequently hindered in virtual team environment, personality attributes like team orientation and propensity to trust may be particularly beneficial in propelling team members to perceive emotional bonds among teammates. Moreover, these characteristics may promote effective interpersonal team processes that have implications for performance and team member attitudes. Along these same lines, given research that team training is effective (Salas et al., 2008), future research should examine the extent that virtual team training, as a team-level input, impacts virtual team functioning, including team processes, trust, and member attitudes. For example, to what extent does training predict the use of different team processes?

Further research on trust dimensions in virtual teams is also needed. The current study found a significant relationship between cognitive trust and team viability at the between-level, but the relationship between affective trust and team viability at the between-level was not significant. Thus, future studies should pursue efforts to understand how cognitive and affective trust function differently in face-to-face versus virtual teams. Given theory and empirical research supporting the need to reconsider traditional team effectiveness models in light of current work arrangements, future

research should also explore alternative models that address the increasing use of virtual teams and organizations, and should continue to study virtual teams using a longitudinal perspective. Particularly when multilevel mediation is hypothesized, researchers should consider utilizing MSEM (Preacher et al., in press)

Conclusion

The current study introduced a fruitful avenue of research with the potential to inform theory and practice. Though the results of the study are somewhat disappointing, in that no group level effects were detected, the study still makes a significant contribution to the virtual team literature. Namely, the theoretical model presented here was developed based on theory and research, incorporating constructs that heretofore have not been included and should be. In particular, given the substantial literature on the importance of trust in virtual teams, and growing evidence that trust is multidimensional, the integration of team processes and trust dimensions reflects a first step towards building a model of virtual team effectiveness. Secondly, considering the significant within-level mediations, the current study is deserving of replication. Notably, the use of a larger sample size may provide enough power to detect the hypothesized mediational effects. Further, regardless of the lack of significant between-level results, this study employed an innovative statistical technique, MSEM (Preacher et al., in press). Thus, this study pushed the envelope in the study of virtual teams by testing an integrated model of virtual team effectiveness using sophisticated statistical techniques that more accurately model genuine team phenomena.

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APPENDIX A: SURVEY ITEMS

Time 1 Survey Items

Team Processes (Mathieu & Marks, 2006)

(T) Denotes transition; (A) Denotes action; (I) Denotes interpersonal

To what extent did your chat room team actively work to…	Not at all	Very little	To some extent	To a great extent	To a very great extent
Develop an understanding of your purpose or mission? (T)	1	2	3	4	5
Identify your main tasks? (T)	1	2	3	4	5
Set goals? (T)	1	2	3	4	5
Prioritize your goals? (T)	1	2	3	4	5
Develop an overall strategy to guide your activities? (T)	1	2	3	4	5
Know when to stick with the given strategy, and when to adopt a different one? (T)	1	2	3	4	5
Determine what needed to be done to achieve your goals? (A)	1	2	3	4	5
Know whether your team was on pace for meeting your goals? (A)	1	2	3	4	5
Assist each other when needed? (A)	1	2	3	4	5
Be willing to ask for help when needed? (A)	1	2	3	4	5
Coordinate your activities with one another? (A)	1	2	3	4	5
Communicate well with each other? (A)	1	2	3	4	5
Encourage healthy debate and exchange of ideas? (I)	1	2	3	4	5
Show respect for one another? (I)	1	2	3	4	5
Stay motivated through challenges? (I)	1	2	3	4	5
Encourage each other to perform to the best of your abilities? (I)	1	2	3	4	5

Share a sense of togetherness and cohesion? (I)	1	2	3	4	5
Maintain a positive attitude about the work? (I)	1	2	3	4	5

Time 2 Survey Items

Cognitive and Affective Trust (Kanawattanachai & Yoo, 2002)

(C) Denotes cognitive trust (A) Denotes affective trust

To what extent do you agree with the following statements regarding your chatroom team:	Strongly Disagree	Disagree	Neither agree nor disagree	Agree	Strongly Agree
Most of my teammates approach his/her job with professionalism and dedication (C)	1	2	3	4	5
Most of my teammates can be relied upon to do as they say they will do (C)	1	2	3	4	5
I can rely on other teammates not to make my job more difficult by careless work (C)	1	2	3	4	5
I see no reason to doubt my teammates' competence and preparation for the job (C)	1	2	3	4	5
If I shared my problems with my team, I know that my teammates would respond constructively and caringly (A)	1	2	3	4	5
I would feel a sense of loss if one of my teammates was moved to another team (A)	1	2	3	4	5
I can “talk” freely to my team about difficulties I am having with a task and know that my team will be willing to “listen” (A)	1	2	3	4	5
I would have to say that we (my team) have made considerable emotional investment in our working relationship (A)	1	2	3	4	5

Time 3 Survey Items

Team Viability (Barrick, Stewart, Neubert, & Mount, 1998)

Please rate your agreement with each statement:	Strongly Disagree	Disagree	Neither agree nor disagree	Agree	Strongly Agree
I believe my team approached its task in an organized manner.	1	2	3	4	5
This team is not capable of working together as a unit (R).	1	2	3	4	5
Our team did not achieve as much as I thought we would (R).	1	2	3	4	5
The team has helped me to meet the personal goals I had in mind when I joined it.	1	2	3	4	5
I feel that working with this particular team will enable me to attain my personal goals.	1	2	3	4	5
This team probably should not work together anymore (R).	1	2	3	4	5
This team should not continue to function as a team on other tasks (R).	1	2	3	4	5
This team accomplished what it set out to do.	1	2	3	4	5
I believe that my personal well-being has been improved as a result of participating in this team.	1	2	3	4	5

(R) indicates reverse-scored item