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Measuring Multilevel Constructs Theoretical And Methodological Features Of Team Behavioral Process Under Compilational Models

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MEASURING MULTILEVEL CONSTRUCTS: THEORETICAL AND METHODOLOGICAL FEATURES OF TEAM BEHAVIORAL PROCESS UNDER COMPILATIONAL MODELS

by

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ABSTRACT

Since at least the 1950s, researchers interested in studying the dynamics of small groups have struggled with how best to measure interaction processes. Although team process measurement issues are not particularly unique in terms of content, measuring multilevel phenomena presents an interesting problem because structural aspects are integral components of emergence. The elemental content of multilevel phenomena is wholly unique and distinguishable from the elemental content of composite units, and emerges as individual behaviors compile to higher levels of analyses. Analogous to chemical structures, behavioral phenomena manifest at higher levels in different structural patterns as members connect to one another through dynamic interactions. Subsequently, multilevel phenomena are more appropriately characterized in terms of pattern in addition to the traditionally measured intensity. The vast majority of teams research conceptualizes and operationalizes multilevel phenomena based on compositional (i.e., additive) models. This approach impedes the further advancement of the science of team effectiveness by capturing content and intensity, but not structure. This dissertation argues that compilational models better capture content, intensity, and structure, and therefore represent a preferred alternative for conceptualizing and operationalizing team processes. This dissertation details measurement issues associated with compositional models in teams research, and provides concepts helpful for reconceptualizing team processes as compilational forms.

Dedicated to my parents, Kazuo and Keiko Murase

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CHAPTER I: INTRODUCTION

The advent of the internet, globalization, and the increasingly competitive global pressures have changed the basic architecture of organizational work to rely on the synergies that arise from teams. Over the past two decades, teams researchers have discovered many of the types of processes teams need to engage in (Marks, Mathieu & Zaccaro, 2001) and interventions useful for creating them (Salas, Nichols, & Driskell, 2007; Salas, Rozell, Mullen, & Driskell, 1999; Cascio & Aguinis, 2008; Cohen & Bailey, 1997; Mathieu, Maynard, Rapp, & Gilson, 2008). However, despite these rapid advances, there are many issues left to contemporary researchers to answer, the most pressing of which is the need to advance the theory and measurement of team processes.

Exploring multilevel phenomena becomes increasingly complex as one attempts to study those that occur at higher levels of analysis. Understanding relationships that occur at team levels cannot be achieved without sophisticated measurement that enables researchers to capture complex phenomena manifest at the team level. However, measurement is a long-lasting issue in psychology as well as in any other sciences, and teams science is no exception to this problem (Salas & Wildman, 2009). Measurement has always been an issue in teams research because science requires theoretical and research foci to span members and levels (Guzzo, 1996; Kozlowski & Ilgen, 2006; Kozlowski & Klein, 2000; McIntyre & Salas, 1996). Development of tools to measure such complex phenomena with great precision is as critical as development of theories. Only with a great theoretical and psychometric advancement, can researchers answer meaningful questions about mechanisms of teamwork (Klimoski & Mohammed, 1994; Mohammed, Klimoski, & Rentsch, 2000).

Input-Throughput-Output (IPO) Model and Development of Teams Research

Research on team behavioral process has been a focal topic since the 1990s. Small group/group dynamics researchers most of whom were trained in social psychology had been dominant until the 1970s (McGrath, 1997). Their research was mainly focused on understanding the effects of individual composition on affective and perceptual social phenomena, or the effects of characteristics on outcomes, rather than on team process. This trend had been traced well in the major reviews, especially the ones published prior to 1993 (McGrath & Kravitz, 1982; Levine & Moreland, 1990; Betternhausen, 1991).

Perspectives on group process among group researchers (e.g., Festinger, 1950; Frederick, 1952; Guetzkow & Simon, 1955; Levine & Moreland, 1990; McGrath & Kravitz, 1982; Shaw, 1964; Tuckman, 1965) were different from those held by current teams researchers (e.g., Ilgen, Hollenbeck, Johnson, & Jundt, 2005; Kozlowski & Ilgen, 2006; Mathieu et al., 2008). Groups researchers conducted research on affective and perceptual social phenomena, which are currently considered emergent states. Emergent states are defined as constructs which arise out of interactions and are dynamic in nature (Marks et al., 2001). Levine and Moreland (1990) and Bettenhausen (1991) focused on emergent states rather than constructs of behavioral team process in their reviews. Bettenhausen summarized in the section "Group Process" past studies on cohesion, commitment, conflict, and goal setting but not on behavioral process constructs such as communication or coordination. Even though in 1982, McGrath and Kravitz summarized studies on small group research and included in their paper behavioral process patterns as a major category, researchers at that time were interested in investigating development or structural development of communication patterns per se, and not in how such different patterns of communication influenced group outcomes. Thus, until the torch was passed onto researchers who were more interested in teamwork in organizational settings, the effects of team behavioral processes had not been actively explored.

System Models

Open systems theory by Katz and Kahn (1978) and the input-process-outcome (IPO) model by McGrath (1984) have made significant contributions to groups research. A group is defined as a collection of interdependent individuals who influence one another through social interactions (Forsyth, 1999), whereas a team is defined as “a distinguishable set of two or more people who interact, dynamically, interdependently, and adaptively toward a common and valued goal/objective/mission, who have been assigned specific roles or functions to perform, and who have a limited life-span of membership (Salas, Dickinson, Converse, & Tannenbaum, 1992, p 4). Since the 1990s, the IPO model has played a significant role in teams research by lending researchers similar frameworks to understand team-level phenomena and make communication and understanding of different research results more effective and efficient (Kuhn, 1996). The model is simple and straight-forward by explaining that: (a) teamwork starts from factors external to the team such as individual member characteristics, task design, and organizational context that serve as system inputs and are relatively stable over time (Cohen & Bailey, 1997); (b) members’ effort, information, and tasks are passed onto or exchanged among each other to produce outcomes or goal attainment, and this process is considered throughput; and (c) finally, temporal as well as final outcomes such as finished products are considered output. Based on this model, researchers have explored potential answers to various research questions whose outcomes have been harmoniously pieced together. Many major review papers have summarized teams research under this model (Cohen & Bailey, 1997; Gist, Locke, & Taylor, 1987; Ilgen et al., 2005; Kozlowski & Ilgen, 2006; Marks etla., 2001; Mathieu et al., 2008). Other researchers have refined the model by breaking down process into two types corresponding to two team phases (transition & action phase) and emphasizing the importance of the sequencing IPO cycles in relation to task- or goal-driven episodes (Ilgen et al., 2005; Marks et al., 2001). Even though researchers have proposed different versions of and components to the IPO model (e.g., Ilgen et al., 2005), the general model has provided the most basic framework which accommodates diverse opinions among researchers on how teamwork unfolds. Under the IPO model, teams research has flourished and significantly contributed to advancement of knowledge on team phenomena.

The IPO model differentiates teams research from group dynamics research by explicitly investigating team process as an explanatory mechanism. Team process is a multi-dimensional construct, composed of cognitive, motivational, affective, and behavioral characteristics (Marks et al., 2001); this is the essence of teamwork. Team process is defined as “members’ interdependent acts that convert inputs to outcomes through cognitive, verbal, and behavioral activities directed toward organizing taskwork to achieve collective goals” (Marks et al., 2001, p. 357). As a result, researchers have examined the effects of various dimensions such as communication (Ancona & Caldwell, 1992; Barrick, Bradley, Kristof-Brown, & Colbert, 2007; Campion, Medsker, & Higgs, 1993; Cummings & Cross, 2003), boundary management (Anocona & Caldwell, 1992; Faraj & Yan, 2009; Marrow, Tesluk, & Carson, 2007), information sharing (Bunderson & Sutcliffe, 2002; Drach-Zahavy & Somech, 2001; Homan et al., 2008; Mesmer-Magnus & DeChurch, 2009), back-up behavior and organizational citizenship behavior (Bachrach, Powell, Collins, & Richey, 2006; Moon et al., 2004; Porter et al., 2003), and coordination (DeChurch & Marks, 2006; Denison, Hart, & Kahn, 1996; LePine, Piccolo, Jackson, Mathieu, & Saul, 2008) (See Table 1). The ways members interact with one another, and the extent to which these behaviors influence performance and objectives, essentially determines the success of a team (LePine et al., 2008). Thus, to understand the team processes whereby members exchange their energy is to understand teamwork.

Researchers have proposed many dimensions of process and demonstrated empirical evidence for relationships between process and outcomes. However, because the process category in the IPO model has not been well-defined and was considered as perhaps too inclusive, many researchers had categorized under this name anything that was hypothesized to take place somewhere between input and outcome as process. Researchers have included affective, motivational, and cognitive states which arise from interactions in the process category (e.g., Bettenhausen, 1991). Numerous studies have empirically demonstrated evidence that these states are vital for understanding teamwork (Beal, Cohen, Burke, & McLendon, 2003; DeChurch & Mesmer-Magnus, 2010; Levine & Moreland, 1990). As representative variables of affective states, cohesion, team satisfaction, and commitment, and team identification have been found to influence and also be influenced by team process and performance (Beal et al., 2003; Van Der Vegt, Van De Vilert, & Oosterhof, 2003; Vegt & Vliert, 2000). As motivational states, collective efficacy (Gully, Incalcaterra, Joshi, & Beaubien, 2002), collective potency (Campion , Medsker, & Higgs, 1993), and multilevel motivational process (Chen, Kanfer, DeShon, Mathieu, & Kozlowski, 2009) have been linked to team performance. As affective/motivational, cohesion (Mullen & Copper, 1994) and team climate (West & Anderson, 1996) have been linked to teamwork. Lastly, team cognition (DeChurch & Mesmer-Magnus, 2010) has been linked to team performance. These constructs had been considered team process, and as a result, team process was considered to subsume all states. Thus, the “Process” part of the IPO model has been very useful for understanding teamwork, but at the same time the ambiguity of its definition allowed researchers in the past to mix all of these types under the same category (Marks et al., 2001).

Separation of Behavioral Process from Emergent States

In order to solve this problem, Marks and her colleagues (2001) proposed behavioral components critical to the team process category and separated those from non-behavioral components such as affective, motivational, and cognitive properties of teams, and distinguished them as emergent states. Their definition of the process has been successful because researchers have found effects of their behavioral components on team performance

(LePine, Piccolo, Jackson, Mathieu, & Saul, 2008), and it clearly delineate how behavioral processes are different from emergent states. Thus it is important to distinguish emergent states from behavioral components of team process (Marks et al., 2001), and to understand how these states influence team process. This is important for two reasons. The first one is a construct validity issue. Emergent states and behavioral processes are conceptually distinctive constructs. Even though all of them emerge out of interaction processes, these states are shaped by but distinct from processes. For example, communication and coordination can be put into the same subsuming construct of team process because they reflect verbal and behavioral interaction, but they should not be confused with cohesion or collective efficacy which indicates the quality of teamwork, shaped by interaction, but existing as states not solely and directly created by member interaction (Marks et al., 2001).

The second reason is to facilitate the better understanding of the temporal sequence of constructs that unfold over time. Behavioral components must be the most proximal to team performance. Many studies have proposed direct links from emergent states to performance outcomes bypassing behavioral process. However, this obscures the understanding of the temporal sequence and teamwork mechanisms because behavioral components drive emergent states which subsequently regulate the way members behave and influence team process (Kozlowski & Ilgen, 2006; Sy, Cote, & Saavedra, 2005). This cycle takes place repeatedly over time (Ilgen et al., 2005; Morgeson & Hofmann, 1999), but members must complete tasks and achieve their collective objectives only through engaging in individual taskwork and team behavioral process. Hence, emergent states can impact team performance conceptually only through regulating behavioral process.

DeChurch & Mesmer-Magnus’ Findings

However, past research has not supported this statement. DeChurch and Mesmer-Magnus (2010) found that team cognition was more strongly related to team performance than to behavioral process. They meta-analyzed the effects of team cognition on teamwork by regressing team performance on team cohesion and behavioral process in the first block, and then onto team cognition in the second block. The result showed that these three predictors together explained 18.4 % of the variance in team performance, and that team cognition accounted for an additional 6.8% of the team performance variance. Meta-analytic regression standardized coefficients for team cohesion, behavioral process, and cognition were .14, .11, and .29, respectively, and the coefficient for the behavioral process was much smaller than that for team cognition. This result is very surprising and counter-intuitive because team cognition has been theorized to impact team performance through enhancing team behavioral process (Cannon-Bowers, Salas, & Converse, 1993). If this is the case, the coefficient for team cognition should not be higher than that for behavioral process, especially given the importance of the direct linkage of behavioral process to performance. Hence, the author submits that this pattern of findings is due to the deficient measurement of team process. In the past decades, teams researchers have proposed and demonstrated numerous dimensions under the behavioral process category and found those effects on team performance (Bettenhausen, 1991; Cohen & Bailey, 1997; Guzzo & Dickson, 1996; Ilgen et al., 2005; Mathieu et al., 2008). This paper will not propose another unique dimension, but rather focuses on measurement issues unique to multilevel research, which has been neglected among teams researchers.

Composition and Compilation Models

Measurement error is prevalent in every science (Kuhn, 1996), and this is an unavoidable reality particularly in social sciences (Cronbach & Meehl, 1955; Nunnally & Bernstein, 1994). Researchers work on developing new measures and/or refining them because an assumption of measurement error is that measures are not well designed to capture everything that needs to be captured. However, this is not always the case. The other type is unique to teams research and is the focus of this paper. This type of measurement error, multilevel measurement error (MME), emerges only at the higher level when researchers adopt a compositional model to aggregate individual responses to the team level even though they should not (Kozlowski & Klein, 2000; Roberts, Hulin, & Rousseau, 1978). MME is conceptually similar to the lack of criterion sufficiency specifically due to the discrepancy between the way a multilevel phenomenon is conceptualized and the way it is measured. The following describes the mechanism of how this second source of measurement error arises in scores represented at the team level.

Compositional Models

Representing multilevel concepts is a complex process that entails aggregation of individual responses. Attempts to capture phenomena that span multiple levels become much harder than measuring individual-level phenomena because researchers cannot aggregate without conceptual and empirical justification for aggregation (James, 1982). Researchers can capture a multilevel construct by assessing either global unit properties or representing shared or configural unit properties through aggregation of individual responses (Kozlowski & Klein, 2000). If researchers think individuals can capture a multilevel construct in a meaningful manner, but the unit of theory is directed at higher levels, they elicit individual responses and aggregate them to the higher level. This is named either direct-consensus or reference-shift in Chan's paper (1998) depending on whether researchers ask respondents to evaluate the phenomenon from their perspective or at the higher level. Otherwise, researchers should directly measure properties of entities at higher levels (Kozlowski & Klein, 2000). Whether to aggregate was once extensively discussed in the organizational climate literature (See James, 1982; James, Demaree, & Wolf, 1984), but discussion of this issue has been neglected in the teams literature. Instead much of teams research blindly aggregates data to the team level. The extent to which compositional models hold in one's study or teams research seems to determine the degree of measurement error in the representation process.

For years, compositional models have been playing a significant role in supporting researchers' aggregation practices (Chan, 1998). Compositional models state that a phenomenon that emerges out of individual-level interactions has a relationship to a form of that phenomenon at higher levels (Chan, 1998; Kozlowski & Klein, 2000; Roberts et al., 1978). Whether a compositional model holds in one's study determines whether or not individual responses can be aggregated because in numerous studies phenomena at higher levels may not manifest in a compositional form. If a higher-level phenomenon is compositional, researchers take an average of responses across all members for aggregation. Justification for the use of aggregation has brought significant impact to the field (James, 1982; James et al., 1984), and composition models have been used as a theoretical criterion for aggregation justification (Janz, Colquitt, & Noe, 1997). When aggregating individual-level data to higher levels, researchers cannot aggregate phenomena that have discontinuous relationships across different levels (Van De Ven & Ferry, 1980). Because any phenomena can be manifested at multiple levels, researchers must determine their unit of theory and use it as a guide to obtain data at the level of interest (Roberts et al., 1978). When researchers obtain individual-level data and have an interest in examining relationships at higher levels, they must be certain that individual perceptions of the phenomenon are functionally as well as structurally similar at higher levels (Morgeson & Hofmann, 1999). Compositional models in this process have been a useful tool for researchers to assess how multilevel phenomena manifest themselves across levels.

It is possible that compositional models are more suitable for representing perceptual phenomena such as climate or culture than they are to collective behavioral processes such as team communication or coordination because the models have been majorly developed in the field of organizational climate (e.g., Chan, 1998; James, 1982). One of main foci of the debate on the appropriate unit of theory for climate revolves around whether researchers should have measured a psychological variable rather than "veridical descriptions of organizational characteristics" (James, 1982, p. 220). According to this view, it is not size or span of control which regulates human behavior, but rather the psychological meaning members assign to or derive from organizational characteristics, and that these meanings regulate the way organizational members behave and interact with one another (Schein, 1990). Therefore, climate researchers are more interested in measuring individual perceptions of those characteristics instead of directly measuring actual properties of an organization, and so the individual has been the unit of theory (James, 1982). Norms, climate, cohesion, and other perceptual phenomena at higher levels emerge out of interactions members engage in (Kozlowski & Ilgen, 2006). Therefore, in order to represent group, departmental or organizational climate, members' responses should converge on certain interpretations or meanings of organizational properties because they are under the influence of the same properties (Klein, Conn, Smith, & Sorra, 2001).

Compositional models and agreement statistics can also be applicable for affective and perceptual processes in teams because these constructs are similar in form to climate constructs. For example, it is logical to examine the degree of members' agreement on cohesion (Beal, Cohen, Burke, & McLendon, 2002), collective efficacy (Watson, Chemers, & Preiser, 2001), and team climate (West & Anderson, 1996) because these phenomena derive out of interactions members engage in and in turn influence their interactions (Klein, Conn, Smith, & Sorra, 2001; Morgeson & Hofmann, 1999). This implies that climate emerges through a compositional model. Because of years of endeavors by organizational climate researchers, individual responses are now accepted as the basic building block of organizational climate constructs, and compositional models provide justification to aggregate them to higher levels. When representing non-perceptual multilevel phenomena, more specifically team behavioral process, researchers must assess whether (a) compositional models hold for this type of constructs, (b) provide justification for aggregation, and (c) determine whether behavioral process at the team level has the same relationship to forms of individual behaviors.

In teams research, the aggregation issue has not been discussed as intensively as in the organizational climate field, but rather the practice from the climate field has been merely accepted as a rule (Klein, Dansereau, & Hall, 1994). However, it is doubtful that members' behaviors emerge as a compositional model at the team level. Rather, team process, conceptually, reflects emergent patterning not isomorphic to the individual behaviors that give rise to it. This suggests that team process emerges in some form of networked pattern. Depending on how researchers look at team process, they come to different conclusions about whether or not it emerges as a compositional model. If team behavioral process is represented as structural patterns, the conceptualization of the structure of behavioral process deviates from a compositional model, and criteria for aggregation based on the compositional model become less relevant.

For example, Jones and James (1979) proposed three criteria for compositional models: (a) aggregated scores describe the given situation; (b) members exposed to the same stimuli respond in a similar manner; and (c) the aggregation will include perceptual similarities with minimized individual differences. These criteria are helpful for determining whether or not to aggregate a perceptually-based phenomenon, but may not be useful for representing patterns of team behavioral process. Unlike climate researchers, teams researchers are interested in behavioral patterns that physically unfold in a process rather than perceptual meanings that arise out of interactions. If at the team level, team process forms some type of structure, each member's behavior does not have the same form of relationship to the higher level; thus it is discontinuous (Kozlowski & Klein, 2000). Hence, the appropriateness of basing team process measures on a compositional model must be reconsidered.

Morgeson and Hofmann (1999) discuss the importance of the structure and function of multilevel constructs. First, they pose a question asking what it means that teams behave. Kozlowski, Gully, Nason and Smith (1999) stated that teams do not behave, but rather individuals do. Morgeson and Hofmann elaborated on this point by defining team process and behavior as collections of individual actions. More specifically, they define a structure as a system of interaction in which individuals meet and engage in joint activities, which are events cycling in varying rhythms (Kozlowski & Ilgen, 2006; Marks et al., 2001; Morgeson & Hofmann, 1999).

The second characteristic of multilevel constructs is function, which refers to the manner in which a construct operates, or relates to outcomes across levels of analysis. Phenomena at multiple levels can exhibit the same function (e.g., Chan, 1998). For example, self and collective efficacies are defined as individual or shared beliefs of the capability to perform tasks; as such they are defined in terms of their relation to performance (Watson, Chemers, & Preiser, 2001). According to Morgeson and Hofmann, defining multilevel constructs in terms of their function helps scholars draw analogies and link constructs across different levels.

However, even if the functions of constructs across levels are similar, this does not indicate that their structures exhibit the same form as well. The structure of a phenomenon at a higher level can be different from that of the same phenomenon at a lower or the individual level. Because the compositional model does not adequately define in what terms multilevel phenomena are similar, sometimes functional similarities of them are taken as a justification for the use of the composition model. A problem arises in a measurement process because if the structure of a given phenomenon changes from the individual to the team level, then a compositional form which assumes no structural change across the levels is not designed to provide an accurate estimate of the construct. While this characteristic is not covered by composition models, compilational models (Kozlowski et al., 1999; Kozlowski & Klein, 2000) explicitly acknowledge the importance of structures to capture phenomena at higher levels.

Compilational Models

The compilation model (Kozlowski et al., 1999; Kozlowski & Klein, 2000) has been gaining popularity as a way to capture emergent team phenomena (Carson, Tesluk, & Marrone, 2007; DeChurch & Mesmer-Magnus, 2010; DeChurch & Zaccaro, in press; Harrison & Klein, 2007; Hitt, Beamish, Jackson & Mathieu, 2007; Mohammed & Angell, 2003; Pearsall, Ellis, & Bell, 2010; Porter et al., 2003; Roberson & Colquitt, 2005). The model states that phenomena at higher levels do not resemble the features of those at lower levels. Kozlowski and his colleagues (1999) have recognized that teams are not simple aggregates of uniform interactions but rather function as complex networks or patterns of intragroup interaction (Guzzo, 1995). Similarly, DeChurch and Zaccaro (2010) argue that complex socio-technical systems like multiteam systems (i.e., teams of teams) require compilational conceptualization and operationalization of process instead of compositional forms.

In such a complex system, there is no simple linear relationship between individual inputs and team process, and simple behaviors or individual properties may not retain the same structure at the higher level. Patterns or structures of networks become the target of investigation rather than a simple high-low continuum. Because the model does not expect individual properties to have relations to a form of those properties at higher levels, this model explains some higher-level phenomena well. If the compositional model holds, measurement errors and individual differences in perception are considered as a “source of inaccuracy" for representing higher-level phenomena and are cancelled out in the aggregation process (Roberts et al., 1978, p.85). However, individual differences in perceptions should not be averaged out if the compilational model is more theoretically appropriate for a given phenomenon, but rather treated as critical elements of higher-level phenomena manifest in a network form. Thus, if this is the case, the compilational model guides researchers to conceptualize behavioral processes at higher levels better than the composition model.

Utility of Compilational Models

Because compilational models are recently advanced and suggested for research application (Kozlowski & Klein, 2000), there are not many studies that have empirically tested the utility of the models. However, there are a handful of empirical studies demonstrating their utility in understanding multilevel phenomena (DeChurch & Mesmer-Magnus, 2010; Pearsall et al., 2010; Resick et al., in press). Even though these studies have not been conducted on team behavioral process variables, they have already shown some promising effects in understanding multilevel constructs. One of the most developed areas is team cognition (e.g., Edwards, Day, Arthur, & Bell, 2006; Lewis, 2003; Lewis, Belliveau, Herndon, & Keller, 2007; also See Mohammed et al., 2000, in press).

Resick and his colleagues (2010) measured team cognition, which was proposed to be manifest in some structural form, and examined the effect of three types of cognition scale (rating, ranking, and network-based) on team adaptability. They found that only the network-based structural representation of team cognition, and not the rating and ranking measures, showed significant relationship with team performance. DeChurch and Mesmer-Magnus (2010) demonstrated more conclusive results on the utility of compilational models. They conducted a meta-analytic study on the effects of team cognition on process and performance and found that team cognition conceptualized in the form of compilation (e.g., transactive memory) predicts team process and performance better than when represented in the form of composition (e.g., shared mental model).

In the past, compositional models have been a powerful tool to help understand multilevel constructs (e.g., Chan, 1998). However, researchers should understand the limitations of the models because phenomena manifest themselves in much more complex forms as they emerge across different levels of analysis. Compilational models are conceptually flexible enough to accommodate differentially emerging structures of multilevel constructs. Unfortunately, it remains unclear as to which form of compilational models multilevel constructs would appear at higher levels (Morgeson & Hofmann, 1999). Conceptual guidance is needed to evaluate the forms of compilational models and to guide the selection of appropriate measures to capture complex patterns. This may hinder the development of theories of and application of compilational models for multilevel constructs (Kuhn, 1996). It may lead to inconsistent applications of different compilational models to understand the same constructs. Thus, developing conceptual guidance for assessing forms of compilational models of a given construct and selecting useful assessment tools is much needed.

From Measurement Error to Conceptual Features of Team Behavioral Process

For traditional psychometric scales designed to measure individual-level phenomena, the structure of a particular phenomenon has not been an issue in conceptualization and measurement as long as the dimensions of the given construct have been appropriately articulated and adequately assessed (Nunnally & Bernstein, 1994). However, in the transition from the individual level to a higher level, a problem arises that a researcher does not need to consider at the lower level. The issue is that information supplied by a scale designed to measure an individual phenomenon may not be adequate to capture a multilevel construct if the researcher simply aggregates them to the higher level. This is due to the fact that the phenomenon that emerges at higher levels manifests itself in a distinct structure not exhibited at the individual level (Kozlowski & Klein, 2000; Morgeson & Hofmann, 1999), and a scale must measure emergent structural features in addition to measuring the amount of the content. Hence, simple aggregation does not provide scores to capture the emergent structure of the higher-level construct. This emergence of the structure inhibits the effectiveness of the measure because traditional scales are designed to measure amounts or levels of perceptual content rather than structural forms (Bernard, Killworth, & Sailer, 1979; Bernard, Killworth, Kronenfeld, & Sailer, 1984).

Negative Effects of Overlooking Structural Features

Ignoring structure in measuring multilevel constructs results in scores that fail to adequately capture a construct variance in a meaningful manner. Generally, the most important criterion for scaling is that scales must appropriately assess the intensity of a stimulus (Nunnally & Bernstein, 1994). Otherwise, scores do not represent unique intensities that belong to only particular numerical values, and, as a result, researchers encounter a serious issue that scales do not provide scores accurately representing the phenomenon of interest. This may be an issue in the current state of measurement in team behavioral process. This point can be more clearly made in an example of communication scores obtained for individuals and teams.

At the individual level, understanding the direction of interaction between individuals can be ignored because it is emitted only from one point to another and to no other directions (A interacting with B; See Figure 1). Therefore, at this level, measuring interaction intensity provides clear information regarding how distanced each individual is from one another on the communication continuum. Each point on the scale indicates unique information about interaction intensity each individual engages in. A numerical value of Point 4, compared to Point 1, indicates that individuals interact more frequently than other individuals whose score is one. However, at the team level, it seems that measuring the volume of communication alone is not adequate and does not effectively differentiate teams on the underlying communication continuum. Measuring communication becomes far more complex than at the individual level. Within each team, interaction takes place in multiple directions (See Figure 1) and forms a pattern of communication connections. This indicates that team-level scores must capture intensity as well as patterns. Simply aggregated scores of communication for teams only provides averaged scores of intensity but ignores information manifest in the patterns. Each numerical value does not stand for one and only one unique property. For example, an overall three point score can mean that every member engages in process at the same level or that some members engage in process at low levels while others engage in high levels of interaction (See Figure 2). These two teams should not be treated the same on the communication continuum.

Effects of Individual Attributes on Structural Features

Considering structures of multilevel constructs becomes even more important if members distinctively differ in traits. If members are exactly the same in terms of their expertise, personality, and all other important individual compositions, and they can be substitutable with each other, and directions of processes are not important. In another words, if the situation is strong enough to place constraints on such individual differences or any unique team structure not to emerge (Wright & Mischel, 1987), researchers can ignore these issues when planning out their measures and can use traditional psychometric process scales. However, if individual differences are important for teamwork (Mumford, Iddekinge, Morgeson, & Campion, 2008; Stewart, Fulmer, & Barrick, 2005), the direction of members' interactions provides important information untapped by traditional scales that measure intensity alone (Bernard et al., 1979, 1984).

In Figure 3, three members in Team A and B predominantly interact with one another. However, for example, if competence of these members of Team A and B are different, interactions between competent members carry different meaning in communication between a competent member and a less competent member or between less competent members (See Figure 4). In Team A, individuals with high competence are not interacting while in Team B, those with high competence are interacting. Team process measures should be appropriately designed to differentiate processes that take place among different members. Numerous studies have demonstrated that people engage in interaction with specific individuals in a systematic way based on status, power, expertise, and certain personality traits (Allen & Cohen, 1969; Frederick, 1952; Hoffman & Zaki, 1995; Kelly, 1951; Larsen & Hill, 1958; Read, 1962).

When measuring social phenomena, researchers carefully choose scales that are psychometrically sound based on evidence of reliability and validity (Nunnally & Bernstein, 1994). There are many criteria that researchers must consider in evaluating the psychometrical properties of a measure of a social phenomenon. For example, content and multi-dimensionality of the construct are important and need to be considered (James, 1973; James & Ellison, 1973; Viswesvaran, Ones, & Schmidt, 1996; Viswesvaran, Schmidt, & Ones, 2005). However, if in addition to these features, phenomena have a structure in the construct space (Morgeson & Hofmann, 1999), conceptualization about it should be clearly made, and scales must be carefully chosen which appropriately assess the conceptual features of the phenomenon. If behavioral process is composed of a series of individual behaviors that manifests a configural form, social network literature will provide the rich body of information to help evaluate which concept conceptual features need to be assessed. Drawing on the literature, the dissertation will assess team behavioral process in terms of patterns and nodes.

Evaluation of Conceptual Features of Team Behavioral Process

This section is arranged in three subsections: (a) emergent structure, (b) individual differences, and (c) influence of structure and individual differences on members' perception of behavioral process. First, it discusses whether team behavioral process can vary in structure. This is the most important assumption of compositional models on which the current measurement practice has been built (Roberts et al., 1978). Second, individual differences that influence the emergence of team structure will be discussed. Traditionally, researchers have not examined how individual differences influence the formation of patterns of team structure. Third, if teams can form different patterns of structure, and individuals influence the emergence of different structural patterns, it is important to examine how such features influence the way members perceive behavioral process.

Emergent Structure of Team Behavioral Process.

The first and foremost important, underlying assumption about structure is whether a team can have different interaction patterns with members who differ in their attributes critical to team process and performance. If behavioral process can be hypothesized to manifest as structurally different patterns at the team level, it will highlight the importance of compilational models, and researchers must conceptualize in which structure the multilevel construct manifests itself and subsequently how it is to be measured. However, at the same time, the teamwork environment creates constraints on the development of differing interaction patterns, and as a result, any structural differences across teams may not emerge in a study (Nelson, 2001). This leads to the current practice that researchers do not utilize scales that assess patterns of interactions in its volume measure. Before delving into further discussion of the emergent structure of team behavioral process, this assumption must be first evaluated on which the entire argument has been built.

Typical Programs of Teams Research

The definition of a team (Sundstorm, 1999) can imply constraints on development of different interaction patterns and also indicate that members equally likely interact with one another. After all, team is a special setting in which members are forced to interact with one another to achieve common goals. Sundstrom (1999) provides characteristics that define a work team as "interdependent roles, interdependent goals, interdepend outcome or shared fate, reporting to the same manager, small size, members seeing themselves as a team, and stable membership" (pp. 8 – 9). In a small team of four to six members, these characteristics are strong forces that help develop identification with the same entity, make them interact with one another equally likely, and make them similarly influential. Unlike large social contexts where members are free to choose whom they want to interact with (e.g., Allen & Cohen, 1969; Larsen & Hill, 1958; Sutton & Porter, 1968), team contexts are different in that patterns of connections among members are somewhat pre-specified. Team contexts impose constraints on the degree to which members use their discretion in selecting members to interact with because each member is convened to the team to fulfill their unique functions to achieve collective purposes (e.g., surgical team), and inputs of all the members are necessary for attaining their goals. In addition, unlike units or departments, the size of teams is much smaller so that teams require interactions that do not allow different structures to develop (Nelson, 2001). Possibly for all these reasons, an implicit assumption might have been held that members are equally likely to interact with every other member and are equally influential over team processes.

On the other hand, there are many literatures demonstrating that there are emergent structures arising in behavioral process at the team level (Balkundi, Barsness, & Michael, 2009; Balkundi, Kilduff, Barsness, & Michael, 2007; Cummings & Cross, 2003; Oh, Chung, & Labianca, 2004; Reagans, Zuckerman, & McEvily, 2004; Shaw, 1964; Sparrowe & Liden, 2005). Because a team process must be manifest based on a series of interactions that take place in multiple directions within the team, it is likely to be expressed in a network-based form, and this feature must be explicitly incorporated into team process measurement. In this trend, researchers have conceptualized team process as patterns captured in matrices rather than intensity depicted. Patterns in members' interactions are not a new concept, and they were extensively researched in the early communication literature. Many structural patterns such as all-channel, wheel, circle and many others have been proposed, and their unique effects on interactions have been examined (Bales, Strodtbeck, Mills, & Roseborough, 1951; Guetzkow, & Simon, 1955; Shaw, 1964).

Reviews on Communication Research Traditions

Researchers in the 1950s and 1960s extensively studied communication flows and patterns that emerged as participants interacted with one another (Bales et al., 1951; Cohen, 1958; Festinger, 1950; Frederick, 1952; Kelly, 1951; Larsen & Hill, 1958; Read, 1962). Tasks utilized in the studies were often simple such as identifying what symbols written on a card were missing in a group (e.g., Alkire, Collum, & Kaswan, 1968; Guetzkow & Simon, 1955). Roles were not differentiated, and interactions were less complex than those currently utilized in teams research (e.g., Hollenbeck et al., 1995;DeChurch & Marks, 2006; Resick et al., in press). However, researchers at that time did not take communication as a simple aggregation of individual communication acts but conceptualized it as patterns of behaviors in teams. Many early studies have already demonstrated that communication does not take place randomly through any possible channels but rather has some regularity.

Bales et al. (1951), Fredrick (1952) and Larsen and Hill (1958) examined ways communication flows through members and found that communication flow is heavily influenced by the members' status, which is referred to the social ranks one possesses (Gould, 2002). Specially, Bales et al. (1951) and Frederick (1952) found that high status members tend to communicate to their entire group, but that not all members behave similarly. The higher their ranking, the more likely it is for them to contact, and be contacted by lower status members. Cohen (1958) examined communication flow in an experimental setting by manipulating participants' belief that they could move up to a high status position based on their performance (mobility condition) or they could not no matter what (non-mobility condition). Their manipulation changed patterns of communication in terms of direction and content. Compared to participants in the mobility condition, those in the non-mobility condition communicated more to their own group rather than to the upper group and discussed irrelevant information more. Those in the non-mobility condition discussed more about critical comments about the upper group than those in the mobility condition. These studies have demonstrated that communication researchers approached interactions as patterns of interactions rather than those that took place randomly.

Varying Relational Structures in Teams

Many studies have shown that members develop different interaction patterns with other members. Other fields such as social psychology have presented results that teams can have different structural forms (Bales et al., 1951; Cohen & Zhou, 1991; Cummings & Cross, 2003; Frederick, 1952; Haleblian & Finkelstein, 1993). Teams can be constructed in different structures which members occupy formal and informal positions with varying degrees of resources, power, and status (Mizruchi & Potts, 1998; Murninghan & Conlon, 1991) and are differentially connected to each other (Cummings & Cross, 2003). Top management teams whose members are highly specialized are sometimes unevenly structured in power with the CEO almost always possessing the highest authority and the other top managers supporting him or her (e.g., Haleblian & Finkelstein, 1993). In teams, interactions are formed in certain patterns among members and may not take place randomly between any given pair of members. Thus, within teams, members form different patterns of relationships and do not necessarily interact in a similar manner with every other member, leading to the alternative assumption about patterns.

Even though many other fields have proposed and empirically demonstrated structural emergence in teams, this legacy was not inherited by teams researchers. Researchers have spent much more time examining the dimensions that define the content of team process (Marks et al., 2001) rather than understanding how patterns of process emerge in a team and influence performance. Discussion about structural effects of interactions on collective performance has been neglected in major review articles (Bettenhausen, 1991; Cohen & Bailey, 1997; Gist et al., 1987; Guzzo & Dickson, 1996; Ilgen et al., 2005; Kozlowski & Ilgen, 2006; Mathieu et al., 2008).

Meanwhile, communications research has made tremendous progress in understanding structural patterns. Without having benefited from results of the literature on communication patterns or network, the teams literature seems to have adopted the implicit assumption about team process that members communicate with every other member like the All-Channel pattern. This assumption allows researchers to ignore different patterns that could emerge in teams and combine members' perceptions of a behavioral phenomenon with that of other members because all members should be able to perceive the same phenomenon in the same manner. This is not explicitly stated anywhere in the literature, but this is manifested in the measurement approaches teams researchers have adopted when aggregating members' responses to the team level by taking an average of all members' responses. This is a logical technique if this assumption is met and a compositional model holds. In addition, from a psychometric standpoint, it is reasonable to take an average of members' responses in order to reduce any individual members' unique responses if differences in their responses represent random error (Nunnally & Bernstein, 1994). However, the assumption that members communicate with every other member must be carefully examined because it determines whether this logic is applicable and, as a result, which measure should be used.

If researchers instead conceptualize team behavioral process as more dynamic, they must consider what structure of the process emerges through interactions (Morgeson &

Hofmann, 1999). The typology of team cognition proposed by Rentsch Small, and Hanges (2008) is useful for guiding researchers to determine a structure of behavioral process. Rentsch et al. describe and contrast three different types of team cognition: perceptual, structural, and interpretive. Perceptual cognition is defined as psychological meaning that members assign to a phenomenon or environment (e.g., team climate). Structural cognition is organized knowledge in which different pieces of information are represented in an organized network structure (Rentsch, Heffner, & Duffy, 1994). Interpretive cognition is cognitive process through which members come to understand a complex environment. Extending their typology to behavioral process, behavioral process conceptualized in a perceptual form is measured on the high-low continuum, while if the process is conceptualized in a structural form, properties of the structure should be the focus of measurement. Teams may not always emerge in different structures. For example, small teams of three members have a limited number of communication channels, and as a result, the variance in the number of the communication channels across teams is low (Clark, 2003). This logic may allow researchers to ignore structural differences and focus on members' perception of how frequently members, for example, coordinate with one another. However, behavioral process cannot be captured by traditional psychometric scales in many cases because members' perceptual description of how frequently members engage in certain behavior does not depict it accurately (Bernard et al., 1979, 1984). Researchers in this case are interested in a certain structural pattern, the way members are connected to one another on a specific behavioral dimension.

Summary of Conceptualization about Team Process

Conceptualization of team structure can be organized along these two dimensions: patterns and individual differences (See Table 2 & 3). The last conceptual feature of members' perceptual differences will become critical in choosing the wording on questions of a scale.

Past studies have shown that there is a gap in the conceptualization of team process by teams researchers and results demonstrated by the other fields (Campion et al., 1993; Clark, 2003; Cummings & Cross, 2003; Mathieu et al., 2000; Marks et al., 2000; Slaughter, Yu, & Koehly, 2009). Researchers should conceptualize how behavioral process emerges at the team level in their studies because this will guide them to select an appropriate process scale later. It is likely that because of unique constraints imposed by team contexts on the development of interaction patterns (Morgeson & Hofmann, 1999), the traditional assumptions (no patterns & no individual differences) are appropriate. At the same time, under some conditions these assumptions may be violated. Thus, researchers must examine critical features of a teamwork context and research design if these features allow teams to develop or inhibit the emergence of dynamic patterns and individual differences (Morgeson & Hofmann, 1999). In this section, past studies are summarized in each of four conditions. A caution about Table 1 is that even though each feature is dichotomized, in reality they should be conceptualized continuously. For keeping the presentation manageable, only two extremes are presented for each feature.

Type I Multilevel Measurement

In the traditional teams literature, most studies use Type I multilevel measurement (See Table 1). All of these studies do not discuss how patterns of interactions can emerge and individuals have different influences. Patterns are usually considered as stable, implying that almost members should be able to communicate and are actually connected to one another. No individual differentiations in a team are assumed. A countless number of studies have conceptualized behavioral process as this type (e.g., Ancona & Caldwell, 1992; DeChurch & Marks, 2006; Marks, Zaccaro, & Mathieu, 2000; Mathieu, Heffner, Goodwin, Salas, & Cannon-Bowers, 2000; Barrick et al., 2007; Lester, Meglino, Kosgaard, 2002; Moon et al., 2004; Stewart et al., 2005).

Type II Multilevel Measurement

Type II multilevel measurement indicates that patterns are explicitly recognized even though in many cases no individual differentiations are assumed. These studies are rooted in the network tradition. Thus, the first assumption about the structure has been developed distinctively from that of teams research. Recently, researchers have applied network techniques to examine network-based variables and team performance (Carson, Tesluk, & Marrone, 2007; Clark, 2003; Klein, Lim, Saltz, & Mayer, 2004; Oh, Chung, & Labianca, 2004; Regans, & Zuckerman, 2001). However, there are still few studies applying these techniques in teams research.

Type III Multilevel Measurement

Type III multilevel measurement recognizes that individuals are different in some or many attributes but does not approach team behavioral process as patterned. In this type, typically leaders or some high profile members are considered as unique from other regular members in terms of specific dispositions or roles. LePine, Hollenbeck, Ilgen, and Hedlund (1997) examined the effects of cognitive ability and conscientiousness on decision-making accuracy separately for leaders and members. Ellis et al. (2005) first sorted members into different levels of criticality and examined the effect of knowledge held by the most and least critical members on three outcomes: planning and task coordination skill, collaborative and problem solving skills, and communication skills. Humphrey et al. (2009) separated the core and regular members and examined their compositional effects on team performance. These studies explicitly recognized that members are different in critical attributes and contribute independently to team performance.

Type IV Multilevel Measurement

At last, Type IV multilevel measurement is the least researched. There are only a few studies taking this approach (e.g., Balkundi, Barsness, & Michael, 2009; Cumming & Cross, 2003). This type recognizes that individuals are different on critical attributes, and that structural patterns are formed. Typically, the networks literature uses techniques to represent team process as patterned but does not conceptualize individuals as different. For example, the density at the team level is sometimes calculated by taking the average of the numbers of ties of each member divided by the maximum number of possible ties within the team (e.g., Oh, Chung, & Labianca, 2004; Reagans & Zuckerman, 2001). An index score obtained is not calculated based on adjustment of individual differences in critical attributes. If this technique is used, researchers recognize a team process as a pattern, but still recognize each member as substitutable. It is possible that in order to maximize the team's internal resources, critical teams should have large numbers of ties, or ties of high profile members should be weighted more than those of regular members before averaging them. Thus, researchers should first examine whether this type of conceptualization of team process is possible and uniquely contributes to understanding teamwork. Based on features that they consider important, they must choose an appropriate technique that allows them to best capture these features (Harrison & Klein, 2007).

For example, if the researcher conceptualizes behavioral process as Type IV but uses a traditional measurement approach and aggregates all members' responses to obtain team-level scores, they may obtain a conservative underestimate of the relationship between process and performance because process is not represented well with the chosen technique. Alternatively, studies that have conceptualized process as Type IV focus on leaders as different from members (Balkundi et al., 2009; Cumming & Cross, 2003). Balkundi et al. use leader brokerage, the extent to which leaders connect ties that are otherwise disconnected among members, to understand leadership effects on team conflict and viability. Unlike other studies that examine general brokerage effects on team performance (e.g., Oh & Kliduff, 2008), they have specified the important location of brokerage in teams and examined the effect. Unfortunately, they did not examine this effect on team performance after controlling for the general brokerages or brokerages positioned by other non-leader members. Thus, it is a next step to analyze the effects of specific individuals on team performance after controlling for the overall team process.

The teams literature has presented that other underlying attributes such as criticality of particular roles and individual differences can be used to select specific non-leader members besides formal leaders who can be critical parts of team structure (Brass, 1984; Ellis et al, 2005; Humphrey et al., 2009). Thus, it is important to choose an appropriate technique that has the most fit with a particular conceptualization by researchers. Thus, now, we turn to measurement techniques (See Table 2 & 3).

Importance of Individual Differences in Capturing Behavioral Process.

The second feature is about nodes. In the network structure, nodes represent individuals (Slaughter et al., 2009). Traditionally, researchers treat members as individuals who are replaceable with each other and treat them all equally with the exception of leaders. For example, many studies have examined the effects of team-level dispositions on performance indices (Barrick, Stewart, Neubert, & Mount, 1998; Bell, 2007). However, they have not examined who is high or low on certain dispositions even though some studies have shown that members are not equal in their importance to teamwork (Ellis, Bell, Ployhart, Hollenbeck, & Ilgen, 2005; Humphrey, Morgeson, & Mannor, 2009). When representing scores for team behavioral process, researchers have ignored individual differences and treated responses of all members equally. This practice implies that individuals hold similar compositions or structural roles that are equally critical to team process and performance. This assumption can be drawn from an aggregation of personality compositions and also process variables to represent team-level scores. Barrick et al. (1998) demonstrate that the mean, maximum, minimum, and standard deviation (SD) of personality and cognitive ability scores are significantly related to team performance. Typically, studies on teams take the same approach in order to represent team-level compositions (e.g., Bell, 2007). For representing team-level process variables, researchers typically take an average of all members' responses or ask independent raters to rate the team-level processes. As can be seen, taking an average or SD of members' scores for a given variable means to equally weight their responses. Because the majority of teams studies follow one of these operationalizations, drawing the assumption about individual differences held by the field is correct (Bell, 2007; Peeters, Van Tuijl, Rutte, & Reymen, 2006; van Vianen & De Dreu, 2001).

It can be argued that for aggregating compositional variables, use of maximum, minimum, and SD of members' scores incorporate individual differences into representing the team structure. These indices are considered to tap into compilational forms (Kozlowski & Klein, 2000). However, taking the highest and lowest score among members may not even be appropriate. Suppose that there are four members whose criticality is different and that Member A is always important due to his/her position (e.g., Brass, 1984). In order to fully take individual differences into account, SD must be calculated by subtracting scores of other members from that of Member A. Taking maximum and minimum scores of team members may not necessarily make sense if individual differences such as status and power are salient. The smartest member may not maximize his/her ability if the leader completely controls resources and opportunities to perform. For example, members holding a leadership position have unequal influence over how members behave (Hofmann & Jones, 2005; Sy, Cote, & Saavedra, 2005). Taking any team member's score just because it is the highest or lowest may not be the most appropriate representational technique after taking into account individual differences. Thus, it is doubtful that these three indices can always assess team structures appropriately.

Individual Differences in Teams

There are several studies promoting the notion that members are different in their criticality to teamwork and team performance (Brass, 1984; Ellis et al., 2005; Graham & Astley, 1990; Humphrey et al., 2009). Ellis et al. have found that not only team-level teamwork knowledge but also those possessed by individual members holding special functions influence three types of process such as planning and task coordination, collaborative problem solving, and communication, when the levels of influence of members' roles on task flow are different. They found that the teamwork knowledge of the most and least critical members is predictive of those processes. Their logic for the influence of low critical members on team processes is that even though their role is not critical to team processes, if their generic teamwork skills are high, they can contribute to team performance by helping develop a better team environment. Humphrey and his colleagues (2009) demonstrate the importance of examining the effects of specific members holding critical positions on team performance separately from the overall effect of all members. Using a sample of professional baseball teams, they were able to find an additional effect of career experience, job-related skill, and money spent only on core members (all pitchers and catchers) on team winning percentage even after controlling for those three predictors of non-core member effects. These studies indicate that in some cases or under some conditions members' roles and criticality become differentiated among them, and some members provide unique contribution to team performance above and beyond what is already accounted for by the generate team process.

Evidence for emergence of individual differentiation in a team can be found from articles on individual dispositions. Unless members are exactly the same in individual differences or even if roles of members are not differentiated, differences in extraversion, self-monitoring, and cognitive ability affect how members influence and accept influence from other members (Bales, 1954; Day & Schleicher, 2006; Kliduff & Day, 1994; Gould, 2000; Mehra, Kliduff, & Brass, 2001; Judge, Bono, Ilies, & Gerhardt, 2002; Judge, Colberet, & Ilies, 2004; Wilke, Young, Mulders, de Gilder, 1995). Members with certain personalities tend to seek out and occupy influential positions. Need for power has been linked to one's likelihood for seeking an influential position. Members low on neurotisicism and high on self-monitoring are more likely to be in a central position in a network (Klein, Lim, Saltz, & Mayer, 2004; Kliduff & Day, 1994). Members with high expertise are expected to perform better than other members. As a result, they are given more power to influence group discussion (Wilke et al., 1995). At last, Judge et al. (2004) found a high meta-analytic correlation between perceived intelligence and leadership emergence. These individual differences gradually place members into informal roles with varying degrees of status and influence in a team structure, and a unique team structure could emerge around those high profile members.

Influence of Structural Emergence and Individual Difference on Members' Perception of Team Process.

Both structural emergence and individual differences influence the extent to which members perceive behavioral team process in a similar manner. This begs an examination of what parts of team behavioral process members evaluate. Currently, teams researchers consider that members perceive their team process in a similar manner and treats members' unique perspectives on process as measurement error. However, if a team process becomes complex, members come to occupy different locations in the team structure and do not necessarily interact with and influence every other member equally. This influences members' perceptions of behavioral process when they are asked to evaluate it. Literatures from other fields provide clues suggesting that members could perceive process differently depending on the degree to which they interact with particular others and where they are located in the social-organizational structure (Ibarra & Andrews, 1993; Sin, Nahrgang, & Morgeson, 2009).

For example, a meta-analytic study on LMX shows moderate agreement in dyadic relationships between supervisors and subordinates, the correlation of .37 even after correcting for unreliability (Gerstner & Day, 1997). Sin et al. (2009) followed up on the LMX meta-analysis by Gerstner and Day (1997) and confirmed the moderate meta-analytic agreement of .37. They found that the relationship between agreement scores by leaders and subordinates is moderated by their relationship tenure. The LMX scores by both leaders and subordinates who indicate that they have high LMX relationship increases as their relationship lasts long while the LMX scores of leaders and subordinates who indicate that they have low LMX relationship do not change even when the relationship lasts long. Another meta-analysis on job performance ratings shows medium agreement on performance ratings between supervisors, peers, and self ratings (Viswesvaran et al., 1996). The result with the LMX agreement is surprising because how agreement on supervisors' and subordinates' perception of the quality of the relationship is relatively low given that this is not a dyadic relationship, and also they interact on a day-to-day basis and rate the same concept, which seems not as dynamic as the concept of team behavioral process. For the result of the second study, supervisors and subordinates have different expectations for the ratee's perception and have different opportunities to observe different performance dimensions (Landy & Farr, 1980). As these studies have demonstrated, even rating one's relationship with a single member or evaluating a member's performance is complex. Following the previous studies, it is assumed that in teams, as overall team structure and process becomes complex, members' perceptions of those diverge due to the fact that they occupy different structural positions and develop different expectations for other members' roles, responsibilities, and performance (Ibarra & Andrews, 1993, Landy & Farr, 1980). It can be further assumed that evaluating complex team process introduces more measurement error than evaluating a dyadic relationship.

Some may argue that agreements on performance ratings among three constituents in Viswesvaran et al.'s study (1996) are different from those on team process among members because raters are located at different organizational levels and observe different facets of performance dimensions depending on the levels (Landy & Farr, 1980; Woehr, Sheehan, & Bennett, 2005) while team members should be located on the relatively similar level, and teams are designed in a way that collaboration and coordination are required and members must interact more frequently (Sundstrom, 1999), which enhances the accuracy of their perception of team process (Klein et al., 2000; Sin et al., 2009). However, as a team size grows, members form clusters within which specific members interact more frequently with one another based on their closely-related tasks and goals than do other members (Davison, Hollenbeck, Ilgen, Barnes, & Sleesman, 2010). This results in fewer opportunities for members to observe the entire team process that takes place between every possible pair of members because they do not work with every other member (Hare, 1952; Rentsch & Klimoski, 2001; Valenti & Rockett, 2008). One of factors that influence the agreement of responses on a scale among members is the degree to which they interact with one another (Klein et al., 2001). This indicates that in a large team where members interact with others at different rates, they may produce reliable information about some interactions only with specific members but not with all other members. However, Bernard and his colleagues (1979, 1982, 1984) reached an astonishing conclusion that self-reports of simple, dyadic-relational behavior (e.g., communication) could be unreliable. They conducted a series of experiments to examine the extent to which self-reported data matched with behavioral data on the degree of communication between two individuals. Four different types of samples were asked to recall the degree to which they communicated with others, and the results demonstrated that their participants could recall less than half of their communications. This indicates that people cannot accurately recall what has and has not happened or the extent to which their social contacts have taken place. According to Sundstrom, McIntyre, Halfhill, and Richards (2000), team sizes can be bigger than 20 or 30 members. Even with a team with 10 members, the maximum number of possible interactions is 45 ties. It is impossible to accurately understand what is going on in every pair of members and produce a valid evaluation of the overall team process. The problem gets worse as team size increases. Most teams research uses small teams, but in practice researchers need to understand large collectives.

In addition, studies have demonstrated structural positions influence the accuracy of assessing a network structure as well as attitudes and perceptions (Bondonio, 1998; Casciaro, 1998; Ibarra & Andrews, 1993; Simpson & Borch, 2005). In their studies, they employed five perceptual outcomes (risk taking, acceptance, information access, interdepartmental conflict, and autonomy), first three of which were found to be influenced by advice centrality, the number of others who ask for work-related advice. They have reasoned that individuals in a central position in their social network enjoy greater access to resources than do others in a peripheral position. This influences the way they perceive their social environment. Even though Ibarra and Andrews did not directly examine how social network positions of members influenced their perception of team process, their results suggest that differences in structural positions could directly and indirectly influence members' perception of team process by, for example, allowing some members to have great access to information than others.

Methodological Features of Behavioral Process Scale

The fit between the conceptualization and measurement of a construct is critical (Harrison & Klein, 2007). Even if researchers have developed a well-defined concept, without a measure sophisticated enough to capture the proposed construct, they cannot empirically examine the effect of the construct on theoretically relevant outcomes

(Mohammed, Klimoski, & Rentsch, 2000). Researchers have not carefully examined how difficult it is to estimate true scores of behavioral process constructs using traditional measures. Because there is an astonishing amount of research being conducted on teams in the last 20 years, it is time now to take a step back and examine this issue in order to move forward. This section is organized along with three features of scales that are considered important for capturing the conceptual features of multilevel constructs under compilational models. Drawing on a study by Mohammed, et al. (2000), three features are selected: frame of reference, representation of patterns, and individual differences. Then, we will evaluate the degree to which scales currently used in the teams literature capture the structural features of the conceptualized construct.

Frame of Reference.

Obtaining responses tapping into the construct of interest requires the appropriate writing of the scale (Schmit, Ryan, Stierwalt, & Powell, 1995). In order to obtain information useable for assessing the construct of interest, Likert type scales are one of most commonly used techniques while others promote the use of consensus ratings (e.g., Kirkman, Tesluk, & Rosen, 2001). Frame of reference (FR) directs respondents’ attention to a specific lens which prompts them to evaluate certain parts of the environment or psychological state. As team process becomes dynamic, the FR plays a significant role in helping them evaluate specific parts of behavioral process. The FR in teams research can be categorized as member-specific or general. For behavioral process scales with the member-specific FR, members’ attention is directed to the team process each member has gone through, whereas the general FR brings their attention to what commonly happens in the process (van Mierlo et al., 2009). Traditionally, teams researchers apply the general FRs to their scales. Within the general FR context, they use either individual- or team-directed prompt (van Mierlo et al., 2009), but because both prompts do not provide information which specific member interacts with other specific members, they are categorized into the general FRs. For example, participant's response to a question, "On average, how often did you share each type of knowledge during the project with group *members*" (Cummings, 2004, p. 357), does not provide the degree to which knowledge sharing takes place between specific members but asks to evaluate the degree to which it happens overall between the person and all other members (See Figure 5). Researchers use mixed frames of reference within the same scale. Campion, Medsker, and Higgs (1993) used three items to measure communication, "*I* frequently talk to other people in the company besides the people on my team" "There is little competition between *my team* and other teams in the company" and "*Teams* in the company cooperate to get the work done" (p. 850). The first question asks about the degree of communication employees themselves engage in while the other two questions ask about the degree of communication their own teams and others teams engage in (See Figure 5). The first type (individual-directed) asks respondents to adapt their own perspective to evaluate the degree to which "they" engage in a behavioral phenomenon with all others while the second type (team-directed) is non-member-specific and asks them to think how all of their members engage in the behavior. However, still these questions do not provide member-specific information, but the focus of this type of FRs is on what generally happens in a team. These formats are used in many other studies (e.g., Campion et al., 1993; Drach-Zahavy & Somech, 2001; Lovelace, Shapiro, & Weingart, 2001; Marks, Zaccaro, & Mathieu, 2000; Faraj & Sproull, 2000; Mathieu, Gilson, & Ruddy, 2006; O'Reilly & Roberts, 1977).

Traditionally, member-specific FRs are not often employed on behavioral process measures in teams research, but this technique has been applied to team contexts in recent years (e.g., Balkundi et al., 2006; Cummings, 2004; Cummings & Cross, 2003; Klein, Lim, Saltz, & Mayer, 2004; Oh et al., 2004; Regans, Zuckerman, & McEvily, 2004; Sha, Dirks, & Chervany, 2006). To make questions member-specific, researchers have to use a sociometric scale format, in which questions are designed to examine the extent to which each member interacts with every other member (See Figure 5). For example, researchers can examine communication with a question "How frequently did you communicate with X during the project?" (Cummings & Cross, 2003, p. 203). In this way, researchers can obtain information about the degree to which communication takes place between every pair of specific members. Social network researchers have developed this type of format to represent pattern-based numerical values. Only this format allows them to use network analysis techniques, but some researchers use this FR and simply take an average of all members' responses to represent team-level scores (Cummings & Cross, 2003).

The Effect of Frame of References on Respondents' Perceptions

The extent to which team behavioral process becomes complex determines the choice of a type of FR. Even though this is a neglected area of research, a small number of researchers have conducted research on effects of FRs (Kirkman et al., 2001; Klein et al., 2001; van Mierlo et al., 2009). These researchers have demonstrated that team members may not have perceived similarly what is happening in process to themselves and their team. Recently, using two of Chan's (1998) composition models, direct-consensus and referent-shift, van Mierlo and her colleagues (2009) thoroughly examined whether questions with two levels of FR (e.g., "Do you" & "Does your group") elicit similar responses on work autonomy and variety, and test whether patterns of responses are similar using correlations, factor analysis, ICCs, and R_{wg} at three levels such as the individual, within-group, and between-group level. Direct consensus model indicates that a construct resides at the high level, and respondents directly evaluate the high-level phenomenon and average their responses in order to represent high-level scores. Reference-shift model indicates that individual responses are meaningful but the phenomenon of interest exists at the high level. Even though their question items were almost identical, correlations between scores represented based on the direct-consensus and referent-shift were surprisingly low, indicating that depending on reference points their respondents evaluated different parts of their group. In addition, they assessed members' perceptions on environmental features such as work autonomy and variety which were relatively stable across members.

There is a potential concern about the use of the general FRs. Researchers do not know which exact frame of reference respondents adopt to evaluate the construct being evaluated. Unlike assessing phenomena at the individual level, raters must evaluate the overall team process or each interaction that takes place in every pair of members and somehow come up with a unique summation process of those scores in order to produce a team-level score. It is difficult to estimate what cognitive evaluative process respondents take in order to generate team-level responses. For example, the general FR of team-directed does not indicate which members each respondent considers when evaluating their team's action. The general FR of individual-directed indicates the starting point of the evaluating process, which is themselves, but does not indicate which members they think they engage in action with when responding to this type of question. It is possible that if questions ask about a general team process, some respondents use members whom they most interact with, the degree to which they interact with high profile members, the degree to which high profile members interact with other high profile members, or the degree to which low profile members interact with high profile members. As team process becomes complex with a large number of members, the degree of discretion respondents can use become limitless and introduce source of confusion or even inaccuracy in team-level data.

If respondents perceive team process differently, averaging all of their scores to obtain team-level scores may contain too much measurement error or reduce the amount of valuable information that is otherwise useful for understanding team behavioral process if scores are not averaged. For example, researchers treat these members equally and obtain inter-rater reliability to see if responses from different members can be aggregated. For aggregation justification, researchers provide intra-team agreement statistics such as R_{wg} (James, 1982; James et al., 1984; LeBreton & Senter,) or intraclass correlation, ICC_1 and ICC_2 (Bartko, 1976; James, 1982; Shrout & Fleiss, 1979).

James et al. (1984) introduced a procedure to assess the absolute agreement index indicating the proportion of the variance in a set of judgments relative to the overall variance of judgments. ICC_1 is a point estimate of interrater reliability within each unit for which typically individual observations are averaged while ICC_2 represents an index of variance over those units (James, 1982). This practice has been well accepted among teams researchers (Campion et al., 1993). A brief summary of intra-team agreement statistics in teams studies ranges widely from .27 to .98 (Campion et al., 1993; Campion, Papper & Medsker, 1996; Chen & Klimoski, 2003; Drach-Zahavy & Somech, 2001; Lester, Meglino, & Korsgaard, 2002; Lovelace, Shapiro, & Weingart, 2001; Mathieu, Heffner, Goodwin, Salas, & Cannon-Bower, 2000). This suggests that members or independent raters have wide variability in their perception of overall team performance (Hare, 1952). Given the wide range of the numbers of team members in those studies, another possibility can be assumed that team processes occurred between members so that members or independent raters rated processes that took place only to them but did not pay attention to processes that occurred to others, and as a result, their ratings might not converge. The empirical results presented so far do not provide explanations for how members or independent raters cognitively process information to somehow evaluate different interaction patterns and come up with specific numerical values of overall team process. Team process can be complex to a point where traditional psychometric scales cannot capture the variance accurately.

One solution for this is to direct respondents with a specific frame of reference and ask them to evaluate the degree to which they interact with every other member (Schmit, Ryan, Stierwalt, & Powell, 1995; Wright & Mischel, 1987). Schmit et al. (1995) demonstrated the effect of FR by altering and comparing different FRs on a personality inventory. Drawing on self-presentation theory, which states people choose personality items describing what they hope to be depicted, they added words “at work” to the end of each question item in order to make explicit situations being asked. The manipulation (general vs. work specific personality question items) influenced the way respondents described themselves, and their scores in the work specific question condition were higher on conscientiousness, neuroticism, and agreeableness than those in the general question condition. In their second study, they examined criterion validity by correlating personality scores with GPA. This time, they used a reference “school” on the scale to make sure that participants in the work specific question condition in the study 1 did not merely describe themselves in a positive light. The result showed higher criterion validity for the reference-specific question condition than for general question condition. Following these studies, this paper argues that using a specific frame of reference will improve the accuracy of responses on team process. Especially, when members interact at different rates with different members and have fewer opportunities to observe interactions that take place among other members, this technique seems to reduce measurement errors by directing respondents to the specific targets. This is critical for multilevel research because depending on how questions are worded, they direct respondents to focus on behaviors in different situations or evaluate different parts of the construct of interest.

Representation: Patterns

Representation is defined as the technique to obtain a specific data pattern (Mohammed et al., 2000). When aggregating to the team level, researchers tend not to consider the degree to which a specific pattern emerges and how it influences team performance. If the given construct is conceptualized to develop a pattern, the traditional representation technique such as averaging individual scores is not the best way to capture it. As a team process becomes patterned, at the team level what seems to be important is to understand which members engage in a series of interactions with which other members. Such series of interactions that take place within a team create patterns of interactions that are manifested at the team level (Kozlowski et al., 1999). Thus, if a team process is manifested as patterned, a shared perception among team members provides only perceptual information of what commonly happens in process to all of members (Klein et al., 2001) but not structural information of how members are connected (Rentsch et al., 2008).

Cummings and Cross (2003) examine effects of communication, hierarchy, and core-periphery on planning and completion quality of project teams. They obtained communication scores by averaging members' responses and hierarchical structure scores by first dichotomizing members' responses on communication and running the hierarchy routine in KrackPlot, a network visualization PC program for social networks. Regression coefficients of planning and completion quality are .15 and .30 for communication, and -.58 and -.52 for hierarchical structure, respectively. These results clearly indicate that network indices provide better estimate of relationships with performance. This suggests that choices made by researchers on types of representation technique are critical, and do not necessarily provide the same information (Cummings & Cross, 2003; Resick et al., in press).

Techniques currently available to capture behavioral patterns can be found in the social networks literature (Clark, 2003; Slaughter et al., 2009). The social network literature applies indices that are better suited to capturing patterned relationships than are techniques traditionally used in the teams literature. Instead of merely averaging members' scores, these techniques examine structural properties of network (Clark, 2003; Slaughter et al., 2009). There are various properties of a network that have been empirically shown to influence outcomes at different organizational levels such as density (Reagans & Zuckerman, 2001;

Reagans et al., 2004) and structural holes (Balkundi et al., 2007; Cummings & Cross, 2003). These characteristics significantly differ from traditional-psychological measures in the power of detecting specific structural properties. In the following paragraphs, differences in characteristics between traditional process scales and network representation techniques are illustrated.

Network Representations

Density is one of the most widely used network characteristics. The definition of density is the proportion of a number of ties to a maximum number of possible ties of a team (Clark, 2003). Past studies have demonstrated that teamwork density significantly influences group performance (Collins & Clark, 2003; Hansen, Mors, & Lovas, 2005; Mehra, Dixon, Brass, & Robertson, 2006; Oh et al., 2004; Reagans & Zuckerman, 2001; Reagans et al., 2004). Contents of density vary across studies, but all of them have been shown to influence team-level behavior and performance. Some studies calculated density scores of communication frequency and found that they affected team productivity measured by managers and senior executives (Reagans & Zuckerman, 2001; Reagans et al., 2004).

Structural holes have been demonstrated to influence team performance (Balkundi et al., 2009; Balkundi et al., 2007; Cummings & Cross, 2003). Structural holes are defined as the degree to which individuals connect others who are otherwise disconnected (Knoke & Yang, 2008). Balkundi et al. (2007) found that high performing teams tend to have moderate proportions of structural holes while low performing teams are likely to have low or high proportions of structural holes. Both studies conducted by Balkundi et al. (2009) and Cummings and Cross (2003) examined effects of leadership structural holes, which is the degree to which a leader positioned him-/herself in between two members who were otherwise disconnected, on team performance indicators. The study by Balkundi et al. found negative relationships of the leadership structural holes with team conflict and viability while

Cummings and Cross found the negative relationship with the planning and completion quality of team projects.

As team size increases, teams must have a right mixture of structural holes and density. In teams, if the size is small, high density constraints the emergence of structural holes. Small teams with high density of interactions indicate that many members are all connected to one another. However, teams with at least moderate size have an adequate number of potential interaction channels that allow both characteristics to emerge and influence outcomes independently of each other (Soda et al., 2004). As a hypothetical illustration that both characteristics can exist in a team, suppose that there are two teams of four members. In the first team, three members in a team of four interact with one another (three lines among A, B, & C) while in the second team, four members interact in a way that A and B are connected, B and C are connected, and C and D are connected. In this case, the first team has no structural hole while the second team has two structural holes (B and C). This is an example of a very small team. As team size increases, the structure of teams becomes much more complex because max numbers of potential channels increase and as a result allow different characteristics to develop.

Both network indices significantly differ in their characteristics from traditional measurement techniques. High scores of a traditional and network scale indicate something conceptually different in their meaning. For example, high scores of traditional scales typically indicate positive meanings. However, high density scores indicate that all members are connected to every other member and do not necessarily benefit from such a high overall connection within their team (Lechner, Frankenberger, & Floyd, 2010; Soda, Usai, & Zaheer, 2004). Oh et al. (2004) found that a bell-shape relationship between team performance and density and that too much connection starts hurting team performance. Balkundi and his colleagues demonstrated that too many or too few structural holes hurt team performance because too many structural holes indicate that members do not engage in coordination and communication well while too few structural holes require members to coordinate with every other member and too much energy from them. However, high scores on the psychometric process scales do not provide this type of information unless the scale has items assessing negative effects of high process quality. As team behavioral process becomes patterned, information provided by psychometric scales becomes limited while information by network indices will increase in quality. In addition, low scores on psychometric scales do not indicate whether team members do not, for example, interact as much as they should, or only a few members interact while others do not. Such information can be extracted via structural holes.

Examination of the degree to which these indices capture team processes, and contrast between two types of techniques can contribute to the teams literature. It is still possible that psychometric scales can provide scores that adequately capture team behavioral process if team process does not emerge as patterned due to limited interaction choices or strong constraints on interactions. To date, the teams literature has found relationships between numerous process variables and performance indicators (Campion et al., 1993, 1996; DeChurch & Marks, 2006; LePine et al., 2008; Marks et al., 2000, 2005; Mathieu et al., 2000; Porter, 2005). This suggests a possibility that psychometric behavioral process scales have been successfully designed with high construct validity and can capture enough variance of those process variables. However, according to Bedwell, and her colleagues (2010), across *Journal of Applied Psychology* and *Academy of Management Journal* in the last 10 years of teams research only 10 % of behavioral variables have been represented in compilational forms. If team behavioral process manifest in compilational forms, it is also possible that representation of team process scores in network indices explain more variance beyond that accounted for by traditional process scales and helps develop further understanding of teamwork (e.g., Cummings & Cross, 2003).

Representation: Individual Differences

The last methodological feature is whether researchers represent team-level scores by taking into account individual differences. Even though individual differences are the essence of psychology, in the teams literature, researchers often neglect considering individual effects when averaging members' scores and treating them all equally. With the exception of using leaders' scores, regular members are treated similarly on individual attributes and roles which are critical to group dynamics. When aggregating individual responses to the team level, researchers average members' scores and do not weight scores of any individuals higher than those of any other members. However, members in the team context do not randomly interact with others. Their interaction patterns are heavily influenced by members' dispositions, skills, knowledge, and roles. For example, many studies have demonstrated that individuals perceived as high potential performers are more likely to influence others with whom they interact (Dembo & McAuliffe, 1987; Foddy & Smithson, 1996; Frederick, 1952; Gould, 2002; Silver, Cohen, Crutchfield, 1994; Wilke et al., 1995).

For example, when developing a plan, high profile members more likely influence the direction of planning than do regular members and sets a stage for which subsequent actions or even the success of the project are pre-determined. When coordinating actions, low profile members likely adjust the timing of engaging in their action around the timing when high profile members perform their task (Ancona & Chong, 1996). The network literature has accumulated many studies demonstrating that high profile members tend to position themselves and occupy a critical role to connect other members in their network (Balkundi & Harrison, 2006; Bono & Anderson, 2005; Mehra, Dixon, Brass, & Robertson, 2006; Oh & Kilduff, 2008). If such individual differences in team process convey critical information in understanding teamwork, by averaging members' scores, researchers lose important information in representing team-level phenomena. When such information should be retained at the team level, researchers should adapt a technique that incorporates individual differences into representing scores at the team level. This indicates that researchers should start examining ways to represent team-level scores that are also adjusted by members' unique differences. The first challenge is how to identify those non-leader members who attract members' attention or around whom patterns of interaction emerge.

Emergence of Status Differentials

There are many individual dispositions that influence group dynamics. One of the mechanisms through which those dispositions influence members' interactions is the emergence of status differentials (Berger, Cohen, & Zelditch, 1972; Gould, 2002; Skvoretz & Fararo, 1996). Influence and status have been recognized as major forces underlying a social structure, and determine how people interact with one another in the system (Allen & Cohen, 1969; Anderson, Berger, Cohen, & Zeditch, 1966; Bales et al., 1951; Berger, Cohen, & Zeditch, 1972; Cohen, 1958). Status is defined as an evaluative outcome of attributes that produces differences in group process and outcomes (Gilovich, Keltner, & Nisbett, 2011). Influence is defined as the ability to make changes in the actions of others (Anderson, Spataro, & Flynn, 2008). Members do not randomly interact with one another but rather show systematic patterns of interaction with one another which are governed by status and influence. Studies have demonstrated that specific flows emerge between members of different statuses (Berger et al., 1972; Cohen & Zhou, 1991; Dembo & McAuliffe, 1987; Friedkin, 1993). Some members dominate and have more influence over what course of action the team should take, which shape interactions into a pattern.

Status characteristics theory (SCT) is particularly useful for understanding how individuals come to acquire or be bestowed status and power by others (Berger et al., 1972). It states that there are general and specific status cues people use to estimate a focal person's potentiality for performance (Berger et al., 1972; Driskell, Olmstead, & Salas, 1993). Cues about individuals provide information that varies in the degree to which it is directly related to performance information. For example, people think that social categories such as gender and race to which they have membership can imply performance potentiality while other cues are more specific to the task such as mathematical ability. In some jobs that require a high level of physical force, gender can be used as a proxy to candidates' performance potential if a recruiter has to choose between males and females. Because male candidates are more likely to have more muscle fibers than do female candidates, gender is considered to provide critical information about their future performance. In teamwork, there are specific abilities that are closely related to team performance based on tasks being performed and contexts where they interact (Stevens & Campion, 1994, 1999; Barrick et al. 1998; Bell, 2007; Morgeson et al, 2005; Porter et al., 2003). Team members must engage in formal and informal communication and interactions to develop a plan and alternatives, reach a consensus on critical decisions, and coordinate their actions in order to achieve their objectives and goal (Marks et al., 2001). It is these communication, coordination, and interaction, through which members gradually come to recognize members' expertise and potentiality of contribution to team performance (Bunderson, 2004; Gould, 2002). Such performance expectations held by members shape the way they interact with other members and lead to status differences (Cohen & Zhou, 1991; Gould, 2002; Foddy & Smithson, 1996; Milanovich, Driskell, Stout, & Salas, 1998; Wilke et al., 1995). The SCT helps explain which dispositions lead to expectation for performance potential, and the SCT model is summarized in Figure 6.

Gender Effect

Gender is one of most prevalent social cues that people rely on to form performance expectations and evaluate the effectiveness of others (Eagly & Karau, 2002). The literature on gender stereotypes has demonstrated robust effect of gender on the evaluation of leadership effectiveness, promotion (Lyness & Heilman, 2006). According to social congruity theory, the match is critical between behaviors associated with gender stereotypes and behaviors expected to be engaged in (Eagly & Karau, 2002). For example, people evaluate males more favorably than females on tasks stereotyped in masculine terms (Eagly, Karau, & Makhijani, 1995). In social roles that are typed as muscular such as leadership or social dominant roles, males benefit from their gender because people expect males to fill in those roles (Eagly & Karau, 2002). Therefore, following hypotheses were drawn.

Hypothesis 1a: Male participants are more likely to be perceived high on performance expectation than are female participants.

Hypothesis 1b: Male participants are more likely to be perceived high on status than are female participants.

Past research has found that personality, needs, and general cognitive ability (GMA) are related to teamwork process and performance (Barrick et al., 1998; Bell, 2007; Day et al., 2005; Devine & Philips, 2001; LePine, Hollenbeck, Ilgen, & Hedlund, 1997; McClough & Rogelberg, 2003; Morgeson et al., 2005; Neuman & Wright, 1999; Peeters et al., 2006; Thoms, Moore, & Scott, 1996; Prewett, Walvoord, Stilson, Rossi, & Brannick, 2009; Stevens & Campion, 1994, 1999; Stewart, 2006; van Vianen & De Dreu, 2001). As members interact, they find out others' expertise and levels of abilities, and gradually form expectations about their potential performance (Skvoretz & Fararo, 1996). Social skills and self-monitoring are critical skills in team contexts. To perform well in a team means to work well with others (Miller, 2001). Because team members must exchange tasks and information to generate ideas and plans and engage in process to achieve team objectives (Ellis et al., 2005; Marks et al., 2001; LePine et al., 2008), even for those high on GMA, without social skills they cannot perform their tasks well. The teamwork environment does not allow them to focus on their own tasks but requires them to engage in context performance to promote a good social environment that enhances team process (Salas et al., 2005; Morgeson et al., 2005). The SCT model in Figure 6 asserts that individual dispositions are positively related to teamwork, but the degree of the relationships is moderated by social skills and self-monitoring. First, each construct is reviewed, and how they interact with one another is discussed.

General Mental Ability

GMA has been most extensively researched and demonstrated to be related to performance in various contexts (Barrick et al., 1993, 1998; Bell, 2007; Day et al., 2005; Salgado, Anderson, Moscos, Bertua, & Fruyt, 2003; Schimdt & Hunter, 1998). Schimidt and Hunter (1998) showed that GMA is one of the most important predictors of overall performance in job training programs more than other predictors such as integrity or personality tests. Barrick et al. (1998) meta-analytically demonstrated the importance of average team GMA scores on performance, and other studies (Bell, 2007; Devine & Philips, 2001) have also shown consistent patterns of relationships between GMA represented in different forms (mean, variance, maximum, & minimum) and team performance. Because members high on GMA are more likely to learn tasks and process complex information quickly and comprehensively than are those medium or low on GMA (Day et al., 2005), the exchange of tasks and information across high GMA members is more effective than that across members with various GMA levels. In addition, acting like a smart member is critical in team contexts. Judge and his colleagues (2004) have found in their meta-analytic study that perceived intelligence is more highly related to leader emergence than the actual cognitive ability score. This suggests that people generally believe GMA is strongly related to high performance and hence give those people seemingly high on this trait a special authority to influence actions of themselves.

Hypothesis 2a: GMA will be likely to positively relate to performance expectation.

Hypothesis 2b: GMA will be likely to positively relate to status.

Meta-analytic studies have demonstrated that expertise has effects on job performance in different tasks that vary in terms of job complexity (McDaniel, Schmidt, & Hunter, 1988; Hunter, 1986). Hunter (1986) found that job knowledge was strongly related to both job performance and supervisory rating. Schmidt and his colleagues (1986) found the effect of job experience on performance through enhancing job knowledge. Quinone, Ford, and Teachout (1995) broken down the concept of work experience in terms of measurement mode (amount, time, & type) and level of specificity (task, job, and organization) and examined meta-analytic relations of these concepts with job performance. They found that all the variables of job experience that are conceptualized differently have significant positive relationships with job performance. Therefore, following hypotheses were drawn.

Hypothesis 3a: Expertise will be positively related to performance expectation.

Hypothesis 3b: Expertise will be positively related to status.

Having high GMA and skills critical for tasks alone are not necessary. Members should have social skills to maximize the effect of their GMA on performance potential perceived by other members. Unlike individual tasks, teamwork contexts require high levels of coordination and interaction among members to produce high-performing teams (DeChurch & Marks, 2005; LePine et al., 2008; Vinokur, Burnstein, Sechrest, & Wortman, 1985). Members interactively create a social context in a way that maximizes their abilities and roles (Hogan & Shelton, 1997; Schneider et al., 2005). Members who cannot participate in this process will suffer even if they have high abilities and great knowledge because they must completely fit themselves into the already-established environment or may not be able to function well in such a context (Schneider, 1975). Even though Hunter and Schmidt (1998) demonstrated the criticality of GMA for one's performance, teamwork contexts require members to put members' GMA into action (Neuman & Wright, 1999; Wright, Kacmar, McMahan, & Deleeuw, 1995). The logic is that members who can influence their work environment will occupy advantageous positions on their teams (Mehra, Kilduff, & Brass, 2001), which will maximize the effect of their abilities to influence teamwork (Kameda, Ohtsubo, & Takezawa, 1997). Thus, relationships between GMA and perceived performance potential will be expected to be moderated by various individual factors such as need for power (McClelland & Burnham, 1976), personality (Barrick et al., 1998), and self-monitoring (Snyder, 1984).

Individual Dispositions and Expertise as Moderating Factors

In addition to expertise and abilities, individual dispositions influence whether or not expertise is fully utilized in teamwork. There are dispositions that influence individual behavior in teamwork. Other studies demonstrate that individual dispositions and expertise interact with each other to influence status emergence. Miller (2001) suggests that teamwork demands not only skills necessary to performing assigned tasks but also skills that enable members to put those abilities into play in social contexts. A meta-analytic study by Judge and his colleagues (2004) suggests that it is not enough for individuals to possess high cognitive ability, but they also need to know how to act like a leader. They did not examine studies that evaluated leadership only in team contexts, but it can be reasonably assumed that team members must possess skills as well as the will to use them to make themselves look more like an expert. Driskell and his colleagues (1993) supported their suggestion. They examined the effect of task and dominance cues used in a leader’s speech to influence whether student participants accepted the speech content. They hypothesized that task cues were more directly related to one’s confidence on leadership, and dominant cues were behaviors intentionally used to dominate social interactions such as high eye contact and intrusive and pointing gestures. They found that leaders utilizing many task cues were influential more than leaders with fewer task cues. These studies all point out that members who can make their expertise effective in teamwork will obtain higher status than those who cannot.

Personality: Five Factor Model

Specific personalities lead to high expectation for performance potential. Personality has been studied extensively in both individual as well as social contexts (Barrick et al., 1998, Bell, 2007; Judge, Bono, Ilies, & Gerhardt, 2002; LePine et al., 1997). Hogan and Shelton (1997) have proposed a theory that explains personality based on three motives that people try to fulfill in a social context: getting ahead, getting along, and making sense. They have described that humans as social animals seek out acceptance and confirmation from others (getting along), power and influence (getting ahead), and try to make their life stable and predictable (making sense). Barrick et al. (2002) added another motivational component "accomplishment striving", the tendency to achieve a difficult goal, to explain the mechanism of personality effect on performance. Personality drives humans to adapt particular strategies to fulfill these motives (Mumford et al., 2008; Morgeson et al., 2005; Stewart et al., 2005). These studies have demonstrated that specific personality facets are related to social and task role (Barrick et al., 2002; Stewart et al., 2005) or contextual and task performance (Morgeson et al., 2005). Because tasks must be individually as well as collaboratively accomplished, members who can effectively engage in them will occupy advantageous positions over others.

Conscientiousness

Numerous studies have accumulated results that five personality factors (conscientiousness, emotional stability, extraversion, agreeableness, and open to experience) are related to task performance even after controlling for GMA (Barrick, Mount, & Strauss, 1993; Morgeson et al., 2005; Neuman & Wright, 1999; Stewart et al., 2005; Tett Jackson, & Rothstein, 1991). Conscientiousness is the tendency to be dependable, planful, persistent, and achievement-oriented. Conscientious members tend to be disciplined and focus on their assignment and strive to achieve goals. Studies have found that it is robustly predictive of various criteria such as supervisor ratings, teamwork, sales performance, and managerial performance (Barrick, Mount, & Judge, 2001; Bell, 2007; Barrick et al., 1998). This personality becomes especially valuable in a team context where members are allowed to be autonomous because they can intrinsically force themselves to work and do not need close supervision (Barrick & Mount, 1993; Morgeson et al., 2005). Barrick et al. (1993) have used goal-setting to explain a mechanism of the effect of conscientiousness on individual performance, and found that conscientious workers are more likely to set goals and be committed to them in order to reach a higher goal and performance. Judge and Ilies (2002) confirmed this relationship at the meta-analytic level and also found significant relationships of conscientiousness with expectancy and self-efficacy. Stewart et al. (2005) have found that high conscientious members are more likely to engage in a task-oriented role in a team context while Morgeson et al. (2005) have demonstrated the positive relationship between conscientiousness and task performance in a team context.

Agreeableness

Agreeableness has been found to be significantly related to various criteria (Barrick et al., 2001; Barrick et al., 1998; Tett et al., 1991) and theoretically important to social situations because one's activities and performance are dependent on others' (Hogan & Shelton, 1998). Agreeable individuals are likely to be sympathetic, altruistic, and selfless (Barrick et al., 2002). Barrick et al. (2002) used Hogan and Shelton's (1997) need concept, getting along, to explain how agreeableness influenced performance ratings of sales representatives. However, their results did not show a significant relationship between getting along and performance ratings, because their participants had individual-based jobs. On the other hand, Morgeson et al. (2005) found that agreeableness is related to a social role and contextual performance in the team context, and Stewart et al. (2005) also showed evidence to a relationship between social roles aggregated to team level and team performance. Finally, Barrick and his colleagues (1998) demonstrated various relationships of agreeableness with criteria identified as critical to teamwork (Cohen & Bailey, 1997; Salas et al., 2004) such as social cohesion (r = .32), team conflict (r = -.38), and workload sharing (r = .56). Thus, members high on agreeableness contribute to team performance by building an environment that facilitates collaboration and coordination. Such contextual behaviors are likely to influence the way other members evaluate them in terms of teamwork skills and subsequently become susceptible to their influence (Johnson, 2001).

Emotional Stability

Emotional stability is defined as the ability to adjust emotion to different situations in terms of stress, anxiety, and depression (Judge & Ilies, 2002). This trait is critical in a team context. Unlike individual tasks which are assigned and closely supervised, in a team environment tasks and responsibilities are ambiguous. Members must take on social different roles that may not explicitly specified because these roles connect members' individual tasks and create a configuration of interactions through which teams accomplish tasks (Stewart et al., 2005). Members low on emotional stability are less likely to be able to adjust to this environment than those emotionally stable (Barrick et al., 2001). Thoms et al. (1996) have found a negative relationship between neuroticism and self-efficacy for group participation, which is in line with Judge and Ilies' (2002) finding that extraversion is negatively related to goal-setting, expectation, and self-efficacy. In addition, contextual performance is critical because of the nature of teamwork that requires high levels of interdependency (Morgeson et al., 2005; Sundstrom, 1999). Members low on emotional stability will feel difficulty figuring out what context performance they need to engage in and when to do it. As a result, they will not obtain help when needed (Homans, 1958). Meta-analytical results by Barrick et al. (1998) demonstrated negative effects of emotional stability on various indicators. Their findings indicated that the higher the scores of the least emotionally stable members, the higher the social cohesion, communication, and workload sharing, the lower the team conflict.

Extraversion

Extraversion is defined as the tendency to be social, assertive, active, and energetic (Goldberg, 1992). Extraversion has been found to be related to individual performance (Barrick & Mount, 1993; Barrick et al., 2002), team performance (Barrick et al., 1998), and leadership emergence and effectiveness (Judge et al., 2002; Kickul & Neuman, 2000). Despite these results, effects of extraversion in team contexts are clear. For example, the relationship between extraversion and individual performance in a team context tends to be negative (Kickul & Neuman, 2000; Stewart et al., 2005). However, extraverts tend to be motivated to participate in teamwork (Thoms et al., 1996) and be perceived as a leader in general contexts (Judge et al., 2002) as well as in team contexts (Taggar, Hackett, & Saha, 1999). Because leadership is a critical factor for team performance (Murase, Jiménez, Sanz, DeChurch, & Resick, in press; DeChurch & Marks, 2006), this paper assumes that extraverts will occupy advantageous positions.

Open to Experience

Open to experience has a unique position in the personality as well as teams literature. Researchers have been perplexed by its non-significant or relatively low relationship with performance criteria (Barrick & Mount, 1991; Griffin & Hesketh, 2004; Peeters et al., 2006). Individuals high on this dimension are described as imaginative, adventurous, curious, broad-minded, and artistically sensitive. In spite of its theoretical linkage to criteria, researchers have found it difficult to find relationships of this personality dimension with performance criteria (Barrick & Mount, 1991). This disappointment let some researchers to exclusion of openness in their studies even though their purpose was to examine the effect of five factor model (e.g., Barrick et al., 1998; Mohammed & Angell, 2003; Prewett et al., 2009).

However, other studies have found significant relationships between openness and team performance (Bell, 2007; Homan et al., 2008; LePine, 2003). In teamwork, adaptability and flexibility are imperative to accommodate differences in members' personality, values, opinions, and work style. LePine (2003) found that teams with high openness members were able to adapt to a new coordination configuration in which members had to pass information onto other members in an order different from the previous session, and their high ability to adapt to the new configuration let to higher team performance. Homan and his colleagues (2008) found the positive effect of openness on performance of teams in which diversity was salient. In teams with a complex team configuration where , for example, members may not be co-located and have to process and integrate various information, members high on openness will not be susceptible to negative effects of members' characteristics differences and seek out information from various members. Openness can bring positive impact to team performance.

All of these studies have suggested that members high on these personality traits will be likely to occupy advantageous positions in their teams than those low on these factors.

Hypothesis 4a: The relationship between GMA and performance potential will be moderated by conscientiousness. For members with high conscientiousness, the relationship between GMA and performance potential will be more strongly positively related than for those with low conscientiousness.

Hypothesis 4b: The relationship between GMA and performance potential will be moderated by extraversion. For members with high extraversion, the relationship between GMA and performance potential will be stronger than for those with low extraversion.

Hypothesis 4c: The relationship between GMA and performance potential will be moderated *by emotional stability. For members with high emotional stability, the relationship between GMA and performance potential will be stronger than for those with low emotional stability.*

Hypothesis 4d: The relationship between GMA and performance potential will be moderated by agreeableness. For members with high agreeableness, the relationship between GMA and perceived performance potential will be stronger than for those with low agreeableness.

Hypothesis 4e: The relationship between GMA and performance potential will be moderated by open-to-experience. For members with high open-to-experience, the relationship between GMA and perceived performance potential will be stronger than for those with low open-to-experience.

Hypothesis 5a: The relationship between gender and performance potential will be moderated by conscientiousness. For female members, the relationship between conscientiousness and performance potential will be stronger than for male members.

Hypothesis 5b: The relationship between gender and performance potential will be moderated by extraversion. For female members, extraversion and performance potential will be more positively related than are those for male members.

Hypothesis 5c: The relationship between gender and perceived performance potential will be moderated by emotional stability. For female members, emotional stability is more highly positively related to performance than for male members.

Hypothesis 5d: The relationship between gender and perceived performance potential will be moderated by agreeableness. For female members, the relationship between agreeableness and performance potential will be more strongly positively *related than for male members.*

Hypothesis 5e: The relationship between gender and performance potential will be moderated by open-to-experience. For female members, the relationship between open-to-experience and performance potential will be more strongly positively related than for male members.

Hypothesis 6a: The relationship between expertise and performance potential will be moderated by conscientiousness. For members with high conscientiousness, the relationship between expertise and performance potential will be stronger than for those with low conscientiousness.

Hypothesis 6b: The relationship between expertise and performance potential will be moderated by extraversion. For members with high conscientiousness, the relationship between expertise and performance potential will be stronger than for those with low extraversion.

Hypothesis 6c: The relationship between expertise and performance potential will be moderated by emotional stability. For members with high emotional stability, expertise and performance potential are more strongly positively related than are those for those with low emotional stability.

Hypothesis 6d: The relationship between expertise and performance potential will be moderated by agreeableness. For members with high agreeableness, expertise and performance potential are more strongly positively related than for those with low agreeableness.

Hypothesis 6e: The relationship between expertise and performance potential will be moderated by open-to-experience. For members with high open-to-experience, expertise and performance potential are more strongly positively related than for those with low open-to-experience.

Need for Power

Need for power (nPower) is a critical driver of members to champion a high-status position in a social environment (Barrick, Stewart, & Piotrowski, 1992; Hogan & Shelton, 1997). Having necessary abilities for teamwork is not sufficient because members must effectively channel their effort into acquiring certain positions in social contexts (Barrick et al., 2002). Studies have demonstrated that members with high nPower are likely to occupy power-related positions (Brown & Miller, 2000; Cornelius, & Lane, 1984; Jenkins, 1994; McClelland & Burnham, 1976) and emerge as leaders (Stahl, 1983). Team contexts are unique situations where members must define their roles and positions (Bales, 1954), and also provide opportunities where they can dominate others when strategizing how to achieve team goals or determining coordination rhythms and cycles (Ancona & Chong, 1996; Marks et al., 2001). In such contexts, power-oriented members are likely to engage in competition with others to demonstrate their superiority over others (Eisenhardt & Zbaracki, 1992). For example, because there are countless ways to reach the same goal, it is important for members with high nPower to implement an action in a way that satisfies their need or at least they need to keep some of their ideas in the action plan (Locke, 1991; Metiu, 2006). When there are multiple ideas and plans competing with one another, the degree of nPower determines the extent to which members assert their ideas. This type of processes is expected to lead others to allow power-oriented members to exercise more influence over and participation in decision-making.

Hypothesis 7a: The relationship between GMA and performance expectation will be moderated by nPower. For members with high nPower, GMA will be more strongly positively related to performance expectation than for those with low nPower.

Hypothesis 7b: The relationship between Expertise and performance expectation will be *moderated by nPower. For members with high nPower, game experience will be more strongly positively related to performance potential than for those with low nPower*

Hypothesis 7c: The relationship between gender and performance expectation will be moderated by nPower. For female members, nPower will be more strongly positively related to performance expectation than for female participants.

Self-Monitoring

Self-monitoring has been found as a driver to seek out positions that enable people to exert influence over others (Mehra, Kilduff, & Brass, 2001; Snyder, 1984). The importance of self-monitoring lies in interactive process of teamwork. Self-monitoring is defined as the ability to control one's self-presentation, expression of emotion, and non-verbal behavior (Snyder, 1984). In a team context tasks are interdependent, and working effectively with other members enhances success of members' own tasks and assignments. It suggests that members must understand how to interact with others effectively in addition to being productive on their own assignments (Miller, 2001). Self-monitoring members are able to perceive and interpret subtle social cues appropriately and adjust their behaviors based on them. Studies have demonstrated that acting in a way that confirms others' expectation of the role enhances leadership emergence (Day, Schleicher, Unckless, & Hiller, 2002; Judge et al., 2004; Zaccaro, Foti, & Kenny, 1991), other impression types of ratings such as likability and speaking ability (Riggio & Friedman, 1986), and objective as well as subjective outcome variables such as performance rating by supervisor and salary even after controlling for personality and GMA (Ferris, Witt, & Hochwarter, 2001; Hochwarter, Witt, Treadway, & Ferris, 2006). In addition, self-monitoring has been found to be related to positioning in a critical role of workflow (Mehra et al., 2001; Oh & Kliduff, 2008). If a high self-monitor occupies a critical position in a team, this member is more likely to outperform others

(Friedkin, 1993; Mehra et al., 2001).

Hypothesis 8a: The relationship between GMA and performance expectation will be moderated by self-monitoring. For members with high self-monitoring, the relationship between GMA and performance expectation will be more strongly positively related than are those for those with low self-monitoring.

Hypothesis 8b: The relationship between expertise and performance expectation will be moderated by self-monitoring. For members with high self-monitoring, expertise and performance expectation will be more strongly positively related than are those for those with low self-monitoring.

Hypothesis 8c: The relationship between training and performance expectation will be moderated by self-monitoring. For members with high self-monitoring, training and performance expectation will be more strongly positively related than are those for those with low self-monitoring.

Performance Expectation as a Mediator

Constructing social status differences is an interactive process through which members look for and use various cues to construct a status hierarchy within a team. Among various factors, performance expectation is a critical base for social status emergence (French & Raven, 1959). Judge and his colleagues (2004) found that in order to be recognized as a leader, a member must not only possess high cognitive ability but also act as if she possesses high cognitive ability. Members recognized as an expert or potentially high performer are likely to be given special treatments by other members. Members who were told they obtained high scores on a bogus task were less likely accept opinions from others (Wilke et al., 1996), were given more time in their turn while discussing with a group, or were likely to influence group interactions more than those who were told they obtained low scores (Dembo & McAlliffe, 1987). Thus, individual attributes can partially influence the emergence of social status through performance expectation.

Hypothesis 9: Performance expectation partially mediates the effects of individual attributes on status.

Status Differentials and Behavioral Process

A social structure is created partially based on individual differences but also a reciprocal process in which all members belonging to the system consciously or unconsciously support the status hierarchy by allowing higher status members to spend significant amount of time on discussing, be influential, and obtain more rewards than themselves (Dembo & McAuliffe, 1987; Foddy & Smithson, 1996; Frederick, 1952; Gould, 2002; Silver, Cohen, & Crutchfield, 1994; Stolte, 1978; Wilke et al., 1995). Once performance expectations are formed, they dictate the emergent patterns of interactions. Foddy and Smithson (1996) have found that participants are more likely to accept influence from their partner to whom they have high performance expectation than from those to whom they have low performance expectation. Wilke and his colleagues (1995) found the same result that people who think they can perform better than their paired partner are less likely to accept influence than are those who perceive their performance to be lower than their partner's performance. By observing how others treat a given person(s), people further recognize the implicit system underlying status differentials and strengthen it by interacting in a way that confirms it (Stolte, 1978).

In team contexts, this process operates where members develop an informal hierarchy and impose a somewhat loose structure on teams. The emergent status hierarchy provides rules on how to interact with members with various status levels to maintain stability in the social system (Schneider et al., 2005; Schneider, White, & Paul, 1998; West & Anderson, 1996). If status differences emerge in the structure, dyadic linkages between certain members become functional different because every linkage will not carry the same role, and as a result some members become more influential in determining team functioning and performance than others (Ellis et al., 2005; Humphrey et al., 2009; Miller, Hickson, & Wilson, 2008).

Ideally, members should freely interact with one another in order to exchange necessary information and ideas and also coordinate and also equally influence decision-making processes (Kozlowski & Ilgen, 2006; LePine et al., 2008; Mathieu et al., 2008). However, if status differences among members emerge and do not allow this ideal situation to take place, researchers should break the overall team process into different types of dyadic processes. The examination of only the overall team process will not produce accurate estimates of how relationships between members at specific status levels differentially influence team performance (Bondonio, 1998; Casciaro, 1998; Ibarra & Andrews, 1993; Simpson & Borch, 2005), and will introduce measurement error. In order to analyze different types of patterns, one approach researchers can take is to create different status clusters and examine effects of them on team performance: (a) interactions within high status members; (b) interactions within low status members; (c) interaction flows from high to low members; and (d) interaction flow from low to high members (e.g., Alkire, Collum, & Kaswan, 1968). These status clusters need to be carefully examined when researchers analyze data because across the clusters the quality and functionality are likely to be different (Han, 1996). Many studies have demonstrated that specific interaction patterns emerge in formal and informal status clusters. (Alkire et al., 1968; Hoffman & Zaki, 1995).

Status similarity and difference influence the degree to which members interact with others in different clusters and they engage in types of behaviors. Han (1996) surveyed a large retail corporation by using sociometric scales and examined interactions in the organization in terms of organizational levels of employees (senior management, managers, lower-level managers, & administrative and support staff), who interacted with whom, types of behaviors they engaged in (give/receive (GR), investigate/explain (IE), advise/consult (AC), & negotiate/persuade (NP)), and within- and cross-divisional behaviors. He found that employees in the same level interacted most frequently while upward interactions were least likely to occur. Individuals at the lower level engage in GR and IE but not AC and NP while top managers engage in various behaviors. This is understandable in the context of types of tasks that lower-level employees engage in. Lower statuses indicate that those employees engage in day-to-day operations whose boundaries are defined by their managers. Thus, those employees do not need to engage in behaviors such as negotiating or advising in order to perform their tasks. On the other hand, main roles of top managers are to develop future plans and strategies (Kotter, 1982), and middle managers put those into practice (Uyterhoeven, 1989). They need to collectively determine the future direction of the reality and construct the reality together. Many experimental and field studies have demonstrated similar results that the proximity between members on their status influences the strength of interactions (Gould, 2002). Interactions among members with a similar status are more likely to take place than with a different status level (Barnlund & Harland, 1963; Copeland, Reynolds, & Burton, 2008; Friedkin, 1993) while an interaction between members with different status levels decreases as the distance between their statuses increases (Allen & Cohen, 1969; Bales et al., 1951; Frederick, 1952).Therefore, when status differences emerge, examining simply aggregated behavioral scores will provide information that is too coarse. Behavioral flows in each cluster need to be examined separately in order to produce rich information.

Interactions within High Status Members

High status members are more influential in discussion of analyzing environmental cues and reaching a conclusion on strategy than low status members (Greve & Mitsuhashi, 2007). Members of high status are equally influential to each other and expect other high status members to be equally competent and more likely to interact with one another (Barnlund &

Harland, 1963). On the other hand, members of low status expect high status members to be more competent and are likely to accept their influence (Milanovich, Driskell, Stout, & Salas, 1998). In a decision making process, exchanging opinions and interpretations of information are more likely to take place among high status members than those and low status members. Silver et al. (1994) found that in generating ideas, low status members generated data- and facts-type of information rather than their own ideas while high status members tended to engage in idea generation. Low status members tend to censor a type of negative information (Cohen, 1958; Read, 1962; O'Reilly, 1978; O'Reilly & Roberts, 1976) or intervene (Alkire et al., 1968) while communicating to high status members. High status members seek advice and exchange information from each other, and in this process they consolidate their ideas based on information and opinions being exchanged. As a result, core members' preferences are reflected and their interactions are influential in determining the direction of the team and formulating strategy (Eisenhardt & Zbaracki, 1992).

However, power struggles can also take place at the high level and may result in decreased performance at the high level. Because those at the high level are most likely to possess high needs for status and power (Brown & Miller, 2000; Eisenhardt & Zbaracki, 1992; McClelland & Burnham, 1976), conflicts may arise if they do not resolve power struggles. This become a critical issue because performance at the highest level is determined by system-level agreement of strategic priorities (DeChurch & Mesmer-Magnus, in press; Iaquinto & Fredrickson, 1997; Mathieu et al., 2000; Resick et al., in press) and coordination (DeChurch & Marks, 2006; LePine et al., 2008; Marks et al., 2005; Mathieu et al., 2008). With conflicts between powerful members, strategic consensus may not reach and negatively influence team coordination and performance (Li & Hambrick, 2005). Especially, agreement on strategic priorities is a critical condition for effective coordination to take place (Mathieu et al., 2000), and powerful members can exercise more influence over the way members with lower status act upon strategies (Cohen & Zhou, 1991), the lack of behavioral interactions between high status members will bring negative impact to system-level performance.

Interactions Flows between High and Low Status Members

Members with high status must obtain information in a timely manner and change plans and strategies based on them if necessary. Eisenhardt (1989) found that executives who make decisions at fast pace in unstable environments tend to use more real-time information than those who do not. Even though lower status members are not involved in a decision-making process as much as are high status members, actively collecting information from them is crucial because it makes different aspects of the environment salient, which high status members may otherwise undervalue (Hollenbeck et al., 1995). Developing and evaluating alternative plans helps decision-makers to generate better decisions in dynamic environments (Eisenhardt, 1989). High and low status members collectively monitor their progress toward their goal in order to adjust their plans if necessary (Marks et al., 2001), and information obtained from low status members functions and is used as environmental feedback to evaluate the existing plan (Lant & Hewlin, 2002).

Interactions between lower and higher status members are also critical. In order to coordinate well, lower status members must know what high status members are planning. Without interaction with high status members, it will be difficult for low status members to coordinate actions with others. Clarifying information is important for coordination, but this is often more difficult for low status members than for high status members (Alkire et al., 1968). Team cognition studies have demonstrated that what is important is which priorities are being shared and not the amount of shared priorities.

Status controls information flow and types of information that are exchanged laterally, upward, and downward (Alkire et al., 1968; Bales et al., 1951; Cohen, 1958; Dino, Reysen, & Branscombe, 2009 Kelley, 1951; Reed, 1962). If members are functionally different, their unique information must be directed and carried to high status members because information possessed by each member is significantly different (Hollenbeck et al., 1995; Hollenbeck, Ilgen, LePine, Colquitt, & Hedlund, 1998). Unique information that should be incorporated into a strategic decision process but is not attended by high status members is likely to be wasted. Information-exchanging behavior must be expressed by those who possess such unique information to those who need it. However, studies have demonstrated that information does not flow freely across levels (Barnlund & Harland, 1963; Larsen & Hill, 1958). Because high status members tend to control resources that satisfy needs of low stats members such as reward, praise, and promotion chance, and also low status members feel anxious about their position within their groups (Moreland, 1985), lows act cautiously about their behaviors and communications with highs and behave in a way that satisfied their needs (Cohen, 1958; O'Reilly, 1978). As a result, types and quality of communication within and across the same status groups become different (Dion, Reysen, & Branscombe, 2009).

Silver et al. (1994) have found that in generating ideas, low status members generated data- and facts-type of information rather than their own ideas while high status members tended to engage in idea generation. A type of negative information is also censored by low status members (Cohen, 1958; Read, 1962; O'Reilly, 1978; O'Reilly & Roberts, 1976). O'Reilly has found that in his experimental study, participants are less likely to send upwardly in hierarchy information that is unfavorable but important to the receiver than downwardly or laterally while they are more likely to send upwardly information that is favorable and important than downwardly. Bales et al. (1951) found that high status members distributed their opinions and ideas to their members more than they received while low status members expressed agreement, disagreement and request for information than they received.

Cohen (1958) has manipulated position and locomotion to examine how low status members adjust their behaviors in interacting with high status members based on those two factors. He has made two different positions (high & low status) more or less desirable and set up two conditions for locomotion where low status members were made believe that they could move up to the high status in the experimental condition while in the control condition low status members were told that they could not move up. He found that low status and mobile participants made significantly fewer critical comments about upper group than low status but non-mobile participants. If a communication or information-exchange measure is designed to ask team members to evaluate the degree to which general communication is engaged in the team, low status members may give a high numerical value, which may otherwise be lower if the measure asks about specific types of information being engaged in the team from them to higher status members. Thus, in order to accurately measure information flow, a scale must measure whether unique information is passed onto core members who need it to make decisions.

Interactions within Low Status Members

Interactions between low status members will influence team performance through enhancing coordination. Members must not only exchange information to develop alternative strategic plans but also need to interact with one another to understand their team and members. Years of findings in teams literature have shown the direct effects of interaction on team performance by influencing affective, motivational, cognitive, and behavioral processes at the collective level. For example, backup behavior is one of the important factors that influence team performance (Salas, Sims, & Burke, 2005). Porter and his colleagues assert that the legitimacy of need for help affects the likelihood of obtaining such behavior from other members (2003). Understanding what actions others are planning to take and what skills and expertise they have will help them enhance shared mental model and subsequently orchestrate actions when necessary (Kozlowski et al., 1999; Makrs, Sabella, Burke, & Zaccaro, 2002; Pearsall, Ellis, & Bell, 2010; Zhang, Hempel, Han, & Tjosvold, 2007). Therefore, interactions within low status members will bring direct impact to team performance.

Summary of Methodological Features

Table 4 summarizes combinations of three methodological features. Based on the combinations of these three features, there are six different types of method from which researchers can choose in order to obtain team level scores on behavioral process in their study. There are two cells in which there is no type of method available because these combinations are not feasible. The first one (N/A1) is overall, patterned, no individuals, and differentiated, and the other (N/A 2) is overall, patterned, and individuals differentiated. The reason for this is because the metric used in these cells is designed to elicit responses about the perception of overall team behavioral process and not to provide any information about the degree to which each member interacts with every other member. Both cells have the metric employed in which questions about the perception of overall team process are used. This type of metric is only available for averaging when researchers want to capture team-level scores, but does not allow them to apply network analytical approaches to examine team process. In order to obtain information about patterned team process, researchers must use socio-metric types of scales. Otherwise, network-based aggregation techniques are not available. Thus, for these two cells, no type is available. In the following paragraphs, each type will be evaluated and discussed.

Measurement approaches in Type A are most frequently used in the current teams literature. Metrics in this category ask about the perceptions of overall team process, and as a result, no information about patterned behavioral process is assessed. Scores at the team level are represented without adjusting for individual differences. This type is convenient for researchers because, unlike sociometric scales and network analytic techniques, a scale is relatively less cognitively intensive, and no high-level computational equations are involved. They can average scores across all members to represent team-level scores. This is less cognitively cumbersome to respondents because they can use their perception of overall team process. At last, researchers do not consider any individual differences in order to adjust team-level scores.

Type B and C are the current measurement approaches in the network literature. They use a sociometric scale to examine the extent to which each member interacts with or is connected to every other member. Only this metric scale allows them to capture structural properties. Researchers apply the sociometric scale to examine different network indices. However, individual differences are not considered in this type, and this has been one of criticisms in the network literature (Borgatti, Mehra, Brass, & Labianca, 2009).

Currently, researchers do not actively take into account individual differences when representing team-level scores (Type D, E, & F). There are a good number of studies attempting to examine effects of specific members' influence over team process, but they are still limited to examining leaders and non-leaders (Cummings & Cross, 2003, Balkundi et al., 2009, Hofmann & Jones, 2005, LePine et al., 1997) while other researchers have started to focus on other non-leader high profile members by examining criticality of members' roles and expertise (Brass, 1984; Ellis et al., 2003; Humphrey et al., 2009). Because many studies have demonstrated effects of individual differences and attributes on team process (Humphrey et al. 2009, Brass, 1984; Ellis et al., 2005; Mehra et al., 2001), researchers should start developing techniques that assess such attributes in the representation of higher-level techniques.

Type D is the combination of the overall FR, no pattern assessed, but individual differences examined. There are not enough studies that examine effects of team behavioral process on performance that specific members engage in because typically studies that examine specific member effects focus on individual dispositions and skills such coordination and solving skills (Ellis et al., 2005), resources spent (Humphrey et al., 2009), highest or lowest scores of personality traits (Barrick et al., 1998; Bell, 2007), and GMA (LePine et al., 1997).

Type E is the combination of the member-specific FR, patter assessed, and individual differences also assessed. In this type, studies have only focused on leaders as analysis of specific network properties, but researchers have conceptualized some members are more important than others and analyzed effects of them on team performance. Cummings and Cross (2003) examined the effect of leader structural holes on team performance. Unlike structural holes unspecificed in networks of teams, they assessed specific locations of holes. Balkundi et al. (2009) have examined the effect of leader degree centrality, the number of times members sought out advice from their leader, and leader betweeness centrality on team conflict and vitality. Similar to the study by Cummings and Cross, they examined the specific network properties. Mehra et al. (2006) examined leader density, the extent to which leaders are connected to other members in their teams. In these approaches, they applied the sociometric scales and network analytical approaches to examine specific locations of members (individual differences). Thus, they are categorized in Type E.

Type F is the combination of the member-specific FR used, no patterns assessed, and whether individual differences are assessed or not. Techniques in this type are not often employed. Cummings and Cross (2003) applied this technique by asking team members to assess the degree to which they communicated every other member and taking an average score for each team. If researchers are interested in representing team-level scores with no patterns, they always use a traditional team scale with overall FR. This explains why these types are not frequently used in the teams or network literature.

Compatibility between Conceptual and Methodological Features

In the teams literature, the structural features of team process at the construct level have not been considered in the past. However, if the structural features at the construct level emerge, researchers must first examine what behavioral process they attempt to conceptualize because depending on their conceptualization of a type of process, they have to choose a different method to appropriately measure and represent scores at the team level (Harrison & Klein, 2007). This is a typical construct issue so that researchers can never see the conceptual features of the construct. Whether appropriate methodological features should be utilized in a measurement process is strictly based on researchers' theoretical reasoning about the form of the construct.

Table 5 summarizes all 24 combinations of the structural and methodological features and indicates the degree of match between these features. Theoretically, if phenomena emerge with some structured form at the construct level, scales with features most powerful capture structural properties should be employed. Even though there is no literature which has examined this issue of team process, it is possible to assume that this logic is appropriate by drawing on the literature of team cognition. Researchers studying team cognition have long considered and researched appropriateness of types of scales in capturing emergent team cognition (DeChurch & Mesmer-Magnus, 2010; Klimoski & Mohammed, 1994; Hoffman, Shadbolt, Burton, & Klein, 1995; Kellermanns, Walter, Lechner, & Floyd, 2005; Langan-Fox, Code, & Langfield-Smith, 2000; Mohammed et al., 2000; Mohammed, Ferzandi, & Hamilton, 2010; Resick et al., 2010). Mohammed et al. (2000; 2010) have argued that team cognition must be captured through an appropriate structure and elicitation technique because the content and structure are integral properties of team cognition, and both of them must be accurately captured. Under the assumption that these two properties are critical features of team cognition, techniques that can reveal patterns of relationships of team cognition should provide more accurate information than should those that cannot capture such patterns. DeChurch and Mesmer-Magnus (2010) have provided empirical results of team cognition effects on team process and performance to support the notion by Mohammed et al (2010). Using meta-analysis, they have examined effects of forms of team cognition (perceptual and structured) on team process and performance. Structural form is team cognition that was assessed through members' perceptions and structured by some type of a representation technique while perceptual form is the one that is measured through members' perception without any attempt to assess its structure. Results are somewhat ambiguous, but overall patterns of results indicate that structured form of team cognition is more predictive of process and performance than perceptual form. This supports the notion by Mohammed et al. (2010).

Based on this table, the author submits that what determines the effectiveness of measurement techniques to represent team-level scores is the congruence between structural and methodological features. Just because researchers use a highly mathematical technique to assess a behavioral phenomenon at the higher level, it does not mean that they can obtain the best information. They may choose a less computationally demanding technique to obtain the same or similar information. In addition, because, a metric for network analysis is cognitively demanding to respondents, they may provide less accurate information, which results in less accurate team-level scores. If not necessary, researchers should avoid using this type of metrics. In the table, Number 11 and 13 have congruence between conceptual and methodological features. However, as is discussed above, the combinations of the methodological features are not congruent between a sociometric scale and no patterned representation. Unless researchers use a sociometric scale to represent network patterns, this type of scales will not be most effective.

As can be seen, congruence is determined by matches between conceptual and methodological features. If individual influences are expected to emerge in interactions such as certain members holding critical positions (LePine et al., 1997), such differences should be reflected in aggregating process. If researchers take an average of members' scores, in spite of the importance of individual differences, an estimate of the emergent construct of team behavioral process may not be the most accurate. The same rule is applied to the match between whether a construct is conceptualized in a stable or dynamic form and the extent to which patterned relationship interactions are represented at the team level. At last, Types of scale metric dictate whether patterned relationships can be examined. Thus, all combinations of the overall FR and patterned relationship are closed out. The overall FR enables researchers to obtain only non-patterned relationships.

Compatibility in Structural Forms on the Predictor and Outcome Side

Conceptualizing multilevel phenomena in a compilational form is important to further advance the state of the teams research because currently there is incompatibility in structural forms between the predictor and criterion side. Compatibility of structural forms between predictors and criteria is critical. This relationship has been theoretically pointed out and empirical demonstrated by many researchers (Ajzen & Fishbein, 1977, 1980; Harrison, Newman, & Roth, 2006). Originally compatibility theory was proposed by Ajzen and Fishbein to attitudinal constructs, but the author extends this theory to include the compatibility of structural forms between the predictor and outcome side to obtain better estimates of relationships in the population. Outcome variables at the team level are almost always represented in the compilational forms. For example, team performance is not a mere aggregation of individual tasks. On the other hand, behavioral variables at the team level on the predictor side have been represented in the compositional forms (DeChurch & Mesmer-Magnus, 2010). This mismatch underestimates true relationships between behavioral process and team performance variables. Many studies have demonstrated enhanced relationships by aligning predictors and criteria in target, context, width of constructs, and time (Foti & Hauenstein, 2007; Harrison et al., 2006). Harrison et al. (2006) examined a relationship between job attitude and individual effectiveness at the meta-analytic construct level. The job attitude construct was represented by job satisfaction and organizational commitment while they represented the width of the construct on the outcome side by including different numbers of outcome variables. They found higher relationships when the factor on the outcome side was represented with numerous indicators than it was represented at the indicator level or with a few indicators. The stronger relationship between team cognition and performance found by DeChurch and Mesmer-Magnus (2010) than that between behavioral process and performance may be due to the compatible form of team cognition with that of performance. Representing behavioral process variables in compilational forms enhances the accuracy of estimates of relationships between behavioral variables and outcomes at the team level, and advances the teams research.

Based on the compatibility table hypotheses will be discussed. Because this paper makes assumptions that team behavioral process should be conceptualized as patterned with individuals not replaceable. The second column of the table has been used to develop hypotheses. Numbers in the parentheses indicate the numbers in Table 5.

Hypothesis 10: Team process psychometric scores adjusted by status will explain the variance of team performance even after controlling for the standard team process psychometric scores (averaged psychometric scores not adjusted) (testing 6 vs. 2).

Hypothesis 11: Team process density scores (sociometric scores not adjusted and patterned) will explain the variance of team performance even after controlling for the standard team process psychometric scores (testing 10 vs. 2).

Hypothesis 12: Team process density squared scores (not adjusted and patterned) will have an inverted U-shape relationship with team performance even after controlling for the standard team process psychometric scores as well as density scores (not adjusted and patterned) (testing 10 vs. 2).

Hypothesis 13: Team process density scores adjusted by status will explain the variance of team performance even after controlling for the standard team process psychometric scores and non-adjusted density scores (testing 14 vs. 2 & 10).

Hypothesis 14: Team process structural holes scores (not adjusted) will explain the variance of team performance even after controlling for the standard team process psychometric scores (testing 18 vs. 2).

Hypothesis 15: Team process structural holes squared scores will have an inverted U-shape relationship with team performance even after controlling for the standard team process psychometric scores as well as team process structural holes scores (testing 18 vs. 2).

Hypothesis 16: Team process structural holes scores adjusted by status will explain the variance of team performance even after controlling for team process structural hole scores unadjusted More specifically, structural holes of high profile members will account for the additional variance after controlling for the standard team process psychometric and the overall structural holes scores (testing 22 vs. 2).

<u>Team vs. Multiteam System Context</u>

Multiteam systems (MTSs) have recently attracted attention from teams researchers. MTSs are defined as a system of more than two teams that work interdependently toward the system level goal (Mathieu, Marks, & Zaccaro, 2001). Teams researchers assert that its theoretical focus is more suited for understanding complex phenomena of collective actions

(DeChurch & Zaccaro, 2010). A mere increase in the number of members creates complex team process. Research programs using a single-team theoretical lens may not produce thorough understanding of complex team phenomena even if initially a project is designed to require single team action (Davidson et al., 2010). A large team breaks into multiple teams for many different reasons such as overlap of members' roles and functions (Davidson et al., 2010), increased complexity of coordination to manage (DeChurch & Marks, 2006), or process loss (Steiner, 1972). Thus, differentiating teams from MTSs is beneficial for teams researchers to advance team science.

MTSs are characterized with a hierarchy of goals and inherently consist of complex as well as simple processes that independently contribute to success of the system- and lower-level goals (Mathieu et al., 2001). One distinguishing character of MTS is this hierarchy of goals. Higher-level goals are not an aggregate of lower-level goals. Teams working toward team-level goals do not necessarily contribute to higher-level goals because of independence of goals. Goals at each level require different coordination of activities across teams. This characteristic lead to the notion that MTS and team processes are theoretically independent and direct effect on the corresponding level of goals. MTS process should have more effect on system-level while team process has more effect on team-level goals because success of system-level goals is significantly determined by the extent to which teams cooperate and coordinate with one another while success of team-level goals is determined by intra-team dynamics (Marks et al., 2005).

The goal of this dissertation is to understand the effect of differential conceptualizations and measures of simple and complex process on team performance. Even though this dissertation is not particularly interested in examining the effect of MTS process on MTS performance, terms "team process" and "MTS process" will be used because processes of MTSs are often more complex than those of teams, and compilational models may be more appropriate. However, the conceptualization and approaches of multilevel measurement developed on this dissertation should be equally applicable to both types of collective processes. For example, a researcher who plans to study teams of six members can conceptualizes team process as no pattern and no individual differences while another researcher who also plans to study teams of six members can conceptualize team process as patterned that should differentiate individual differences. Various factors should be taken into account when researchers conceptualize collective process. Task types (Sundstrom, 1999), environmental factors (Marks et al., 2000), or the number of skills required (Ellis et al., 2005) should all guide researchers to conceptualize the complexity of collective process and determine whether compilational models should be applied. After this point, the term “MTS” is used to refer to complex process while the term “team” is used to refer to simple process.

Practical Importance

Developing measures that appropriate capture team behavioral process is not only critical for advancing a science but also important for practitioners. If a practitioners plans to provide feedback on the quality of teamwork for those whose team process is complex, he has to estimate how complex team process will be and choose an appropriate process measure. If he does not properly evaluate the complexity of team process and choose a psychometric-based measure, he will not obtain an accurate estimate on the quality of teamwork and cannot provide effective feedback that improves teamwork. Thus, if the model developed in this dissertation helps researchers and practitioners to properly evaluate team process and choose a measure, it will not only advance teams science but also have practical utility for practitioners.

CHAPTER II: METHOD

Participants

Seven hundred sixteen participants were recruited from a southeastern university undergraduate psychology research participant pool. There were 390 female participants, and the average age of all the participants was 19 (*SD* = 2.68). A total of 120 multiteam systems participated in this study. Each MTS contained 4 members, arranged into two teams of two members each (See Figure 7). Participants were randomly assigned to different roles. Participants had a choice to receive research credit or 40 dollars. Each experimental session lasted 4-4.5 hours.

Power Analysis

Statistical power is a function of three factors: sample size, alpha, and effect size. In teams research, sample sizes are always an issue due to researchers' theoretical interest focused on the teams level. Because sample sizes are the only factor that researchers have control over, and sample sizes have direct impact on statistical power in multiple regression and moderated multiple regression (Cohen, Cohen, West & Aiken, 2003), ensuring a large MTS sample is critical. Cohen (1992) recommended that power needs to be at least .80, and traditionally in psychology, alpha is set at .05. Effect size used for this calculation was .09, which was obtained from the meta-analysis study on team process by LePine et al (2008). Power analysis calculation yielded 120 MTS-level data points that were required to achieve the power of .80 (Cohen, 1992).

In this dissertation, multicollinearity was a potential issue due to examinations of interaction effects at the individual level as well as new network process indices at the team level. Examinations of moderating relationships require more power (Aguinis, 1995) due to multicollinearity that is likely to occur between two predictors and their product term. Because the product term between predictor A and B contain the same information of its constituent parts, predictor A and B, the overlapping information of the product term leads to an appropriate solution where regression coefficients are unstable, error terms are large, and power decreases (Aguinis, 1995). In addition, five different team process predictors were created based on specific members and tested: (a) the standard team process, (b) process among high profile members, (c) process among low profiles, (d) process among high and low profiles, and (e) process predictor directly multiplied by members' status scores (referred to as status-adjusted score). The standard team process predictor was an average of all members' scores and used as a control predictor because this representation technique has been most often used in teams studies. It was always entered as a control variable into the first block of an equation, and then one of the other four predictors was entered. Because the process predictors b, c, d, and e contained the same information from the standard process as well, there was a potential risk of creating multicollinearity.

Analyses examining moderating effects were the cases where statistical power was most likely to suffer. However, concerns about multicollienarity seem not to be warranted (Cronbach, 1987). He asserted that the loss of statistical power is attributed to (a) the increased number of predictors and (b) little contribution by product terms. Because the number of predictors has direct impact on the likelihood of statistical power (Aguinis, 1995), the power calculations were conducted using the appropriate numbers of predictors that would likely be entered in regression equations. In addition, centering of predictors will be used to alleviate the effect of multicollinearity on regression solutions (Aguinis, 1995). Based on Cronbach's findings (1987), ensuring a large enough sample size seems to provide a solution to the multicollinearity issue. Thus, the final sample size of 120 MTSs was sufficient to reach appropriate statistical power.

MTS Simulation

A real-time strategy game, World in Conflict, was used to create the MTS simulation environment. Each MTS was composed of two teams (US & UN team) with two sub-team each (a two-member-team & a single-member-team) (See Figure 7). The two teams were assigned to different regions in the game so that they might not physically interact with each other but had to be divisionally interdependent through information and resources (e.g., Hollenbeck et al., 2002). Within each team, two sub-teams were functionally interdependent because each team could neutralize only certain types of enemy units. Within two-member teams, members were also functionally interdependent. There were two types of user units in the game: the ground unit was equipped with IED, and the air unit was equipped with missiles. Members played their unit in order to search command points which gave them specific information about the game. Because these command points were located only on the ground, the user playing the helicopter could not enter it and obtain information. They could only search the locations of command points and relay the information to the ground unit user. Information was randomly distributed throughout the entire game region. When members could obtain information useful for themselves and for members in the other division, they could choose to relay the information to members in the other division or might not have done so.

The goal of the mission was to safely move convoys across the map. There were three types of convoys: (a) leading convoys which traveled through both of the divisional sections, (b) US team convoys which traveled through only the US section of the map, and (c) UN team convoys which traveled through only the UN section of the map. These convoys were attacked if members did not neutralize enemy units in sections through which they traveled. In order to safely move the convoys, members had collect information regarding where the enemy units could be potentially located, exchange the information with one another, and neutralize them if necessary.

Three members of each team were located in a single room. Because each team was composed of two independent sub-teams, two members in the same team were seated closely to each other, but a single-member team participant seated in a work station which was physically separated by large metal cabinets from the other two members. They had 21-inchi screens in front of them and used key boards and mice to work on surveys and play the simulation game. Members communicated with one another within and across the teams through a chatting system and microphone-equipped headsets by selecting a specific member to whom they would want to talk. While communication through the headsets cost resources per talk, the chatting system was cost-free, and members chatted with other members without being charged with any resources. They could communicate with only one member at each time.

Procedure

Eight participants arrived in a main meeting room in each session. Then, six of them were randomly chosen by lottery and assigned to different roles. Those six members were directed to the designated work stations where they started the first set of questionnaires. After they completed the questionnaires, they watched a 20-minute stream of seven videos on their computer which were designed to (a) provide information about the basic MTS structure and the locations of teams in the region, (b) indicate the goals and mission, and (c) enhance their identity with their subteam, team, and MTS. In these videos, participants were given background stories of their subteam, team, and MTS and the goals of the mission.

After the videos, three members in each division were directed to a separate room for their interactive training. In this training, trained undergraduate students used a 28 inch screen to explain all the necessary functions that participants had to learn in order to effectively perform their responsibilities in the experiment. The training program for undergraduate student experimenters had three components: (a) they played the game in order to become thoroughly familiar with all the game and unit functions, (b) received sessions about how to train participants, and (c) shadow other experienced experimenters when they ran sessions. Participants were provided with a binder that contains all the necessary information for playing the game as well as their unit function. Participants brought the binder back to their station so that when they did not know how to use the game console, they went to a specific section in the binder to get the information. At the end of the training session, participants were tested with 12 questions on the training information they received (M = 8.10, SD = 1.91). The trainers went over all the questions with participants and corrected any questions they answered wrong, and discussed all of the questions and participants' choices in order to enforce the correct information about the game.

After the training, participants went through three phases of 5-minute transition and 15-minute action episodes (Marks et al., 2001). They were directed back to their stations after the training and start a 5-minute transition process where they were provided with the mission information and a paper map which they used as a scratch paper. Communication software programs appeared on participants' screens, and only members who used the air units could communicate with any other air unit members within and across the divisions. Those members could open one communication channel at each time so that if they wanted to communicate with multiple members, they had to close a communication channel and open a new channel at each time. In this process, they had to come up with strategies about how to achieve their mission goals and coordinate their own team, division, and MTS members. Once five minutes pass, the game appeared on their monitor, and participants started playing it for 15 minutes. This same process repeated two more times over the course of an experimental session.

Apparatus

Each individual workstation required the use of a high performance PC (currently a Dell Optiplex, with RAM and video card upgrades), widescreen 21 inch monitor, and a noise reducing headset. The group meeting area required a PC and a 28 inch monitor to allow for the presentation of briefing and training information to participants. The simulation control center required the use of three high performance PCs to allow the scenario to run, automate virtual team members and teams, and collect real-time data from each participant. To allow for the communication between the workstations and servers, all of the PCs were networked through the building infrastructure due to their distribution across rooms. A real time tactics game, World in Conflict, will be used (Sierra Entertainment, 1997) as a testbed.

Measures

Gender was self-reported by participants. For gender, male was coded as 0 and female was coded as 1.

Expertise. Expertise was measured by a 5-point single-item scale with 1 being "Only once or twice in the last 5 years" and 5 being "Daily." The item asked "How frequently do you play video games?"

Personality. Personality was measured using a 20-item short version of the International Personality Item Pool (IPIP) 5-point Likert scale by Donnellan, Oswald, Baird, and Lucas (2006). They examined psychometric properties of their scale by conducting two separate studies with college student samples. They examined the factor structure of the five factor model and their criterion validities with self-esteem, behavioral inhibition scale, and behavioral approach system. Their scale demonstrated patterns of results with those criteria similar to those produced by the more established personality scale. This 20-item scale seems to be more ideal than the original 50-item scale because it helps reduce participants' cognitive load. An example item is "I am the life of the party." Cronbach's alphas were .83, .72, .73, .58, and .71 for extraversion, agreement, conscientiousness, neuroticism, and openness, respectively.

Cognitive ability. GMA was measured through self-reported GPA and SAT or ACT scores. The author conducted a pilot study to examine the extent to which self-reported GPA and SAT/ACT could be used as a composite estimate of GMA. Nineteen college students at a southern east university were asked to report GPA and either SAT or ACT scores and take a sample 11-item LSAT test. SAT and ACT scores were converted to compatible scores. When LSAT scores were regressed onto GPA and SAT/ACT scores, 75.5 percent of the total variance in LSAT was accounted for by these two types of self-reported scores. Thus, we decided to use self-reported GPA and SAT/ACT scores as an estimate of participants' GMA. For participants who had never taken SAT or ACT, their scores were substituted with the SAT average scores of students who typically applied for the university.

Self-monitoring. Self-monitoring was measured using the 17-item scale developed by Snyder and Gangestad (1986) with True-False responses. There are a few self-monitoring scales, and the 18-item scale is more stable than the other forms (Day, Schleicher, Unckless, & Hiller, 2002). This scale is as psychometrically sound as the original form by Snyder (1974). The total number of True responses indicates the extent to which participants engage in self-monitoring. An example item is "I find it hard to imitate the behavior of other people."

Need for Power. NPower was measured using a measure by Steers and Braunstein (1976). They developed the Manifest Needs Questionnaire, which is composed of 20 items, each five questions of which represent each of four facets of the needs construct (need for achievement, affiliation, autonomy, and dominance). They examined psychometric properties of the scale through three studies and found (a) discriminant validity among the dimensions as well as (b) their scale and a more established scale, and (c) criterion validity with theoretically relevant outcomes. An example question is "I seek an active role in the leadership of a group." In this study, Cronbach's alpha for this scale was was .72.

The following constructs (expertise, influence, & status) were measured by peer rating. Because having these traits is socially valued, self-reported measures are likely to be inflated due to social desirability (Bunderson, 2003; Hambrick, 1981). Information provided by peers has been accepted as a more reliable estimate of perceived influence, power, and expertise within a team than has self-reported information (Bunderson, 2003). In the following scales, each member rated every other member in their team on three constructs.

Performance Expectation. This construct was measured with a single item on a 5-point Likert scale (1 = Not at All & 5 = To a Very Great Extent) by Bunderson (2003). This item asks “To what extent does ________ on your team have knowledge and expertise about the team’s mission tasks?”

Status. This construct was measured with a single item drawn from Anderson, Srivastava, Beer, Spataro, and Chatman (2006); responses were made on a 5-point Likert scale ranging from 1 being “Not at All” to 5 being “To a Very Great Extent”. This scale was designed to evaluate the extent to which other members felt the social standing of the target member. Because status and influence were related concepts, this scale had been chosen to evaluate status from the team members’ perspective while information on the influence variable will be provided by self-reports. They found high internal consistency of their scale. This item asks “To what extent did ______ have status within the group?”

Team process was measured by two types of scales: a psychometric and sociometric scale. Based on Marks et al.’s typology (2001), action and interpersonal process were measured by a psychometric 5-point Likert scale with 9 items each. This scale has been used in various studies and demonstrated psychologically-sound properties (DeChurch & Marks, 2006; Marks et al., 2005; Mathieu, Gilson, & Ruddy, 2006). An example item is “To what extent did each taskforce member make needed adjustments to the initial plan?” Cronbach’s alpha for this scale was .90. The sociometric scale with two questions, cooperation and backup, was used to ask members to evaluate the extent to which they engage in the processes with every other member. An example question is “To what extent did each taskforce member coordinate the activities between one another?”

Outcome variable. Team and MTS performance indices were objectively measured and derived from the game. These constructs were captured by the number of zones the convoy moved. The numbers of zones the US and UN convoys moved represented team-level performance; the number of zones the leading convoys moved represented MTS performance.

Control variables. In this study, there were several control variables (role, communication shock, trust shock, and gender) that might introduce irrelevant variance into the outcomes. Communication and trust shock were manipulations conducted for a separate study. In the communication shock, communication was either centralized or decentralized such that it either matched what was ideal for the task or not. In the trust shock, participants were provided manipulated attitudinal information which would impact the level of trust between divisions. In the control condition, every team trusted each other while in the experimental condition, the divisions did not trust each other. Female number is the number of female participants in a team.

Obtaining Network Indices of Team Process and Communication

In order to obtain density and structural holes network indices, the following approaches were taken. The average strength of connections across members was evaluated as the density index (Reagans et al., 2004).

$$\text{Density Score} = \sum_{i=1}^{N_k} \sum_{j=1}^{N_k} \frac{Z_{ij}}{\max(Z_{iq}) * N_k(N_k - 1)} \quad (1)$$

Where Z_{ij} is the degree to which member *i* is connected to member *j*, max (Z_{iq}) is the strongest tie member *i* has to any member in the team, N_k is the number of members in team k, $N_k(N_k - 1)$ is the maximum number of ties that can exist in team k. This index removes individual differences in preference of reporting high numbers. Scores range from 0, no relationship existing in the team, to 1, all members are connected to every single other member.

Structural hole scores were calculated based on the following equations developed by Burt (1992).

$$P_{iq} = \frac{Z_{\text{iq}} + Z_{\text{qi}}}{\left[\sum_j (Z_{\text{ij}} + Z_{\text{ji}})\right]} \tag{2}$$

$$M_{jq} = \frac{Z_{\text{jq}} + Z_{\text{qj}}}{Max\ (Z_{\text{jk}} + Z_{\text{kj}})} \tag{3}$$

$$\text{Effect size} = \sum_j [1 - \sum_q (P_{iq} * M_{jq})] \tag{4}$$

Subscriptions i, q, j, and k indicate Member *i*, *q*, *j*, and *k*. Z indicates the degree to which an interaction take places. Hence, Z_{iq} represents the extent to which Member *i* interacts with Member *q* while Z_{qi} represents the extent to which Member *q* interacts with Member *j*. In these equations, ties are considered as directional because it is possible that amounts of interactions members engage in vary in every pair and members may not reciprocate to each other. P_{iq} is an aggregated relational information of all ties for Member *i*, and represents the extent to which the directional interaction between Member *i* and *q* is proportional to the sum of all directional interactions which Member *i* engages in with every other member within the team. M_{jq} conceptually implies an aggregated relational information on the degree to which ties Member *q* have with Member *j* are important to

Member *j*. This index represents the extent to which the directional interaction between Member *j* and *q* is proportional to the highest directional interaction among all the directional interactions Member *j* engages in with everyone within the team. The effect size indicates the extent to which Member *i* has redundant connections within the team. This effect size index is further divided by the number of members in order to obtain structural hole scores that range from 0 to 1.

<u>Representing Different Indices of Team Process and Conducting Analyses</u>

When teams researchers estimate the effect of team process on performance, they tend to obtain scores on the overall team process and do not consider whether it should be broken into different types of processes. In order to create status adjustments on behavioral process scores, two approaches were taken: a) multiplying each member's action process score by their status or influence score; b) classifying members' scores into attribute-based clusters. The underlying logic for each approach is different. The first approach implies that interactions among higher status members are always more pivotal, and should be more highly weighted than interactions among are interactions among members lower in status. Thus, if this logic is correct, adjusted scores are calculated based on a linear combination of members' status and action process scores. However, if the second approach is correct, the implied logic states that interactions among members differing in status or influence are qualitatively different. Thus, a linear combination should not be applied, but action process scores that take place in different attribute-based clusters should uniquely contribute to MTS performance. Because these representations of action process have not been conducted in the past, in this dissertation, both of the approaches were employed and tested.

<u>Multiplying Team Process Scores with Status Scores</u>

The goal of this dissertation is to compare and contrast different measurement techniques (Table 4: Type A to Type F). There are six indices that researchers can obtain.

Type A is a combination of the overall frame of reference, no individuals differentiated, and no pattern. This index will be represented by averaging all members' scores which are obtained with a traditional psychological measure. Type B is a combination of the member-specific referent, no individuals differentiated, and pattern. This category was represented by social network indices. Thus, network density and structural holes were calculated and used as predictors. Type C is a combination of the member-specific frame of reference, no individuals differentiated, and no pattern. This was represented by team process density scores. Type D is a combination of the overall frame of reference, individuals differentiated, and no pattern. This index was represented by first categorizing team processes of every pair of members based on status differential categories, and then averaging all members' team process scores which were obtained with a psychometric measure for each status differential category.

The other technique employed to represent indices in this category was to multiply members' perception of action process by their status scores. Type E is a combination of the member-specific frame of reference, individuals differentiated, and pattern. In the past, researchers calculated leaders' structural holes (e.g., Balkundi et al., 2009). This paper calculated structural holes of high-profile members of MTSs (Balkundi et al., 2007). Members with status scores above the median and outside the CI were selected, and their structural holes were calculated. The second method employed was to multiply every directed interaction with members' status scores. In this technique, let S indicate status, and again subscriptions indicate different members.

$$P_{iq} = \frac{Z_{\mathrm{iq}*}S_i + Z_{\mathrm{qi}*}S_q}{\left[\sum_j \left(Z_{\mathrm{ij}*}S_i + Z_{\mathrm{ji}*}S_q\right)\right]} \quad (5)$$

$$M_{jq} = \frac{Z_{\mathrm{jq}*}S_j + Z_{\mathrm{qj}*}S_q}{Max\ (Z_{\mathrm{jk}*}S_j + Z_{\mathrm{kj}*}S_k)} \tag{6}$$

$$\text{Effect size} = \sum_j \sum_q (P_{iq} * \ M_{jq}) \tag{7}$$

The original equations are adjusted by each member's status, and this has been made based on that notion that interactions engaged by higher status members are more important (Dembo & McAuliffe, 1987; Foddy & Smithson, 1996; Frederick, 1952; Gould, 2002; Silver, Cohen, Crutchfield, 1994; Wilke et al., 1995). In this case, the equation for the effect size was not adjusted and indicates the extent to which members have redundant interactions. Thus, interpretation of this index becomes opposite from that of structural holes.

Finally, Type F is a combination of the member-specific frame of reference, individuals differentiated, and no pattern. This index was represented by first categorizing team processes of every pair of members based on status differential categories, and second averaging all members' team process scores which are obtained with a sociometric scale for each status differential category. The second technique is to multiply density scores by members' scores based on the similar implications for the adjustment for structural holes above. Every member's interaction was multiplied by his/her status score, and those members' interaction scores were summed and divided by the max number of interactions within the team.

Calculating Status Differential Categories

In order to calculate status differential categories of team process, median scores were calculated based on the mean scores of MTSs, and confidence intervals were calculated using alpha of .05. Sometimes, median splits are employed, but there are issues associated with the median split approach (e.g., reduction of statistical power, Aiken & West, 1991). One critical issue is that researchers may not be certain whether a difference between an above-average score and below-average score, both close enough to the mean, is meaningful. In order to avoid the issue, the standard error was calculated and used to create the medium category. Thus, five types of relations were created as follows. The High-High (HH) category was made if two scores were above the median and outside the confidence interval (CI) with alpha of .05. The High-Medium (HM) category was made if two scores were above the median, and one score is outside the CI but the other score was inside the CI. The High-Low (HL) category was made if one score was above the median and outside the CI while the other score was below the median and outside the CI. The Medium-Medium (MM) category was made if both scores were inside the CI. At last, the Low-Low (LL) category was made if both scores were below the median and outside the CI.

Hypothesis Testing and Analysis Plans

Table 7 summarizes all the hypotheses and planned tests. All of the hypotheses were tested using, linear mixed model (Peugh & Enders, 2005; West, Welch, & Galecki, 2007), multiple regression (Cohen et al., 2003) and mediation test (Barron & Kenny, 1986).

Although no predictors at the team level were hypothesized to influence the emergence of performance expectation, linear mixed model was used to test the individual-level hypotheses. Because of the violation of independent data, information from members embedded within the same teams was likely to be similar to one another (Hofman, 1997). As a result, parameter estimate scores would have been biased if the ordinary least squares technique had been used. In order to overcome this issue and obtain precise estimates, linear mixed model was used.

In testing Hypotheses 4 to 9, linear mixed model with interaction terms was used. Status was regressed onto (a) control variables, (b) the centered constituent parts of a moderator (predictor A & B), and the product term of the constituent parts. In order to assess the moderator effect, incremental validity of the moderator, were examined through F tests for change statistics and ΔR^2.

For those hypotheses that did not require the examination of moderated relationships, team performance outcomes were regressed onto the standard team process psychometric score first, and then onto other types of team process scores that were obtained by a sociometric scale and represented by social network approach. In order to assess incremental validity of social network indices, F tests for change statistics and ΔR^2 were examined.

CHAPTER III: RESULTS

Table 8 summarizes intraclass correlation (ICC) 1 and 2 (James, 1982), as well as within-group inter-rater agreement (R_{wg}: James et al., 1984; LeBreton, James, & Lindell, 2005). The majority of variables in this study were measured at the individual level, and then had to be aggregated to the team as well as taskforce level. Statistical justification for aggregation of the variables was necessary (Jones & James, 1979; Kozlowski & Klein, 2000). Inter-rater reliability and agreement indices provide information for researchers to make a decision on whether or not to aggregate individual items to the collective level. ICC and R_{wg} are widely employed for justification of aggregating variables to higher levels (LeBreton & Senter, 2008; Bliese, 2000). ICC indicates the ratio of between-group variance to total variance (McGraw & Wong, 1996) while R_{wg} represents "agreement via a proportional reduction in error variance" (LeBreton et al., 2005, p. 129) by subtracting from 1 the proportion of the observed variance on a variable to the expected variance when there is a complete lack of agreement (James et al., 1984).

The majority of ICC1 and ICC2 values indicated that status, performance potential, and influence of members measured at Time 1 and 2 were significantly influenced by team- as well as taskforce-level variables. This suggests the violation of the independence of data, and higher-level variables need to be controlled for when individual-level outcomes are examined (Kenny & La Voie, 1985).

R_{wg} indices suggest low agreement on members' perceptions of others' status, performance potential, and influence over a course of their interactions (LeBreton & Senter, 2008). It indicates that composite scores of these variables contain substantial amount of error, which may potentially lead to Type II error if results fail to reject the null hypotheseis. Thus, extra caution needs to be taken when results are interpreted.

Due to the violation of independence of data, and the ICC results, linear mixed model analysis seemed appropriate for testing any relationships embedded in the MTS context. In these hypotheses, individual-level dependent variables were assumed to be influenced by individual dispositions.

Examining the Emergence of Performance Expectation and Status

Table 9 summarizes means, standard deviations, and correlations of individual attribute variables. Influence and status were exceptionally highly correlated ($r = .82$, $p < .01$) so that they were combined together and labeled as status. Many correlations were statistically significant due to a large sample size even though their strengths were relatively small. Surprisingly, personality variables were not correlated with one another.

Table 10 summarizes linear mixed model results indicating which individual attributes gave rise to performance expectation and status at time 1. Hypotheses 1a to 3b stated that gender, GMA, and expertise were likely to be related to performance expectation. Role, communication shock, trust shock, the interaction between communication and trust shock, and female number were controlled in analysis. Among many variables, gender was significantly, positively related to performance expectation, ($\beta = .09$, $p < .05$). This indicates that female participants were more likely to be perceived high on PE than were male participants. Even though the coefficient for gender was statistically significant, Hypothesis 1a was not supported because it was hypothesized that male participants would be more likely to receive high scores on performance potential than would females. The regression results showed that the other predictors did not have statistically significant effects on the outcomes. Thus, Hypotheses 1a to 3b were not supported.

Table 11 summarizes linear mixed model results in which performance expectation time 2 was first regressed onto the five personality variables and their interaction effects with gender, expertise, and GMA. Hypotheses 1a to 3b were further examined based on relationships of gender, GMA and expertise with PE time 2. However, the result for the basic model showed that none was statistically significant. Thus, Hypotheses 1a to 3b were not supported at time 2.

The mixed model analyses of the personality interaction model examined Hypotheses 5a to 5d. These hypotheses posited that personality variables would significantly interact with gender to influence PE. The results for this model showed that personality variables statistically significantly interacted with gender. Even after controlling for PE and status time1, conscientiousness and open-to-experience statistically significantly interacted with gender (β = -.10, $p < .01$; β = .14, $p < .05$, respectively). Figure 8 shows that among male participants, there was a positive relationship between PE and conscientiousness, but this pattern was different for female participants. Among females, as conscientiousness went up, the PE score went down. For the interaction between gender and open to experience, there was a positive relationship between PE and open to experience among male participants while there seemed to be no relationship for female participants (See Figure 9). Thus, even though there were significant interactions found between two personality variables and gender, Hypotheses 5a to 5b were not supported. I discuss these interactions in the discussion section.

Hypotheses 6a to 6d stated that personality would significantly interact with expertise to influence performance expectation. The result for the expertise interaction model showed that personality variables statistically significantly interacted with expertise. There was a statistically significant interaction effect between agreeableness and expertise (β = -.06, $p < .01$). Among participants low on expertise, PE increased as agreeableness increased. However, among participants high on expertise, PE significantly decreased as agreeableness increased (See Figure 10). There was a statistically significant interaction effect found between openness and expertise (β = -.03, $p < .05$). Among participants low on expertise, there seemed to be no relationship between PE and openness, but this relationship became negative among those high on expertise (See Figure 11). Even though the results showed statistically significant interactions, they failed to support the specific patterns of the hypotheses. Hence, Hypotheses 6a to 6d were not supported.

Hypotheses 7a to 7c and 8a to 8c stated that need for power and self-monitoring would interact with GMA, expertise, and gender to influence performance expectation. Linear mixed models were conducted to examine these hypotheses. Performance expectation time 2 was regressed onto first the control variables, second gender, expertise, and GMA, and third self-monitoring, and need for power. However, none of hypotheses from 7a to 7c came out to be statistically significant. Additionally, interaction terms of self-monitoring and need for power with gender, expertise, and GMA were created and examined. However, the interaction terms were not statistically significant either. Thus, Hypotheses 8a to 8c were not supported.

Hypothesis 9 stated that performance expectation mediates the effect of individual variables on status. Table 12 summarizes linear mixed models that tested whether performance expectation T2 mediated the relationships between predictors and interactions and status time 2. Status and performance expectation T1 were used as control variables. First, Table 9 showed that there was a significant correlation between status and performance expectation T2 ($r = .71$, $p < .05$). In order to test the mediation effect of performance expectation on status, status T2 was regressed onto performance expectation T2 after all the predictors. Results for the gender model showed that the interaction effect between gender and open-to-experience on status disappears after performance expectation T2 was entered into the equation while the interaction effect between gender and extraversion did not. In addition, for the GMA model, the interaction effect between GMA and open-to-experience disappeared after performance expectation T2 was entered into the equation.

Table 13 provides further support for the mediation effect of PE T2 on status. The coefficient for the interaction effect between expertise and self-monitoring became marginally significant after PE T2 was entered into the equation. Thus, these results partially support the mediation effect of PE T2 on status.

Examining the Effect of Status-based Adjustment on Enhancing the Predictive Validity of Action Process

Hypothesis 10 stated that team process psychometric scores adjusted by status would explain the variance of team performance even after controlling for the standard team process psychometric scores. This hypothesis tests #6 against #2 in Table 5. This hypothesis was examined by two approaches. The first one was status classification approaches where the overall action process was broken into different scores by member status. The second approach was multiplication of the action process scores by members' status scores. Results of both approaches appear in Table 14 and 15.

Table 14 summarizes correlations of status-classified action process scores with the outcome. Because the numbers of different status members varied across teams, degrees of freedom varied as well across correlations. There were four notable patterns in this table. The first one was that the standard action process variable was more strongly related to middle status members' perceptions of action process (AP) ($r = .72$, $p < .01$) than were the other two status-classified APs. The strength of the relationship between this standard AP and AP scores of high or low status members were half as strong as that of the relationship with the middle members' perception ($r = .38$, $p < .01$; $r = .37$, $p < .01$, respectively). Second, these AP scores were differentially related to MTS performance. The standard action process and middle status members' perceptions of AP were not statistically significantly related to MTS performance, whereas high and middle status members' perceptions of AP were more strongly related to MTS performance than were the other types of APs ($r = .18$, $p < .10$; $r = .23$, $p < .05$, respectively). At last, interestingly, the three different status members' perceptions of AP were not correlated with one another, indicating that they did not agree on how to evaluate the quality of AP. At last, the status-classification approach seemed to work better than did the status multiplication approach. MTS AP adjusted status was not correlated to MTS performance (r = .13, *n.s.*) while high and low status members' perceptions of AP were related to the performance (r = .18, p < .10; r = .23, p < .05, respectively).

Table 15 summarizes regression analysis results for MTS performance. Even though the correlation table suggests low correlations among three status-classified members' perceptions of AP, regression analysis provides further insight regarding varying weights of coefficients of these variables with the outcome variables. One cautionary note is that degrees of freedom had tremendously gone down from 117 to 63 due to low status members' perceptions of AP for which only a small number of data points are available. Thus, two separate analyses based on two approaches and degrees of freedom were conducted.

The regression results indicated that action process adjusted by members' status was not predictive of MTS performance, but the result for the status class model showed that the regression coefficient of high status members' perception of AP was statistically marginally significant (β = .22, p < .10). Adding members' perceptions of AP separated into different status classes added extra eight percent of the MTS performance variance to the predictive power of the model even though it was not significant (ΔR^2 = .08, p > .10). This was potentially due to the small sample size. In terms of hypothesis testing, even though it was a relatively large unique variance of MTS performance explained by the stats-class-based team process, hypothesis 10 was not supported.

<u>Examining the Effect of Density Type Indices on Performance Variables</u>

Table 16 summarizes means, standard deviations, and correlations of different types of density scores. This table contains two different approaches to create different density scores: the first one was based on multiplication of density scores by members' status; the second one was based on status classifications of density scores. There were a couple of notable points in this table. First, the correlations between MTS coordination and backup density scores and between MTS coordination and backup density status-adjusted scores were exceptionally high (r = .90, p < .01 & r = .95, p < .01, respectively). Hence, these variables were combined together and named as MTS Process Density. The other thing was that status was exceptionally highly correlated to both MTS process adjusted score (r = .92, p < .01 & r = .88, p < .01, respectively). However, the adjusted density score and status were not combined together in order to test hypotheses.

Hypothesis 11 stated that MTS process psychometric scores adjusted by status would explain the variance of MTS performance even after controlling for the standard team process psychometric scores. This hypothesis compared #10 against #2 in Table 5. Table 16 contains correlations of status-classified density scores and the outcome variable. Because there were only small numbers of data available for certain density variables (e.g., n = 6, r = .45 for low-to-low-member density variable and MTS performance), it was not feasible to conduct regression analysis. Inspection of the correlations between different types of density scores and the outcome variable suggested that status-classified density scores might potentially provide information unique from that provided by the standard AP. HM, HL, and ML status density variables were statistically significantly correlated to MTS performance, but MM status density variable was not related. Because of low correlations of HM status density variable with HL and ML status density score (r = .12, *n.s.*, & r = .07, *n.s.*, respectively), it was plausible that HL status density variable provided unique information from those provided by the other two. Unfortunately, an estimation on the way these status-classified density variables were related to the outcome was limited. Therefore, Hypothesis 11 was not supported.

Table 17 summarizes two different model evaluations in order to demonstrate the effect of MTS coordination density Time 3 on MTS performance Time 3. The following models were created to test (a) the incremental validity of the density score, (b) density square score, and (c) the status-adjusted density score for MTS performance T3 over and beyond what was accounted for by the standard psychometric score and basic control variables. All the target variables were measured and collected at the third time except for the control variables. The results further showed that MTS process density variable statistically significantly increased the predictive power of the regression model for MTS performance (Δ $R^2 = .06$, $p < .05$, $\beta = .32$, $p < .05$), suggesting support for Hypothesis 11.

Hypothesis 12 stated that MTS process density scores would have an inverted U-shaped relationship with MTS performance. In order to test this hypothesis, MTS performance was regressed onto the MTS process density square score after controlling for the control variable, standard team process psychometric score, and MTS process density score after controlling for the control variable, standard team process psychometric score, and MTS process density score. The results showed that the density square variable did not add any unique variance to what was already accounted for by the model after controlling for the density score. Hence, Hypothesis 12 was not supported (See Figure 15).

The status-adjusted density model tests Hypothesis 13 stating that the status-adjusted coordination density would significantly, positively predict MTS performance even after controlling for the status score and density score. This hypothesis compared #14 against #2 and 10 in Table 5. Status-Adjusted Density models summarizes regression results in which the effect of MTS process status-adjusted density variable on MTS performance T3 was examined. The result for Model 1 and 2 showed that the status-adjusted process density adds 6 percent of the unique MTS performance variance to what was already explained by the previous model, and the adjusted density score was statistically significantly predictive of the performance ($\Delta R^2 = .06$, $p < .05$, $\beta = .79$, $p < .01$). Therefore, this supports Hypothesis 12.

Testing the Effect of Structural Holes of Coordination and Backup Behavior on MTS Performance Variables

In the following analyses, the effect of MTS process structural holes variable on MTS performance was examined. Tables 18 and 19 were prepared to test Hypothesis 14 to 16 that MTS process structural holes would be likely to positively predict MTS performance even after controlling for the psychometric action process. The correlations between MTS structural holes coordination and backup score and between MTS SH coordination and backup status-adjusted score were exceptionally high ($r = .84$, $p < .01$ & $r = 1.00$, $p < .05$, respectively). Therefore, these were averaged to create MTS process SH and status-adjusted SH variable. A pattern of correlations among status T2, process SH T3, process SH T3 adjusted, MTS performance T2 and 3 was similar to that among the density scores and MTS performance outcomes. A high correlation between status T2 and process SH T3 adjusted was observed ($r = .87$, $p < .01$) while process SH T3 adjusted was more strongly related to MTS performance T3 ($r = .28$, $p < .01$) than was status T2 ($r = .17$, $p < .10$). However, process SH T3 was not related to MTS performance T3 ($r = .17$, *n.s.*).

Table 19 shows regression analysis results to examine the effect of process structural holes on MTS performance and Hypothesis 14 that process structural holes scores would explain the variance of team performance even after controlling for the standard team process psychometric scores (testing 18 vs. 2 in Table 5). The result for the structural holes model demonstrated that the coordination structural hole did not significantly predict MTS performance, indicating that the hypothesis was not supported. Because MTS performance T2 was controlled for in this analysis, it was suspected that the effect of the unadjusted SH on MTS performance T3 disappeared.

Hypothesis 15 stated that process structural holes would have an inverted U-shape relationship with MTS performance. This hypothesis was tested by squaring the process structural holes variable and regressing MTS performance onto it after controlling for the standard action process variable and the process structural holes variable. Figure 16 summarizes scatter plots of the relationship between MTS process structural holes and performance. However, the result for this model shows that the process structural holes square variable does not have a statistically significant relationship with MTS performance. Thus, this hypothesis is not supported.

Hypothesis 16 stated that the process structural holes variable adjusted by status would be predictive of MTS performance even after controlling for the psychometric action process variable and the unadjusted coordination density. The result for this model showed that the status-adjusted process SH variable was statistically significantly, positively predictive of MTS performance T3 even after controlling for MTS performance T2, the standard action process and process structural holes variable, and status ($\Delta R^2 = .10$, $p < .01$, $\beta = .74$, $p < .01$). Thus, Hypothesis 16 was supported.

<u>Examining the Effect of Team-Level Process Density Variables on Team Performance</u>

In order to examine Hypotheses 17 to 20, linear mixed model was conducted due to the violation of independence of data. Teams were embedded in MTSs, and their performance variables were correlated.

Table 20 summarizes means, standard deviations, and correlations of team-level process variables and outcome. The strengths of relationships between the process variables and the outcome seemed weaker than those at the MTS level.

Table 21 summarizes results of regression analyses examining the effect of team structural holes on team performance. Hypotheses 17 and 18 stated that team process obtained by a psychometric scale would be more predictive of team performance even after controlling for team process density variable and status-adjusted density variable. Team performance T3 was regressed onto a) communication and trust shock, team performance T2, and team average status T3; b) team process density in the second block; c) and the standard team process variable. The coefficients for the team process density and standard team process variable were not statistically significant. Thus, Hypothesis 17 was not supported. Then, team performance T3 was regressed onto the status-adjusted team process density variable after the team process density variable, and then the standard team process variable. The results showed that none of them was significant. Hence, Hypothesis 18 was not supported either.

Hypothesis 19 and 20 stated that team process obtained by psychometric scale would be more predictive of team performance even after controlling for team process structural holes variables. The results showed that the team process structural holes variable was significantly predictive of team performance (β = -23.90, p < .01), but the standard team process variable was not predictive of the outcome. Additionally, the standard team process variable was not predictive of performance even after controlling for the team process SH status-adjusted variable. Thus, neither hypothesis was supported.

Supplemental analyses were conducted (presented in Tables 22 & 23) in order to evaluate the incremental validity of current behavioral process indicators after controlling for two representative variables for the affect and cognition construct, transactive memory system (TMS) and social identity. First, MTS performance was regressed onto the standard psychometric process measure, TMS, and social identity, and then either the density or structural holes index. Results demonstrate that significant effects of density-type indices and structural holes on MTS performance even after controlling for the TMS and identity variables (density before status-adjusted density entered: β = .30, p < .05, R^2 = .04; status-adjusted density: β = .33, p < .05, R^2 = .04; & status-adjusted structural holes: β = .40, p < .01, R^2 = .04).

CHAPTER IV: DISCUSSION

Summary

The goals of this dissertation were three-fold: (a) to elaborate a new conceptualization of team behavioral process in terms of compilational multilevel constructs (i.e., where process is a patterned construct shaped by status differentials) ; (b) to examine the predictors of status within teams and multiteam systems, and (c) to evaluate the effectiveness of various indices of team behavioral process based on the compatibility between the compilational conceptualization and operationalization of behavioral process. Measurement has always been one of main issues in advancing an area of scientific inquiry (Kuhn, 1996). In the science of team effectiveness, the systems-based approach to teams stands as the dominant paradigm in the area; this paradigm posits that transformation processes are the essential linking mechanism between inputs like leadership and member composition to outcomes like goal accomplishment and viability.

Despite this theoretical assertion, the measurement of team processes has been a key factor limiting the advancement of the science of team effectiveness. A meta-analytic study by DeChurch and Mesmer-Magnus (2010) indirectly highlights this issue. DeChurch and Mesmer-Magnus found that team cognition, a team emergent state, was more predictive of team performance than were behavioral processes. Conceptually, we would not expect this result because behavioral processes are more proximal predictors of performance than is team cognition (Cannon-Bowers et al., 1993). This raises the question: why aren't team behavioral processes more predictive of team performance than emergent states? I posit that misalignment in the conceptualization and operationalization of team processes as compilational multilevel constructs is one important explanation (Ajzen & Fishbein, 1977). This dissertation will advance a new approach for the conceptualization, measurement, and representation of team and multiteam processes.

This dissertation asserts that congruence between conceptualization and representation of team process must be achieved. Drawing on both psychology and social network literatures, it has developed theoretical structural features of team process (patterns & individual) differences that researchers must pay attention to. It has identified that there are three methodological features of representation to best capture team process differentially conceptualized (frame of reference, patterning representation, and status differentiation). The degree of match between these features of conceptualization and representation of team process determines the degree to which researchers obtain appropriate estimations of behavioral phenomena in team process.

In order to test this assertion, a sample of 240 teams constituting 120 MTSs interacted to conduct a laboratory-based humanitarian aid task. Individual traits, perceptions of one another, team processes, and team outcomes were all measured variables. Hypotheses were developed at the individual level as well as MTS/team level and designed to examine how individual differences contributed to the emergence of performance expectation and status, and the effect of differentially-represented team process indices on team performance after controlling for the standard process variable most often used in teams research were tested.

Results of analyses of individual attributes demonstrated that personality, expertise, and gender contributed to the emergence of performance expectation and status. However, the emergences took place in a complex manner. Individual attributes interacted with one another to influence performance expectation and status. Results of analyses of MTS and team process demonstrated that social network indices and indices adjusted by status significantly were much predictive of performance than were the standard team process variable. Therefore, these findings support the congruence of compilational conceptualization and representation of MTS process.

Evaluation of Hypotheses

The model, the status emergence model, delineated relationships between individual attributes and status. Status can be distinguished as either formal or informal. Formal status arises from tangible sources such as organizational position and financial resources. In contrast, this dissertation focused on informal status, which arises from personal traits, expertise, and abilities (French & Raven, 1959; Judge et al., 2004). Additionally, MTS members had to evaluate the status of their teammates relative to one another based upon relatively little information. Thus, status as evaluated in this study would be expected to be more state-like than trait-like.

Results of multilevel analyses of the model failed to support the hypotheses (See Table 7). Contrary to expectations, gender, cognitive ability, and expertise did not have direct effects on the emergence of status in multiteam systems. These results were surprising given that these attributes have been found to have robust effects on performance expectation and status in prior work (Anderson, John, Keltner, & Kring, 2002; Bunderson, 2003; Cohen & Zhou, 1991; Dembo & McAuliffe, 1987; Wilke et al., 1995).

Although results did not show main effects of the individual attributes on performance expectation, results demonstrate rather unique patterns of interaction effects in unexpected directions. Interaction effects between gender and personality on performance expectation and status show consistent patterns that these outcomes (i.e., performance expectation and status) decrease as personality dimensions (conscientiousness & openness) become stronger among female participants. These results are unexpected based on general findings of the positive effect of conscientiousness on performance (Barrick & Mount, 1993; Barrick et al., 1993; Barrick et al., 2002).

Role congruity theory (Eagley & Karau, 2002) provides insight for the negative relationships between conscientiousness and performance expectation among females. This theory states that the degree to which stereotypical behaviors expected for a group of members is incongruent with behaviors expected for a certain role increases the likelihood that prejudice or discrimination among evaluators against the group will arise (Lyness & Heilman, 2006). Using this theory, Eagley and Karau explain why women have had difficulty getting into leadership positions in organizations for which muscular and male gender-typed behaviors are generally expected. Heilman and her colleagues (2004) demonstrated another disadvantage for women successful at male-dominated jobs. Due to stereotypes, there are two types of behaviors that females should and should not engage in. Even if women are able to overcome the barrier to male-dominated positions and become successful, this implies that they violate behavioral norms because usually these positions require dominant behaviors prescribed to males. As a result, their colleagues like them less even though they perceive them to be successful (Heilman et al., 2004).

Stereotypes exert stronger effects in contexts in which people do not have norms and rules to turn to when evaluating other people's quality than in contexts in which norms and rules are clear and equally strongly exert influence on how they should evaluate others (Eagly & Karau, 1991). When people have time to get to know other members, stereotypes cease to bias the way they evaluate others because people attend more to deep-level attributes such as values (Harrison et al., 2002). However, in situations where people do not have enough opportunities to know others such as in short laboratory experiments, they do not have any other information to rely on to evaluate others. Accordingly, they turn to surface-level attributes such as race and gender as cues to evaluate the quality of social roles other people play and rely on stereotypes to evaluate others.

According to role incongruity theory, new interpretations can be drawn based on these interaction results. Because conscientiousness and openness are positively related to leadership emergence (Judge et al., 2002), females high on these traits may have engaged in behaviors more prescribed for males. However, the task in this study was a military strategy game, a masculine-type game, and might have made salient the expectation of leader masculine behaviors in participants' mental model. If females had engaged in masculine behaviors, not only did incongruity between their gender and stereotypes for leader behaviors take place, but also females were punished because of their violation of gender-typed behaviors.

Sauer (2011) adds another perspective to the findings of this study. He found that task-oriented behaviors a leader engages in make followers perceive him as confident in the beginning of team formation where his status is not consolidated while his participative behaviors make followers perceive him as less confident. Thus, in my study with short-lived teams, female members high on openness were perceived less confident because members might not have had stereotypes that females would be strong leaders. As a result, they might have been perceived to possess less performance potential. However, male members were not perceived this way because their gender was congruent with members' stereotypes regarding who should act as a leader. Therefore, males might have benefitted by being high on openness and did not suffer from the incongruity between behaviors they engaged in and behaviors expected for their gender.

The relationships between personality variables and performance expectation were moderated by expertise. Even though past studies have found positive relationships between personality variables and other outcomes such as leadership for which performance expectation is an essential part (Judge et al., 2002), these personality variables exerted negative effects on performance expectations. These patterns are perplexing, but studies suggest that strong leadership is required in the beginning of the formation of a team (Fiedler, 1964; Sauer, 2011). In the beginning of team formation where a leader has not cemented his informal status, followers perceive the leader as less self-confident if he frequently consults with them (Sauer, 2011). Because this study employed short-lived teams, members might have needed to act assertively in order to be perceived as an expert on tasks. Perhaps, those high on agreeableness and openness may have been perceived as less confident by others. Expertise also played a role in moderating these relationships. As expertise became higher, the more negative the relationships between these two personality variables and performance expectation became. Because expertise was a domain-specific factor (Berger et al., 1977), members expected those who often played video games to play a leadership role. However, because those high on expertise and also high on agreeableness or openness did not act assertively as a leader. Studies have showed that disappointment takes place when the initial expectation exceeds a desired outcome (Kahneman & Trversky, 1979; van Dijk, Zeelenberg, & van der Pligt, 2001). Therefore, members might have been more disappointed at those than others low on expertise and on one of the personality variables.

Unlike its relationship with performance expectation, the relationship between openness and status was positive and moderated by GMA. Interestingly, openness did not have any effect on status acquisition for those high on GMA while it has the strongest, positive effect on status for those one *SD* below on GMA. It is possible that members low on GMA but high on openness might have tried to obtain information from various members and incorporated them into their decision-making process while those high on GMA as well as openness may have talked to others and obtained their opinions and information but acted on their own opinion due to their higher GMA. Wilke et al. (1995) found that people who were told that they obtained higher task score than their partners were less like to accept opinions from them, and those who told that they obtained lower score than their partners were more likely to accept their partners' opinions. Based on their finding, it is plausible that there is a positive relationship between openness and status among low GMA members while openness did not have any effect on the emergence of status among high GMA members.

Gender moderates the relationship between personality and status acquisition. For the relationship between extraversion and status, the pattern was expected. There was a negative relationship among male participants while it was positive among females. This was very surprising especially given that extraversion has been found to have positive effects on status acquisition in social groups as well as work environments (Anderson, John, Keltner, & Kring, 2001; Harms, Roberts, & Wood, 2007). Furthermore, this interaction pattern is different from the one found by Neubert and Tagger (2004) and does not follow role congruity theory (Eagly & Karau, 2002). For male members, being social hurts their status while it benefits status among female members. If directive behaviors were expected for males (Sauer, 2011), being highly social created a mismatch between members' observations and their expectations. However, females had to be social enough to overcome the stereotypical barrier held by others. However, the interaction pattern between openness and gender on status was the same as the one found in the interaction effect between openness and gender on performance expectation. This pattern was in line with role congruity theory (Eagly & Karau, 2002). Additionally, because gender was role congruent, male members benefitted by being open to others' opinions while female members suffered (Lyness & Heilman, 2006).

The status emergence model was mainly constructed based on status characteristic theory (Berger et al., 1972). Even though this study failed to support hypotheses derived from the model, the patterns of the results suggest that SCT influences the emergence of performance expectation and status in a much more complex manner. When Cohen and Zhou (1991) examined the effect of individual attributes on status based on SCT, they only tested the main effects of those variables. Bunderson (2003) also examined main effects of specific status cues on perceived expertise in a team. However, role congruity theory states that the way people evaluate leadership depends on the degree of match between behaviors leaders engage in and stereotypes toward leadership. Sauer (2011) demonstrated that leaders' directive and participative behaviors influence followers' perceptions of leadership differently depending on whether their status is established in their group. Lyness and Heilman (2006) found that performance evaluations are related to an interaction between gender and stereotyped positions. In this study, specific and general status cues completely independently exert effects on the emergence of performance expectation and status, and they can interact with one another to influence the emergence of performance expectation and status. SCT has been established as a theory to guide many studies, and many of them have examined main effects of domain-oriented and diffused cues on performance expectation. In order to further advance the theory, exploration of interaction effects of these cues and interactions of contextual effects with the cues is necessary.

Challenges in Finding Individual Difference Effects on Social Relationships

This study failed to support many of the hypotheses about the role of individual differences in predicting team functioning. This null finding is representative of a general pattern in teams research where overall, the evidence thus far has only weakly linked individual differences to team processes. From a practical standpoint, understanding how to comprise or assemble teams is a critical question. Given that differences in prior experience, personality, ability, and values likely shape the emergent dynamics of the team, the lack of conclusive evidence to expose the nature of these linkages represents a key omission in teams research. There are a number of possible explanations for this lack of evidence.

One possible explanation is that the way in which these relationships are modeled does not afford enough sensitivity to capture the phenomenon. According to network theories, relationships emerge due to not only attributes of the focal person but also relationships that the focal person has with others. Practically speaking, if person A is highly extroverted, her effect on a given team's process is not only dependent on her level of extroversion, but also the level of extroversion of the other members of the team, and the relationships within the team that determine the extent to which this trait will come to shape the team.

For example, a transitive relationship is described as three relationships between A and B, B and C, and A and C. A relationship is likely to emerge between A and C if A trusts B who trusts C (Contractor, Wasserman, & Faust, 2006). It is also possible that social relationships emerge as a result of similarity effects of some attributes between two individuals or effects of dyadic relationships (Contractor et al., 2006; Edwards & Parry, 1993). However teams researchers often try to understand social relationships as a function of direct effects of one's individual attributes on others. Thus, rather than modeling relationships solely based on only one-way attribute effects, researchers should comprehensively evaluate the effects of individual attributes in conjunction with dyadic-, triadic-, and network-level relational configurations on the emergence of social relationships (Robin, Pattison, Kalish, & Lusher, 2007). This is a promising area for future research on teams.

Exponential Random Graph Approach

Researchers in social network have been proposing a new analytical framework called exponential random graph modeling (ERGM). According to the field of social network, this approach is more theoretically aligned with a tie dependence assumption that ties are depend on the emergence of other ties than are traditional analytical techniques such as regression and can be more powerful (Robin et al., 2007). This technique has demonstrated some promising results (Contractor et al., 2006).

However, this approach does not come in without any costs. Each analysis is conducted based on the sample size of each network. Therefore, if this approach is employed in this study, the analysis may not generate accurate parameter values of the attribute effects because of a small sample size of six members. Unlike traditional analytical approaches, this approach cannot take advantage of the overall sample size of, in this case, 720 individuals. Because the large number of parameters will be tested based on a small network, it is very likely that parameter search may not generate stable estimates of coefficients. Thus, unless, the number of parameters can be significantly reduced by modifying the model, the application of this technique to this dissertation is limited.

Testing the Predictive Utility of Team Process Indices

Testing the Compatibility Hypotheses

This study examined the compatibility of the way team process was conceptualized and measured and its incremental validity to team performance over the standard team process psychometric variable. Results of analyses failed to support Hypothesis 10 that the team process psychometric variable adjusted by status was more predictive of team performance than was team process psychometric variable.

The other hypotheses (11 &13) were supported. Team process density and status-adjusted density variables were predictive of team performance even after controlling for the team process psychometric variable. In addition, results also support the hypothesis (16) that team process status-adjusted structural holes were predictive of team performance even after controlling for the team performance psychometric variable and non-adjusted structural holes. The non-adjusted structural holes variable was not predictive of team performance.

These results support some of the compatibility-score predictions of my model (See Table 5). In this study, MTSs were examined, and as a result, I conceptualized MTS process to manifest in complex patterns with individual differences because members had to synchronize their coordination within their own team as well as across teams (Marks et al., 2005). This led to hypotheses that a team process density status-adjusted variable would be more predictive than a team process density variable, and the team process density variable was more predictive than was a team process psychometric variable. A similar pattern of results was found in relationships between structural holes variables and team performance.

The logic for this prediction was that the match in complexity between the conceptualization and operationalization of team processes afforded by status-adjusted patterned scores (i.e., network scores) would enable them to better predict performance, than would the more simplistic psychometric process scores.

In addition to analyses of MTS process effects on performance, effects of team process on performance were examined. Team interaction dynamics were conceptualized as simpler than MTS dynamics due to smaller team size of three members. Hypotheses were set in order that the standard team process variable was most predictive followed by density scores, density status-adjusted score and structural holes score, and at last structural holes status adjusted score. However, only the structural holes were predictive of team performance. The results showed that the higher the structural holes in a team, the lower the team performance would become. Interestingly, in multiteam systems, density scores were strongly predictive of MTS performance, whereas in teams, density scores were not predictive. This suggests that in both teams and multiteam systems, more complex patterned operationalizations of process lead to better predictive ability. The structural holes variable and density variable both reflect structure. However, the structural holes variable captures a more complex pattern. Density reflects the overall saturation of ties in a collective; structural holes reflect the patterned arrangement of those ties such that each member is not redundantly connected to the other two members.

An additional explanation for the effect of structural holes on team performance is that structural holes are a representative triadic-level index while density is a dyadic-level index (Burt, 1992). In this study, teams had three members. Thus, the triadic level index was a more appropriate index than density because it captures the team relationship as whole while density can capture parts of the relationship and then the information has to be to the team level. An additional distinction between density and structural holes can be found among teams whose ties are sparse. In those teams, the structural hole index might evaluate team process in much more detail than would an index of density. These two indices are correlated. There can be much variance in structural holes among teams which have fewer ties, however, as density increases, there is a ceiling on the variance possible in structural holes. As indicated in Table 16, the average density among teams in the current study was moderate, and so there was room for observed variance across teams in structural holes.

These findings further advance the state of teams research that team process is critical for team performance (DeChurch & Mesmer-Magnus, 2010; LePine et al., 2008; Marks et al., 2005; Mathieu et al., 2006) and found that structural features of team process are essential. However, findings that process density was predictive of MTS but not predictive of team performance while non-structural holes became critical for team performance suggest that those structures do not exert simple effects on performance. Rather, structural features might even interact with contents of team process to create different patterns of relationships between process and performance. For example, structural holes of team process (coordination and backup behavior combined) had a negative relationship with performance for the task used in this study. However, Balkundi and his colleagues found (2007) that structural holes had a convex relationship with team performance while Oh and his colleagues (2004) also found a convex relation between density and performance. However, contents of process they examined are different. Balkundi et al. examined friendship while Oh et al. examined advice relationship. other process dimensions might become also important than coordination. Examination of how contents and structural features of process create differential patterns of relationships with performance is needed to further advance teams science.

Status Effects on MTS Performance

Another interesting finding was the positive relationship between average MTS status and performance. Status has been extensively investigated in social psychology and understood as a driving force of social structures (Pfeffer & Moore, 1980; Skvoretz & Fararo, 1996). However, teams researchers have not paid enough attention to this construct. The finding in this dissertation can potentially highlight the utility of status and bring it back into teams research as an important variable.

A potential mechanism that explains the effect of positive status on MTS performance is one's trust to other members regarding performance potential. A type of status evaluated in this study was informal status or social standing in a group based on members' performance. Therefore, average status scores imply that members trust those higher on status for their potential performance. Communication studies have demonstrated that information tends to flow toward high status members (Allen & Cohen, 1969). High status members tend to like one another and share information while low status members do not trust one another and as a result are less likely to communicate or share critical information. Thus, average status scores influence MTS performance by influencing critical process activities among members.

R_{wg} *& Status Scores*

This study has obtained low R_{wg} scores which were below the traditional acceptable cutoff (.70: LeBrenton, & Senter, 2008). Generally, low agreement index indicates that scores should be cautiously aggregated across members, and can result in underestimates of relationships of interest and increase type II error. In this dissertation, communication channels were arbitrarily constrained so that each member could interact only with certain members. The constraints must have limited agreement on their perceptions of other members' statues (Klein et al., 2004). However, the average status score was found to have a positive relationship with MTS performance, and process indices adjusted by status were predictive of MTS performance. These results alleviate some concern regarding type II error, and most likely disagreement on status scores among members impacted the underestimates of the relationships between the process indices and MTS performance.

However, the author questions whether agreement indices have any boundary conditions. Application of agreement indices had been a focal discussion topic in the organizational climate literature, and assumptions about whether or not the members of an organization agree in their perception of an organizational phenomenon have traditionally been based on compositional emergence models (James & Jones, 1979). However, for phenomena which compilational models are more theoretically appropriate, researchers need to question the appropriateness of calculating agreement indices. In essence, if a perception meaningfully exists a pattern of perceptions where agreement is not theoretically specified, then a high agreement index would not be expected. This is likely the case with MTSs. The interaction in MTSs becomes much more localized than in a small team, and so members may not need to interact with every other member, all of which lead to decreasing agreement on emergent psychological phenomena. Additional research is needed to detail the conditions under which agreement indices are more and less appropriate

Theoretical Contribution to Teams Research

The results of this study point out the importance of compatibility between how researchers conceptualize team process and how they measure it. The study contributes to teams science in two ways. First, the way the emergence of team process is conceptualized is critical. In the past, teams researchers have developed various dimensions that define team process (Rousseau, Aube, & Savoie, 2006), but only recently have researchers started paying attention to the patterning of team process (Kozlowski & Kelin, 2000). The lack of theoretical development on the structure of team process hinders advancement on measures because different concepts of team process structure provide a theoretical blueprint of team process which delineates structural features needed to be captured. Unless researchers explicitly conceptualize it, they will not find out what to measure. Thus, my theoretical framework was designed to indicate which theoretical features of team process should be evaluated and help determine in what forms team process would emerge.

Results of analyses at the individual and MTS level together have demonstrated the importance of individual attributes to team functioning. Even though none of the hypotheses of individual attributes was confirmed, supplemental analyses suggest that attributes interact with one another in a complex manner to give rise to the emergence of status. Additionally, although it was not hypothesized, analyses showed that the average status variable was significantly predictive of MTS performance.

Furthermore, results of MTS process effect on MTS performance have shown that status-adjusted network indices explained unique variance of MTS performance even after controlling for non-adjusted network indices. These results indicate that members come to occupy differing informal positions in the MTS to bring differential impacts to the performance. These results are in line with findings by Ellis et al. (2005) that leaders and highly critical members have significantly higher impact on team process and performance than do other regular members. Thus, weighting individuals equally when calculating process indices may not generate an accurate estimate of the process construct. Therefore, attributes should be more carefully treated and even incorporated into team process representations. At last, researchers need to explore how critical attributes emerge in team process and differentiate members' criticality to performance.

This leads to my second contribution: how should team process be measured? It is not beneficial for researchers to always use complex techniques to obtain scores. If they conceptualize simple team process to emerge, they can choose a simple representation technique which generates scores capturing it as well as scores derived from a complex technique. In order to obtain social network indices, researchers submit scores to sophisticated equations. However, unless researchers understand complex mathematical equations, there is a danger of not knowing what mistakes they make or where they make mistakes if this happens. If there are simpler techniques to represent scores to accurately estimate relationships, researchers should turn to them. Therefore, the compatibility between conceptualization and measurement of team process is key to further empirical development in teams research.

Any disparity between researchers' conceptualization and measurement of team process gives rise to multilevel measurement error. Multilevel measurement error is unique in a sense that it emerges at levels higher than the individual level. Structural properties of multilevel constructs become extremely critical when they manifest themselves in networks. As the way researchers measure them deviates from an appropriate measure (e.g., psychometric items used rather than sociometric items), multilevel measurement error becomes an issue. However, in psychology, psychometric theories have been dominant. Not only has conceptualizing higher-level constructs in terms of structural properties been neglected, but also methodology and measurement designed to capture such information have been still foreign. Thus, this paper has introduced the new type of measurement error to call attention for the importance of compatibility between conceptualization and measurement.

In the past, many studies on teams may have underestimated relationships between behavioral process and team performance due to incompatibility between the conceptualization and measurement of team process. When Sundstrom and his colleagues (2000) reviewed team sizes sampled in studies, they found that many studies sampled more than 10 members. It is not a perfect estimate, but as team size goes up, so does complexity of team process because the number of relationships members have to manage exponentially increases. If this is the case, many of these studies should have used social network indices to estimate relationships. This argument is supported by the meta-analytic finding by DeChurch and Mesmer-Magnus (2010) that behavioral process is less predictive of team performance than is team cognition. It is possible that many researchers could not have published or might have decided not to publish papers because they failed to find relations that involved team process or mechanisms part of which behavioral process was essential. Because behavioral processes are conduits through which affect, motivation, and cognition bring impact to team performance, conceptualization and measurement must be integrated into researchers' research practice.

Network Approaches and Individual Attributes

This study has contributed to the social network field by incorporating individual attributes into representations of networks. In psychology, uniqueness of individuals is an essential assumption. Literatures across different areas of psychology have demonstrated that individual differences matter (e.g., Barrick et al., 1998; Bell, 2004). However, neither teams research nor social network has actively incorporated individual difference information directly into the way they represent higher-level phenomena. Employing status differences, one of critical factor underlying social structures, this study differentiates members from one another. More specifically, inputs of higher status members were weighted higher than those of lower status members. Results support the hypotheses that network indices adjusted by status scores have higher impact on MTS performance due to more accurate representations of MTS-level phenomena than those not adjusted by the scores. The results suggest that researchers interested in higher-level relationships must not only think about importance of structural information into their conceptualization but also evaluate whether individuals will be significantly distinctive from one another. Additionally, researchers must explore other ways of incorporate individual differences into representations of higher-order phenomena.

Teams Research and Social Network

Teams researchers have inherited the research tradition from social psychology and group dynamics while social network had come from communication and sociology. There are mutual benefits for both of the fields if they import into their field theories and measurement techniques developed in the other field. For example, relationships teams researchers investigate inherently manifest themselves in networks. Employing network approaches and statistical techniques such as ERGMs (Robins et al., 2007), teams researchers can understand complex team phenomena much more accurately. Researchers in social networks can appreciate many concepts and theories developed in teams research. For example, sometimes the field of social networks is described as mathematically-oriented, and as a result, theoretical development is lagged behind more in this field than it is in teams research. Meanwhile, teams research has advanced theoretical understanding on collective affect, behavior, and cognition. Teams research has developed many dimensions of team process such as elaboration of information, backup behavior, cooperation, information-sharing, and so force, which can be useful for social network research. Thus, both fields can take an advantage of each other by incorporating into their research measurement and theoretical advancement developed in the other field.

Implications for Measurement

Selecting measures most appropriately capturing any phenomena of interest is the foundation for building any science. For many decades, psychometric theory-based measures are most frequently employed among industrial and organizational (I/O) psychologists. However, many relationships that they are interested in investigating are often found to be at higher levels and manifest in networks. Thus, there may have been multilevel measurement error in the field that has made researchers underestimate the relationships in the past. At the same time, the field of social network has been making substantial advancement in analytical techniques and indices to capture network-based phenomena. I/O psychologists, specifically teams researchers, can significantly benefit from network-based representations of multilevel phenomena by employing sociometric items and then applying social network indices. Studies that employed network-based representations of team process have already demonstrated that researchers can understand team phenomena differently (e.g., Bulkundi et al.,2007, Oh et al., 2004). Thus, if researchers are interested in higher-level relationships, it will be beneficial for them to employ psychometric- as well as network-based approaches to obtain indices of multilevel phenomena.

Implications for Practitioners

The same logic that goes to researchers goes to practitioners. They must employ network-based approaches to accurately understand multilevel phenomena. Practitioners who provide professional advices on how to, let's say, enhance team process need to first obtain accurate information regarding the process. If the information is not accurate, subsequently the quality of their services will be diminished. This implication does not just go to practitioners providing advice on team-based situations but also goes to those who manage multiteam systems and other units larger than teams. Relationships at levels higher than the team level become much more complex to understand and capture with psychometric measures because members will not possess accurate perceptions of what is going on in their department. Sociometric items and social network indices will provide much more accurate and detailed information regarding these higher-level relationships. Thus, practitioners also need to carefully examine how complex processes of interest are. Based on their estimation of the complexity of them, they should employ psychometric and also sociometric measurement.

Limitation

There are important limitations that deserve attention. This study employed short-lived teams in a laboratory setting to test hypotheses. Researchers argue that teams go through qualitatively different stages (Kozlowski et al., 1999; Tuckman, 1965). It can be a potential issue for results found in the status emergence model because some social phenomena such as performance expectation and status may require time to fully develop. Harrison and his colleagues (2002) found that deep-level attributes such as personality and values interacted with the level of collaboration to influence the quality of team process. Their results showed that the higher the collaboration, the more effective the deep-level attributes became. In my study, participants had to spend time on learning how to play the game and figuring out what criteria were critical for their performance. They might not have had enough time to interact with their members, and those social phenomena might not have become stable as indicated by the results of the agreement indices. For example, field studies that examined status effect on team dynamics had long-lived teams where members understood a set of important skills, expertise, and knowledge to their job, knew who had those, and was able to produce better estimates of members' status variation (e.g., Bunderson, 2004; Harrison et al., 2002). Unlike other status studies that used simple manipulations or tasks such as which member scored better than others (e.g., Wilke et al., 1995), in my study members had different critical roles to their tasks and had to figure out who had what skills and expertise. In such a complex task, the task duration might not have been enough. If the study had been longer, it might have influenced the relationships found in the status emergent model.

The task employed in this study provides limitation on the extent to which the findings are generalized to other situations. The task in this study requires members to engage in information-sharing and simple integration of different pieces of information to appropriately move the convoy. However, there are other types of tasks that teams must engage in. For example, top management teams engage in information-sharing, negotiation, and decision-making. Research and development teams must engage in higher level of idea and information synthesis to enhance their creativity. Thus, the findings in this study may not be simply generalizable to teams that must engage in other types of tasks.

Motivation is another concern. There was no consequence to participants when they failed to perform in the game. Additionally, they knew their team would disband after the experiment so that they would not worry about their reputation as a good team member. This might have lowered their motivation to stay focused and put effort into the study (Sackett, Zedeck, & Fogli, 1988). Even though some participants had high abilities, if they were not motivated to perform better, they would not put effort into the study (Klehe & Anderson, 2007). While some other members tended to be generally motivated, and even if they did not have high abilities, they might have appeared to possess high abilities during the short time of the experiment. If in this study participants had to face real consequence, relationships between individual attributes and performance expectation and status might have been different.

The other issue is arbitrary constraints imposed on communication structure. Because this study was part of a large project, communication structures were manipulated, and all members in each team did not have enough opportunities to observe and equally interact with every other member. It was possible that members without enough interaction with others turned to general impressions and stereotypes (Feldman, 1981; Lance, LePointe, & Fisicaro, 1994). Without this constraint, participants could have observed members' actual behaviors (DeNisi & Peters, 1996), and their evaluations of other members' performance expectation and status might have converged.

Evaluations of other process dimensions are important. In this study, coordination and back-up behavior were represented differently to obtain indices, and their effects on team performance were examined. However, there are many other process dimensions that are equally important to team performance such as communication, cooperation, and implicit coordination, (Marks et al., 2001; Rico, Sanchez-Manzanares, Gil, & Gibson, 2008; Salas et al., 2005). Like the differential effects found in this and Balkundi et al.'s study (2007), these dimensions may have differential effects on team performance depending on how they are conceptualized and represented to obtain indices. If these dimensions had been examined, patterns of results might have been different at the MTS and team levels of analysis. It is imperative to also extend my model to other process dimensions to examine their effects on team performance.

Conclusion

This dissertation examined the degree to which the compatibility between conceptualization and measurement of team process was important in relation to team performance. Even though individual-level relationships did not come out as expected, the individual model provided me with insights about how performance expectation and status would emerge. Additionally, the incremental validity of network indices non-adjusted and adjusted by status was significant even after controlling for the standard team process variable. Furthermore, network-based and status –adjusted network-based indices were still significantly predictive of MTS performance even after controlling for the affect and cognitive variables. These two findings are central to this dissertation because they first give some insight about why DeChurch and Mesmer-Magnus (2010) found the stronger effect of cognition on collective performance than that of behavioral process; and second, it highlights the importance of the compatibility between the concenptualization and measurement of multilevel constructs.

This dissertation provides evidence that researchers in the future can tremendously benefit by incorporating other representation techniques into their research in addition to traditional representation techniques such as the team average and/or standard deviation. My compatibility table that guides us in evaluating theoretical structural features of team process should be treated as a basic model and needs further expansion of other features that are theoretically critical. In this way, researchers can more appropriately test their models and produce scientific discoveries about teams.

APPENDIX A: FIGURES

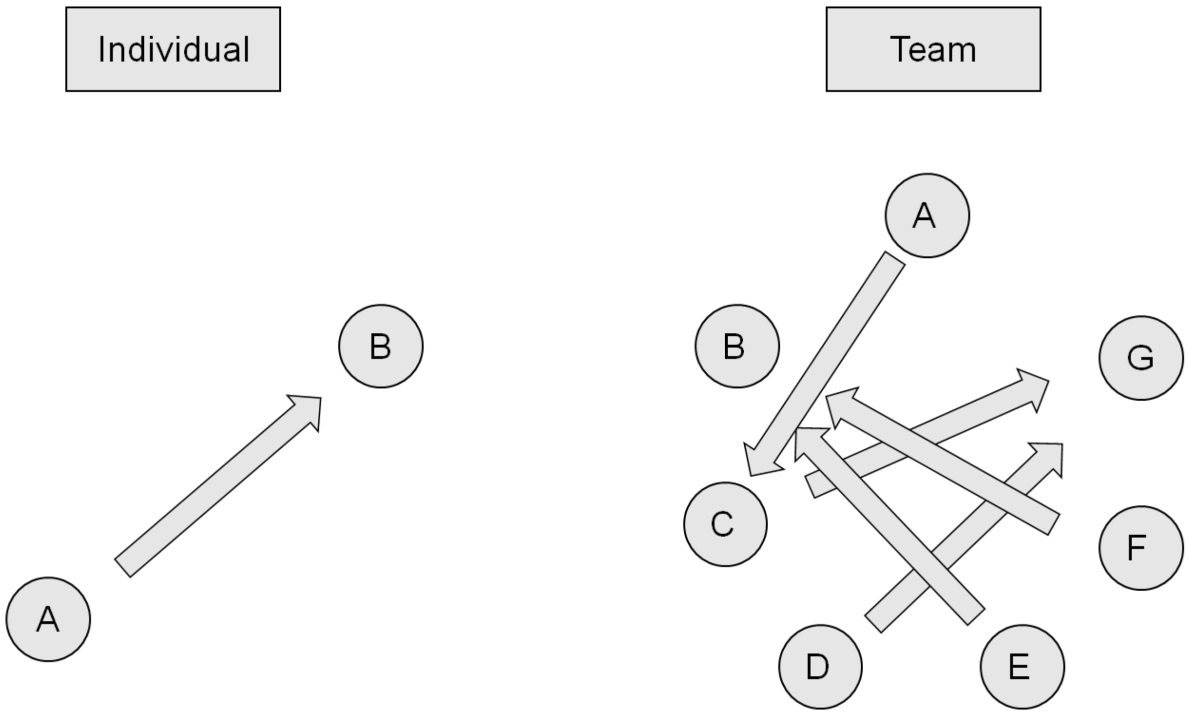


Figure 1: Illustration of Information Exchange Paths at the Individual and Team Level.

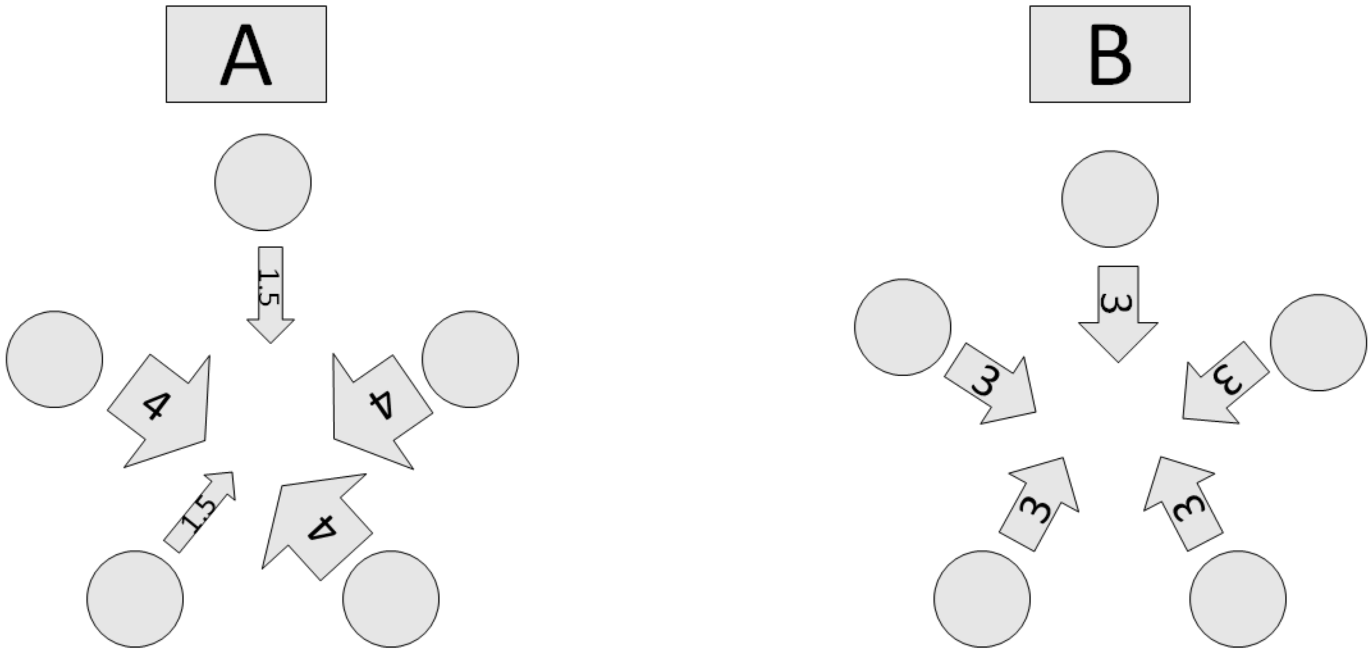


Figure 2: Illustration of the Scoring Issue of Team-Level Communication.

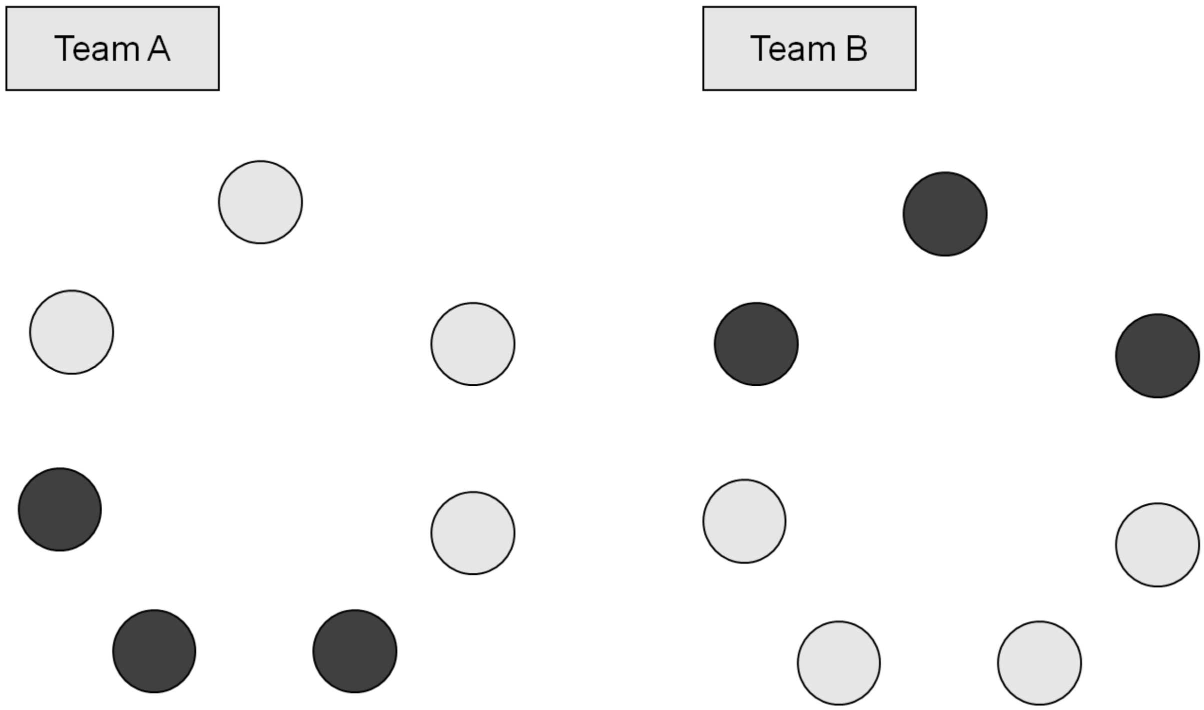


Figure 3: Illustration of Members' Interactions.

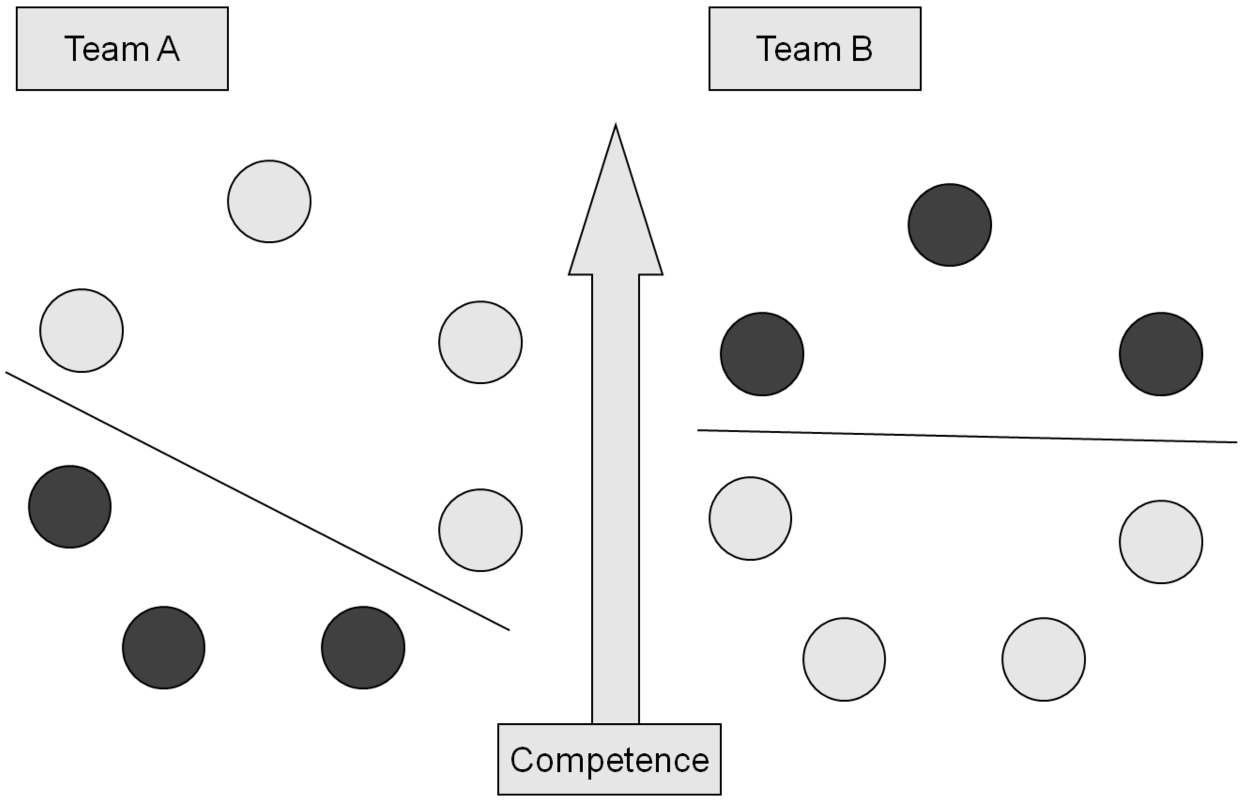


Figure 4: Illustration of Members' Interactions with Competence.

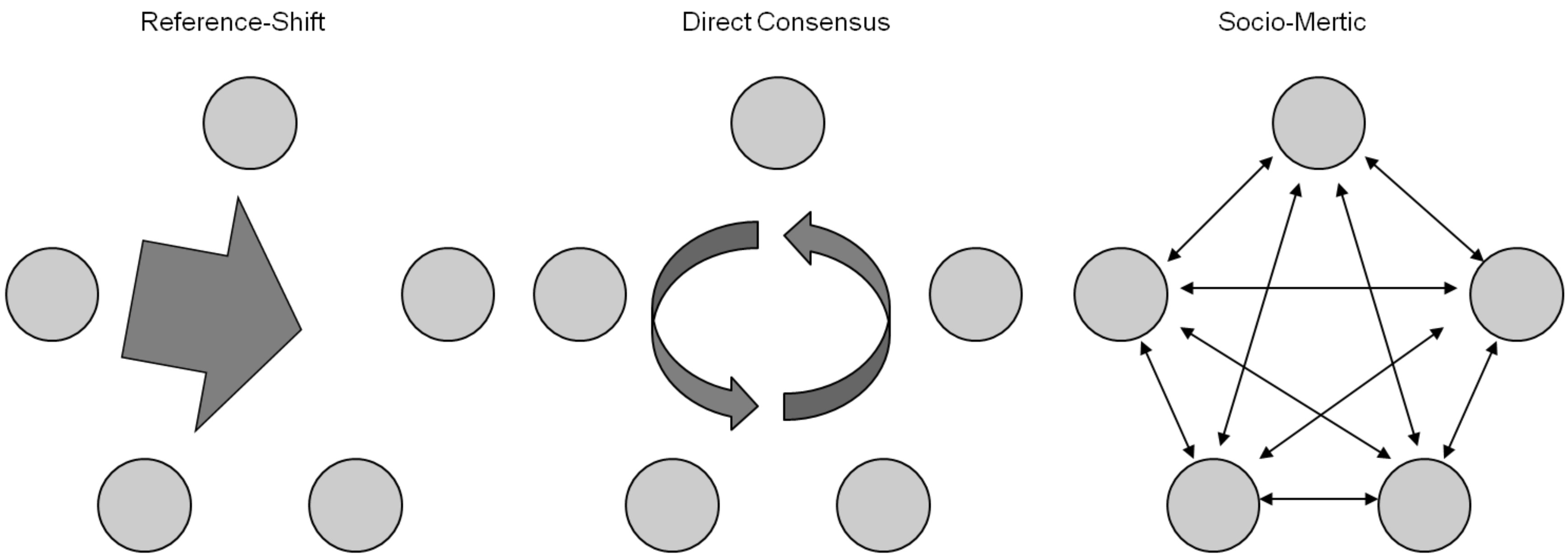
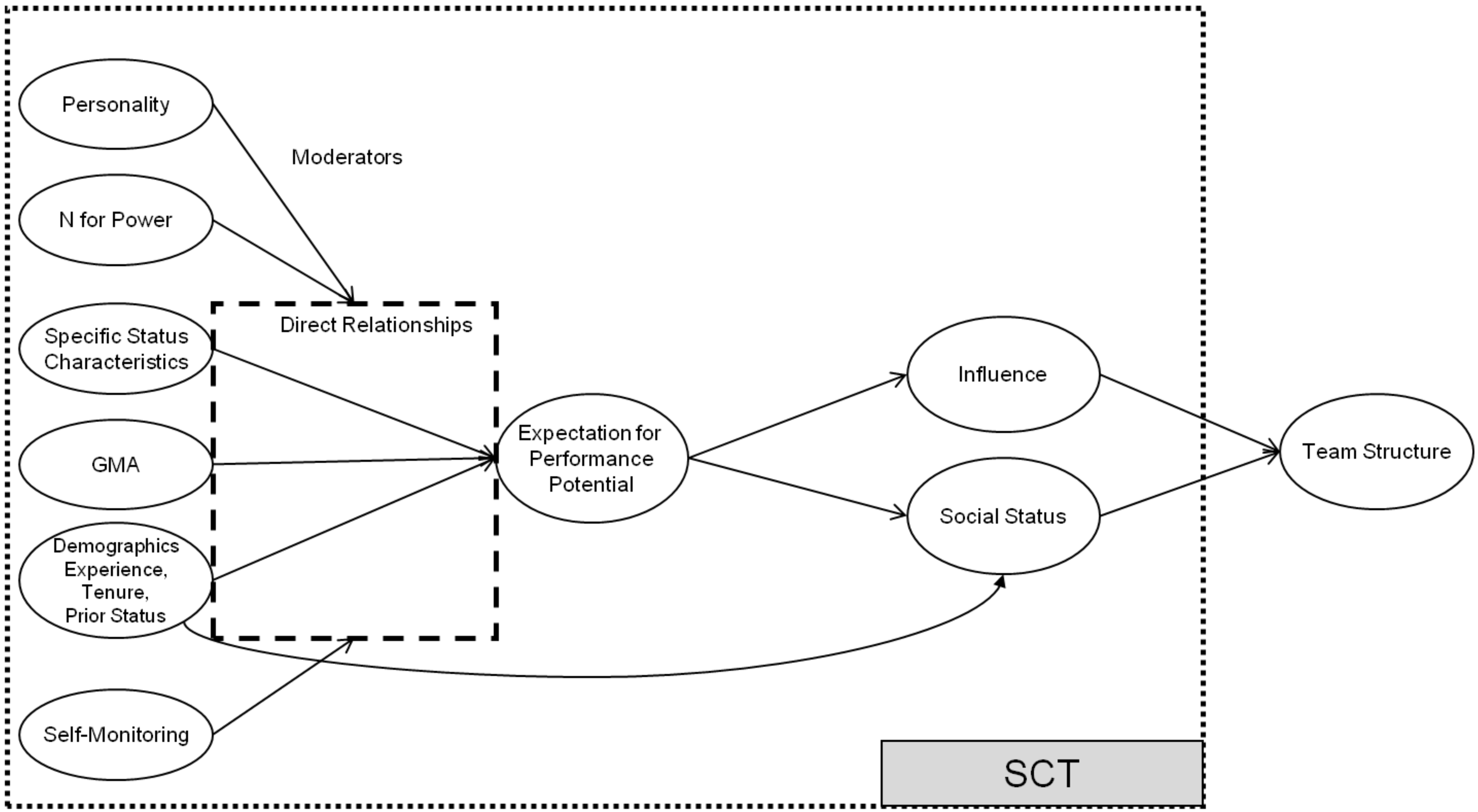


Figure 5: Perceptual Directions across Measurement Models



Note: The box indicates direct relationships. Arrows directed at the box indicate moderating effects.

Figure 6: Status and Influence Acquisition Process.

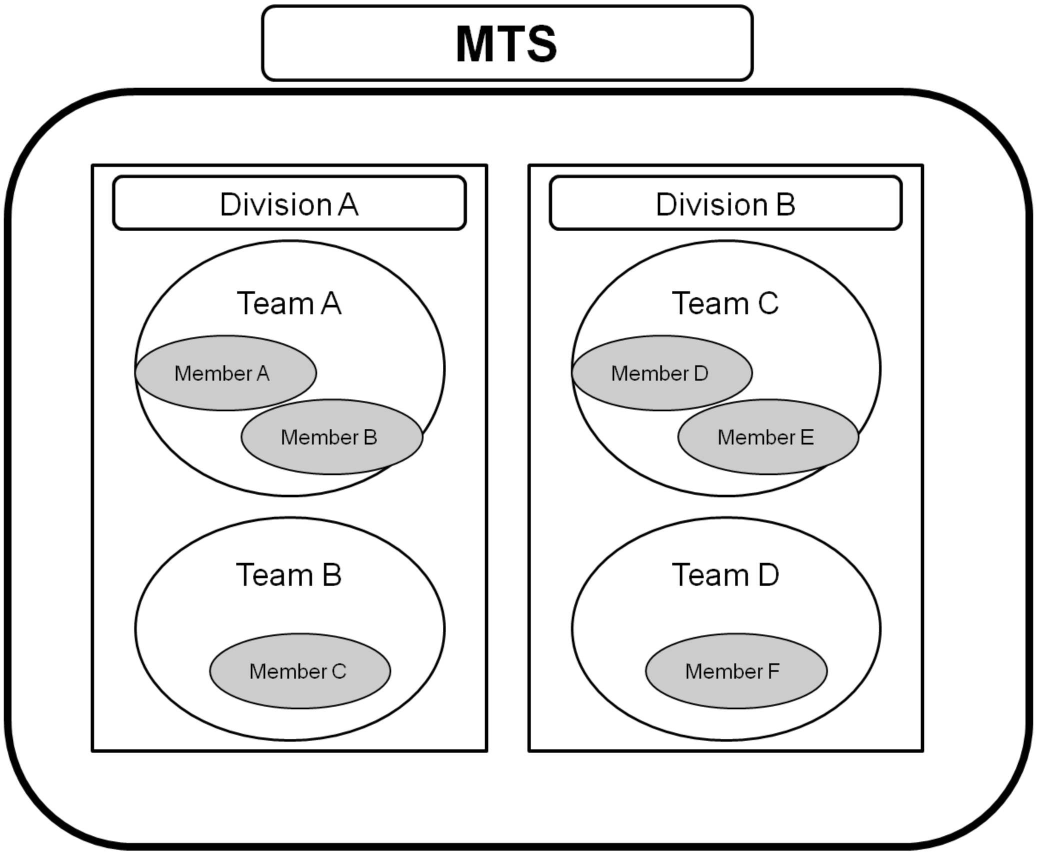


Figure 7: MTS Structural Design

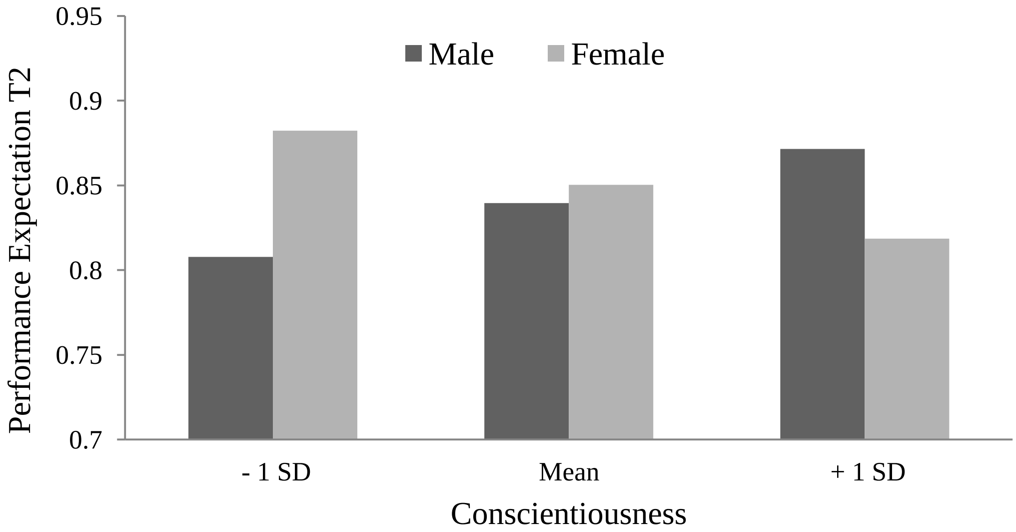


Figure 8: Interaction Effect between Gender and Conscientiousness on Performance Expectation Time 2

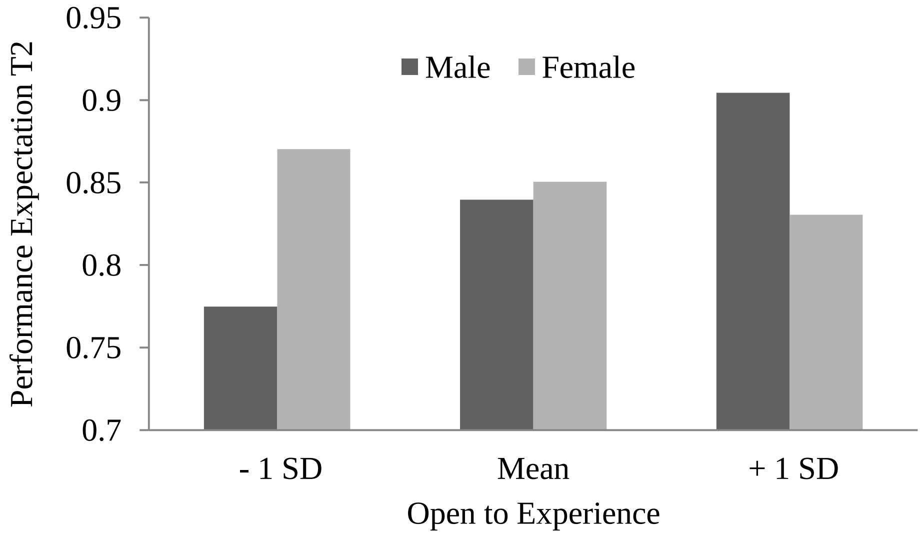


Figure 9: Interaction Effect between Gender and Open-to-Experience on Performance Expectation Time 2

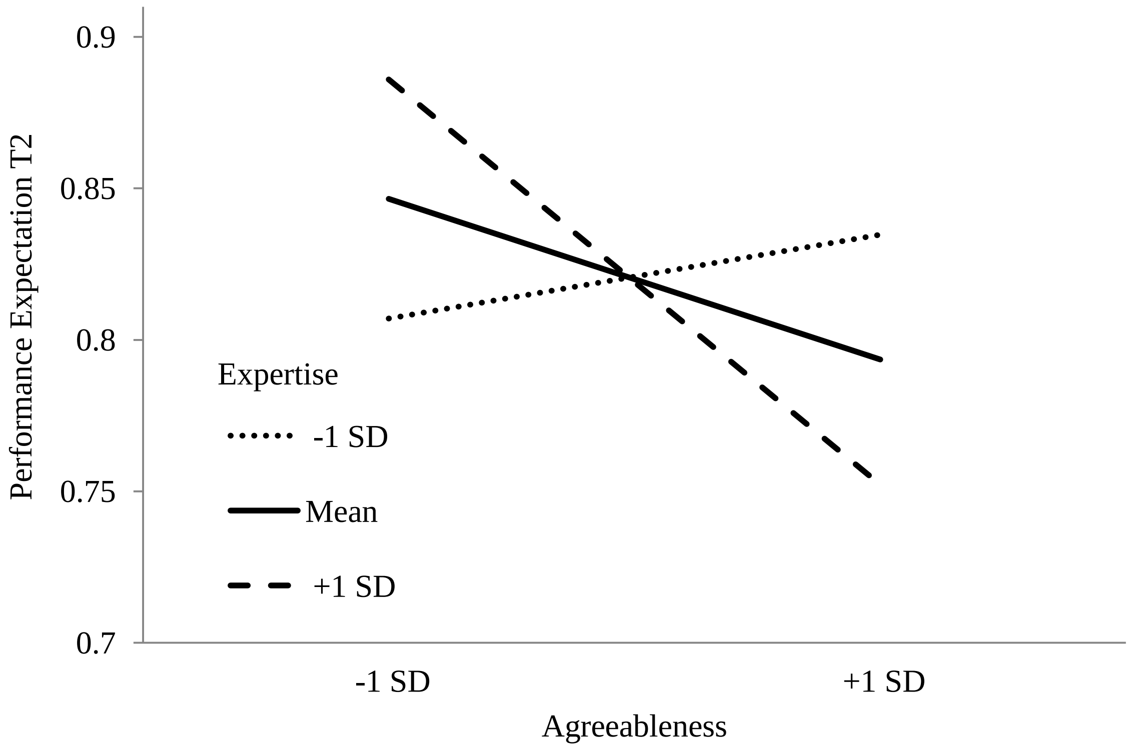


Figure 10: Interaction Effect between Expertise and Agreeableness on Performance Expectation Time 2

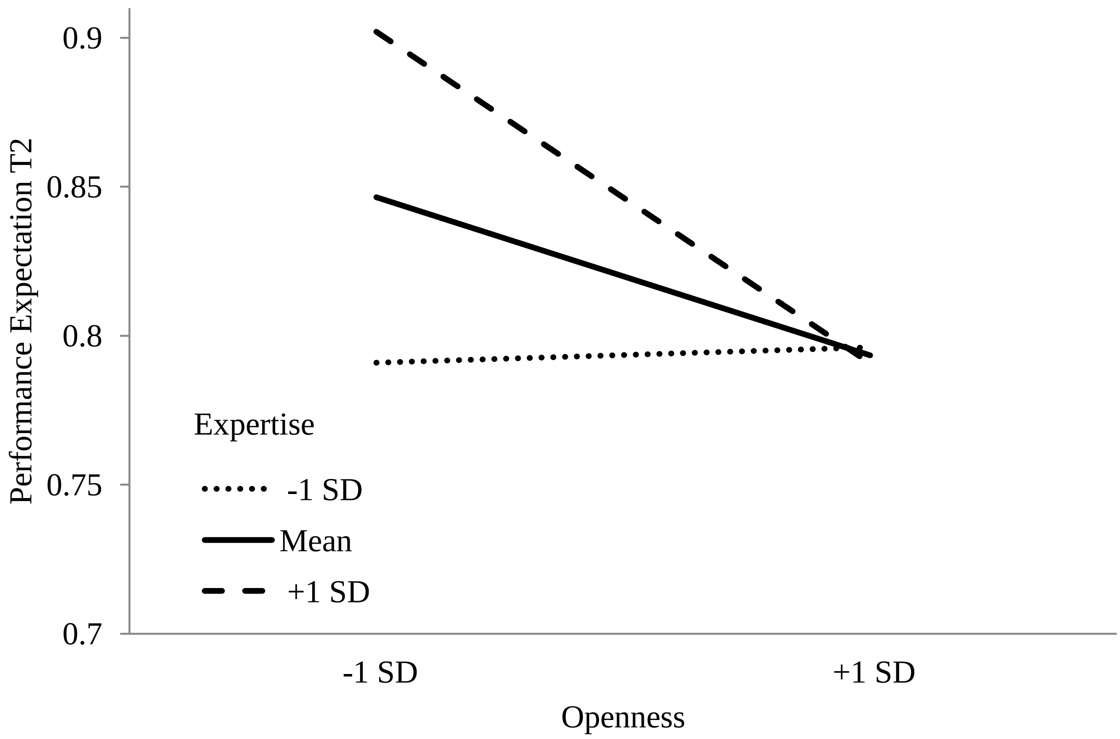


Figure 11: Interaction Effect between Expertise and Open-to-Experience on Performance Expectation Time 2

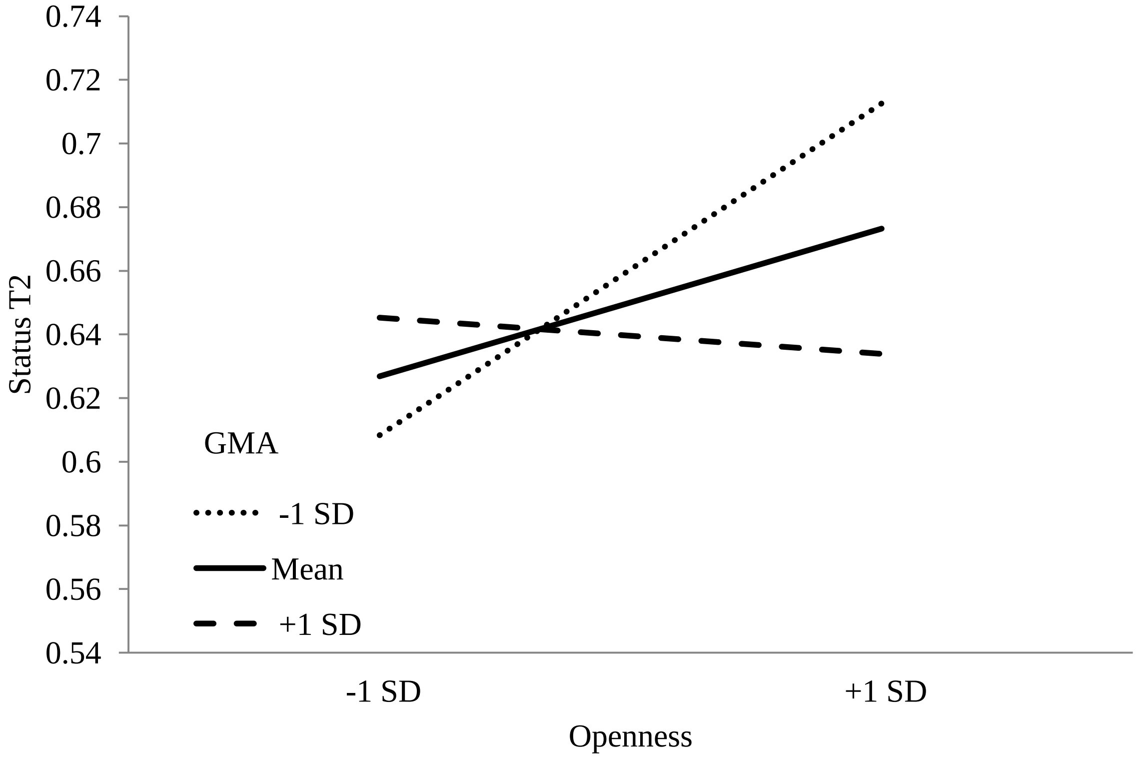


Figure 12: Interaction Effect between GMA and Open-to-Experience on Performance Expectation Time 2

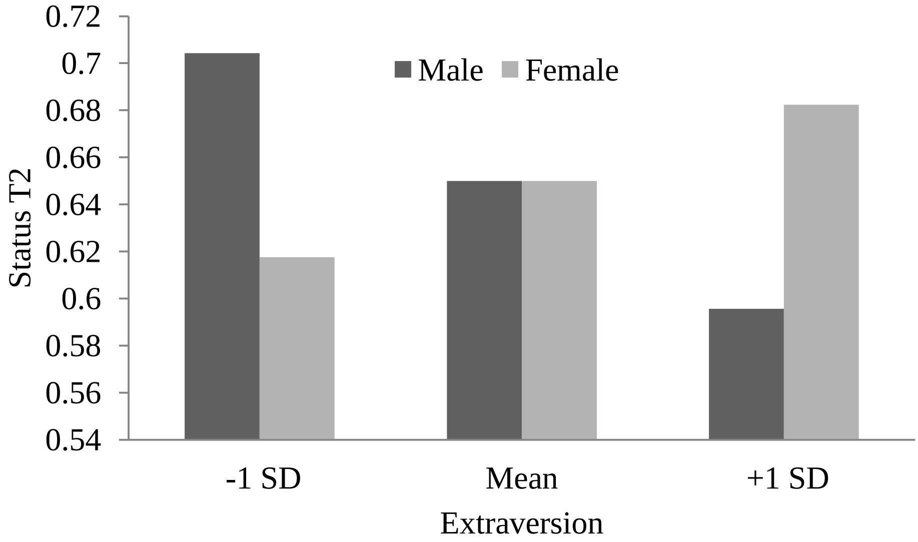


Figure 13: Interaction Effect between Gender and Extraversion on Status Time 2

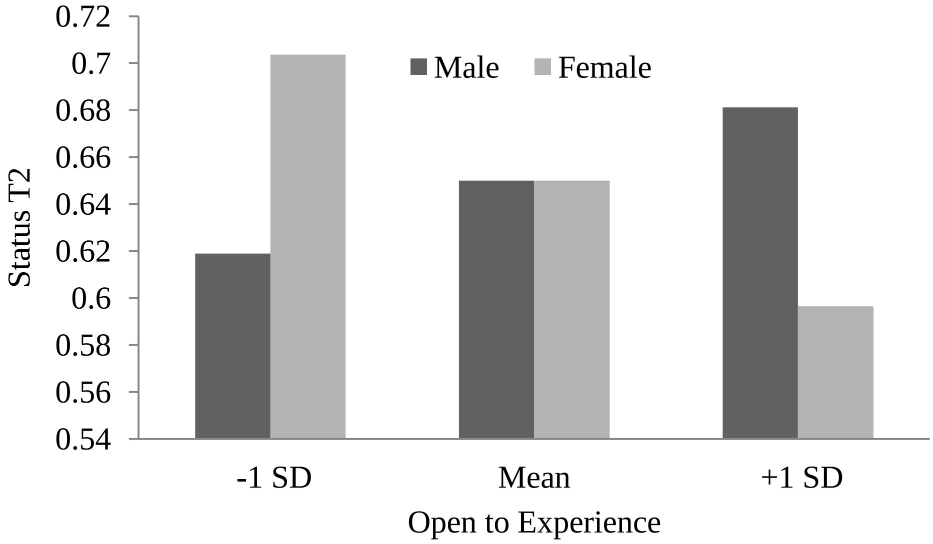


Figure 14: Interaction Effect between Gender and Open-to-Experience on Status Time 2

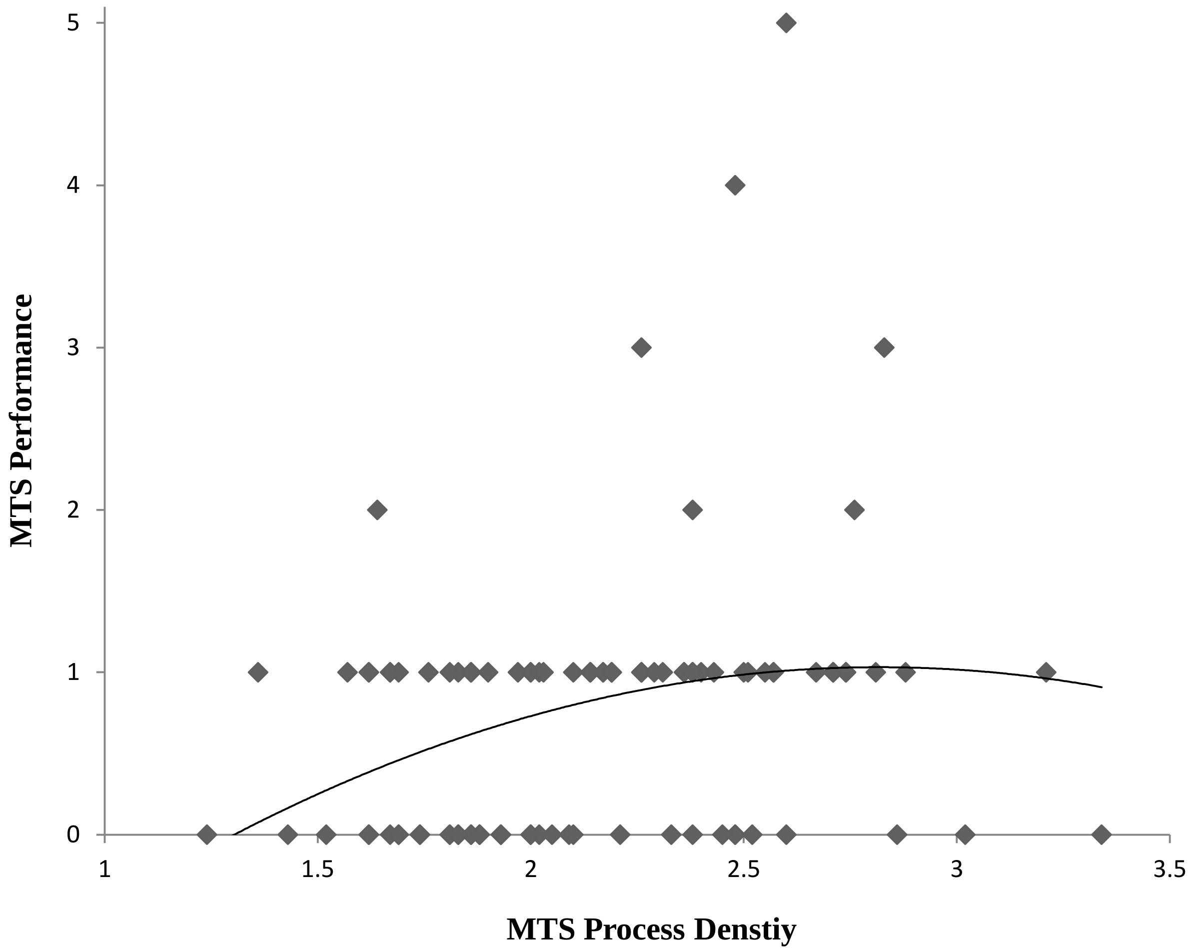


Figure 15: An Inverted U-Shape Relationship between MTS Process Density and Performance

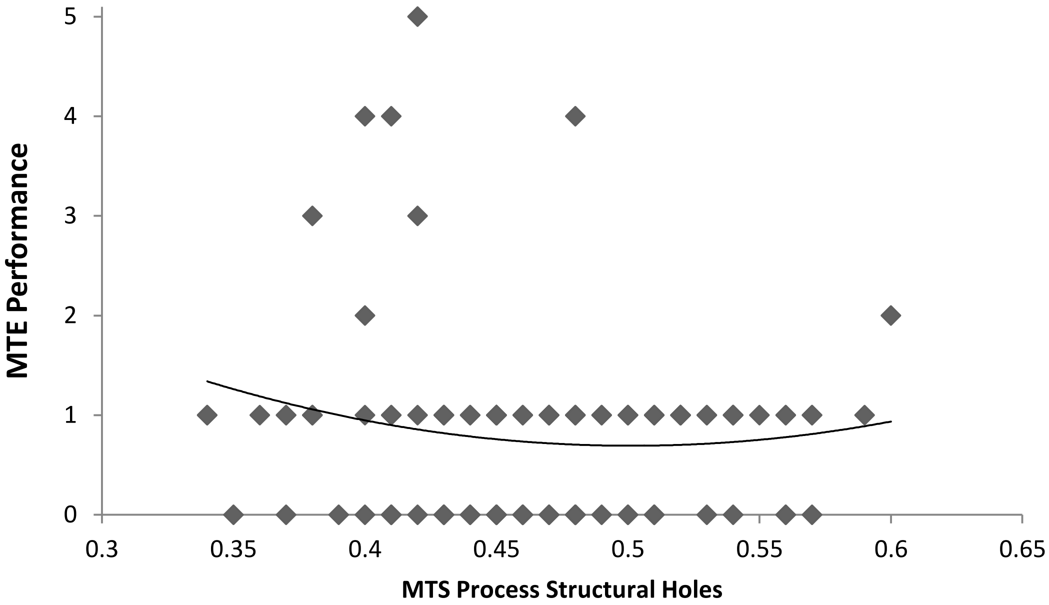


Figure 16: A U-Shape Relationship between MTS Process Structural Holes and Performance

APPENDIX B: TABLES

Table 1: Summary of Teams Literature

Author(s) & Year	Behavioral Content	Individual Differentiation	Pattern	Assumption Type	Representation	FR
Anocona & Caldwell (1992)	Boundary Management Communication Group Process	No	No	Type I	Mean	General
Amason & Sapienza (1997)	Affective & Cognitive Conflict	No	No	Type I	Mean	General
Bachrach, Powell, Collins, & Richey (2006)	OCB	No	No	Type I	Mean	General
Balundi, Barsness, & Michael (2009)	Leader Brokerage	Yes	Yes	Type IV	Social Network Technique	Specific
Banks & Millward (2007)	Team Process	No	No	Type I	Single-Rater	General
Barrick, Bradley, Kristof-Brown, & Colbert (2007)	Communication	No	No	Type I	Mean	General
Bunderson & Sutcliffe (2002)	Information Sharing	No	No	Type I	Mean	General
Campion, Medsker, & Higgs (1993) Campion, Papper, & Medsker (1996)	Workload sharing Communication/ Cooperation	No	No	Type I	Mean	General

Table 1

Author(s) & Year	Behavioral Content	Individual Differentiation	Pattern	Assumption Type	Aggregation	FR
Cumming & Cross (2003)	Communication Structural Holes Leader Structural Holes	No No Yes	No Yes Yes	Type I Type III Type IV	Mean UciNet V UciNet V	Specific
Carmeli & Shaubroeck (2006)	Behavioral Intergration	No	No	Type I	Mean	General
Carson, Tesluk, & Marrone (2007)	Shared Leadership	No	Yes	Type II	Network Approach	Specific
Cole, Walter, & Bruch (2008)	Dysfunctional Behavior	No	No	Type I	Mean	General
Cummings (2004)	Intragroup Knowledge Sharing	No	No	Type I	Mean	General
DeChurch & Marks (2006)	Coordination Process	No	No	Type I	Mean	General
Denison, Hart, & Kahn (1996)	Coordination with Other Teams	No	No	Type I		
Drach-Zahavy & Somech (2001)	Exchanging Information Learning Motivation Negotiating	No	No	Type I	Mean	General
Gibson, Cooper, & Conger (2009)	Constructive Conflict	No	No	Type I	Mean	General
Gilson, Mathieu, Shalley, & Ruddy (2005)	Creativity Process	No	No	Type I	Mean	General
Hoegl & Gemuenden (2001)	Teamwork Quality	No	No	Type I	Mean	General
Homan, Hollenbeck, Humphrey, van Knippenberg, Ilgen, & Van Kleef (2008)	Information Elaboration	No	No	Type I	Mean	General

Table 1

Author(s) & Year	Behavioral Content	Individual Differentiation	Pattern	Assumption Type	Aggregation	FR
Janz, Colquitt, & Noe (1997)	Team Process	No	No	Type I	Mean	General
Johnson, Hollenbeck, Humphrey, Ilgen, & Junt (2006)	Information Sharing	No	No	Type I	Mean	Specific
Kearney, Gebert, & Voelpel (2009)	Information Elaboration	No	No	Type I	Mean	General
Lester, Meglino, & Kosgaard (2002)	Communication/ Cooperation	No	No	Type III		
Lovelace, Shapiro, & Weingart (2001)	Intrateam Communication	No	No	Type I	Mean	General
Marks, DeChurch, Mathieu, Panzer, & Alonso (2005)	Transition & Action Phase Process	No	No	Type I	Mean	General
Marks, Zaccaro, & Mathieu (2000)	Communication	No	No	Type I	Mean	General
Marrown, Tesluk, & Carson (2007)	Boundary-spanning Behavior	No	No	Type I	Mean	Specific
Mathieu, Gilson, & Ruddy (2006)	Team Process	No	No	Type I	Mean	General
Mathieu, Heffner, Goodwin, Cannon-Bowers & Salas, & (2005)	Team Process	No	No	Type I	None	General

Table 1

Author(s) & Year	Behavioral Content	Individual Differentiation	Pattern	Assumption Type	Aggregation	FR
Mathieu, Heffner, Goodwin, Salas, & Cannon-Bowers (2000)	Team Process	No	No	Type I	None	General
Moon et al. (2004)	Supportive Behavior Communication	No	No	Type I	Mean	Specific
Moye & Langfred	Information Sharing	No	No	Type I	Mean	General
Porter (2005) Porter, Hollenbeck, Ilgen, Ellis, West, & Moon (2005)	Backing-up Behavior	No	No	Type I	Mean	General
Stewart & Barrick (2000)	Communication Conflict	No	No	Type I	Mean	General
Stewart, Fulmer & Barrick (2005)	Task and Social Role	No	No	Type I	Mean, Variance, Skewness of Distribution	Specific
Simsek, Lubatkin, & Dino (2005)	Behavioral Intergration	No	No	Type I	Mean	General

Table 2: Team Structural Assumptions

		Individual Differences	
		Individuals are replaceable.	Individuals are not replaceable.
Pattern	No	Type I: Traditional	Type III: Traditional
	Yes	Type II: Network Approach	Type IV: Structural Representation with Actor Attributes

Table 3: Detailed Summary of Types of Conceptual Features

Type of Conceptual Feature	Description of Conceptualization	Sample Studies
Type I	No patterns of interactions are assumed to emerge, and status and influences of individuals are not considered to arise.	Stewart et al., 2005 Simsek et al., 2005 Porter et al., 2005
Type II	Patterns of interactions are explicitly recognized, but status and influences of individuals are not considered to arise.	Clarks, 2003 Klein et al., 2004 Oh et al., 2004
Type III	Individual differences in status and influence are recognized, but patterns of interactions are not assumed to emerge.	LePine et al., 1997 Ellis et al., 2005 Humphrey et al., 2009
Type IV	Both individual differences in status and influence and patterns of interactions are assumed to emerge.	Balkundi et al., 2009 Cumming & Cross, 2003

Table 4: Methodological Features

		No Individuals Differentiated		Individual Differentiated	
		Pattern			
		Yes	No	Yes	No
Frame of Reference	Overall	N/A 1	(Type A) Current Method of Teams Literature	N/A 2	(Type D) No Frequently Used
	Member-Specific	(Type B) Current Method of Networks Literature	(Type C) Density Index	(Type E) No Frequently Used	(Type F) No Frequently Used

Table 5: Summary of Congruence Between Theoretical and Methodological Features

				Theoretical Features							
				Individual Differences				No Individual Differences			
				Pattern							
				No		Yes		No		Yes	
Methodological Feature	Frame of Reference	Representation	Status Differentiation	Compatibility Score							
	Overall FR	Not Patterned (Compositional)	No	1.	2	2.	0	3.	3	4.	1
			Yes	5.	3	6.	1	7.	2	8.	0
		Patterned (Compilational)	No								
			Yes								
	Individual-Specific FR	Not Patterned (Compositional)	No	9.	0	10.	1	11.	2	12.	2
			Yes	13.	1	14.	2	15.	1	16.	1
		Patterned (Compilational)	No	17.	0	18.	2	19.	1	20.	2
			Yes	21.	1	22.	3	23.	0	24.	3

Table 6: Summary of Measures and Representations.

Construct	Measure	Scale Type	Representation Method
Demographic Information (age, gender, race, teamwork experience, & game experience)	Self-reported information was used to obtain gender information. Teamwork and game experience will be measured by a 1-item, 5-Likert scale each.	Psychometric inventories and scales were used. In these scales, participants evaluate their own traits.	Composite variables were created by averaging single items. Those composite variables were aggregated to the team level.
Personality	A 20-item short version of IPIP with a 5-point Likert scale developed Donnella et al. (2006) was used. A sample item is "I am the life of the party."		
Cognitive Ability	Self-reported GPA, ACT and SAT scores were used.		
Self-monitoring	A 17-item scale developed by Snyder & Gangestad (1986) were used. A sample item is "I find it hard to imitate the behavior of other people."		
Need for Power	A 20-items developed by Steers & Braunstein (1976) were used. A sample item is "I seek an active role in the leadership of a group."		

Performance Expectation	A single-item, 5-point Likert scale developed by Bunderson (2003) were used. A sample item is “To what extent does ________ on your team have knowledge and expertise about the team mission’s tasks?”		
Perceived Influence Success	A 9-item, 5 point Likert scale developed by Barry & Bateman (1992) were used. A sample item is “This co-worker values my input on important matters.”	A sociometric type is used in which each member evaluates every other member.	Composite variables will be created by averaging single items. Those composite variables will be aggregated to the team level.
Status	A 7-item, 5-point Likert scale developed by Anderson et al. (2006) were used. A sample item is “To what extent did ______ have status within the group?”		

Team Process	A 6-item, 5-point Likert scale developed by DeChurch & Marks (2005) were used to measure action and interpersonal process. A 2-item, 5-point socio-metric scale were used. A traditional psychometric sample question is “To what extent did each taskforce member coordinate the activities between one another?” A sociometric sample item is “To what extent did each taskforce member coordinate the activities between one another?”	Both psychometric and sociometric scales were used.	Three types of representation techniques were used; (a) traditionally-used techniques in psychology, (b) social network techniques, and (c) aggregation methods based on specific members. a. Composite variables were created by averaging single items. Those composite variables were aggregated to the team level. b. Structural holes and density scores will be obtained based the equations by Reagans et al. (2004) for density, and by Balkundi et al. (2007) for density. c. In order to obtain scores of this type, first members’ status scores were calculated. Based on a status classification or multiplication approach, different indices were obtained.
Team Performance	The number of squares the convoy moves and convoy units lost. Objective indices were derived from the simulation game.		

Table 7: Summary of Hypotheses and Planned Statistical Tests

	Hypothesis Description	Planned Statistical Test	Confirmed?
1a	Male participants are more likely to be perceived high on performance expectation than are female participants.	Performance expectation was regressed onto gender.	Rejected
1b	Male participants are more likely to be perceived high on status than are female participants.	Status was regressed onto gender.	Rejected
2a	GMA will be likely to positively relate to performance expectation.	Performance expectation was regressed onto GMA.	Rejected
2b	GMA will be likely to positively relate to status.	Status was regressed onto GMA.	Rejected
3a	Expertise will be positively related to performance expectation.	Performance expectation was regressed onto game experience.	Rejected
3b	Expertise will be positively related to status.	Performance expectation was regressed onto game experience.	Rejected
4a	The relationship between GMA and performance expectation will be moderated by conscientiousness. For members with high conscientiousness, the relationship between GMA and performance expectation will be more strongly positively related than for those with low conscientiousness.	Performance expectation was regressed onto the interaction term between conscientiousness and GMA, after controlling for conscientiousness and GMA.	Rejected
4b	The relationship between GMA and performance expectation will be moderated by extraversion. For members with high extraversion, the relationship between GMA and performance expectation will be stronger than for those with low extraversion.	Performance expectation was regressed onto the interaction term between extraversion and GMA, after controlling for extraversion and GMA.	Rejected
4c	The relationship between GMA and performance expectation will be moderated by emotional stability. For members with high emotional stability, the relationship between GMA and performance expectation will be stronger than for those with low emotional stability.	Performance expectation was regressed onto the interaction term between emotional stability and GMA, after controlling for emotional stability and GMA.	Rejected

Table 7

	Hypothesis Description	Planned Statistical Test	Confirmed?
4d	The relationship between GMA and performance expectation will be moderated by agreeableness. For members with high agreeableness, the relationship between GMA and performance expectation will be stronger than for those with low agreeableness.	Performance expectation was regressed onto the interaction term between agreeableness and GMA, after controlling for agreeableness and GMA.	Rejected
4e	The relationship between GMA and performance expectation will be moderated by open-to-experience. For members with high open-to-experience, the relationship between GMA and performance expectation will be stronger than for those with low open-to-experience.	Performance expectation was regressed onto the interaction term between conscientiousness and GMA, after controlling for conscientiousness and GMA.	Rejected
5a	The relationship between gender and performance expectation will be moderated by conscientiousness. For female members, the relationship between conscientiousness and performance expectation will be stronger than for male members.	Performance expectation was regressed onto the interaction term between conscientiousness and gender, after controlling for conscientiousness and gender.	Rejected
5b	The relationship between gender and performance expectation will be moderated by extraversion. For female members, extraversion and performance expectation will be more positively related than are those for male members.	Performance expectation was regressed onto the interaction term between extraversion and gender, after controlling for extraversion and gender.	Rejected
5c	The relationship between gender and perceived performance expectation will be moderated by emotional stability. For female members, emotional stability is more highly positively related to performance expectation than for male members.	Performance expectation was regressed onto the interaction term between emotional stability and gender, after controlling for emotional stability and gender.	Rejected
5d	The relationship between gender and performance expectation will be moderated by agreeableness. For female members, the relationship between agreeableness and performance expectation will be more strongly positively related than for male members.	Performance expectation was regressed onto the interaction term between agreeableness and gender, after controlling for agreeableness and gender.	Rejected

Table 7

	Hypothesis Description	Planned Statistical Test	Confirmed?
5e	The relationship between gender and perceived performance expectation will be moderated by open-to-experience. For female members, the relationship between open-to-experience and performance expectation will be more strongly positively related than for male members.	Performance expectation was regressed onto the interaction term between open-to-experience and gender, after controlling for open-to-experience and gender.	Rejected
6a	The relationship between expertise and performance expectation will be moderated by conscientiousness. For members with high conscientiousness, the relationship between expertise and performance expectation will be stronger than for those with low conscientiousness.	Performance expectation was regressed onto the interaction term between conscientiousness and expertise, after controlling for conscientiousness and gender.	Rejected
6b	The relationship between expertise and performance expectation will be moderated by extraversion. For members with high conscientiousness, the relationship between expertise and performance expectation will be stronger than for those with low extraversion.	Performance expectation was regressed onto the interaction term between extraversion and expertise, after controlling for extraversion and gender.	Rejected
6c	The relationship between expertise and performance expectation will be moderated by emotional stability. For members with high emotional stability, expertise and performance expectation are more strongly positively related than are those for those with low emotional stability.	Performance expectation was regressed onto the interaction term between emotional stability and game experience, after controlling for emotional stability and gender.	Rejected
6d	The relationship between expertise and performance expectation will be moderated by agreeableness. For members with high agreeableness, expertise and performance expectation are more strongly positively related than for those with low agreeableness.	Performance expectation was regressed onto the interaction term between agreeableness and expertise, after controlling for agreeableness and gender.	Rejected
6e	The relationship between expertise and performance expectation will be moderated by open-to-experience. For members with high open-to-experience, expertise and performance expectation are more strongly positively related than for those with low open-to-experience.	Performance expectation was regressed onto the interaction term between open-to-experience and expertise, after controlling for open-to-experience and gender.	Rejected

Table 7

	Hypothesis Description	Planned Statistical Test	Confirmed?
7a	The relationship between GMA and performance expectation will be moderated by nPower. For members with high nPower, GMA will be more strongly positively related to performance expectation than for those with low nPower.	Performance expectation was regressed onto the interaction term between nPower and GMA, after controlling for nPower and GMA.	Rejected
7b	The relationship between expertise and performance expectation will be moderated by nPower. For members with high nPower, Expertise will be more strongly positively related to performance expectation than for those with low nPower.	Performance expectation was regressed onto the interaction term between nPower and expertise, after controlling for nPower and game experience.	Rejected
7c	The relationship between gender and performance expectation will be moderated by nPower. For female members, nPower will be more strongly positively related to performance expectation than for female participants.	Performance expectation was regressed onto the interaction term between nPower and gender, after controlling for nPower and gender.	Rejected
8a	The relationship between GMA and performance expectation will be moderated by self-monitoring. For members with high self-monitoring, the relationship between GMA and performance expectation will be stronger than that for those with low self-monitoring.	Performance expectation was regressed onto the interaction term between self-monitoring and GMA, after controlling for self-monitoring and GMA.	Rejected
8b	The relationship between expertise and performance expectation will be moderated by self-monitoring. For members with high self-monitoring, Expertise and performance expectation will be more strongly positively related than that for those with low self-monitoring.	Performance expectation was regressed onto the interaction term between self-monitoring and expertise, after controlling for self-monitoring and game experience.	Rejected
8c	The relationship between gender and performance expectation will be moderated by self-monitoring. For members with high self-monitoring, training and performance expectation will be more strongly positively related than that for those with low self-monitoring.	Performance expectation was regressed onto the interaction term between self-monitoring and gender, after controlling for self-monitoring and gender.	Rejected

Table 7

	Hypothesis Description	Planned Statistical Test	Confirmed?
9	Performance expectation mediates the effect of individual variables on status.	Status was regressed onto performance expectation after all the variables and interaction terms.	Partially Supported
10	MTS process psychometric scores adjusted by status will explain the variance of MTS performance even after controlling for the standard team process psychometric scores (psychometric scores averaged over members and not adjusted by any individual attributes) (testing 6 vs. 2).	The MTS performance variable was regressed onto the standard team process psychometric variable and then MTS process variable adjusted by status. R^2 change was assessed to examine the incremental validity of the density score.	Rejected
11	MTS process density scores (sociometric scores not adjusted and patterned) will explain the variance of MTS performance even after controlling for the standard MTS process psychometric scores (testing 10 vs. 2).	The MTS performance score was regressed onto the MTS process variable obtained by a psychometric scale, and then MTS process density variable. R^2 change was assessed to examine the incremental validity of the density score.	Supported
12	MTS process density squared scores (not adjusted and patterned) will have an inverted U-shape relationship with MTS performance even after controlling for the standard MTS process psychometric variable as well as density variable (not adjusted and patterned) (testing 10 vs. 2).	(a) The MTS performance variable was be regressed onto the MTS process score represented by the psychometric measurement techniques, (b) density scores of coordination process as a control variable, and (c) density square scores of coordination process. R^2 change was be assessed to examine the incremental validity of the density square score.	Rejected
13	MTS process density scores adjusted by status will explain the variance of team performance even after controlling for the standard MTS process psychometric scores and non-adjusted density scores (testing 14 vs. 2 & 10).	The team performance score was be regressed onto the standard team process psychometric score and then team process structural holes scores adjusted by status. R^2 change was be assessed to examine the incremental validity of the density score.	Supported

Table 7

	Hypothesis Description	Planned Statistical Test	Confirmed ?
14	MTS process structural holes (not adjusted) will explain the variance of MTS performance even after controlling for the standard team process psychometric scores (testing 18 vs. 2).	The MTS performance variable was regressed onto the MTS process score represented by the psychometric items, and then MTS structural holes scores of coordination process. R^2 change was assessed to examine the incremental validity of the structural holes coordination score.	Rejected
15	MTS process structural holes square score will have an inverted U-shape relationship with MTS performance even after controlling for the standard team process psychometric scores as well as MTS process structural holes scores (testing 18 vs. 2).	(a) The MTS performance variable was regressed onto the MTS process score represented by the psychometric measurement techniques, (b) structural holes of coordination process as a control variable, and (c) structural holes square scores of coordination process. R^2 change was assessed to examine the incremental validity of the structural holes square score.	Rejected
16	Team process structural holes scores adjusted by status will explain the variance of team performance even after controlling for team process structural hole scores unadjusted More specifically, structural holes of high profile members will account for the additional variance after controlling for the standard team process psychometric and the overall structural holes scores (testing 22 vs. 2 & 18).		Supported
17	Team process (psychometric scores not adjusted and patterned) will explain the variance of team performance even after controlling for the standard team process density variable (testing 11 vs. 3).	The team performance variable was regressed onto the team process density variable, and then the standard team process variable. R^2 change was assessed to examine the incremental validity of the density score.	Rejected

Table 7

	Hypothesis Description	Planned Statistical Test	Confirmed ?
18	Team process density scores adjusted by status will explain the variance of team performance even after controlling for the standard team process psychometric scores and non-adjusted density scores (testing 15 vs. 3 & 11).	The team performance score was regressed onto the standard team process psychometric score and then team process structural holes scores adjusted by status. R^2 change was assessed to examine the incremental validity of the density score.	Rejected
19	Team process structural holes scores (not adjusted) will explain the variance of team performance even after controlling for the standard team process psychometric scores (testing 19 vs. 3).	The team performance score were regressed onto the team process score represented by the psychometric items, and then structural holes scores of coordination process. R^2 change was assessed to examine the incremental validity of the structural holes coordination score.	Rejected
20	Team process structural holes scores adjusted by status will explain the variance of team performance even after controlling for team process structural hole scores unadjusted More specifically, structural holes of high profile members will account for the additional variance after controlling for the standard team process psychometric and the overall structural holes scores (testing 24 vs. 3 & 19).		Rejected

Table 8: Summary of Aggregation Properties

	ICC(1)	ICC(2)	R_{wg} Uniform	R_{wg} Slightly Skew
MTS Status T1	11.67**	13.50**	0.47	0.20
MTS Influence T1	12.67**	15.67**	0.38	0.08
MTS PE T1	21.00**	21.83**	0.50	0.25
MTS Status T1	15.00**	16.83**	0.44	0.17
MTS Influence T1	15.50**	19.00**	0.35	0.03
MTS PE T1	23.50**	24.50**	0.46	0.20

** $p < .001$. PE = performance expectation.

Table 9: Summary of Means, Standard Deviations, and Correlations of Individual Attributes

		M	*SD*	1	2	3	4	5	6	7	8	9
1	Role	3.50	1.71									
2	Comm. Shock	.62	.49	-.00								
3	Trust Shock	.47	.50	.00	-.06							
4	Female #	4.41	2.06	.00	.05	.01						
5	Gender	.54	.50	.02	-.06	-.08*	.21**					
6	Expertise	-.00	1.35	-.02	.00	-.00	.00	-.52**				
7	GMA	.18	152.77	.02	-.00	.00	.00	-.15	.10**			
8	Extra	.00	.73	.03	.00	.00	.00	.13*	-.14**	-.11**		
9	Agreeable	-.00	.54	.05	-.00	-.00	.00	.20**	-.19**	-.08*	.26**	
10	Conscious	-.00	.78	.02	.00	-.00	.00	.08*	-.12**	-.10**	.02	.11**
11	Neuro	-.00	.59	-.01	.00	-.00	.00	.13**	-.15**	-.10**	-.01	.05
12	Openness	-.00	.56	-.01	.00	-.00	.00	-.14**	.15**	.18**	.15**	.09*
13	SM	.00	1.67	.05	.00	.00	.00	.12**	-.15**	-.14**	-.08*	.08*
14	N Power	-.00	.58	-.01	.00	-.00	.00	-.11	.04	-.02	.30**	.02
15	PE T1	2.00	.48	-.07	-.05	-.01	-.03	-.20**	.07	.02	-.02	-.04
16	PE T2	1.79	.55	-.08*	-.05	.01	-.04	.07^{+}	.01	.02	-.02	-.02
17	Status T1	1.65	.48	-.07^{+}	.01	.14**	-.14**	-.16**	.10**	.04	-.02	-.02
18	Status T2	1.52	.51	-.08*	-.07*	.02	-.08*	-.08*	.05	.05	-.04	-.03

Note: ** $p < .01$, * $p < .05$, $^{+}$ $p < .10$; For gender, the higher number indicates female.
Extra = Extraversion, Neuro = Neuroticism, Open = Open to Experience, SM = Self-Monitoring, PE = Performance Expectation

Table 9

Summary of Means, Standard Deviations, and Correlations of Individual Attributes

		10	11	12	13	14	15	16	17
1	Role								
2	Comm. Shock								
3	Trust Shock								
4	Female #								
5	Gender								
6	Expertise								
7	GMA								
8	Extra								
9	Agreeable								
10	Conscious								
11	Neuro	$-.12^{**}$							
12	Openness	.06	$-.10^{**}$						
13	SM	$.09^{*}$	$-.08^{*}$	$-.16^{**}$					
14	N Power	$.09^{*}$	.04	$.15^{**}$	$-.10^{**}$				
15	PE T1	-.04	-.02	.00	-.03	-.02			
16	PE T2	-.04	.00	.03	.00	-.04	.43		
17	Status T1	-.01	-.03	.03	-.03	-.01	$.44^{**}$	$.29^{**}$	
18	Status T2	-.03	-.01	.01	-.01	-.01	$.29^{**}$	$.71^{**}$	$.40^{**}$

Note: ** $p < .01$, * $p < .05$, $^{+}$ $p < .10$; For gender, the higher number indicates female.
Extra = Extraversion, Neuro = Neuroticism, Open = Open to Experience, SM = Self-Monitoring, PE = Performance Expectation

Table 10: Linear mixed Model Analysis Examining the

Effects of Individual Attributes on the *Emergence of PE and Status at Time 1*

	PE T1	
	Estimate/ SE	
Intercept	1.90/.09	1.90/.09
Communication Shock	.13/.10	.13/.10
Trust Shock	.04/.09	.04/.09
Interaction btw C x T	-.14/.15	-.13/.14
Gender	.09/.03*	.09/.04*
Expertise	.01/.01	.01/.01
Training Score	.00/.01	.00/.01
GMA	-.00/.00	-.00/.00
Extraversion	.02/.02	.02/.02
Agreeableness	-.02/.03	-.02/.03
Conscientiousness	-.02/.02	-.02/.02
Neuroticism	-.01/.02	-.01/.02
Openness	-.03/.02	-.04/.02
Residual		.10**
Intercept		.11**

** $p < .01$, * $p < .05$, + $p < .10$

Role and female number were included but not significant.

Table 11: Linear mixed model analysis examining the effects of individual attributes on the emergence of PE at time 2

	Outcome = PE T2		
	Estimate/ SE		
	Basic Model	Personality Interaction	Expertise Interaction
Intercept	1.70/.11**	.84/.13**	.82/.13**
Communication Shock	.18/.13	.14/.11	.12/.11
Trust Shock	.11/.13	.12/.10	.22/.20
Interaction btw C x T	-.26/.18	-.22/.16	-.21/.16
Training Score	.01/.01	.00/.01	.00/.01
Status T1		.15/.04**	.16/.04**
PE T1		.34/.04**	.33/.04**
Gender	.05/.04	.01/.04	.01/.04
Expertise	-.02/.01	-.02/.01^{+}	-.02/.01
GMA	.00/.00	.00/.01	.00/.00
Extraversion	-.01/.02	-.03/.03	-.02/.02
Agreeableness	-.01/.03	.04/.04	-.00/.03
Conscientiousness	-.02/.02	.05/.03^{+}	-.01/.02
Neuroticism	-.01/.02	.05/.03	.01/.02
Openness	.03/.03	.11/.03**	.05/.02^{+}
Gender x Extraversion		.03/.04	
Gender x Agreeableness		-.10/.06^{+}	
Gender x Conscientiousness		-.10/.05**	
Gender x Neuroticism		-.10/.05^{+}	
Gender x Open to Exp.		-.14/.05**	
Expertise x Extraversion			.01/.01
Expertise x Agreeableness			-.06/.02**
Expertise x Conscientiousness			-.03/.02^{+}
Expertise x Neuroticism			-.00/.02
Expertise x Open to Exp.			-.04/.02*
-2 Log Likelihood	629.36	510.31	520.11
AIC	683.36	578.31	587.11
Residual	.11/.01	.09/.01**	.10/.01**
Intercept	.17/.03	.13/.02**	.13/.02**

** $p < .01$, * $p < .05$, $^{+}$ $p < .10$

Role and female number were included but not significant.

Table 12: Linear Mixed Model Analysis Examining the Effects of Individual Attributes on the Emergence of Status at Time 2

	Outcome = StatusT2							
	Estimate/ SE							
	Basic Model		GMA Model			Gender Model		
Intercept	1.42./.10**	.65/.12	1.42/.10**	.65/.12**	.25/.11*	1.43/10**	.65/.12**	.12/.11*
Communication Shock	.06/.11	.01/.10	.08/.11	.02/.10	-.04/.08	.08/.11**	.01/.10	-.06/.08
Trust Shock	-.02/.10	-.00/.09	-.01/.10	.00/.09	-.06/.07	-.01/.10**	-.00/.09	-.07/.07
Interaction btw C x T	.02/.15	.07/.14	-.01/.15	.06/.14	.16/.11	-.01/.15	.13/.13	.18/.11
Training Score	.02/.01*	.01/.01	.02/.01*	.01/.01^{+}	.01/.01	.02/.01*	.01/.01	.01/.01
Status T1		.32/.04**		.33/.04**	.25/.04**		.32/.04**	.24/.04**
PE T1		.15/.05**		.15/.05**	-.03/.04		.16/.05**	-.03/.04
PE T2					.51/.03**			.52/.04**
Gender	.04/.04	-.00/.04	.04/.04	.01/.04	-.00/03	.03/.04	.00/.04	.00/.03
Expertise	.01/.01	.00/.01	.01/.01	.00/.01	.01/.01	.01/.01	.00/.01	.01/.01
GMA	.00/.00	.00/.00	.00/.00	.00/.00	.00/00	.00/.00	.00/.00	.00/.00
Extraversion		-.02/.03	-.02/.02	-.02/.02	-.01/.02	-.01/.01	-.07/.03*	-.05/.02*
Agreeableness		-.00/.03	.01/.03	.01/.03	.01/.02	-.01/.04	-.00/.04	-.03/..03
Conscientiousness		-.02/.02	-.02/.02	-.02/.02	-.01./.02	.01/.03	-.00/.03	-.03/.02
Neuroticism		.01/.02	.01/.03	.01/.02	.00/.02	.02/.03	.01/.03	-.01/.03
Openness		-.02/.03	-.02/.03	-.02/.03	-.04/.02^{+}	.05/.04	.05/.04	-.01/.03
GMA x Extraversion			-.00/.00	.00/.00	.00/.00			
GMA x Agreeableness			-.00/.00	-.00/.00	-.00/.00			
GMA x Conscientiousness			.00.00	-.00/.00	.00/.00			
GMA x Neuroticism			-.00/.00	-.00/.00	-.00/.00			
GMA x Open to Exp.			-.00/.00	-.00/.00*	-.00/.00			
Gender x Extraversion						.08/.07^{+}	.11/.04**	.10/.04**
Gender x Agreeableness						-.05/.04	.01/.06	.03/.03
Gender x Conscientiousness						.02/.06	-.03/.04	.07/.05
Gender x Neuroticism						-.04/.06	.01/.06	.04/.04
Gender x Open to Exp.						-.15/.06**	-.14/.05**	-.06/.05
-2 Log Likelihood	660.17	539.35	630.43	534.07	350.63	624.04	527.28	343.52
AIC	704.17	597.35	694.43	602.01	420.63	688.04	595.28	411.52
Residual		.11/.01**	.12/.01**	.10/.01**	.08/.01**		.10/.01**	.08/.00**
Intercept		.09/.02**	.11/.02**	.08/.01**	.06/.01**		.09/.02**	.06/.01**

$^{**}p < .01$, $^{*}p < .05$, $^{+}p < .10$

Role and female number were included but not significant.

Table 13: Linear Mixed Model Analysis Examining the Effects of Individual Attributes on the Emergence of Status at Time 2

	Outcome = StatusT2		
	Estimate/ SE		
Intercept	1.43/.10**	.64/.12**	.27/.11**
Communication Shock	.05/.11	-.01/.10	-.07/.08
Trust Shock	-.02/.10	-.00/.09	-.05/.07
Interaction btw C x T	.02/.15	.08/.13	.16/.11
Training Score	.02/.01*	.01/.01	.01/.01
Status T1		.34/.04**	.26/.04**
PE T1		.15/.04**	-.03/.04
PE T2			.50/.03**
Gender	.03/.04	-.00/.04	-.01/.03
Expertise	.01/.01	.00/.01	.01/.01
GMA	.00/.00	.00/.00	.00/.00
Self-Monitoring	.00/.91	.01/.01	.01/.01
N Power	-.00/.03	.00/.03	.02/.02
Expertise x Self-Monitoring		.01/.01*	.01/.01+
Expertise x N Power		-.01/.02	-.01/.02
-2 Log Likelihood		532.60	354.29
AIC		596.60	420.29
Residual		.10/.01**	
Intercept		.10/.02**	

** $p < .01$, * $p < .05$, + $p < .10$

Role and female number were included but not significant.

Table 14: Status-based Classification Correlations among Action Process, Status, and Outcome

		Mean	SD	1	2	3	4	5	6
1	MTS Standard AP	1.41	.46						
2	MTS AP Adjusted by Status	.23	.08	.84** (117)					
3	High Status Members' Perception of MTS AP	.18	.14	.38** (104)	.59** (104)				
4	Middle Status Members' Perception of MTS AP	.24	.10	.72** (119)	.78** (117)	.05 (104)			
5	Low Status Members' Perception of MTS AP	.31	.19	.37** (79)	.34** (77)	.19 (64)	-.06 (79)		
6	Status	1.49	.40	.56** (117)	.52** (117)	.15 (104)	.47** (117)	.38** (77)	
7	MTS Performance	5.10	2.50	.06 (124)	.13 (115)	.18+ (103)	-.04 (117)	.23* (77)	.20* (117)

Note: ** < .01, * < .05, + < .10; Numeric values in the parentheses indicate degrees of freedom.
AP indicates Action Process.
The standard AP is the reference variable against which the other types of AP should be compared.
MTS AP adjusted by status is the variable created by multiplication of AP score with status.
Different status members' perceptions of MTS AP are the status-classified variables.

Table 15: Regression of MTS Performance onto Status-based Action Processes

	Outcome = MTS Performance Time 3						
	Basic Model		Corrected AP		Status Class Model		
Communication	.11	.12	.14	.14	.13	.16	.19
Trust Shock	.17*	.18*	.16^{+}	.17^{+}	.24^{+}	.23^{+}	.14
MTS Performance T2	.23**	.22*	.21*	.20*	.14	.13	.05
MTS Standard AP T3		.05	-.10	-.27			
Status T3			.24*	.22		.15	.23
MTS AP Adjusted by Status				.22			
High Status Members' Perception of MTS AP							.22^{+}
Middle Status Members' Perception of MTS AP							-.21
Low Status Members' Perception of MTS AP							.10
R	.30	.30	.36	.37	.30	.33	.44
R^2	.09*	.09*	.13**	.14**	.09	.10	.19
ΔR^2		.00	.04*	.01		.02	.08
** < .01, * < .05, $^{+}$ < .10			*N* = 117			*N* = 63	

Table 16: Summary of Means, Standard Deviations, and Correlations of Density Scores

		M	*SD*	1	2	3	4	5	6
1	Communication Shock	.61	.49						
2	Trust Shock	.48	.50	-.04 (120)					
3	MTS Performance T2	4.07	2.62	.13 (120)	-.04 (120)				
4	Status T3	1.47	.38	-.12 (119)	.03 (119)	.07 (117)			
5	MTS Standard AP T3	1.39	.45	-.11 (120)	-.07 (120)	.13 (120)	.56** (117)		
6	MTS Process Density T3	2.16	.41	.09 (100)	-.01 (100)	.28** (99)	.62** (92)	.71** (100)	
7	MTS Process Density T3 Adjusted by Status T3	.93	.52	-.09 (114)	.03 (114)	.11 (113)	.92** (114)	.55** (114)	.77** (90)
8	MTS HH Status Process Density T3	.47	.24	-.04 (16)	.28 (16)	-.41 (16)	-.05 (16)	.07 (16)	.41 (12)
9	MTS MM Status Process Density T3	.45	.12	.06 (111)	-.04 (111)	.04 (110)	.43** (111)	.25** (111)	.65** (87)
10	MTS LL Status Process Density T3	.65	.23	.40 (6)	-.16 (6)	.54 (6)	.23 (6)	.45^{+} (6)	1.00* (3)
11	MTS HM Status Process Density T3	.44	.12	.12 (103)	.08 (103)	.12 (102)	.29** (103)	.26* (103)	.57** (81)
12	MTS HL Status Process Density T3	.40	.20	.23 (52)	-.03 (52)	.12 (51)	.12 (63)	.23^{+} (63)	.20 (42)
13	MTS ML Status Process Density T3	.48	.12	.12 (74)	-.04 (74)	.08 (73)	.24* (74)	.38** (74)	.48** (59)
14	MTS Performance T3	5.10	2.51	.11 (120)	.16^{+} (120)	.23** (120)	.20* (117)	.06 (120)	.26* (99)

Note: ** $p < .01$, * $p < .05$, $^{+}$ $p < .10$; Numeric values in the parentheses indicate degrees of freedom; AP indicates Action Process.

Table 16

		7	8	9	10	11	12	13
1	Communication Shock							
2	Trust Shock							
3	MTS Performance T2							
4	Status T3							
5	MTS Standard AP T3							
6	MTS Process Density T3							
7	MTS Process Density T3 Adjusted by Status T3							
8	MTS HH Status Process Density T3	.01 (16)						
9	MTS MM Status Process Density T3	.54** (111)	.21 (14)					
10	MTS LL Status Process Density T3	.14 (6)	-.50 (3)	-.33 (6)				
11	MTS HM Status Process Density T3	.40** (103)	.59* (16)	.48** (100)	-.78 (5)			
12	MTS HL Status Process Density T3	.11 (52)	.75* (10)	-.11 (50)	-.67 (5)	.12 (52)		
13	MTS ML Status Process Density T3	.28** (74)	.01 (10)	.19 (71)	.49 (6)	.07 (63)	.62** (52)	
14	MTS Performance T3	.31** (113)	-.09 (16)	.06 (110)	.45 (6)	.34** (102)	.30* (51)	.33** (73)

Note: ** $p < .01$, * $p < .05$, $^{+}$ $p < .10$; Numeric values in the parentheses indicate degrees of freedom.
AP indicates Action Process.

Table 17: Regression of MTS Performance onto Density Scores

	DV = MTS Performance Time 3				
	Density Model			Status-Adjusted Density Model	
Communication	.10	.10	.06	.08	.12
Trust Shock	.21*	.21*	.20*	.18^{+}	.21^{+}
MTS Performance T2	.23**	.24*	.21*	.19^{+}	.19^{+}
AP Process T3		.05	-.17	-.24	-.16
MTS Process Density T3			.32*	.28^{+}	-.03
Status T3				.17	-.42
MTS Process Density Adjusted by Status T3					.79**
R	.33	.33	.41	.43	.49
R^2	.11*	.11*	.17**	.18**	.24**
ΔR^2		.00	.06*	.01	.06*

** $p < .01$, * $p < .05$, $^{+}$ $p < .10$

Table 18: Summary of Means, Standard Deviations, and Correlations of Structural Holes

		M	*SD*	1	2	3	4	5	6	7
1	Communication Shock	.61	.49							
2	Trust Shock	.48	.50	-.04						
3	MTS Performance T2	4.07	2.62	$.11^{+}$	.06					
4	Status T2	1.49	.40	$-.17^{+}$	.03	.07				
5	MTS Standard AP T3	1.41	.46	-.14	-.06	.13	$.60^{**}$			
6	MTS Process SH T3	2.23	.47	-.11	-.00	.09	-.03	.03		
7	MTS Process SH T3 Adjusted by Status T3	19.87	16.82	-.15	-.04	.10	$.87^{**}$	$.47^{**}$	-.13	
8	MTS Performance T3	5.10	2.50	.11	$.15^{+}$	$.24^{**}$	$.17^{+}$	.04	-.10	$.28^{**}$

Note: ** $p < .01$, * $p < .05$, $^{+}$ $p < .10$; Numeric values in the parentheses indicate degrees of freedom.
AP indicates Action Process.
SH indicates Structural Holes

Table 19: Regression of MTS Performance on Structural Holes

	DV = MTS Performance Time 3				
	Structural Holes Model				Attribute-Adjusted Structural Holes Model
Communication	.10	.10	.09	.10	.13
Trust Shock	.18^{+}	.18^{+}	.17^{+}	.15	.20*
MTS Performance T2	.21*	.20^{+}	.21*	.21*	.19*
MTS Standard AP T3		.05	.05	-.07	-.04
MTS process SHole T3			-.09	-.08	-.01
Status T3				.23*	-.46*
MTS process SHole Adjusted by Status T3					.74**
R	.30	.30	.31	.37	.48
R^2	.09*	.09*	.10^{+}	.14*	.23**
ΔR^2		.00	.01	.04*	.10**

** $p < .01$, * $p < .05$, $^{+}$ $p < .10$

Table 20: Summary of Means, Standard Deviations, and Correlations of Team Level Variables

		Mean	SD	1	2	3	4	5	6	7	8	9
1	Communication Shock	.61	.49									
2	Trust Shock	.48	.50	-.04								
3	Team Performance T2	5.63	4.16	.07	.01							
4	Team Status T2	1.69	.77	-.05	.01	.08						
5	Team Standard AP T3	1.48	.63	-.16*	.04	.13*	.21**					
6	Team Process Density T3	.58	.18	-.07	-.01	.05	.44**	.33**				
7	Team Process Status-Adjusted Density T3	2.32	2.07	-.04	-.03	.12	.92**	.22**	.45**			
8	Team Coordination SH T3	.70	.02	-.04	.04	-.03	-.05	-.12+	-.16*	-.09		
9	Team Coordination Status-Adjusted SH T3	15.41	23.27	-.01	.03	.10	.81**	.18**	.32**	.94**	.00	
10	Team Performance T3	5.34	2.62	.14*	.11	.06	.14*	.06	.10	.13+	.11	.13*

Note: ** < .01, * < .05, + < .10; Numeric values in the parentheses indicate degrees of freedom.
AP indicates Action Process.

Table 21: Linear Mixed Models Examining the Effect of Structural Holes on Team Performance

	DV = Team Performance Time 3		
Intercept	22.71/5.72	23.66/5.99**	26.26/7.05**
Communication	-.67/.44	-.75/.46	-.82/.52
Trust Shock	-.46/.44	-.54/.49	-.77/.52
Team Performance T2	.00/.04	-.01/.04	-.00/.04
Team Standard AP T3		-.01/.26	-.35/.31
Team process SHole T3	-23.90/8.11**	-.25.03/8.40**	-28.89/9.78**
Team Status T3			.50/.50
Team process SHole Adjusted by Status T3			-.00/.01
-2 Log Likelihood		1006.34	846.10
AIC		1022.34	866.10
Residual		2.76	2.81/.45
Intercept		4.30	4.83/.97

** < .01, * < .05, $^{+}$ < .10;

Table 22: Examination of Density Effects with TMS and Identity as Controls

	DV = MTS Performance Time 3				
	Density Model			Status-Adjusted Density Model	
Communication	.10	.11	.07	.07	.07
Trust Shock	.21*	.22*	.21*	.17	.14
MTS Performance T2	.23*	.24*	.25*	.20+	.19+
AP Process T3		.08	-.12	-.24	-.16
MTS Transactive Memory T3		.06	.07	.07	.06
MTS Identity T3		-.14	-.17	-.15	-.15
MTS Process Density T3			.30*	.28+	-.05
Status T3				.17	-.30
MTS Process Density Adjusted by Status T3					.33*
R		.41	.45	.43	.49
R^2	.11**	.13*	.17**	.18**	.22**
ΔR^2		.02	.04*	.01	.04*

** $p < .01$, * $p < .05$, + $p < .10$

Table 23: Examination of MTS Structural Holes Effect on MTS Performance with TMS and Identity as Controls

	DV = MTS Performance Time 3				
	Structural Holes Model			Attribute-Adjusted Structural Holes Model	
Communication	.09	.10	.09	.12	.15
Trust Shock	.17^{+}	.18^{+}	.18^{+}	.16^{+}	.20*
MTS Performance T2	.27**	.23*	.24*	.24*	.21*
MTS Standard AP T3		.14	.14	-.02	.00
MTS Identity T3		.05	.02	.11	.09
MTS Process Density T3		-.14	-.12	-.17	-.16
MTS process SHole T3			-.08	-.05	-.01
Status T3				.26*	-.09*
MTS process SHole Adjusted by Status T3					.40*
R	.35	.37	.38	.43	.47
R^2	.12**	.14*	.14*	.18**	.22**
ΔR^2		.02	.01	.04*	.04*

** $p < .01$, * $p < .05$, $^{+}$ $p < .10$

APPENDIX C: IRB APPROVAL FORM

University of Central Florida Institutional Review Board
Office of Research & Commercialization
12201 Research Parkway, Suite 501
Orlando, Florida 32826-3246
Telephone: 407-823-2901 or 407-882-2276
www.research.ucf.edu/compliance/irb.html

University of Central Florida

Corrected Letter: expiration date 7/7/2011

Approval of Human Research

From: **UCF Institutional Review Board #1**
FWA00000351, IRB00001138

To: **Leslie Ann DeChurch** and Co-PIs: **Daniel Doty, Eduardo Salas, Miliani Jimenez, Shawn Burke, Toshio Murase**

Date: **July 08, 2010**

Dear Researcher:

On 7/8/2010, the IRB approved the following human participant research until 07/7/2011 inclusive:

Type of Review: IRB Continuing Review Application Form

Modification Type: NOTE: as part of continuing review, research modified in that monetary compensation will no longer be given to participants

Project Title: VOSS: Creating functionally collaborative infrastructure in virtual organizations

Investigator: Leslie Ann DeChurch

IRB Number: SBE-08-05766

Funding Agency: U.S. Army Research Institute for the Behavioral & Social Sciences(ARI)

Grant Title:

Research ID: 24096022

The Continuing Review Application must be submitted 30days prior to the expiration date for studies that were previously expedited, and 60 days prior to the expiration date for research that was previously reviewed at a convened meeting. Do not make changes to the study (i.e., protocol, methodology, consent form, personnel, site, etc.) before obtaining IRB approval. A Modification Form **cannot** be used to extend the approval period of a study. All forms may be completed and submitted online at https://iris.research.ucf.edu .

If continuing review approval is not granted before the expiration date of 07/30/2010, approval of this research expires on that date. When you have completed your research, please submit a

Study Closure request in iRIS so that IRB records will be accurate.

Use of the approved, stamped consent document(s) is required. The new form supersedes all previous versions, which are now invalid for further use. Only approved investigators (or other approved key study personnel) may solicit consent for research participation Participants or their representatives must receive a copy of the consent form(s).

In the conduct of this research, you are responsible to follow the requirements of the Investigator Manual.

On behalf of Joseph Bielitzki, DVM, UCF IRB Chair, this letter is signed by:

Signature applied by Joanne Muratori on 07/08/2010 11:41:38 AM EDT

IRB Coordinator

APPENDIX D: INFORMED CONSENT

University of Central Florida

Multiteam System Study Phase II
Informed Consent

Informed Consent

<u>This consent form requires a signature!</u>

Principal Investigator(s): Leslie DeChurch, Ph.D.

Sub-Investigator(s): Toshio Murase, MS
Miliani Jimenez, BA
Daniel Doty, BS

Sponsor: Army Research Institute

Investigational Site(s): University of Central Florida, Department of Psychology

How to Return this Consent Form:

Please have your child bring the signed portion of this consent form to their session they have signed up for. At the beginning of the session one of the senior researchers (i.e., Toshio Murase, Miliani Jimenez, or Daniel Doty) will collect the signed documentation authorizing your child to participate in the experiment. *If your child does not bring a signed consent form to the experiment, they will not be able to participate in the experiment.*

Introduction: Researchers at the University of Central Florida (UCF) study many topics. To do this we need the help of people who agree to take part in a research study. You are being asked to allow your child to take part in a research study which will include about 800 people that must be 18 years of age or older to be included in the research study or have parental authorization at the time of the experiment (if you are under the age of 18. Your child is being invited to take part in this research study because he or she is a student at the University of Central Florida.

The person doing this research is Leslie DeChurch of UCF Psychology Department. UCF students learning about research are helping to do this study as part of the research team. Their names are: Toshio Murase, Miliani Jimenez, and Daniel Doty.

What you should know about a research study:

- Someone will explain this research study to you.
- A research study is something you volunteer for.
- Whether or not you take part is up to you.
- You should take part in this study only because you want to.
- You can choose not to take part in the research study.
- You can agree to take part now and later change your mind.
- Whatever you decide it will not be held against you.
- Feel free to ask all the questions you want before you decide.

Purpose of the research study: The purpose of this study is to examine how leadership influences decision-making effectiveness in multiteam systems (teams of teams).

What your child will be asked to do in the study:
- Complete a computer based individual training session
- Work together as a team in playing the computer game World in Conflict.
- Fill out surveys on a few different occasions. All surveys will be administered via the computer. You will be asked general questions about your feelings in working in teams, as well as how you prefer to handle various situations.
- Be videotaped to allow experimenters to evaluate performance at a later date.

Location: The study will take place at the UCF Psychology Department in room 203 D, E, and F.

Time required: We expect that your child will be in this research study for 3 hours.

Audio or video taping: Your child will be audio and video taped during this study. If you do not want your child to be audio and video taped, they will not be able to be in the study. Discuss this with the researcher or a research team member. If your child is audio taped, the tape will be kept in a locked, safe place. The tape will be erased or destroyed 10 years after data has been collected. The audio tapes will be kept for this duration because the review process when publishing an article is long and on occasion reviewers require authors to recode data.

Funding for this study: This research study is being paid for by the Army Research Institute.

Risks: We do not expect any harm to your child by being in the study. If he or she gets upset or feels discomfort at any time during the study, he or she may ask to take a break. Your child may also withdraw at any point, without penalty. If your child is participating in the experiment for research credit or extra credit for his or her class, your child will be given credit equal to the amount of time participated, if he or she were to withdraw.

Benefits: Possible benefits include learning more about the research process and working in a team setting. Many organizations today are adopting team-based designs thus this experience can be seen as a learning experience.

Compensation: Additionally, if your child is participating in this experiment for course credit, he or she will be awarded the credit for the amount of time he or she participates in this study. Your child also has the option of being compensated with $40 after participating. He or she must select one or the other; both credit and monetary compensation cannot be awarded to participants.

Study contact for questions about the study or to report a problem: If you have questions, concerns, or complaints or think the research has hurt your child talk to Dr. DeChurch. Contact information is as follows: Leslie DeChurch ldechurc@mail.ucf.edu, Toshio Murase toshio.murase@gmail.com, Miliani Jimenez miliani.jimenez@gmail.com, Daniel Doty d.doty84@gmail.com, and Shawn Burke sburke@ist.ucf.edu.

IRB contact about you and your child's rights in the study or to report a complaint Research at the University of Central Florida involving human participants is carried out under the oversight of the Institutional Review Board (UCF IRB). This research has been reviewed and approved by the IRB. For information about the rights of people who take part in research, please contact: Institutional Review Board, University of Central Florida. You may also talk to them for any of the following:

- Your questions, concerns, or complaints are not being answered by the research team.
- You cannot reach the research team.
- You want to talk to someone besides the research team.
- You want to get information or provide input about this research.
-

If your child is harmed because he or she takes part in this study: If your child is injured or made sick from taking part in this research study, medical care will be provided. Depending on the circumstances, this care may be provided at no cost to you. Contact the investigator for more information.

If you believe your child has been injured during participation in this research project, you may file a claim with UCF Environmental Health & Safety, Risk and Insurance Office, P.O. Box 163500, Orlando, FL 32816-3500 (407) 823-6300. The University of Central Florida is an agency of the State of Florida for purposes of sovereign immunity and the university's and the state's liability for personal injury or property damage is extremely limited under Florida law. Accordingly, the university's and the state's ability to compensate you for any personal injury or property damage suffered by your child during this research project is very limited.

Withdrawing from the study:
If your child decides to leave the experiment, he or she will be awarded credits for the time spent in the study. If monetary compensation was selected, and your child decides to leave the experiment, they will not be compensated. If the study needs to be ended early due to technical difficulties, your will receive credit or compensation (one must be selected) for participation in the study and his or her name will be submitted for the iPad random drawing at the end of the Summer A and Summer B sessions.

Your signature below indicates your permission for the child named below to take part in this research.

DO NOT SIGN THIS FORM AFTER THE IRB EXPIRATION DATE BELOW

Name of participant

Signature of parent or guardian

Date

- ❑ Parent
- ❑ Guardian (See note below)

Printed name of parent or guardian

Assent

❑

- ❑ Obtained
  - ❑ Not obtained because:
  - ❑ IRB determined that assent of the child was not a requirement
  - ❑ The capability of the child is so limited that the child cannot reasonably be consulted.

Note on permission by guardians: An individual may provide permission for a child only if that individual can provide a written document indicating that he or she is legally authorized to consent to the child's general medical care. Attach the documentation to the signed document.

APPENDIX E: PERSONALITY MEASURE

Based on a 5-point scale, please honestly answer the following questions about yourself.

1. Am the life of the party.
2. Sympathize with others' feelings.
3. Get chore done right away.
4. Have frequent mood swings.
5. Have a vivid imagination.
6. Don't talk a lot.
7. Am not interested in other people' problems.
8. Often forget to put things back in their proper place.
9. Am relaxed most of the time.
10. Am not interested in abstract ideas.
11. Talk to a lot of different people at parties.
12. Feel others' emotions.
13. Like order.
14. Get upset easily.
15. Have difficulty understanding abstract ideas.
16. Keep in the background.
17. Am not really interested in others.
18. Make a mess of things.
19. Seldom feel blue.
20. Do not have a good imagination.

APPENDIX F: SELF-MONITORING

Based on true/false, answer these questions honestly about yourself.

1. I find it hard to imitate the behavior of other people.
2. At parties and social gatherings, I do not attempt to do or say things that others will like.
3. I can only argue for ideas which I already believe.
4. I can make impromptu speeches even on topics about which I have almost no information.
5. I guess I put on a show to impress or entertain people.
6. I would probably make a good actor.
7. In groups of people, I am rarely the center of attention.
8. In different situations and with different people, I often act like very different persons.
9. I am not particularly good at making other people like me.
10. I'm not always the person I appear to be.
11. I would not change my opinions (or the way I dothings) in order to please someone else or win their favor.
12. I have considered being an entertainer.
13. I have never been good at games like charades or improvisational acting
14. I have trouble changing my behavior to suit different people and different situations.
15. At a party, I let others keep the jokes and stories going.
16. I can look anyone in the eye and tell a lie with a straight face (if for a right end).
17. I may deceive people by being friendly when I really dislike them.

APPENDIX G: NEED FOR POWER

Based on a 5-point scale, please honestly answer the following questions about yourself.

1. I do my best work when my job assignments are fairly difficult.

2. I try very hard to improve on my past performance at work.

3. I take moderate risks and stick my neck out to get ahead at work.

4. I try to avoid any added responsibilities on my job.

5. I try to perform better than my workers.

6. I seek an active role in the leadership of a group.

7. I avoid trying to influence those around me to see things my way.

8. I find myself organizing and directing the activities of others.

9. I strive to gain more control over the events around me at work.

10. I strive to be "in command" when I am working in a group.

APPENDIX H: TEAM PROCESS

Please answer each of the following questions separately regarding your division.

Not at all	Very Little	To Some Extent	To a Great Extent	To a Very Great Extent
1	2	3	4	5

1. To what extent did my division make needed adjustments to the initial plan?
2. To what extent did my division plan on the fly as you were working on the task?
3. To what extent did my division redistribute tasks among the members as needed?
4. To what extent did members of my division communicate well with each other?
5. To what extent did my division smoothly integrate our work efforts?
6. To what extent did my division coordinate our activities with one another?
7. To what extent did my division coordinate our activities with one another?
8. To what extent did my division balance the workload among the members?
9. To what extent did my division assist each other when help was needed?

APPENDIX I: MTS PROCESS

Please answer each of the following questions separately regarding your taskforce as a whole.

Not at all	Very Little	To Some Extent	To a Great Extent	To a Very Great Extent
1	2	3	4	5

1. To what extent did my taskforce make needed adjustments to the initial plan?

2. To what extent did my taskforce plan on the fly as you were working on the task?

3. To what extent did my taskforce redistribute tasks among the members as needed?

4. To what extent did members of my taskforce communicate well with each other?

5. To what extent did my taskforce smoothly integrate our work efforts?

6. To what extent did my taskforce coordinate our activities with one another?

7. To what extent did my taskforce coordinate our activities with one another?

8. To what extent did my taskforce balance the workload among the members?

9. To what extent did my taskforce assist each other when help was needed?

APPENDIX J: SOCIOMETRIC ACTION PROCESS

Please answer each of the following questions separately regarding your taskforce as a whole.

Not at all	Very Little	To Some Extent	To a Great Extent	To a Very Great Extent
1	2	3	4	5

1. To what extent did each taskforce member coordinate the activities between one another?

2. To what extent did each taskforce member assist others when help was needed?

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