STARS

Electronic Theses and Dissertations, 2004-2019

2014

Exploring new boundaries in team cognition: Integrating knowledge in distributed teams

Stephanie Zajac
University of Central Florida

University of
Central Florida

STARS
Showcase of Text, Archives, Research & Scholarship

EXPLORING NEW BOUNDARIES IN TEAM COGNITION: INTERGRATING
KNOWLEDGE IN DISTRIBUTED TEAMS

by

STEPHANIE A. ZAJAC
B.S. University of Central Florida, 2006
B.S. University of Central Florida, 2011

A thesis submitted in partial fulfillment of the requirements
for the degree of Master of Science
in the Department of Psychology
in the College of Sciences
at the University of Central Florida
Orlando, Florida

Summer Term
2014

Major Professor: Eduardo Salas

ABSTRACT

Distributed teams continue to emerge in response to the complex organizational environments brought about by globalization, technological advancements, and the shift toward a knowledge-based economy. These teams are comprised of members who hold the disparate knowledge necessary to take on cognitively demanding tasks. However, knowledge coordination between team members who are not co-located is a significant challenge, often resulting in process loss and decrements to the effectiveness of team level knowledge structures. The current effort explores the configuration dimension of distributed teams, and specifically how subgroup formation based on geographic location, may impact the effectiveness of a team's transactive memory system and subsequent team process. In addition, the role of task cohesion as a buffer to negative intergroup interaction is explored.

My thesis is dedicated to my amazing parents, Dave and Judy Zajac, whose unwavering support inspired me at every step of the way. In addition, it is dedicated to all my friends who were there to encourage me and provide me with positive feedback when I needed it the most. Lastly, it is dedicated to my dog Isabella who stayed up many long nights with me.

ACKNOWLEDGMENTS

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

x

LIST OF ACRONYMS/ABBREVIATIONS

GDT Geographically Distributed Team

TMS Transactive Memory System

CHAPTER ONE: INTRODUCTION

Statement of the Problem

Technological advancements, globalization, and the shift toward a knowledge-based economy have all driven the changing nature of the workplace environment (Dunning, 2002; Pulakos, Arad, Donovan, & Plamadon, 2000). Developments in computer-mediated communication have improved the quality and availability of information exchange regardless of location. Furthermore, organizations that function within a global marketplace often require collaboration across organizational, spatial, or temporal boundaries (Boudreau, Loch, Robey, & Straud, 1998; Salas et al., 2008). Finally, highly mechanistic tasks have been replaced in part by cognitively demanding, knowledge-intensive activities such as strategic planning, product design, and decision-making (Cooke, Salas, Cannon-Bowers, & Stout, 2000). There has been a distinct shift from production-based economies to service and knowledge-based economies, which require a more flexible organizational structure (Townsend, DeMarie, & Hendrickson, 1998). These recent organizational trends, taken together, have given rise to an increasing number of geographically distributed teams (GDTs) that rely on virtual tools to tackle knowledge-intensive tasks.

GDTs are not only necessitated by some contexts, but also offer several potential benefits to both organizations and their employees. For example, organizations are not limited by geographic boundaries when searching for employees with the requisite knowledge, skills, and abilities, and can recruit top talent regardless of location (Johnson, Heiman, O'Neill, 2001). For employees, virtual communication tools provide flexibility in schedules as well as physical

location, allowing work to take place at a time and site that is most convenient (Johnson, et al., 2001).

However, GDTs that possess a depth and breadth of knowledge only provide the potential for optimal performance. In order to operate at their full capacity, team members must also be able to engage in effective teamwork behaviors (e.g. information sharing). The importance of teamwork in achieving positive team outcomes has been demonstrated across multiple domains including healthcare (Manser, 2009), military (Prince & Salas, 1993), aviation (Salas, Fowlkes, Stout, Milanovich, & Prince, 1999), and management (Edmondson, Roberto, & Watkins, 2003). However, much of the extant research has been based on the traditional team structure and does not consider the added level of complexity brought about by distributed environments. What little evidence that does exist suggests that spatial and temporal boundaries present a challenge to essential team processes (e.g. coordination) and that team performance is significantly inhibited by the lack of interpersonal interaction that typically engenders trust and social attraction to the team (Kirkman, Rosen, Gibson, Tesluk, & McPherson, 2002). According to Bell and Kozlowski (2002), distributed teams are becoming a norm for today's organizational environments, and they will continue to play an integral role in the future. Therefore, it is critical we move toward a deeper understanding of distributed team performance.

Toward this end, taxonomies of the dimensions of distribution have begun to emerge in the literature (e.g. Saunders & Ahuja, 2006, O'Leary & Cummings, 2007; Kirkman & Mathieu, 2005), and laid the groundwork for future investigation. However, temporal and spatial dimensions have received the bulk of the attention, and there are a significantly smaller number of extant theoretical and empirical investigations into the relationships between configuration of the team (defined as the number of geographic sites and number of members per site; O'Leary &

Cummings, 2007) and performance outcomes. As a dimension of distribution, configuration provides a readily observable and unavoidable division of team members into distinct subgroups.

Team configurations can lead to subgroup formation based on the distinct geographic locations, which in turn can limit the degree of collaboration with outgroup members and negatively impact intergroup dynamics (Polzer, Crisp, Jarvenpaa, & Kim, 2006). To exacerbate this issue, distributed teams are often comprised of members who have no prior familiarity with each other and who are brought together on a short-term, ad-hoc basis (e.g., Joint Force Operations; Pascual, Mills & Blendell, 1999). These teams rely on computer-mediated communication (CMC) tools, and may come together in-person infrequently if at all. Lack of shared experiences and opportunity to develop familiarity may inhibit team member's identification with and commitment to the team, and leave members prone to feelings of isolation and detachment (Kirkman, et al., 2002). Decreased interpersonal interaction may also limit the opportunity for members to recognize each other's expertise. These deleterious subgroup dynamics may extend to impact the emergence of the team-level cognitive variables that facilitate the coordination of information.

GDTs are frequently comprised of members with various functional backgrounds and the wide range of expertise necessary to engage in complex task execution. Therefore, individual team members hold unique knowledge that must be integrated to achieve superordinate goals. In order for this distributed knowledge to be useful at the team level, however, it must move from being individually- held to being part of a collective pool available to any member who may require it (Okhuysen & Eisenhardt, 2002). In distributed teams, this means knowledge must not only move between members of one location, but across geographical boundaries as well. While research regarding the impact of distribution on team cognition is scarce, evidence suggests that

these teams may face significant challenges. For example, distribution has been shown to have a negative relationship with information sharing behaviors as well as the formation of team-level knowledge structures (Mesmer-Magnus & DeChurch, 2009; Cramton, 2001).

One such knowledge structure that has been identified in the literature (e.g. Maynard, Mathieu, Rapp, & Gilson, 2012) as critical for distributed team success is a team's transactive memory system (TMS). TMSs are a team-level knowledge structure that allow for the division of cognitive labor and provide members access to information as needed. A TMS can be conceptualized as a means for organizing a team's collective pool of knowledge and facilitating information exchange. Therefore, teams operating with a highly effective TMS are able to quickly locate knowledge and engage in effective coordination to meet the demands of the task. According to Fiore, Salas, Cuevas, and Bowers (2003) team-level cognitive variables may be even more important to performance in a distributed context where member actions are unclear and the lack of salient non-verbal cues can cause misinterpretation. Additionally, affective team-level variables may play an important role in GDTs.

Cohesion, a psychosocial trait which commonly develops from interaction among team members and has been shown to facilitate performance in co-located teams (Marks, Mathieu, & Zaccaro, 2001), may prove to be an explanatory variable in distributed team performance. According to Carless and De Paola (2000), cohesion is a multi-dimensional construct that represents an attraction and commitment toward both team members (i.e., social cohesion) and the teams' goals (i.e., task cohesion). Baba and colleagues (2004) suggest distribution limits team interaction, and thus lowers overall cohesion. However, given the documented challenges to social interaction among distributed team members, task cohesion may play a unique and significant role. Commitment to the team's goals may mitigate the negative effects of physical

4

distance between subgroups. Specifically, it may impact the degree to which team members share and process diverse information in pursuit of shared goals.

<center>Purpose</center>

The purpose of the current effort is to parse out the top-down effects of configuration (as a dimension of distribution) on team cognition and team process, and to identify affective mechanisms that may play a role in the strength and direction of these relationships. As previously stated, while there has been some theoretical groundwork, empirical investigation into configurational distribution, and distributed teams in general, is lacking. Therefore, this multipronged effort begins with an attempt to clarify the various dimensions of distribution discussed in the literature. This will serve as a foundation to later discuss the specific effects of configuration on the effectiveness of a team's TMS. Next, I move on to an examination of how distinct configurations (i.e., co-located, fully distributed, balanced, and imbalanced teams) impact the formation of team's transactive memory system, and conclude with TMSs subsequent effect on an important dimension of team process. The first research question I aim to investigate is:

Research question 1: How do different distributed team configurations (i.e. co-located, fully distributed, balanced, imbalanced) affect the effectiveness of a team's TMS?

Next, the current study explores how a distributed team's TMS affects processes critical to performance in knowledge-intensive tasks. According to Fiore, Salas, Cuevas, and Bowers (2003), distributed teams that focus additional energy on pre-process activities (e.g. planning) will be better able to reallocate resources (e.g. knowledge) among distributed members when required. Plan formulation, therefore, will be of particular importance in distributed teams

<center>5</center>

tackling tasks that require knowledge integration, and may ultimately lead to higher overall performance. Therefore, the second research question that will be addressed is as follows:

Research question 2: How does a distributed team's TMS affect the ability to engage in effective plan formulation?

Finally, I conclude by looking at the team's level of cohesion, and how the specific task dimension may play a unique role in distributed teams. Research has generally ignored the multidimensional nature of the cohesion construct in distributed structures. GDTs do not have the same potential for interpersonal interaction and thus it has been suggested that it is more difficult to create an attraction to the group. However, it is largely unknown how the task cohesion, which is not dependent on social interaction, operates in a distributed environment. Therefore, my third research question is as follows:

Research question 3: How does the level of a team's task cohesion affect the strength or direction of the relationship between configurational distribution and the effectivness of team's TMS?

Unfortunately, a gap exists in the literature addressing how distribution affects the formation of team-level cognitive variables. I hope to take a step toward addressing this identified gap and improve our understanding of the underlying mechanisms of distributed team performance. Specifically, I plan to advance research on team configurations in order to understand how team structure can influence the effectiveness of team cognition and processes critical to performance.

CHAPTER TWO: LITERATURE REVIEW

Distributed Teams

Teams have traditionally been 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 each been assigned specific roles or functions to perform, and who have a limited life-span of membership (Salas, Dickenson, Converse, & Tannenbaum, 1992)." The literature on team performance contains an immense amount of both empirical and theoretical work, and frameworks that attempt to explain the cognitive, affective, and behavioral mechanisms that drive team performance abound (e.g. Fleishman & Zaccaro, 1992; Salas, Stagl, & Burke, 2004; Burke, Stagl, Salas, Pierce, & Kendall, 2006). In addition, the literature has also acknowledged that teams can exist within a multitude of environmental conditions (e.g. context) that can alter both the strength and direction of input-performance relationships (Cohen & Bailey, 1997). To this end, team performance has been examined in conjunction with the top-down effects of a variety of contextual features, including temporal restraints (Ellis, 2006), stress (Driskall & Salas, 1991), and ill-defined tasks (Schraw, Dunkle, & Bendixen, 1995).

Recently, calls have been put forth to address the impact of unique organizational conditions as they have changed the structure of teams and therefore the nature of team performance (e.g., Mathieu, Maynard, Rapp, & Gilson, 2008). One such development that has dramatically influenced the formation of teams and the way members integrate their interdependent contributions is the increased reliance on distributed teams. In fact, a recent survey conducted by the Society for Human Resource Management (SHRM) indicated that nearly half of all organizations use virtual teams (defined as crossing space, time, or temporal

7

boundaries), citing increased productivity and a global focus as reasons for their implementation (Minton-Eversole, 2012). The growing prevalence of this new organizational form has driven research exploring the potential benefits and drawbacks of distribution. However, there is a dearth of empirical investigation aimed at exploring the top-down influence of this contextual variable, and we need a better understanding of its effect on critical team process, states, and performance in order to advance both theory and practice (Salas, et al., 2008). Some of the literature on traditional team performance may be able to be leveraged to inform our understanding of distributed teams; however, frameworks of team performance that specifically address the unique facets of distribution are needed.

Distributed teams share many defining features with traditional team structures (e.g. interdependence, shared goals). They have been defined as "groups of people with a common purpose who carry out interdependent tasks across locations and time, using technology to communicate much more than they use face-to-face meetings" (Crampton, 2001; p. 346). As may be expected considering this general definition, overlap and ambiguity abound in the literature on distributed teams. Distributed teams are often mentioned in the same breath as virtual teams, and the literature stemming from these areas is unmistakably intertwined. Indeed, definitions of virtual teams often focus on communication mode, but include physical or temporal dispersion as a key feature (e.g. Bergiel, Bergiel, & Balsmeier, 2008; Lipnack & Stamps, 1997; Yoo & Kanawattanachai, 2001). While distributed teams can share many characteristics with virtual teams, Kirkman and Mathieu (2005) call for a distinction between these disparate dimensions in order to enhance our theoretical and practical understanding of how they differentially operate and the conditions that lead to effective performance within each. The authors contend that many face-to-face teams do in fact rely on virtual communication tools

8

to some degree, but physical distance is an antecedent, not a prerequisite, of virtuality. I agree with this assertion and contend that distribution and virtuality should not be used synonymously as is often the case. However, I argue that there is value in integrating the empirical evidence and theory from these two streams of research, and that in some instances virtuality may actually be considered a dimension of distribution.

In fact, O'Leary and Cummings (2007) argue the specific makeup of a distributed team is based on several dimensions, all of which can have differential implications for team process and performance as well as the types of challenges likely to be most salient. These authors suggest distributed teams can also differ on the degree of each dimension, and researchers have begun to address this issue in their proposed conceptual models (e.g. Saunders & Ahuja, 2006; Bell & Kozlowski, 2002). While many of the difficulties that exist across distributed team structures will stem from similar contexts (e.g., lack of face-to-face contact), some challenges are more prominent depending on the specific intrateam boundary that must be overcome. Therefore, in the next section I briefly outline the dimensions of distributed teams (*see* table 1), and address some of the issues and challenges contained within each.

Table 1. Dimensions of Distribution

Dimension	Definition	Cite
❖ Virtuality	"The degree to which teams use technology to communicate and coordinate their activities and efforts"	Maynard et al., 2012, p. 348
❖ Geographic Dispersion	Distribution which "at least two team members are situated at different locations"	Mortenson & Hinds, 2001, p. 213
❖ Temporal Dispersion	Distribution which "captures the extent to which team members' normal work hours overlap"	O'Leary & Cummings, 2007, p.438
❖ Lifespan	Distinction between "temporary and ongoing distributed teams based on the perceived life span of their tasks."	Saunders & Ahuja, 2006, p. 665
❖ Configuration	"The arrangement of members across sites independent of the spatial and temporal distances among them"	O'Leary & Cummings, 2007, p. 439

Level of Virtuality

Distributed teams, by nature, must rely on virtual tools to communicate and coordinate resources with members who are not co-located. Virtuality has been conceptualized as a continuum, and is defined as "the degree to which teams use technology to communicate and coordinate their activities and efforts" (Maynard, Mathieu, Rapp, & Gilson, 2012, p. 348). In addition to the amount of virtual communication, specific characteristics of the technology medium used have also been examined as facets of virtuality. One such characteristic is the degree of media richness, or "the ability to change understanding within a time interval" (Daft & Lengel, 1986; p. 560). Media richness theory suggests communication modes vary in part on their ability to accurately reproduce the message sent, which includes the relevant social and

10

non-verbal cues as well as the availability of feedback. When contextual details such as tone of voice or facial expressions are absent (i.e. as in the case of less rich forms such as email), the ability to learn from communication may decrease and the risk of miscommunication may be greater.

According to Kirkman and Mathieu (2005) a key facet of virtuality is the synchronicity of the communication mode. Synchronous modes of communication (e.g. audio conferencing, video conferencing) enable "real-time" exchange of information, allow for immediacy of feedback, and can enable the use of non-verbal communication cues. The drawback, which may be particularly salient for distributed teams with conflicting time zones and schedules, is that all parties must be available for same-time participation (Walther, 1996). Asynchronous modes enable communication with others at a different time and/or place. They allow team members to exchange messages when it convenient for their schedule, and are especially useful when carrying on an exchange over a long period of time or when resources and information need to be shared (e.g. a document or article). Drawbacks include increased decision making time (Baltes, Dickson, Sherman, Bauer, & LaGanke, 2002) and lack of social presence normally gained from interpersonal interaction (Walther, 1996). Recent evidence has suggested that the level of interdependence will impact which mode is most beneficial (Rico & Cohen, 2004), and that virtual teams that have access to a variety of synchronous and asynchronous communication tools experience the highest levels of performance (Dennis, Fuller, & Valacich, 2008). Although it has likely received the bulk of attention, the level of virtuality in terms of communication media is only one dimension of a distributed team.

Geographic Dispersion

As researchers continue to delineate the differences between traditional and face-to-face teams, spatial dispersion is another often cited dimension of distribution. Several terms have been used when discussing teams whose members are not physically co-located (e.g., spatially distributed teams, globally dispersed teams, technology-mediated teams, virtual teams; see Muethel & Hoegl, 2010; Fuller, Hardin, & Davison, 2007; Holton, 2001). For the purpose of the current effort, I refer to team structures that include spatial dispersion as geographically distributed teams (GDTs). GDTs refer specifically to teams whose members are physically separated; distance can range from different locations within the same city to separate continents (Mortenson & Hinds, 2001). Unlike traditional teams, geographically distributed teams rarely interact face-to-face and therefore must engage in critical team processes (e.g., communication) through technology-mediated means. While traditional teams may also rely heavily on virtual communication tools, it is the reduced degree of spontaneous communication that differentiates geographically distributed teams (O' Leary & Cummings, 2007). For example, while two colleagues who work in separate departments of an organization may commonly rely on virtual tools (e.g. chat), if need be they may choose to hold an impromptu face-to-face meeting to clear up confusion.

Unfortunately, geographic distance has been evidenced to result in reduced overall communication frequency, as well as delay in task completion and reduction in perceived helpfulness of remote coworkers (Herbsleb, Mockus, Finholt, & Grinter, 2007). Lack of face-to-face contact can also be problematic for the implementation of and commitment to shared team-level goals (Hertel, Konradt, & Orlikowski, 2004). In addition, geographically distributed teams are often composed of members from culturally diverse nations who hold different perceptions

12

of time. Saunders, Van Slyke and Vogel (2004) propose that culturally heterogeneous teams can encounter conflict when members hold disparate "time visions", particularly when setting deadlines, coordinating activities, and measuring performance.

Temporal Dispersion

Spatial and temporal dispersion are two dimensions of distribution that are often considered in tandem, with few empirical investigations parsing out their differential impact on team processes and performance. While many of the challenges inherent to these team structures do indeed overlap, some are unique to collaborating across temporal boundaries. Team members who must cross different time zones can have few, if any, overlapping work hours and therefore must rely on asynchronous communication. According to Cummings, Espinosa, and Pickering, (2009) this can result in an even greater degree of coordination delay than spatially distributed teams who are still able to collaborate in real-time and receive immediate feedback. In addition, team process can suffer from what Espinosa and Carmel (2003) refer to as vulnerability costs, or time lost to resolving conflict and correcting mistakes.

Lifespan

Answering the call for a more in-depth classification of team structures in order to refine conceptualizations of process and performance, researchers have proposed the need for a distinction in team lifespan as a separate dimension of distributed teams. Saunders and Ahuja (2006) assert that much of the empirical and theoretical work in the area of distributed teams is aimed at teams that are both temporary and ad hoc. The authors argue that while distinctions have been made for temporal, spatial and organizational dimensions, team lifespan (short-term vs. ongoing) has been largely ignored. Short-term teams (e.g. project teams assembled to meet a

13

specific objective) often have set deadlines to meet goals, operate under time pressure, and perform one task cycle (Devine, Clayton, Philips, Dunford & Melner, 1999). Relationships that manifest in the short-term may not extend to long-term team functioning. Alternatively, long-term relationships that do not manifest in the short term may be overlooked. Evidence presented by Kelly & Loving (2004) suggests that this may due in part to a focus on task-related interaction goals (as opposed to interpersonal interaction goals) among team members who operate within limited time constraints. In addition, temporary teams may interact differently due to the fact that there is no anticipation of future interaction (Saunders & Ahuja, 2006).

Configuration

Configuration, perhaps currently the most underexplored dimension of distribution, is defined as the number of geographic locations represented by the team and the relative number of members at each site (O'Leary & Cummings, 2007). Although configuration is a fundamental characteristic of geographically distributed teams (GDTs), research addressing the issue at the team-level is sparse and has only recently started to gain attention (O'Leary, 2002). Unfortunately, past studies exploring the effects of geographic distribution often conceptualize it as a dichotomous variable (distributed vs. face-to-face teams), and thus they do not capture other configurations (e.g. partially distributed team structures -see table X) common in today's organizations and limit the conclusions that can be drawn (Stagl et al., 2007).

According to O'Leary & Cummings (2007), two key aspects of the configurational dimension of dispersion are the isolation of individual team members and the balance or imbalance of subgroups at different geographical locations (see table 2 for a list of possible configurations). Both of these variables can present challenges to team process (e.g.,

14

communication, knowledge coordination) in terms of intergroup relations between locations, majority/minority conflicts, and subgroup formation (e.g. Bos, Shami, Olson, Sheshin, & Nan, 2004; Mortenson & Hinds, 2001). Furthermore, feelings of separation and remoteness from the team are likely to increase for those who are the sole team members (e.g. isolates) at a geographic location. Taken together, these issues represent a significant challenge for interaction among distributed team members. While the importance of configuration has been noted and discussed (e.g. O'Leary & Mortenson, 2007), empirical investigation is limited. Therefore, as this represents a substantial gap in the literature, configuration and its top-down impact on team process is the focus of the current effort and will be covered in greater detail in subsequent chapters.

Table 2. Potential team configurations

Configuration	Definition	Cite
❖ Fully co-located	Teams where all members are in the same geographic location	O'Leary & Mortensen, 2005
❖ Balanced subgroups	Teams with a balanced number of members at each location and no geographic isolates	O'Leary & Mortensen, 2005
❖ Imbalanced subgroups	Teams with an uneven number of members at each location, and whose structures do not include any isolated members	O'Leary & Mortensen, 2005
❖ Imbalanced with isolates	Teams with an uneven number of members at each location, and whose structures includes at least one isolated member	O'Leary & Mortensen, 2005
❖ Fully distributed	Teams where all members are completely dispersed, with no two members at the same location	O'Leary & Mortensen, 2005

Summary

Removing the limitations imposed by physical location and temporal distance when composing teams has potential benefits for the team and the organization within which it is nested. However, distribution adds an additional level of complexity to team performance and has been evidenced to produce obstacles to effective team processes such as communication and coordination (Fiore, Salas, Cuevas, & Bowers, 2003). Furthermore, distribution may inhibit the development of cognitive and affective emergent states that have been evidenced to facilitate performance such as trust (Jarvenpaa, Knoll & Liedner, 1998), transactive memory systems (Kanawattanachai & Yoo, 2007) and cohesion (Fiore et al., 2003).

As is clear by the previous descriptions, the dimensions of distribution can overlap and often cause similar barriers to performance. However, I argue that they are unique enough to be considered separately. Although in some cases one dimension may be a prerequisite to another (e.g. for a team to be temporally distributed, they must also be geographically distributed), this is not always the case (e.g. a geographically distributed team may all reside in the same time zone). Research on distributed teams is still in its nascent stages, and exploration into the impact of specific dimensions is valuable but limited. However, authors have begun to lay the theoretical groundwork on configurational distribution, making this an area ripe for empirical investigation.

Transactive Memory Systems

In a review by Mathieu, Maynard, Rapp, & Gilson (2008) summarizing the progress made in team effectiveness research, the authors assert that there is a gap in the literature exploring the role of emergent states (e.g. team cognition) in global teams. Indeed, while team cognition research has grown substantially in the past decades, relatively few studies have looked

at the impact of contexts such as virtuality and distribution on the coordination and integration of team member knowledge (see Cramton, 2001; Espinosa, Slaughter, Kraut, & Herbsleb, 2007; Kanawattanachai & Yoo, 2007; Kotlarski & Oshri, 2005; Sole & Edmondson). Even fewer studies have discussed the specific dimension of configurational distribution and its influence on team cognition (see O'Leary & Mortenson, 2010). Given the prevalence of distributed teams and the unique structures (e.g. balanced and imbalanced subgroups) they take on in the real world, this is a gap that needs to be addressed if we are to more fully understand how distributed teams operate.

Therefore, the following section explores a critical team-level cognitive emergent state (i.e. transactive memory systems) and how configurational distribution may impact its emergence. Recently, researchers have begun to turn to the literature on self-categorization and group dynamics in exploring the complex relationships between distribution and team outcomes (e.g. Polzer, et al., 2006). I aim to extend this work by utilizing theory on intergroup relations, including Social Identity theory (Tajfel & Turner, 1986) and Self-Categorization Theory (Turner, Hogg, Oakes, Reicher, and Wethererall, 1987), as a foundation to explain how balanced or imbalanced subgroups may facilitate or impede the emergence of a highly functioning TMS. Furthermore, the review and hypotheses that follow aim to begin unlocking what Wildman and colleagues (2012) call the "black box" of team cognition research. The authors assert that much extant work focuses on the relationship between knowledge constructs and performance, while largely ignoring the cognitive, behavioral, and affective variables that may be mediating this relationship. Therefore, as plan formulation is an essential team process (and may be even more important in teams that engage in knowledge-intensive tasks), I examine how transactive

17

memory systems influence the degree to which distributed teams engage in effective plan formulation.

Overview of Transactive Memory Systems

A TMS has been defined as "the shared division of cognitive labor with respect to the encoding, storage, retrieval, and communication of information" (Hollingshead, 2001, p. 1080). While similar to other team cognition variables (e.g. shared mental models), transactive memory systems focus on knowledge that is distributed among the team. The theory behind transactive memory was developed by Wegner, Giuliano, and Hertel (1985) as a means of describing how intimate couples depend on each other to store and recall information. This concept was then advanced beyond the dyadic level (e.g. Liang, Moreland, & Argote, 1995), and is now used as a means to explain how teams coordinate the distributed knowledge needed to execute cognitively demanding tasks. TMSs, therefore, can be thought of as an underlying mechanism by which distributed information is organized and utilized to achieve team-level goals.

TMSs have traditionally been conceptualized as a collective cognitive emergent state, and are critical for collaborative goal attainment in teams (Bedwell et al., 2012). While emergent states originate in individual interaction, they manifest at the team level and can be defined as "constructs that characterize properties of the team that are typically dynamic in nature and vary as a function of team context, inputs, processes, and outcomes" (Marks et al., 2001, p. 357). They are formed by both the task-related and informal (i.e. social) interaction of individuals, and are constrained by the contextual environment within which the individuals operate (Kozlwoski & Klein, 2000). Indeed, environmental features of the environment can influence the formation of a team's TMS (e.g. acute stress; Ellis, 2006).

According to Lewis (2003) a TMS emerges when team members draw on others' knowledge and combine the requisite information to achieve interdependent goals. Therefore, a functioning TMS must consist not only of member expertise (i.e., individual memory systems), but also knowledge of others' area of expertise. Specifically, Lewis (2003) delineates three dimensions: (1) specialization (the structure of knowledge held by team members, or where specific expertise lies within a team), (2) coordination (effective, organized processing of information), and (3) credibility (member's perceptions of the reliability of others' knowledge). According to Brandon and Hollingshead (2004), the optimal state of a TMS is convergence and is reached when all members share an accurate, common, and validated understanding of the location of expertise. When convergence exists, new information is efficiently funneled to the appropriate expert, and encoded information is both accessed and shared as needed.

The relationship between a team's TMS and performance has been well established (e.g., Austin, 2003; Lewis, 2004; Zhang, Hempel, Han, & Tjosvold, 2007). TMSs have been linked to additional positive team outcomes such as an increase in requesting and accepting back-up when needed (Smith-Jentsch, Kraiger, Cannon-Bowers, & Salas, 2009), learning as well as the transfer of learning to other tasks (Lewis, Lange, & Gillis, 2005), and member satisfaction (Michonov, Olivier-Chiron, Rusch, & Chiron, 2008). Several explanations for the positive impact of an effective team-level TMS exist. Individuals act as an external knowledge source for others, resulting in a larger pool of information than would otherwise be possible for any one individual (Wegner, 1986). According to Kozlowski & Bell (2003) the specialized knowledge held by experts is likely to get deeper, given that each expert is responsible for encoding information in their unique area. In addition, specialization will reduce the cognitive load on each member and also reduce duplication of efforts. According to Rau (2005) members are only responsible for

their own area of expertise and knowledge of the expertise of others, and this allows for greater task-coordination.

The conceptualization of TMS is beginning to move toward that of a hybrid construct, or a blend of both emergent state and team process (Mathieu et al., 2008). Specialization refers to the blueprint or pattern of knowledge throughout the team; the location of expertise. Credibility stems from the characteristic or qualities of an individual and refers to how reliable a members' information is as perceived by others. These dimensions, therefore, are cognitive in nature and emerge from the dynamic interactions of team members. Coordination, alternatively, is a behavioral team process as it refers to the actual transactions that transpire among individual team members. These transactive processes refer to (1) comparing individual knowledge, (2) establishing expertise, (3) searching for needed information, and (4) communicating information (Hollingshead, 1998a). In a recent review conducted by Lewis and Herndon (2011), the authors assert that the common definitions of TMS often focus only on a "shared understanding" and ignore the differentiation of knowledge as well as the process component. Furthermore, the authors stress the dynamic nature of TMS functioning, asserting that the structural components influence the encoding, storage, and retrieval processes, in turn serve to update the structure.

Antecedents of a TMS

Several compositional, psychosocial, and contextual factors have been linked to the emergence of an effective or ineffective TMS. One such factor is the knowledge of one's own unique expertise and awareness of the fact that others members hold unique task-relevant information as well (Lewis, 2004). Stasser, Stewart, and Wittenbaum (1995) found that when team members were explicitly told others had unique information and given the specific details

20

about each member's expertise they performed better on a hidden profile task. In the absence of explicit information, team members may base assumptions of expertise on surface-level demographic characteristics. For instance, Thomas-Hunt and Phillips (2004) found that gender affects the degree to which others ascribe expertise as well as a team's ability to utilize expertise to complete a knowledge-intensive task. Ethnicity is another demographic variable that can influence the recognition of expertise, and exerts a stronger influence on teams with a short lifecycle (Bunderson, 2003). In addition, team process variables can potentially influence the effectiveness of a team's TMS.

Communication, which enables members to exchange information about their own expertise and solicit the expertise of others, is another often studied antecedent of a team's TMS. Lewis (2004) found that the frequency of task-oriented communication can improve initial development of a TMS in teams as well as the maturation of a TMS over time. However, the author also found that this effect did not hold for teams using computer-mediated communication. Also looking at communication mode, He, Butler, and King (2007) found that face-to-face communication had a positive influence on member's ability to locate expertise, but computer-mediated communication did not have a significant effect. Overall, these studies provide support for the importance of face-to-face communication.

Team conflict can be relationship- or task- oriented, and may also influence the effectiveness of a team's TMS. Relationship conflict involves interpersonal incompatibility, and can undermine focus on the task and cooperation among team members (Mannix, Griffith, & Neale, 2002). Rau (2005) suggests two explanations (1) conflict can lead to distrust, or an unwillingness to rely on other members, or (2) conflict may prevent a team from initially developing awareness. The author found that an awareness of location of expertise in the team

positively predicts performance, but that this relationship does not hold when there is a high level of relationship conflict present.

Psychosocial constructs and social relationships can impact the degree to which members are willing and able to utilize expertise effectively. Trust has been conceptualized as both an important dimension of TMS (e.g. Kanawattanachai & Yoo, 2007) as well as an antecedent. As an antecedent, trust can be parsed into at least two dimensions that each have a unique effect on both the structure of knowledge and transactive processes: (1) trust in members' task-related ability, and (2) interpersonal trust (Akgün, Byrne, Keskin, Lynn, & Imamoglu, 2005; Ashleigh & Prichard, 2012). Prior familiarity with team members also significantly influences TMS emergence, as members are more likely to have first-hand knowledge of each other's' expertise (Lewis, 2004). In addition, teams comprised of familiar members are more likely to share their own unique knowledge as well as consider information given from other team members (Gruenfeld, Mannix, Williams, & Neale, 1996).

Finally, characteristics of the operating environment play a critical role in the effectiveness of a team's TMS. Task interdependence is central to the development of a TMS (Wegener et al., 1991), and therefore the level of interdependence is an important variable. In a study conducted by Zhang and colleagues (2007) task- and goal- interdependence were both found to be positively related to TMS emergence. Furthermore, Akgün and colleagues (2005) found task interdependence increased the positive relationship between TMS and critical team outcomes. As previously mentioned, stress can also affect the development of a TMS, but the direction of the relationship depends on the type of stressor introduced. While a hindrance stressor (e.g. role conflict) negatively relates toTMS emergence, a challenge stressor (e.g. job complexity) may actually serve to promote emergence (Pearsall, Ellis, & Stein, 2009).

While TMSs have received much attention in face-to-face teams, there is very little evidence on the antecedents to effective TMSs in distributed teams that rely heavily on virtual communication. However, initial findings suggest the literature on traditional teams may be leveraged to understand TMSs in a distributed environment. For example, Kanawattanachai & Yoo (2007) suggest that the frequency and type of communication may affect the dimensions of TMS in distributed teams as well. Specifically, the authors found that the frequency of initial task-oriented communication played a crucial role in member's knowledge of expertise location and level of cognition-based trust. Furthermore, once a team's TMS had been formed, coordination of task-knowledge became central to team performance.

Configuration, as a dimension of distribution and the focus of the current study, has been initially explored as a potential antecedent to the effectiveness of a team's TMS. O'Leary & Mortensen (2010) found that distribution led to a change in group dynamics, and that the formation of subgroups in distributed teams led to a less effective TMS. However, research in this area is limited and much more work remains to be done.

In sum, teams are capable of synergistically combining individual team member competencies (e.g., knowledge) to perform above and beyond the ability of any one member (Salas, Goodwin, and Burke, 2009), and TMSs may be a critical element behind this phenomenon. Initial findings indicate distribution may have a negative effect on a team's TMS, and are especially concerning because an effective TMS may be key to successful performance in a distributed environment (Kotlarsky & Oshri, 2005). Given the nature of distributed teams, as will be covered in the following section, both ability and motivation to engage in transactive processes are likely affected by configurational distribution. Therefore, further empirical investigation into how distribution affects this team-level cognitive variable is needed.

TMS and Configurational Distribution

As previously stated, geographically distributed teams are frequently composed of members with the diverse knowledge necessary to successfully execute complex, cognitively demanding tasks. Often, the wide range of requisite knowledge is not available in a single location, or knowledge is embedded within different geographic markets (Griffith & Neale, 2001). While distributed expertise has the potential to increase team performance (e.g. through an increased knowledge base), it may actually have a detrimental effect when members do not gain access to the team's complete pool of information. Sole and Edmondson (2002) propose that functional or occupational diversity can lead to miscommunication, and that information does not always flow easily between work sites. Indeed, the nature of a GDT can impact the degree to which teams are able to integrate and utilize the diverse knowledge held by members who are not co-located. Therefore, effective and efficient knowledge structures that facilitate the integration of unique information may be especially critical in teams whose members reside at disparate geographic sites.

GDTs may experience what Carton and Cummings (2012) classify as identity-based subgroups due to differences in physical location, with intergroup processes grounded in social identity. Geographic locations provide a natural basis for identification, and can affect the extent to which members are willing and able to integrate individually held knowledge. Recent empirical investigations have considered configuration a type of team diversity, and therefore turned to the literature on social categorization. Theories in this domain are distinct in the way they explain identity formation and the resulting processes; however, they all point to similar outcomes from the dynamic interactions of diverse subgroups. The few extant empirical studies

on configuraton have mostly looked at balanced subgroups (e.g. Polzer et al., 2006), while imbalance within subgroups has received very little attention.

Subgroup Formation and TMS

Crawford and Lepine (2013) put forth three fundamental elements of structure that describe the essential patterns of team interaction, one of which is subgrouping. Subgrouping can present obstacles to communication and transfer of resources within the team (Scott, 2000). In fact, adverse or impeded interaction between subgroups at separate locations is likely to be the root cause of much of the process loss in distributed teams. Therefore, extant research on the formation and influence of subgroups can be leveraged to understand how subdivided teams impair the team processes essential for the development of an effective TMS.

Many theories of intergroup relations were originally introduced to explain the relationship between diversity in team composition and team outcomes. Originally, diversity was often defined in terms of demographic variables, such as race, nationality, gender, and age (Lau & Murnigham, 1998). Theories of subgroup dynamics have since been extended to include diversity based on a number of different characteristics that stem from within and outside the team, including ideological diversity, education, tenure, functional background, and organizational characteristics (Bezrukova et al., 2012; Dyck & Starke, 1999; Rico et al., 2012; van Knippenberg et al., 2011). Most recently, configuration has been argued as a team-level compositional variable, with diversity represented by differences in the number of sites as well as the number of members at each site (O'Leary & Mortensen, 2010).

Social Identity Theory (SIT), pioneered by Tajfel and Turner (1986), is often cited as an explanatory concept behind intergroup relations. SIT suggests that individuals define themselves

by their perceived membership in a group and that they in turn gain emotional and value significance from this association. Members may view the group to which they belong, the ingroup, differently from outgroups resulting in ingroup favoritism and bias. Favoritism is defined as "any tendency to favor the ingroup over the outgroup, in behavior, attitudes, preferences or perception" (Turner, Brown, & Tajfel, 1979, p. 187). The underlying hypothesis, according to Turner and Onorato (1999), is that social comparisons based on identity result in pressure to differentiate ingroups as superior in order to attain a positive view of one's self and group. While not necessarily grounded in aggression or hostility toward the outgroup, favoritism can cause members to more positively evaluate others of their own group in terms of both social and task-related competencies. Ingroup bias, on the other hand, develops when favoritism is unfair, judgments are made without evidence, and treatment of the outgroup is discriminatory.

Self-Categorization Theory was developed by Turner (1985) as an extension or elaboration of SIT, namely to address questions that arose from the original theory. Specifically, Hogg and Terry (2000) assert that Self-Categorization Theory addresses the social cognitive processes through which an individual's identity is formed (i.e. self-categorization and depersonalization). A central tenet of the theory is that individuals categorize themselves and others based on group prototypes, or sets of attributes that characterize a group and distinguish it from others. Group members are therefore seen as encompassing a certain prototype and less as unique individuals, a process which the theory refers to as depersonalization. In turn, self-categorization leads individuals to identify themselves as part of a distinct ingroup. Taken together, these theories provide the foundation for how a team's physical structure, considered as a type of team diversity, forms a basis for identity.

Subgroups formed by members in physically distinct locations have been theorized to have a negative impact on a number of team processes and psychosocial states (e.g. cohesion, communication, and task and relational conflict; Axtell, Fleck, and Turner, 2004). Cramton and Hinds (2005) suggest that, if not managed correctly, an 'us' versus 'them' attitude can give rise to ethnocentrism and escalated conflict. Polzer and colleagues (2006) found evidence to support that subgroups in GDTs lead to heightened conflict and reduced trust. Findings from Hinds & Morternson (2005) corroborate with this evidence, and suggest that GDTs experience more task and interpersonal conflict than their collocated counter parts. Through the lens of SIT, self-categorization results in the positive perception or bias toward other ingroup members. Depersonalization extends these favorable perceptions uniformly to all ingroup members, and thus results in a pattern of ingroup liking, trust, and harmony (Hogg, 2006). Overall, these findings, coupled with the logistical constraints inherent to GDT functioning (e.g. reduced face-to-face communication, lack of shared experiences), can hinder the effectiveness of team-level cognitive variables.

In fact, Cramton and Hinds (2005) suggest that differences in physical location can actually intensify the tension in subgroup interactions, and acknowledge that information sharing may suffer in the process. In a field study of geographically distributed collaborative project teams, Cramton (2001) uncovered several of the barriers to establishing mutual knowledge structures. These include failure to share contextual information, unevenly distributed information, difficulty communicating information, and differences in informational access. Taken together the barriers result in an adverse effect on information exchange and interpretation, and ultimately on the formation of mutual knowledge and the effectiveness of dispersed collaboration.

In one of the only empirical investigations to look at configuration of a GDT and TMS emergence specifically, O'Leary and Mortensen (2010) proposed that the boundaries imposed by subgroup formation would hinder the effectiveness of the team knowledge structure. The authors found that teams comprised of subgroups identified less with the overall team and had a significantly lower transactive memory system than teams without subgroups. This may owe to the fact that many of the aforementioned factors leading to a highly functioning TMS (e.g. face-to-face communication) are impeded or obviated in a GDT. In fact, configuration may impact the dimensions of a TMS separately by inhibiting the extent to which members recognize expertise and the reducing the perception of outgroup member credibility.

Subgroups and emergence of TMS specialization

Subgroups formed by configuration may affect not only a team's ability to share and integrate knowledge, but their willingness and motivation to do so as well (Ren & Argote, 2011). For a transactive memory system to begin, members must learn something about one another's specialization (Wegner, 1987). Put another way, members must be aware of the location of knowledge within the team (i.e. who knows what) in order for it to be utilized at the team level. Perceived expertise can be achieved through the identification of specific or task-related cues (e.g. organizational tenure, educational achievements) or diffuse cues (e.g. gender, ethnicity), and effects an individual's influence within a group (Bunderson, 2003). Cue recognition can be achieved through self-disclosure, information gathered through task-related conversation, or shared experiences. Unfortunately, many of the means by which members recognize expertise cues are limited in GDTs. Members of GDTs have less opportunity for interpersonal interaction, and communication between distributed members is less frequent. Those individuals who are not

co-located do not have the same opportunities to share common experiences as their co-located members, and furthermore often lack familiarity and a history together. Therefore, awareness of specialized knowledge presents a significant challenge. While subgroups may easily recognize intragroup knowledge, knowledge across subgroups may be more difficult to uncover.

To compound this issue, as individuals categorize themselves by membership in particular subgroups or roles, it leads to self- and other-stereotyping based on the relevant characteristics (Turner and Onorato, 1999). This in turn may cause members of an ingroup to view themselves as having more in common with other ingroup members and to view outgroup members as being distinct, thus reducing the desire for interpersonal interaction with the outgroup. Furthermore, self-categorization leads to the "outgroup homogeneity effect" (Turner, Oakes, Haslam & McGarty, 1994), where outgroup members are viewed as more homogenous than ingroup members. If outgroup members are perceived as relatively similar to one another, and there is less opportunity and desire for interaction with them, it becomes unlikely that they will be attributed specific expertise by members of another subgroup.

Subgroups and emergence of TMS credibility

Subgroup boundaries can also hinder member's perceptions of the credibility of outgroup members' information. Specifically, team members may judge information that resides within members of their ingroup as more credible due to a general preference for ingroup members (i.e. ingroup favoritism) and a tendency to evaluate their competencies (i.e., knowledge, skills, and abilities) more favorably. In turn, they may seek and employ knowledge from ingroup members more frequently than that of outgroup members. If conflicting opinions exist between subgroups, members are likely to have more confidence in their own ingroup members' opinions regardless

of expertise. In extreme conditions bias behavior may cause subgroups to actively avoid sharing and accepting information from an outgroup member. Evidence for the emergence of bias can be found in Cramton's (2001) field investigation of distributed project teams. The author found that subgroups actively withheld task-relevant information from outgroup members.

Decreased levels of interpersonal and task-related trust may also impact the credibility of team member knowledge across subgroups, and thus members' willingness to integrate knowledge from an outgroup member. Politis (2003) found that trust has a significant positive relationship on the facets of knowledge acquisition, or the obtainment of information from those with the relative expertise. The author goes on to suggest that trust will not only affect the degree to which members seek information, but also the degree to which the expert feels safe disclosing information. Jarvenpaa , Knoll, and Leidner (1998) explored whether trust can be developed in teams who (1) do not have a past history and (2) are geographically dispersed. The authors posited that lack of previous shared team experiences as well as disparate geographic locations would both impede the potential for trust. Furthermore, through an analysis of case studies the authors found that while it is possible for these teams to develop a type of 'swift' trust, it is easily broken. Ingroup favoritism may lead members of a subgroup to trust each other's task-related information more than outgroup members, thus attributing them more credibility. In addition, as outgroup members are viewed as homogenous, if one member of an outgroup provides unreliable information, the negative consequences for trust may extend to all members at that location.

Summary

In sum, the awareness of knowledge within a GDT will be hindered due to reduced cue recognition across subgroups and the stereotyping of both ingroup and outgroup members.

Reduced opportunity and desire for social interaction will limit the opportunity to learn more about outgroup members and thus members will likely adjust their original perceptions to create more accurate attributions of expertise. Credibility of outgroup members, and thus the willingness to seek and accept information from them, will suffer due to ingroup favoritism and bias as well as decreased levels of both task and interpersonal trust . Because of these barriers to an effective TMS, task-relevant knowledge of disparate subgroups may not become part of the larger collective pool from which the team can draw. Even if expertise is recognized, if credibility is not established expert knowledge may not be utilized by outgroup members.

Configurational Structures and TMS

Self-Categorization Theory refers to the salience of an identity, or an individual's readiness to act on categories that appear relevant and useful as well as the match between perceived category and the reality of the situation (Turner, Hogg, Oakes, Reicher, and Wehterall, 1987). The authors stress that the salience of an identity is variable, and depends on the immediate context of the situation. According to Hogg (2000) people tend to draw on categories that are either chronically accessible (e.g. frequently employed) or situationally accessible (e.g. perceptually salient). They then compare the category to the social field to investigate fit, or the degree to which a category accounts for similarities and differences among individuals. Once the ingroup category is activated, it then accentuates the distinctiveness of each group and depersonalizes behavior.

Polzer and colleagues (2006) suggest members may use differences in geographic location as a basis for self-categorization. Geographic distribution provides for objective, structural diversity that is readily observable between subgroups and cannot be ignored or

overlooked (O'Leary & Mortensen, 2010). Membership in a particular subgroup is both highly predictable and relatively unchanging. Furthermore, division based on geographic location is inherently related to knowledge-based interdependent tasks, as information must move both within and between sites. I argue that the probability of the perceived salience of subgroup differences based on configuration will be high.

The literature in which diversity is based on geographic configuration is still in its nascent stages, and there is dearth of empirical investigation on the relationship between subgroups based on location and team outcomes. However, the disparate team configurations that exist (i.e., co-located, fully distributed, balanced, and imbalanced) may hold implications for subgroup formation and the degree of negative subgroup interaction. This in turn may differentially impact the effectiveness of a team's TMS.

Co-located Teams

Co-located teams do not have the opportunity to form subgroups based on location, and therefore will not realize the same negative consequences of geographic distribution. Interpersonal interaction will not be impeded by the ingroup-outgroup status and conflict that is engendered from self- categorization with a specific work site. Ingroup status, and the subsequent bias and favoritism, may in fact be attributed to the entire team. Members therefore will benefit from both the increased opportunity and desire to share individually held information with teammates, and to accept and integrate information from others more readily.

The physical limitations inherent to configuration will also be avoided. Co-located teams are able to meet face-to-face more often and have a greater opportunity for interpersonal interaction. Increased frequency of communication, as well as the possibility of spontaneous

communication, should positively influence a team's ability to locate knowledge. Conflict may be mitigated as misunderstandings that arise from miscommunication and lack of nonverbal cues should be limited. These teams will also be more likely to benefit from familiarity and shared experiences with other members. Finally, members will also benefit from direct access to the full knowledge base of the team.

Therefore, I propose that co-located team structures (i.e. teams who do not experience subgroup formation on the basis of physical dispersion) will result in a more effective TMS:

Hypothesis 1a: *Co-located team structures will have a more effective TMS as compared to balanced or imbalanced subgroup structures.*

Fully Distributed Teams

Distributed teams configurations that do not contain balanced or imbalanced subgroups (i.e. fully distributed teams) will still experience the negative impact of geographic distribution, but to a lesser degree. According to O'Leary and Mortenson (2010) geographically isolated members are viewed as unique to the remainder of their teammates, thus combating the outgroup homogeneity effect and increasing the probability that others will attribute them expertise and seek information from them. Furthermore, as they have no co-located members with which to form a bond, isolates are more apt to put forth effort to interact and seek knowledge from outgroup members.

As there is a weak basis for self-categorization into subgroups, isolates are more likely to identify with the overall team and will not experience the same categorization-driven tensions that drive conflict (O'Leary & Morternson, 2010: Polzer et al., 2006). There is only one individual at each geographic location, and so there is no basis for majority-minority group conflict. Therefore, I argue that these team structures will experience potentially deleterious

33

subgroup relationships to a lesser degree, and will have a more effective TMS than other distributed configurations.

Hypothesis 1b: Fully distributed team structures will have a more effective TMS as compared to balanced or imbalanced subgroup structures.

Balanced Subgroups

Teams comprised of balanced subgroups, or two subgroups with an equal number of members at each location, may result in the greatest degree of negative subgroup interaction. Thatcher, Jehn, and Zanutto (2003) found that balanced subgroups gave rise to the highest levels of conflict. Polzer and colleagues (2006) also found evidence that balanced groups encountered both affective and task conflict. The authors assert that increased conflict is engendered from equal size and power. Lau and Murningham (1998) suggest equal size may cause subgroups to be diametrically opposed, or completely opposite in position, which intensifies any potential negative interaction.

Nishii and Goncalo (2008) propose a related explanation for increased levels conflict based on Competition Theory. The authors suggest that teams often perceive competition over a finite set of resources, and when subgroups are of equal size, they are more likely to perceive their dominance and resources are threatened. This in turn can lead to increased competition and conflict. Competition can cause subgroups to put their own goals above the goals of the larger collective (Beersma et al., 2003), and may cause members of different subgroups to withhold knowledge, or be unresponsive or incomplete when responding to a request for knowledge.

Ultimately, heightened conflict can restrict the flow of information between subgroups. While the literature on task conflict and team level outcomes is contradictory, relationship

conflict has been consistently shown to exert a negative influence on variables such as member commitment and performance (DeDrue & Weingart, 2003; de Wit, Greer, & Jehn, 2012). In terms of a team's TMS, relationship conflict can not only lead to difficulties in knowledge location, but can restrict member's use of an established TMS. Specifically, interpersonal conflict can result in threat anxiety that limits a member's desire to depend on others for information as well as their ability to process new information once received (Pelled, 1996; Rau, 2005).

Balanced subgroup also experience lower levels of identification-based trust (Polzer et al., 2006). Trust, an important antecedent to the effectiveness of a team's TMS, may be especially important in GDTs. Jarvenpaa, Knoll, and Liedner (1998) suggest that for distributed teams, trust is the foundation of open and effective information exchange. Low levels of trust could also result in an unwillingness to rely on members of the outgroup for information. It could also affect the degree to which outgroup member information is seen as credible.

In sum, I assert that teams with balanced subgroups represent the most potential for deleterious intergroup dynamics, and are therefore likely to experience the greatest decrement to team level knowledge structures. Specifically, balanced subgroups can lead to heightened conflict and reduced levels of trust between geographic locations, both previously established as having negative associations with TMSs. Conflict and reduced trust may restrict members' motivation to share information, as well as cause outgroup members' information to be perceived as less credible. Therefore:

Hypothesis 1c: Teams with balanced subgroup structures will have a significantly less effective TMS as compared to co-located, fully distributed, or imbalanced structures.

Imbalanced Subgroups

Imbalanced configurations contain an unequal numbers of members across separate geographic locations. While these teams will still experience the challenges imposed by geographic boundaries, the negative outcomes of subgroup interaction may occur to a lesser degree than in balanced teams. For instance, subgroups with the same number of people at each location will have unique information held by each member spread evenly across the team. In contrast, imbalanced teams will contain one subgroup with a numerical majority and therefore will have more unique information held in one location. Members of the majority group will have direct access to a larger portion of team member knowledge, and more opportunity to interact and become familiar with team members. In turn, they will be more likely to locate and utilize unique member knowledge. Additionally, a larger percentage of the team will be attributed in-group status, and extended favoritism and bias that positively affects the desire to seek and share information.

The larger subgroup may also have more opportunity for the development of what Nishii & Goncalo (2008) refer to as cross-cutting subgroups (e.g. based on gender, age, or ethinicity). Cross-cutting subgroups distort the lines between ingroups and outgroups and weaken strong subgroup identification. In imbalanced teams, there are not only more co-located members with which to form cross-cutting subgroups, but also more opportunity to learn about additional member characteristics through interpersonal interaction. According to the authors, conflict is also lessened in subgroups of unequal size because the larger group does not perceive the smaller to be a serious threat to resources.

In sum, imbalanced subgroups will still suffer from ineffective subgroup interactions caused by geographic distribution. While this may ultimately impact the effectiveness of a TMS,

it may be to a lesser extent than balanced team configurations. A larger portion of the team will

have access to a greater percentage of knowledge. Cross-cutting subgroups and reduced conflict

will mitigate negative intergroup interactions. Therefore:

Hypothesis 1d: *Imbalanced subgroup structures will have a more effective TMS than balanced subgroup structures.*

Team Process: Plan Formulation

One significant challenge for distributed teams is the high potential for process loss, and

subsequently the inability to realize the process synergy often experienced in face-to-face teams

(Kirkman, Rosen, Gibson, Tesluk, & McPherson, 2002). As mentioned previously, there is an

increased dependence on cognitive skills as the nature of tasks changes, and cognitive processes

such as monitoring, planning, and decision making are critical to this emerging information-

based work (Cooke, et al, 2003). Therefore, plan formulation represents a critical distributed

team process, and is understudied in the literature on teams (in both face-to-face and distributed

context). While plan formulation has been highlighted in recent models of team performance

(e.g. Burke Stagl, Salas, Pierce & Kendell, 2006), it has been largely ignored in comparison to

other key team processes such as communication and coordination. Furthermore, as previously

stated, information management that occurs prior to task execution (e.g. planning) may be even

more salient in distributed teams as it may mitigate the effect of process loss (Fiore et al., 2003).

The Role of TMS

While the relationship between a team's TMS and team performance has been well-

established, there has been a lack of empirical work on how this team-level cognitive variable

may impact a team's ability to engage in effective processes. Put another way, the explanatory

mechanisms through which TMS improves performance are largely unexplored, especially in

37

distributed environments. Stout & Salas (1993) assert that planning can be used by teams either before or during task execution to exchange knowledge relevant to the task's requirements, including roles and responsibilities, the informational requirements of other members, and team expectations. The authors propose that effective planning can ultimately lead to better team decisions. Theoretical frameworks (e.g. Foire et al., 2003) suggest that this team function may be even more essential in distributed teams.

Plan formulation is defined as the phase in which the team develops a task strategy and then decides on a course of action (Salas, Rosen, Held, & Weismueller, 2008). Teams recognize cues in the task environment, and then draw from the team-level knowledge pool to address them. In teams with distributed knowledge, each member holds a part of the information necessary to form an accurate and effective task strategy. Therefore, the team's ability to locate members with the required knowledge should impact the quality and comprehensiveness of the plan. In addition, team members must be able to trust information provided by other members. If information is not considered reliable, it is unlikely it will be utilized in the plan formulation process. In addition, Lewis (2004) asserts that matching team members to tasks in the planning phase is more efficient when task assignments are based on the member's actual expertise, and requires knowledge of where expertise resides. Therefore, it is expected that teams who hold an effective TMS will engage in more effective plan formulation.

Hypothesis 2: A team's TMS effectiveness will positively impact the ability to engage in effective plan formulation.

Griffith and colleagues (2003) acknowledge that an effective TMS may be more difficult to develop in teams that work in a virtual environment, including those that are geographically distributed. However, they argue that a highly functioning TMS can still emerge under certain

38

conditions, and that a team's TMS is responsible for turning individual member's knowledge into usable team knowledge. In order for team knowledge to be leveraged in the planning stage of a task, it is essential that team members are aware of where knowledge resides in the team (i.e. which members may need additional knowledge, which members are able to supply required knowledge, etc.). For individual knowledge to become part of the team's overall strategy for task execution, it is also critical that members view information as credible.

A team's configuration, as discussed above, should impact the degree to which knowledge is shared and integrated at the team level. In turn, this team knowledge structure allows members to draw from a complete pool of information during the planning phase of task execution. Therefore, distributed teams with an effective TMS should be able to engage in more effective plan formulation. Put another way, configuration will affect the team's ability to engage in effective plan formulation, and this effect will be full-mediated by the team's TMS.

Hypothesis 3a-d: The effects of configuration (i.e., co-located, fully distributed, balanced, and imbalanced) on plan formulation will be fully mediated by the team's TMS.

Task Cohesion

In addition to cognitive emergent states, affective emergent states (e.g., cohesion) also arise from the interactions of team members (or subgroups) and have the potential to significantly alter the direction and strength of the relationship between distribution and team-level outcomes. Cohesion has been defined as "a dynamic process which is reflected in the tendency for a group to stick together and remain united in the pursuit of its goals and objectives" (Carron, 1982; p. 124). While numerous conceptualizations exist, the majority of researchers now view cohesion as a multi-dimensional construct, with separate facets (e.g. social, task, belongingness, morale) that differentially effect team process and performance (Bollen &

Hoyle, 1990; Widmeyer, Brawley, & Carron, 1985). In a review that attempts to shed light on the inconsistencies in previous findings and move toward a unified operationalization of cohesion, Casey-Campbell and Martens (2009) cite issues in the reliability and validity of the most often used four-dimensional measure of cohesiveness (i.e., the Group Environment Questionnaire; Widmeyer et al., 1985).The authors assert that, taken together with the evidence presented in recent reviews of the literature (e.g. Carless and De Paolo, 2000; Dyce and Cornell, 1996), a measure that includes only two dimensions of task-and social-cohesion may be of most value.

Overall, research suggests a negative relationship between distribution and cohesion (e.g. Cramton, 2001), but does not consider the multi-dimensional nature of the construct. Indeed, both theoretical and empirical work has largely ignored the differential effects of the separate dimensions (i.e. social and task) or focused solely on the isolation of the social dimension. As evidence suggests that the dimensions are independently related to team-level outcomes, this may result in overlooking each dimensions unique contribution to team process and performance (Beal, Cohen, Burke, & McLendon, 2003).

For example, Baba and colleagues (2004) suggest that given the lack of opportunity for interpersonal interaction, communication between distributed team members is less frequent and comprehensive, which in turn will inhibit group cohesion. In addition, Hinds and Bailey (2003) assert that technology-mediated communication can lead to negative relational interactions and affective conflict, which may therefore reduce cohesion in these teams even further. The authors argue that teams relying on this communication mode will experience less of an overall belonging to the team.

However, these reviews do not consider the possibility that the separate dimensions of cohesion may not be uniformly impacted by distribution, and therefore refer only to overall cohesion. I contend that, given the fact that the development of task and social cohesion are not formed on the same basis, we have to consider the dimensions separately in order to more fully understand cohesion's role in distribution. Tziner (1982) proposes that social cohesion is based on a common bond of interpersonal attraction. Task cohesion, on the other hand, is engendered in the value of high performance and goal attainment, and task cohesive team members will focus more on task-related communication (as opposed to interpersonal communication) and efficient completion of goals. Therefore, the emergence of task cohesion may play a unique role when social cohesion is inhibited by lack of interpersonal interactions.

Specifically, a commitment to the task should help to attenuate the effects of negative subgroup interaction. Task cohesion stems from individual goal's being dependent on the attainment of overall team goals, and is represented by a shared commitment to the group's goals and the perceived need for a collective effort. High-levels of task cohesion will cause members to put forth strong effort and work to overcome boundaries (Zaccaro, Gualtieri, and Minionis, 1995).

Task cohesion affects outcomes such as the group's level of integration and interaction (Zaccaro et al., 1995). Beal and colleagues (2003) suggest commitment to the task is also likely to be reflected in motivation to perform well. Taken together, the effects stemming from task cohesion (i.e. increased integration and interaction, motivation), may result in individual members being more likely to put forth strong effort to overcome potential boundaries to effective subgroup interactions (e.g. ingroup favoritism and bias). Co-located teams are already likely to experience more interpersonal communication. They have the opportunity for

41

spontaneous communication, and do not have to expend additional energy to overcome the physical and social boundaries of geographic distribution. Task cohesion, therefore, may be even more instrumental for the effectiveness of a team's TMS in a distributed setting. Specifically, task cohesion may mitigate the adverse impact on team knowledge sharing behavior, as members may be more motivated to share and integrate unique knowledge from outgroup members if it leads to achievement of shared goals.

Support for this assertion can be found in van Knippenberg, De Dreu and Homan (2004), where the authors introduce the Categorization-Elaboration Model (CEM). According to the CEM, the degree of elaboration (the extent to which teams exchange, discuss, and integrate knowledge) between members with diverse task-relevant information depends in part on the team's task motivation. Teams with high task motivation (e.g. from task cohesion), then, may be more apt to interact with outgroup members despite the fact they are viewed as dissimilar. Meyer and Shermuly (2012) provide empirical evidence in support of the CEM. The author's found that in teams with subgroup division, when task motivation was present in addition to positive diversity beliefs (i.e. perceiving value in diversity), a higher level of group performance was achieved.

In sum, task cohesion may have a differential effect on the effectiveness of a team's TMS depending on the configuration of a team. It may help distributed teams with subgroups overcome the boundaries inherent to both the specialization and credibility dimensions of TMS. Team's high on this dimension of cohesion will perceive the need for a collective effort, and thus may be more willing to recognize and utilize outgroup member knowledge. Commitment to the task may result in motivation to include outgroup members in information exchange, and to integrate this information into the larger collective pool of knowledge. Furthermore, task

motivation will result in a higher communication frequency of unique task-relevant information.

Taken together, this dimension is hypothesized to be a significant moderator of the

configuration-TMS relationship, such that task cohesion will help mitigate negative subgroup

interaction in distributed teams. Therefore:

Hypothesis 4a-d: *Task cohesion will moderate the relationship between configuration (i.e., co-located, fully distributed, balanced, and imbalanced) and TMS effectiveness, such that the positive effect of task cohesion for teams with subgroups will be greater than the positive effect for teams without subgroups.*

Figure 1. Hypothesized relationships between study variables

Table 3. Overview of Study Hypothesis

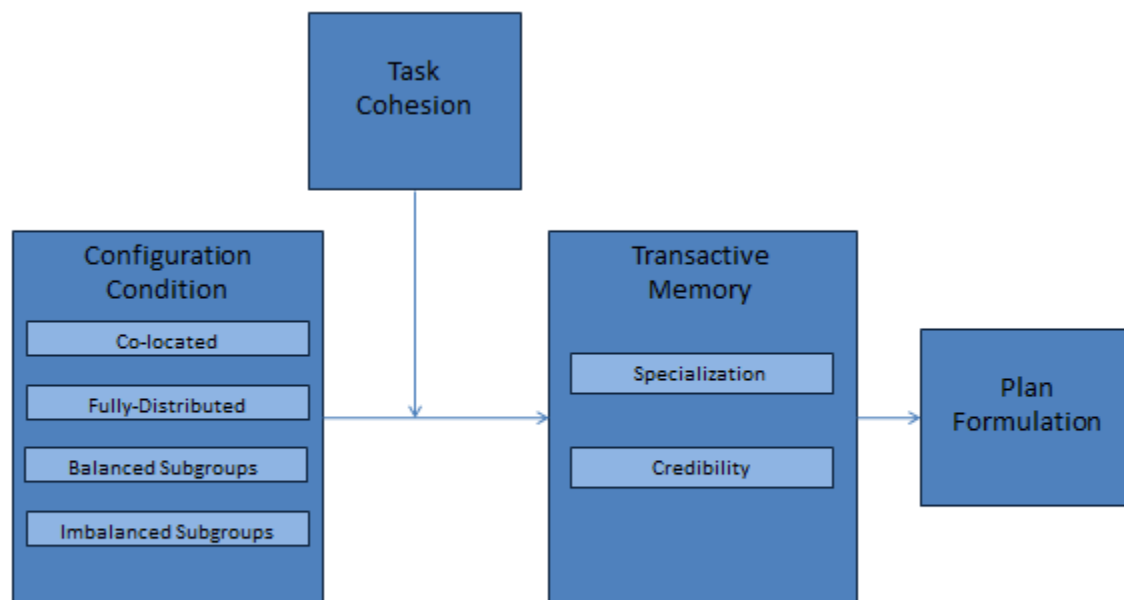| Hypothesis	Predicted Relationship
❖ 1a	Co-located team structures will have a more effective TMS as compared to balanced or imbalanced subgroup structures.
❖ 1b	Fully distributed team structures will have a more effective TMS as compared to balanced or imbalanced subgroup structures.
❖ 1c	Teams with balanced subgroup structures will have a significantly less effective TMS as compared to co-located, fully distributed, or imbalanced structures.
❖ 1d	Imbalanced subgroup structures will have a more effective TMS than balanced subgroup structures.
❖ 2	A team's TMS effectiveness will positively impact the ability to engage in effective plan formulation.
❖ 3a-d	The effects of configuration (i.e., co-located, fully distributed, balanced, and imbalanced) on plan formulation will be fully mediated by the team's TMS.
❖ 4a-d	Task cohesion will moderate the relationship between configuration (i.e., co-located, fully distributed, balanced, and imbalanced) and TMS effectiveness, such that the positive effect of task cohesion for teams with subgroups will be greater than the positive effect for teams without subgroups.

CHAPTER THREE: METHODOLOGY

Participants

Participants were recruited from both the undergraduate and graduate student population at universities located within the South East region of the United States. The sample consisted of 320 participants comprising 80 separate four-person teams. Teams were dispersed across the five conditions as follows: 15 co-located teams, 16 full-distributed teams, 16 imbalanced (3-1) teams, 17 imbalanced (2-1-1) teams, and 16 balanced teams. The final sample consisted of 47% percent male, with an age range of 18 years to 52 years (M= 19.66, SD= 3.43). The total combined time for completion of the pre-survey questionnaire and experimental laboratory session (i.e. both the online survey and in-person requirements) was 3.5 hours. The participants were given a choice of $24 or 3.25 extra credit points toward university classes as compensation for completion of the study.
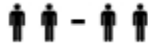
Design

Teams were randomly assigned to one of four distinct configuration conditions. The configuration manipulation was operationalized as both a varied number of geographic locations and varied number of members at each location. Configuration ranged from fully distributed (i.e. with all members at separate physical locations) to varying degrees of imbalance (see table 4 for configuration conditions). While level of virtuality (i.e. the type and degree of technology used) represents an important dimension of distributed teams, the purpose of the current paper is to parse out the specific effects of configuration. Therefore, the communication tool used (i.e. teleconference) was the same for each team. The design was developed in order to allow for a

45

direct comparison of balanced and imbalanced team structures, which has received very little empirical attention.

Participants were randomly assigned to teams in each of four configurational conditions. To reduce the chance of pre-performance team member familiarity, precaution was taken to ensure participants were not given the chance to interact while waiting for the experimental session to begin. Rooms were located throughout the building, and teams communicated through the use of video and audio meeting software (i.e. GoToMeeting). The experimenter was able to monitor and communicate with participants at all times. Although team members could not see the experimenter, they were able to ask questions if necessary throughout the entire experiment.

Table 4. Distributed conditions of the current study

Configuration of teammates	Description
🧍-🧍-🧍-🧍	Fully distributed. Each team member is at a separate geographic location.
🧍🧍 - 🧍🧍	Balanced subgroups. An equal number of members are located at each of two geographic regions.
🧍🧍🧍 - 🧍	Imbalanced subgroups. There are an uneven number of members across locations.
🧍🧍- 🧍- 🧍	

<u>Task</u>

Teams engaged in a hidden profile task, where each member received a disparate profile consisting of both overlapping information available to the entire team as well as information that was unique to each member. In order to successfully complete the interdependent task, members had to share and integrate their information to make an optimal decision (Mesmer-Magnus & DeChurch, 2009; Stasser & Titus, 1985). The testbed for the current study was Democracy 2, a simulation-based computer game that focuses on political strategy. Each team

member represents a prime minister in control of a fictional country called "Libria", and holds

unique information on the influential constituents and the policies that they support. Team

members who are not co-located share a screen via GoToMeeting, although only one member

can be in control of the mouse at any given time.

The game consists of 10 separate decision rounds. The teams receive 7 political capital

points each round, which is what they use to change policies that ultimately effect performance

outcomes. Policies differ in the number of political capital points they require to change as well

as the time it will take for them to be implemented (i.e. if the change will take place immediately

or in a future round). The user-interface of the game provides information on constituent

happiness, sectors of the economy and the policies within each, and current expenditures. After

reviewing the current state of the country, teams could choose to make a decision within each

round, or skip through rounds to build up political capital points. After each round, teams were

given feedback on how their decisions affected the state of the economy (debt), as well as the

happiness of constituent groups and what percentage of the population intended to vote for them.

They could then use this information to inform their planning for the subsequent round.

As can be seen, this task represents an ill-defined problem solving context, where there is

more than one correct strategy that leads to goal attainment. In addition, Democracy 2 can be

considered a complex, knowledge-intense task. Team members must collaborate in order to

decide when and how to adjust policies in order to influence the happiness of important

constituent groups and reduce national debt, with the overall team goal of being re-elected at the

end of the final decision performance round. Therefore, performance is derived from the level of

constituent happiness and overall debt. However, some decisions that may benefit one

constituent group may detrimentally impact another. Therefore, the interdependent task requires

teams to share their individually held information in order to develop an effective overall plan. Because nowledge was distributed and individuals had to recognize and coordinate the expertise of others, this makes Democracy 2 an ideal task to investigate TMS emergence.

<div align="center">Procedure</div>

Prior to arrival, participants filled out a pre-survey online. When they arrived at the site for the in-person portion of the experiment, each team member was randomly assigned to one of the 12 conditions and given one of four distinct roles (i.e. Prime Minister A, B, C, and D). Depending on the condition, participants were escorted by the experimenter to one of up to four rooms located throughout one building. Via online videoconferencing software (GoToMeeting) the experimenter was able to see and communicate with all participants, while the participants could only hear the experimenter. In case of questions or technological issues, the participants could initiate conversation with the experimenter. Members in disparate geographic locations had to rely on the use of virtual tools to communicate with their team members. Once informed consent was obtained, the session began.

Prior to the training round, teams were given a brief overview of the task, and asked to introduce themselves and the role they would be taking on during the experiment. Team members were encouraged to remember each other's roles, and told that each member held unique information. Each session began with a 20 minute training video where team members learned how to navigate the Democracy 2 simulation as well as the team goal and how to make decisions that will positively influence performance. Teammates each had materials that provided tips for playing the game and scrap paper to take notes. After the video, teams engaged in a two part practice round. First, teams were given a list of tasks to complete during 10 minutes

of guided practice in order to ensure they were familiar with and understood the game. The experimenter then went over their performance on the tasks, supplied the correct answers if necessary, and answered any questions that arose. The second part of practice was unguided, and teams were given 30 minutes to practice making decisions. The objective of the practice round was twofold: (1) allow the team to become familiar with the task, and (2) allow interaction with other team members in order to facilitate the emergence of both cognitive and affective emergent states.

At completion of the practice round, participants were administered a set of surveys with measures for both transactive memory systems and task cohesion. After receiving adequate time to complete the measures, the team performance round began. During this time, participants could communicate with the experimenter if technical difficulties arose, but otherwise were not allowed to ask questions directly about the task. Teams were given one hour to complete 10 rounds, with warnings at the 30, 15, and 1 minute marks. During the performance round, each participant had access to unique information on 5 different sets of constituents, including the percentage of the population they made up as well as the policies that directly influence them and the political capital needed to change each policy. At this point, the team is reminded that the goal is to please the majority of the population and that they each held different information. At the conclusion of the performance round, participants were debriefed and compensated for their time.

Measures

A multi-method measurement design was used to collect data throughout the study. An on-line pre-survey was used to assess demographic information prior to the in-person sessions.

During the course of the experiment, participants filled out self-report measures of team competencies. In addition, each session was recorded and then coded using behaviorally anchored rating scales (BARS) specifically designed for this study. A team of trained raters used the BARS to assess team process. An objective measure of team performance was obtained from output from the Democracy 2 simulation.

Task Cohesion

Task cohesion was measured with a scale from Carless and De Paola (2000), which the authors adapted from Widmeyer, Brawley, & Carron's (1985) Group Environment Questionnaire. The four-item scale measured the extent to which team members viewed the team's level of commitment to the task and unification in support of team goals. An example item is "Our team is united in trying to reach its goals for performance." The 5 point likert scale ranged from 1 (strongly disagree) to 7 (strongly agree). Reliability for this scale was .70.

Transactive Memory Systems

The specialization and credibility dimensions of transactive memory systems were assessed with a measure adapted from Lewis (2003). The measure includes 5 items for specialization (ex. "Each team member has specialized knowledge of some aspect of the game"), and 5 items for credibility (ex. "I was comfortable suggesting procedural suggestions from other team members). These dimensions were rated on a 5-point likert scale with anchors of 1 (strongly disagree) to 5 (strongly agree). Coordination (ex. "To what extent does your team actively work to coordinate activities with each other") was assessed with a measure adapted from Marks and colleagues (2001) and was rated on a 5-point likert scale from 1 (not at all) to 5

(to a very great extent). The reliability of the full scale reached an acceptable level (Nunnaly, 1970) at .79.

Plan Formulation

Plan formulation was measured with behaviorally anchored (BARS) created specifically for the task used in this study. The taxonomy of team processes by Marks, Mathieu, and Zaccaro (2001) was used as a guide during their development. The scale ranged from 1 (Hardly any skill) to 5(Complete skill), and a description of the behaviors that would be present at each level was given in order to guide raters as they coded each team. A set of 6 raters went through an extensive training period where they taught how to recognize the relevant behaviors. Before coding individually, the team jointly coded 20% of the sessions in order to establish inter-rater reliability.

CHAPTER FOUR: FINDINGS

Table 5 provides the means, standard deviations and correlations between the variables of interest. To ensure the meaningfulness of the variables conceptualized as shared team-level properties, it is necessary to first assess the within-group agreement of team members and between-group variance across teams (Klein & Kozlowski, 2000). To assess within-group agreement the r_{wg} index was calculated for cohesion and transactive memory systems, and the mean r_{wg} values were .82 and .68, respectively. To assess between-group variance, ICC(1) and ICC (2) were calculated, resulting in values of ICC(1): .73, .70, and values ICC(2): .79, .70. Both r_{wg} and ICC values were only minimally below or above suggested acceptable level (Bliese, 2000), and thus individual data was aggregated to the team level.

For the team process measure (i.e. plan formulation), a set of six trained raters coded the communication logs of 20% of the teams in order to first establish inter-rater agreement. The coders used behaviorally anchored rating scales (BARS) to rate teams on transition, action, and interpersonal processes. The mean r_{wg} value calculated for the transition processes (of which plan formulation is included) was .80, within the acceptable range for aggregation. For each of the teams that were coded jointly, disagreements among raters were reviewed and consensus reached so that there was 100% agreement. The trained raters then equally split the remaining team communication logs and coded them separately.

Hypotheses were tested using a bootstrapping method: Hayes (2012) PROCESS macro for moderated mediation. PROCESS uses an OLS regression-based path analytic framework for estimating direct and conditional indirect effects of moderated mediation. This resampling method is a more robust method of analyses for small samples in that it makes no assumptions about the shape of the sampling distribution of the statistic (Preacher, Rucker, & Hayes, 2012). In

addition, it has greater power and the macro provides asymmetric bootstrap confidence intervals

in addition to significance tests.

Table 5 . Means, SDs, and reliabilities of team-level variables

Condition	Variable	M	S.D.	1	2	3
Co-located	1. TMS Overall	3.41	0.39	.		
	2. Plan Formulation	3.27	0.9	.75*	.	
	3. Task Cohesion	5.66	0.54	0.49	0.36	.
Fully distributed	1. TMS Overall	3.48	0.4			
	2. Plan Formulation	3.10	0.81	.60*	.	
	3. Task Cohesion	5.46	0.46	.57*	.61*	.
Imbalanced	1. TMS Overall	3.43	0.34	.		
	2. Plan Formulation	2.92	0.9	.38*	.	
	3. Task Cohesion	5.53	0.73	.59*	.62*	.
Balanced	1. TMS Overall	3.42	0.47	.		
	2. Plan Formulation	2.69	0.9	0.19	.	
	3. Task Cohesion	5.51	0.74	0.47	0.32	.

Configurational Distribution and TMS Effectiveness

Hypothesis 1a-d proposed that the configurational structure of the distributed teams (i.e.,

co-located, fully distributed, balanced, or imbalanced) would affect the effectiveness of a team's

TMS. Specifically, co-located teams and fully-distributed teams would realize the most effective

TMSs, followed by teams with imbalanced subgroup structures (both 11-1-1 and 111-1

conditions). Teams with a balanced subgroup structure were hypothesized to realize the least

effective TMS. To test this set of hypotheses, I used PROCESS model 7 for moderated

mediation (see figure 2 and 3 for the conceptual and statistical diagrams, respectively). The

independent variable (i.e. configurational distribution) is categorical, and therefore was dummy

coded prior to being entered into the analysis. The balanced subgroups condition was chosen as

the referent category, as this would result in the most meaningful comparisons. For the test of

each individual hypothesis, the remaining dummy coded variables were added to the model as

covariates. The tested model also included plan formulation as the outcome variable, TMS as the

mediating variable, and task cohesion as the moderator variable.
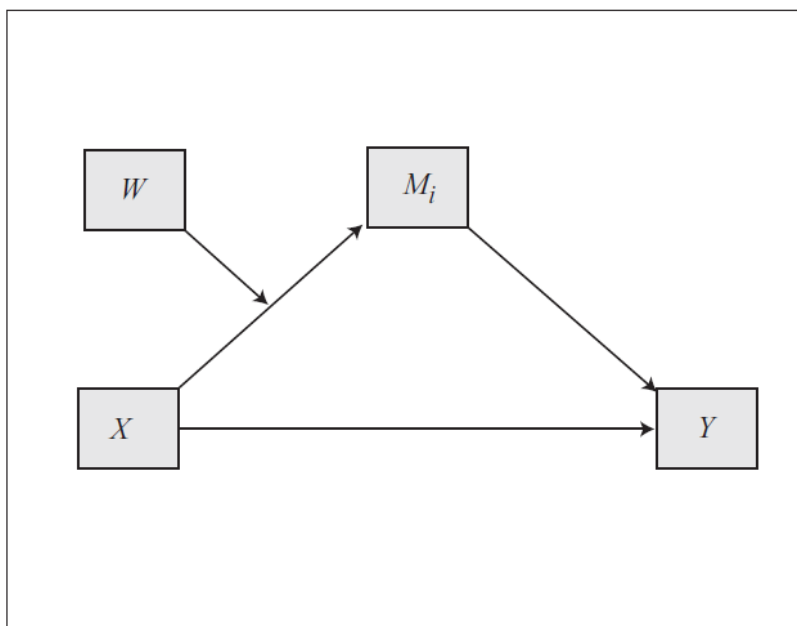
Figure 2. Conceptual diagram (adapted from Hayes, 2013)
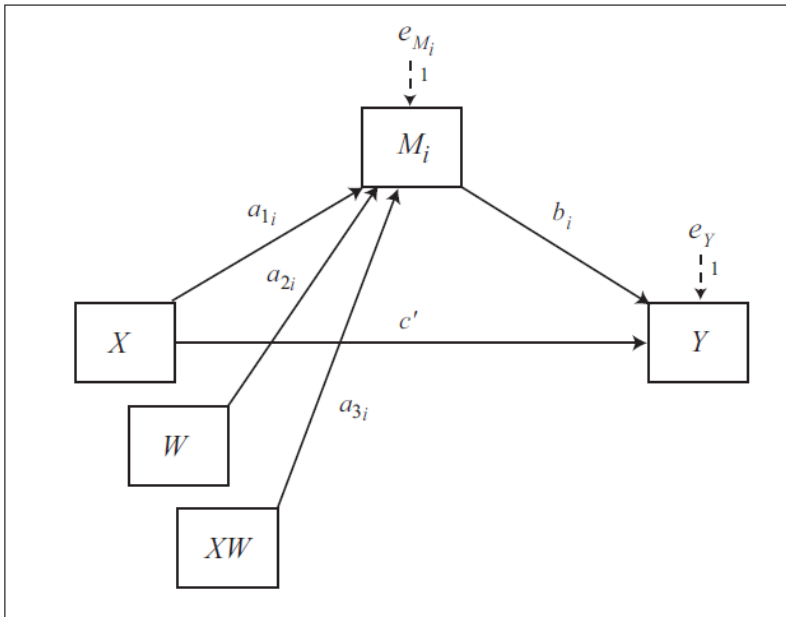
Figure 3. Statistical diagram (adapted from Hayes, 2013)

Hypothesis 1a proposed fully co-located teams would realize a more effective TMS than balanced or imbalanced subgroup teams. Table 6 provides the results for the regression of configuration (co-located) on TMS. Configuration (co-located) did not significantly impact the effectiveness of a team's TMS: $t(13) = -.45$, p=.67. The 95% confidence interval for this effect included zero [-2.56, 1.65]. Thus, the mean level of TMS for the co-located teams did not differ significantly from the mean level of TMS for the balanced subgroup condition, and there was no evidence to support hypothesis 1a. The remainder of the first set of hypotheses revealed a similar pattern of results, and they are displayed in tables 7-9, respectively. Specifically, configuration (fully-distributed) did not significantly impact the effectiveness of a team's TMS, $t(14) = -1.2$, p= .29, [-3.46, 1.06]; configuration (imbalanced 3-1) did not significantly impact the effectiveness of a team's TMS, $t(14) = -1.04$, p=.30, [-2.5, .79]; configuration (imbalanced 2-1-1) also did not significantly impact the effectiveness of a team's TMS $t(15) = 1.37$, p= .17, [-.53, 2.87]. These analyses suggest that configuration condition did not affect the team's mean level of

TMS. Possible explanations for this unexpected finding will explored further in the following chapter.

Table 6. Regression Results for Transactive Memory Outcome – Co-located Condition

Predictor	B	(SE)	t	p	LLCI	ULCI
Constant	1.85	(.39)	4.74	.00	1.07	2.63
Configuration (Co-located)	-.45	(1.06)	-.43	.67	-2.56	1.65
Cohesion	.28	(.069)	4.13	<.0001	.15	.42

(n= 15, bootstrap sample= 1,000)

Table 7. Regression Results for Transactive Memory Outcome- Fully Distributed Condition

Predictor	B	(SE)	t	p	LLCI	ULCI
Constant	1.93	(.38)	5.07	.00	1.17	2.69
Configuration (Fully Distributed)	-1.2	(1.13)	-1.06	.29	-3.46	1.06
Cohesion	.27	(.067)	4.0	<.0001	.14	.40

(n= 16, bootstrap sample= 1,000)

Table 8. Regression Results for Transactive Memory Outcome- Imbalanced Condition (3-1)

Predictor	B	(SE)	t	p	LLCI	ULCI
Constant	2.02	(.42)	4.78	.00	1.18	2.87
Configuration (Imbalanced Condition 3-1)	-.86	(.83)	-1.04	.30	-2.5	.79
Cohesion	.25	(.07)	3.38	P<.001	.10	.40

(n= 16, bootstrap sample= 1,000)

Table 9. Regression Results for Transactive Memory Outcome- Imbalanced Condition (2-1-1)

Predictor	B	(SE)	t	p	LLCI	ULCI
Constant	1.57	(.40)	3.9	.0002	.76	2.36
Configuration (Imbalanced 2-1-1)	1.17	(.85)	1.37	.17	-.53	2.87
Cohesion	.34	(.07)	4.77	P<.000	.20	.48

(n=17, bootstrap sample= 1,000)

Task Cohesion as a Moderator

In addition, hypothesis 4a-d proposed that the team's collective level of task cohesion would moderate the relationship between the configurational structure of a team and TMS effectiveness. Specifically, it was hypothesized that a high level of task cohesion would attenuate the negative effects of configuration with subgroups. The PROCESS model 7 was again utilized to assess this interaction effect. The results for hypotheses 3a are shown in table 10. The interaction effect between configuration (co-location) and task cohesion was not significantly predictive of TMS: $t(12) = -.38$, p.71, [-.30, .44]. Therefore, no evidence was found in support of Hypothesis 3a. Again, the remaining hypotheses for the moderating effect of task cohesion were not supported, and results are shown in tables 11-13, respectively. Specifically, the interaction between configuration (fully-distributed) and task cohesion was not significantly predictive of TMS, $t(13) = 1.13$, p=.26, [-.18, .64]; the interaction between configuration (imbalanced 3-1) and task cohesion was not significantly predictive of TMS, $t(13) = 1.03$, p= .30. [-.14, . 43]; and the interaction between configuration (imbalanced 2-1-1) and task cohesion was also not significantly predictive of TMS, $t(13) = -1.36$, p= .18, [-.53, .10]. Overall, the level of task cohesion did not interact with configuration to predict to TMS, and there is no evidence to

suggest that the effect of task cohesion is varies for different team configurations. Therefore, no further analysis of the simple effects was necessary. This pattern of results is not surprising, as there was no evidence for a relationship between configuration and TMS. Task cohesion does, however, display an important pattern of relationships that will explored further in the following sections.

Table 10. Regression Results for Interaction-Co-located Condition

Predictor	B	(SE)	*t*	***P***	LLCI	ULCI
Interaction	.07	(.19)	.38	.71	-.30	.44

Interaction= Configuration (Co-located) Task Cohesion

Table 11. Regression Results for Interaction-Fully Distributed Condition

Predictor	B	(SE)	*t*	*p*	LLCI	ULCI
Interaction	.23	(.21)	1.13	.26	-.18	.64

*Interaction= Configuration (Fully Distributed)*Task Cohesion

Table 12. Regression Results for Interaction- Imbalanced Condition (3-1)

Predictor	B	(SE)	*t*	*p*	LLCI	ULCI
Interaction	.15	(.14)	1.03	.30	-.14	.43

*Interaction= Configuration (Imbalanced 3-1)*Task Cohesion

Table 13. Regression Results for Interaction- Imbalanced Condition (2-1-1)

Predictor	B	(SE)	*t*	*p*	LLCI	ULCI
Interaction	-.22	(.16)	-1.36	.18	-.53	.10

*Interaction= Configuration (Imbalanced 2-1-1)*Task Cohesion

Hypothesis 2 proposed that a team's TMS will positively relate to ability to engage in effective plan formulation. Again, this hypothesis was tested with PROCESS model 7 for moderated mediation. The direct effect of a team's TMS on plan formulation was significant, $t(78)= 4.14$, $p<.0001$. The confidence interval did not include zero, [.34, .98]. Consistent with hypothesis 2, this provides strong evidence that as a team's TMS becomes more effective (i.e. as members become more aware of and trust the expertise of others), the ability of the team to develop a goal-directed plan of action increases.

Table 14. Regression Results for Plan Formulation outcome

Predictor	B	(SE)	*t*	*p*	LLCI	ULCI
TMS Overall	.66	(.16)	4.14	.0001	.34	.98

Team TMS as a Mediator

Hypothesis 3a-d stated that the configuration of a distributed team will affect the degree to which teams can engage in effective plan formulation, and the relationship will be fully mediated by the effectiveness of a team's TMS. A separate test for the indirect effect of configuration condition on plan formulation was conducted. The remaining dummy coded distribution conditions as well as task cohesion were entered into the model as covariates. The PROCESS macro was again used to test indirect effects, using model 4 for mediation (entering the remaining study variables as covariates helps to protect against type 1 error associated with running multiple significance tests). The results for hypotheses 2a are presented in table 15. The 95% confidence interval for this effect included zero [-.21, .01], and therefore the results show no support for the indirect effect of configuration (co-location) on plan formulation through TMS. As in previous analyses, the remainder of this set of hypotheses received no support, and

are presented in table 16-18. Specifically, the 95% confidence interval for hypothesis 2b included zero [-.05, .23]; the 95% confidence interval for hypothesis 2c included zero [.17, .10]; and the 95% confidence interval for hypothesis 2d included zero [-.10, .15].Taken together, the results stemming from this set of hypotheses suggests there is no evidence that TMS mediates the effect of configuration on plan formulation.

Table 15. Regression Results Indirect Effect – Co-located Condition

Predictor	B	(SE)	LLCI	ULCI
Configuration (Co-located)	-.02	(.07)	-.21	.07

Table 16. Regression Results Indirect Effect – Fully Distributed Condition

Predictor	B	(SE)	LLCI	ULCI
Configuration (Fully Distributed)	-.03	(.06)	-.05	.23

Table 17. Regression Results Indirect Effect – Imbalanced Condition (3-1)

Predictor	B	(SE)	LLCI	ULCI
Configuration (Imbalanced 3-1)	-.004	(.06)	-.17	.10

Table 18. Regression Results Indirect Effect – Imbalanced Condition (2-1-1)

Predictor	B	(SE)	LLCI	ULCI
Configuration (Imbalanced)	-.007	(.05)	-.10	.15

Exploratory Analyses

In light of the previous findings, exploratory analyses were conducted to interpret relationships for which a priori hypotheses were not made. Specifically, prior analyses indicated that task cohesion may indeed play a critical role in the effectiveness of a team's TMS and subsequent plan formulation. Therefore, additional analyses were conducted to investigate: 1) the direct effect of task cohesion on plan formulation, 2) the direct effect task cohesion on the effectiveness of a team's TMS, and 3) the indirect effect of task cohesion on plan formulation through TMS as a mediator. Once again, bootstrapping techniques (i.e., PROCESS; model 4 for partial mediation) were used to produce asymmetric confidence intervals. The confidence intervals for the direct effect of task cohesion on plan formulation effect do not contain zero, [.17, .59]. Therefore, the post-hoc analysis provides evidence to support task cohesion as a positive and significant predictor of a team's level of effectiveness in plan formulation (*see* table 19). Additionally, task cohesion emerged as a positive and significant predictor of the effectiveness of a team's TMS, with the confidence intervals for the direct effect not including zero [.17, .42].

Table 19. Regression Results for Direct Effect of Task Cohesion on Plan Formulation

Predictor	B	(SE)	LLCI	ULCI
Task Cohesion	.38	(.10)	.17	.59

Table 20. Regression Results for Direct Effect of Task Cohesion on TMS

Predictor	B	(SE)	LLCI	ULCI
Task Cohesion	.29	(.06)	.17	.42

Finally, the confidence interval for the indirect effect of task cohesion on plan formulation did contain zero, [-.005, .28]. Therefore, there is only weak evidence to support an effect of task cohesion on plan formulation through a team's TMS (*see* table 21).

Table 21. Indirect Effect of Task Cohesion on Plan Formulation through TMS

Predictor	B	(SE)	LLCI	ULCI
Distribution (co-located)	.11	(.07)	-.005	.28

CHAPTER FIVE: CONCLUSION

New team structures that are capable of confronting unique challenges and complex operational environments have emerged, and differ significantly from teams as they have been previously defined and studied. Teams no longer need to be co-located to complete interdependent tasks. Therefore, researchers have begun to call for exploration into how the dimensions of distribution affect important team outcomes. Once such request for future research has been for a closer look at how configuration, or the geographic dispersion of members, influences team process and knowledge integration. Teams "in the wild" can take on any number of different patterns, but past research has focused predominately on balanced or fully distributed teams. Therefore, this study extends previous research by looking at a variety of team structures (e.g. imbalanced teams, teams with and without isolates), the potential consequences for team dynamics, and how this ultimately drives the effectiveness of transactive memory systems.

Although there has been some recent attention in the literature (e.g. Cramton, 2001), little is known about how distributed knowledge moves from the individual to team-level in geographically-distributed teams. More research is needed on the contexts that facilitate or inhibit the flow of information between sites. Overall, the current effort aimed to elucidate how (i.e. through what mechanisms) and under what conditions configuration may impact team functioning. To that end, the following section offers an in depth look at the proposed hypotheses, as well as and an investigation of the significant but unexpected relationships found in the exploratory analyses.

Team Configuration and the Impact on TMS Effectiveness

As is evident from the previous chapter, the results provide no support for the extension of social categorization theory to configuration in geographically distributed teams. There was no evidence to suggest that the structure of a distributed team (i.e. number of locations, number of members in each location) influenced the effectiveness of team's TMS, and this statement holds across each configuration type; co-located, fully-distributed, balanced, and imbalanced. While this research domain is still in its nascent stages, much of the previously published work has reported some degree of relationship between configuration on a team's knowledge structure as well as group level affect and process variables (e.g. O'Leary & Mortenson, 2010). Therefore, the current study suggests that previous findings do not hold under all contexts, and that there may be boundary conditions around the importance of configuration.

There are several potential explanations for the pattern of null results. First, it may be that the lifespan of a team influences the degree to which configuration plays a part in team interaction. Ad hoc, short-term teams (e.g. project teams) similar to those used in this study often operate under strict deadlines and dissipate once the overall goal has been reached. It is possible that the type of negative subgroup interaction observed in previous research, and hypothesized in the current study, takes time to unfold and therefore would not be seen under these conditions. In a similar vein, teams brought together for a specific purpose or goal may experience different social norms. Specifically, there is no expectation for future interaction, and therefore bias and conflict may be mitigated.

A second explanation for the findings may be that the virtual tool used (i.e. teleconference) positively affected the quality and frequency of communication, so that this relatively rich communication mode (as compared to computer-mediated communication)

allowed teams to experience benefits similar to that of face-to-face communication. Finally, the experimental procedure and measures used may have been partially responsible for the null results. Participants were explicitly told the each team member held unique task related information and were asked to state their role within the team. This may have facilitated an effective TMS and mitigated the effects of configuration. Also, the Lewis (2003) measure for TMS is relatively general, and results may have varied if a finer level of data was collected.

The Moderating Role of Task Cohesion

Hypotheses 4a-d proposed that task cohesion would play a moderating role in the relationship between configuration and TMS. Specifically, high levels of task cohesion would help mitigate the effect of negative interaction for team structures with subgroups. Alternatively, co-located and fully-distributed teams do not experience the same degree of negative interaction (e.g. subgroup bias, in-group favoritism) and therefore will not benefit to the same degree. The results do not provide evidence in support of this set of hypothesis. There was no main effect of configuration on the effectiveness of a team's TMS, and there was no interaction effects when task cohesion was added to the model.

Lack of support for the first set of hypotheses (and therefore no difference in the effectiveness of TMSs in teams with and without subgroups) suggests that negative interactions either did not take place, or did not affect team process. Without the negative subgroup dynamics, the proposed moderation of the relationship between configuration and TMS also did not occur (i.e. there are no negative subgroup interaction to be mitigated by task cohesion). However, task cohesion appeared to play a different role than was hypothesized, and this will be discussed further below.

66

TMS and Distributed Team Process

Hypothesis 2 proposed that a team's TMS will positively relate its ability to engage in effective plan formulation, a process emphasized as critical to the success of teams who are not co-located. The results provide evidence in support of the hypothesis. Teams with a well-developed TMS are aware of the location of knowledge on the team. When responding to cues in the environment, members know who should be delegated tasks in order to increase efficiency and can draw from the team-level pool of knowledge when forming plans. Furthermore, they perceive information from teammates as being credible, and are therefore more likely to integrate it when formulating a task strategy. Overall, it is suggested that teams with an effective TMS, when responding to task cues or delegating task assignments, will be more likely to utilize distributed knowledge. These results extend previous research in a number of important ways, as explicated in the following section.

Theoretical Implications

The current study helps to untangle the dimensions of diversity, and progresses our understanding of configuration as a unique but underexplored facet. Theoretical and empirical research on the configuration of a team as a specific dimension of distribution has just begun to emerge. Carton and Cummings (2012) suggested that subgroup formation has the potential to hinder knowledge integration and can limit the extent to which knowledge is accessible to the team (Carton & Cummings, 2012). Indeed, the small body of empirical work suggests the way a team is dispersed across geographic sites can significantly impact shared team level knowledge structures such as TMS (O'Leary & Mortenson, 2010).

The results suggest, however, that these effects may not hold under all contexts, and consideration is necessary for the type of team and environment in which they operate. For example, when the team under consideration is analogous to the current sample (e.g. short term, formed for a single purpose) geographic distribution may not give rise to negative (or positive) interaction in the short-term. Therefore, while theory based on social categorization (e.g. SIT) may provide insight into distributed team functioning under certain contexts, research is needed on the conditions that engender subgroup formation and subsequent deleterious subgroup interaction.

Extant research has shown that, as is already well-established in face-to-face teams, TMS positively influences geographically distributed team performance. For example, in conducting a field study with supply chain teams, Maynard and colleagues (2012) found that TMS related positively to team effectiveness (operationalized as generating ideas, developing a final project, etc.). In fact, the authors propose that some of the drivers of performance in traditional teams (e.g. TMS) may become even more important in distributed teams who face additional challenges to coordination. The current study goes one step further in distributed team cognition research by looking at how TMS may affect behavioral mechanisms (i.e. plan formulation) important for team performance. Teams who are able to recognize specialized knowledge (not only from members at their own site, but across sites as well) and who trust the information given from teammates regardless of location are more effective at creating courses of action to reach a desired goal. Furthermore, they are better able to respond to cues in the environment and adjust plans as necessary.

Lastly, this current work extends the antecedents of effective TMSs in distributed teams to include previously unexplored constructs that may significantly impact the formation of team-

level knowledge structures and team process. Cohesion is often discussed as a unidimensional construct, with research emphasizing the detriment of reduced interpersonal interaction on social cohesion. However, task cohesion, which does not rely on positive intergroup interaction to the same extent, may prove to drive effective team process in distributed environments. While task cohesion did not moderate the relationship between configuration and TMS as proposed, this could have been due to the absence of negative subgroup interaction. Exploratory analyses revealed that task cohesion may be a valuable construct to explore in future distributed team performance models.

<div align="center">Practical Implications</div>

The results of the current study hold practical value to those that form and manage distributed teams. Specifically, the results offer insight into when practitioners should consider the effects of configurational distribution, and when it may not be a salient issue. If teams are formed under an ad-hoc, short-term basis, configuration may not hold serious implications for team process and performance. However, it should be emphasized that future research is needed to replicate the current results before the recommendations outlined here are implemented.

Past research has emphasized the importance of psychosocial constructs (e.g. trust, cohesion) for distributed team performance, and presented the barriers inherent to their development in GDTs. Lack of face-to-face interaction, shared experiences, and team familiarity are thought to inhibit the development of these emergent states. However, it may be the case that team-level task cohesion, which is not dependent on interpersonal interaction, can mitigate the negative effects of distribution. While empirical work on the antecedents of task cohesion is lacking, we do know that it develops from the valence of superordinate goals and high

performance (Tziner, 1982). Therefore, interventions that target overall commitment to the task by emphasizing the interdependent nature of the work and superordinate team goals may be beneficial. Task cohesion arises when individual goal attainment is bound to the team's collective success (Zaccaro et al., 1995), and therefore it may also be useful stress the interdependent nature of the task.

While results are not conclusive on the specific effects of team structure on TMS, it is clear from previous research and the current results that TMS plays a critical role in team process. Therefore, practitioners may want to develop interventions aimed the antecedents of TMS known to be inhibited in a distributed environment. To this end, frequent teleconferencing and short face-to-face visits can contribute to awareness of expertise and the transfer of knowledge between different geographic sites (Oshri, van Femna, & Kotlarsky, 2008). If this is not economically viable, an intervention could be as simple as making the expertise of each team member explicit (e.g. through a directory, company website) before the team engages in any tasks.

Limitations and Future Research

Several limitations of the study deserve mention, and the study design may in part be responsible for the pattern of null findings. First, teams were formed in a controlled laboratory setting with undergraduates. While the teams utilized here do share many characteristics with certain team types found in real-world organizations (i.e. they were formed ad-hoc, were formed for the completion of a specific goal, had members with distributed knowledge, etc.), caution should be used when generalizing these findings to an applied population. Furthermore, the study utilized one communication type and one task type (e.g. in the current study, teleconference was

70

the only medium used for communication); therefore, configuration should be looked at across a range of contextual features to determine when and if it has a significant impact on knowledge formation and team process.

In addition, self-report measures were used to collect data on task cohesion and transactive memory systems. Self-report data are subject to self-report bias, or the tendency for individuals to respond in a socially desirable way (e.g. to over report behaviors viewed as appropriate; Donaldson & Grant-Vallone, 2002). In a similar vein, self-report data are also subject to demand characteristics, or the process by which participants try to confirm the researcher's hypotheses by providing data that are in line with predicted relationships (Staw, 1975). Lastly, the use of self-reported data for more than one construct (i.e. in this case, both task cohesion and TMS) creates a risk of common method variance, which represents systematic error and the inflation or deflation of relationships between the variables (Podsakoff & Organ, 1986 ; Spector, 2006).

Finally, it may be that teams with a short lifecycle do not have enough time and interaction to develop a strong basis for psychosocial constructs such as trust and cohesion. Alternatively, a short lifespan may also negate the emergence of conflict, especially when there is no expectation of future interaction. Therefore, a final limitation of the study design may be that there was not enough time for the hypothesized negative intergroup interactions to emerge and influence team level outcomes.

To date, there is a limited body of research on the configurational dimension of distribution. Given the contributions of this study, I suggest a threefold agenda for future research to advance understanding of geographically distributed teams. First, empirical investigation into the utility of social categorization theory as an explanatory mechanism for

distributed team performance is needed. Future studies should aim to replicate the current findings as well as explore additional features of the team or task environment (e.g. team size, virtual communication medium, leadership structure) that either obviate or intensify the effects of subgroup interaction. Furthermore, this should be carried out in a laboratory as well as applied setting to increase the generalizability of the findings. Essentially, we need a better understanding of under what conditions configuration manifests in social interaction that detracts from process.

Second, future research should aim to uncover the team-level variables (in addition to configuration) that drive TMS effectiveness. There is ample support in the literature to suggest that TMS is an important factor in both traditional and distributed teams. What is lacking, however, is research that looks at the antecedents of TMS in GDTs. The results of the exploratory analysis suggest that task cohesion may be predictive of team-level knowledge formation and effective team process in GDTs. Cohesion is often operationalized as a social attraction, engendered from interpersonal interaction and shared experiences among team members. However, task cohesion emerges in part from the need to work interdependently to achieve shared team-level goals (Zaccaro, Gualtieri, & Minionis, 1995), and may not rely to the same extent on positive intergroup relationships. Research might address the question of whether or not social cohesion (or other psychosocial traits identified as important in the literature) is necessary in GDTs, or if a strong commitment to the task and team goals is can result in effective performance.

Finally, future research should continue to investigate the mechanisms through which team level knowledge structures in GDTs affect performance. It has been suggested that team planning is especially important in distributed teams (e.g. Fiore et al., 2003), but empirical

72

evidence to support this assertion (as well as to explore additional critical team process) is needed. In line with Wildman and colleagues (2012), I emphasize the need to explore the behavioral processes that are influenced by team cognition. As a science, we are behind on understanding how cognition influences traditional face-to-face team process, and practice has already outpaced scientific development with the emergence of distributed teams.

Conclusion

Configurational distribution has been evidenced to influence team process and the effectiveness of team-level knowledge structures. Specifically, extant research suggests that variables such as the number of sites and the number of members per site can affect team identification, TMSs, coordination, conflict, and trust in GDTs (O'Leary & Mortenson, 2010; Polzer et al., 2006). However, the current effort suggests that there may be boundary conditions (e.g. team lifespan and purpose, communication medium, and expectation for future interaction) for the influence of configuration on team-level variables. Additionally, task cohesion may be instrumental in facilitating distributed team process and effective knowledge structures. Results of the exploratory analysis suggest task cohesion may influence the effectiveness of a team's TMS and their ability to engage in effective plan formulation. Future research should aim to include task cohesion as a potential explanatory mechanism in GDT performance, as well as continue to investigate variables that drive the formation of team-level knowledge structures in GDTs.

APPENDIX A: IRB APPROVAL LETTER

University of Central Florida Institutional Review Bo:
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

Approval of Human Research

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

To: **Shawn Burke** and Co-PIs: **Eduardo Salas, Stephen M. Fiore**

Date: **May 14, 2012**

Dear Researcher:

On 5/14/2012, the IRB approved the following human participant research until 5/13/2013 inclusive:

Type of Review:	IRB Continuing Review Application Form
Modification Type:	[Consent form revision, Add'n of co-inv's, Methodology Revisions, Add'n of Test Instruments, etc] (received on xx/xx/20xx) *<Delete this section if n/a>*
Project Title:	Shared Leadership: Moving Beyond Virtuality and Distribution to Build Capacity in Virtual Organizations
Investigator:	Shawn Burke
IRB Number:	SBE-10-07005
Funding Agency:	National Science Foundation
Grant Title:	
Research ID:	N/A

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 5/13/2013, 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 Sophia Dziegielewski, Ph.D., L.C.S.W., CF IRB Chair, this letter is signed by:

Signature applied by Joanne Muratori on 05/14/2012 03:29:53 PM EDT

Joanne Muratori

APPENDIX B: TRANSACTIVE MEMORY SYSTEMS

Lewis, K. (2003). Measuring transactive memory systems in the field: Scale development and validation. *Journal of Applied Psychology, 88*(4), 587-604.

INSTRUCTIONS: Below are a number of statements regarding your team. *Please indicate the extent to which the statement is true.*	
To what extent do you agree or disagree?	1 = Strongly Disagree 2 = Somewhat Disagree 3 = Neither agree nor disagree 4 = Somewhat Agree 5 = Strongly Agree

Specialization

1	Each team member has specialized knowledge of some aspect of the game.	①	②	③	④	⑤
2	I have knowledge about an aspect of the game no other team member has.	①	②	③	④	⑤
3	Different team members are responsible for expertise in different areas.	①	②	③	④	⑤
4	The specialized knowledge of several different team members was needed to complete the game's tasks.	①	②	③	④	⑤
5	I know which team members have expertise in specific areas.	①	②	③	④	⑤

Credibility

6	I was comfortable accepting procedural suggestions from other team members.	①	②	③	④	⑤
7	I trusted that other members' knowledge about the game was credible.	①	②	③	④	⑤
8	I was confident relying on the information that other team members brought to the discussion.	①	②	③	④	⑤
9	When other team members gave information, I wanted to double-check it for myself.	①	②	③	④	⑤
10	I did not have much faith in other members' "expertise".	①	②	③	④	⑤

APPENDIX C: PLAN FORMULATION

Definition: Formulation of strategies and courses of action for mission accomplishment. This dimension includes generic planning, contingency planning, and reactive strategic adjustment.

Examples: - Developing a specific plan to gain constituents without upsetting other constituents
- Communicating the proper sequence of actions to team members
- Considering factors that might alter their mission plan (e.g., losing a prime minister, sudden change in spending)
- Recognizing and adjusting team actions or responsibilities to adapt to unexpected events (e.g., situations arising)
- Engaging in contingency planning consisting of verbally walking through "what if" scenarios which might emerge while playing

Scale:

Complete Skill (5) – Team members developed a primary course of action for achieving the team's goals and were able to detect and quickly adapt/coordinate their actions to unexpected situations with appropriate actions. The team tested and strengthened its plan using "what if" scenarios. All team members were aware of and understood how their individual task responsibilities fit into the primary and secondary courses of action.

Very Much Skill (4)

Adequate Skill (3) - Team members had difficulty developing a primary course of action for achieving the team's goals. The team briefly tested and its plan using "what if" scenarios. All team members were aware of their individual task responsibilities but might not have understood how they fit into the primary and secondary courses of action.

Some Skill (2)

Hardly Any Skill (1) –Team members did not develop a primary course of action for achieving the team's goals. Instead, they simply changed things within the game and saw what happened. The team did not plan ahead for potential scenarios which might emerge. Team members were unaware of their individual task responsibilities and how they fit into the primary and secondary courses of action.

APPENDIX D: TASK COHESION

Adapted from Carless & Paola (2000)

	INSTRUCTIONS: Below are a number of statements regarding your team. **Please indicate the extent to which you agree or disagree with the following statements.**	
	To what extent do you agree or disagree?	1= Strongly disagree 2= quite disagree 3= slightly disagree 4= neither disagree or agree 5= quite agree 6= slightly agree 7= Strongly agree
1	Our team is united in trying to reach its goals for performance	① ② ③ ④ ⑤ ⑥ ⑦
2	I'm unhappy with my team's level of commitment to the task	① ② ③ ④ ⑤ ⑥ ⑦
3	Our team members have conflicting aspirations for the team's performance	① ② ③ ④ ⑤ ⑥ ⑦
4	This team does not give me enough opportunities to improve personal performance	① ② ③ ④ ⑤ ⑥ ⑦

REFERENCES

Akgün, A. E., Byrne, J., Keskin, H., Lynn, G. S., & Imamoglu, S. Z. (2005). Knowledge

    networks in new product development projects: A transactive memory

    perspective. *Information & Management*, *42*(8), 1105-1120.

Ashleigh, M., & Prichard, J. (2012). An integrative model of the role of trust in transactive

    memory development. *Group & Organization Management*, *37*(1), 5-35.

Austin, J. R. (2003). Transactive memory in organizational groups: The effects of content,

    consensus, specialization, and accuracy on group performance. *Journal of Applied*

    Psychology, *88*(5), 866.

Axtell, C. M., Fleck, S. J., & Turner, N. (2004). Virtual teams: Collaborating across

    distance. *International Review of Industrial and Organizational Psychology*, *19*, 205-248.

Baba, M. L., Gluesing, J., Ratner, H., & Wagner, K. H. (2004). The contexts of knowing: Natural

    history of a globally distributed team. *Journal of Organizational Behavior*, *25*(5), 547-

    587.

Baltes, B. B., Dickson, M. W., Sherman, M. P., Bauer, C. C., & LaGanke, J. S. (2002).

    Computer-mediated communication and group decision making: A meta-

    analysis. *Organizational Behavior and Human Decision Processes, 87*(1), 156-179.

Beal, D. J., Cohen, R. R., Burke, M. J., & McLendon, C. L. (2003). Cohesion and performance

    in groups: A meta-analytic clarification of construct relations. *Journal of Applied*

    Psychology, *88*(6), 989-1004.

Bedwell, W. L., Wildman, J. L., DiazGranados, D., Salazar, M., Kramer, W. S., & Salas, E.

    (2012). Collaboration at work: An integrative multilevel conceptualization. *Human*

    Resource Management Review, *22*(2), 128-145.

Beersma, B., Hollenbeck, J. R., Humphrey, S. E., Moon, H., Conlon, D. E., & Ilgen, D. R. (2003). Cooperation, competition, and team performance: Toward a contingency approach. *Academy of Management Journal*, *46*(5), 572-590.

Bell, B. S., & Kozlowski, S. W. (2002). A typology of virtual teams implications for effective leadership. *Group & Organization Management*, *27*(1), 14-49.

Bergiel, B. J., Bergiel, E. B., & Balsmeier, P. W. (2008). Nature of virtual teams: a summary of their advantages and disadvantages. *Management Research News*, *31*(2), 99-110.

Bezrukova, K., Thatcher, S., Jehn, K. A., & Spell, C. S. (2012). The effects of alignments: Examining group faultlines, organizational cultures, and performance. *Journal of Applied Psychology*, *97*(1), 77.

Bliese, P. D. (2000).Within-group agreement, non-independence, and reliability: Implications for data aggregation and analysis. In K. J. Klein&S.W.J.Kozlowski (Eds.), *Multilevel Theory, Research, and Methods in Organizations* (pp. 349-381). San Francisco: Jossey-Bass.Brandon, D. P., & Hollingshead, A. B. (2004). Transactive memory systems in organizations: Matching tasks, expertise, and people. *Organization Science*,*15*(6), 633-644.

Bray, C. D., & Whaley, D. E. (2001). Team cohesion, effort, and objective individual performance of high school basketball players. *The Sport Psychologiust , 15*(3), 260-275.

Bollen, K. A., & Hoyle, R. H. (1990). Perceived cohesion: A conceptual and empirical examination. *Social Forces*, *69*(2), 479-504.

Bos, N., Shami, N. S., Olson, J. S., Cheshin, A., & Nan, N. (2004). In-group/out-group effects in distributed teams: An experimental simulation. *Proceedings of the 2004 ACM conference on Computer supported cooperative work* (429-436). Chicago, IL.

Boudreau, M. C., Loch, K. D., Robey, D., & Straud, D. (1998). Going Global: Using information technology to advance the competitiveness of the virtual transnational organization. *The Academy of Management Executive*, *12*(4), 120-128.

Bunderson, J. S. (2003). Recognizing and utilizing expertise in work groups: A status characteristics perspective. *Administrative Science Quarterly*, *48*(4), 557-591.

Burke, C. S., Stagl, K. C., Salas, E., Pierce, L., & Kendall, D. L. (2006). Understanding team adaptation: A conceptual analysis and model. *Journal of Applied Psychology, 91,* 1189-1207.

Carless, S.A. & De Paola, C. (2000). The measurement of cohesion in work teams. *Small Group Research*, *13,* 71–88.

Carton, A. M., & Cummings, J. N. (2012). A theory of subgroups in work teams.*Academy of Management Review*, *37*(3), 441-470.

Carron, A.V. (1982). Cohesiveness in sport groups:interpretations and considerations. *Journal of Sport Psychology, 4,* 123–138.

Cascio, W. F. (2000). Managing a virtual workplace. *The Academy of Management Executive*, *14*(3), 81-90.

Casey-Campbell, M., & Martens, M. L. (2009). Sticking it all together: A critical assessment of the group cohesion–performance literature. *International Journal of Management Reviews*, *11*(2), 223-246.

Chang, A., & Bordia, P. (2001). A multidimensional approach to the group cohesion-group performance relationship. *Small Group Research*, *32*(4), 379-405.

Choi, S. Y., Lee, H., & Yoo, Y. (2010). The impact of information technology and transactive memory systems on knowledge sharing, application, and team performance: A field study. *Mis Quarterly*, *34*(4), 855-870.

Cohen, D. J. & Alonso, A. (2013). Enhancing the practice of teamwork in organizations: Emerging themes. In E. Salas, S. Tannenbaum, D. Cohen, & G. Latham (Eds.), *Developing and enhancing high-performance teams: Evidence-based practices and recommendations.* San Francisco, CA: Jossey-Bass.

Cohen, S. G., & Bailey, D. E. (1997). What makes teams work: Group effectiveness research from the shop floor to the executive suite. *Journal of Management*, *23*(3), 239-290.

Connaughton, S. L., & Shuffler, M. (2007). Multinational and Multicultural Distributed Teams: A review and future agenda. *Small Group Research, 38*(3), 387-412.

Cooke, N. J., Kiekel, P. A., Salas, E., Stout, R., Bowers, C., & Cannon-Bowers, J. (2003). Measuring team knowledge: A window to the cognitive underpinnings of team performance. *Group Dynamics: Theory, Research, and Practice*, *7*(3), 179.

Cooke, N. J., Salas, E., Cannon-Bowers, J. A., & Stout, R. (2000). Measuring team knowledge. *Human Factors: The Journal of the Human Factors and Ergonomics Society*, *42*(1), 151-173.

Cramton, C. D. (2001). The mutual knowledge problem and its consequences for dispersed collaboration. *Organization Science, 12*(3), 346-371.

Cramton, C. D., & Hinds, P. J. (2005). Subgroup dynamics in internationally distributed teams: Ethnocentrism or cross-national learning? In B. M. Staw & R. M Kramer (Eds.), *Research in organizational behavior*, (Vol.26, pp. 231-263). Greenwhich, CT: JAI Press.

Cummings, J. N., Espinosa, J. A., & Pickering, C. K. (2009). Crossing spatial and temporal

boundaries in globally distributed projects: A relational model of coordination delay. *Information Systems Research*, *20*(3), 420-439.

Daft, R. L., & Lengel, R. H. (1986). Organizational information requirements, media richness and structural design. *Management science*, *32*(5), 554-571.

De Dreu, C. K., & Weingart, L. R. (2003). Task versus relationship conflict, team performance, and team member satisfaction: a meta-analysis. *Journal of applied Psychology*, *88*(4), 741.

de Wit, F. R., Greer, L. L., & Jehn, K. A. (2012). The paradox of intragroup conflict: A meta-analysis. *Journal of Applied Psychology*, *97*(2), 360.

Dennis, A. R., Fuller, R. M., & Valacich, J. S. (2008). Media, tasks, and communication processes: A theory of media synchronicity. *MIS Quarterly*, *32*(3), 575-600.

Devine, D. J., Clayton, L. D., Philips, J. L., Dunford, B. B., & Melner, S. B. (1999). Teams in organizations prevalence, characteristics, and effectiveness. *Small Group Research*, *30*(6), 678-711.

Donaldson, S. I., & Grant-Vallone, E. J. (2002). Understanding self-report bias in organizational behavior research. *Journal of Business and Psychology*, *17*(2), 245-260.

Driskell, J. E., & Salas, E. (1991). Group decision making under stress. *Journal of Applied Psychology*, *76*(3), 473-478.

Dunning, J. H. (2002). *Regions, globalization, and the knowledge-based economy.* New York, NY: Oxford University Press.

Dyce, J.A. and Cornell, J. (1996). Factorial validity of the Group Environment Questionnaire among musicians. *Journal of Social Psychology*, 136, 263–264.

Dyck, B., & Starke, F. A. (1999). The formation of breakaway organizations: Observations and a

    process model. *Administrative Science Quarterly*, *44*(4), 792-822.

Earley, C. P., & Mosakowski, E. (2000). Creating hybrid team cultures: An empirical test of

    transnational team functioning. *Academy of Management Journal*, *43*(1), 26-49.

Ellis, A. P. (2006). System breakdown: The role of mental models and transactive memory in the

    relationship between acute stress and team performance. *Academy of Management*

    Journal, *49*(3), 576-589.

Espinosa, J. A., & Carmel, E. (2003). The impact of time separation on coordination in global

    software teams: a conceptual foundation. *Software Process: Improvement and Practice,*

    8(4), 249-266.

Espinosa, J. A., Slaughter, S. A., Kraut, R. E., & Herbsleb, J. D. (2007). Team knowledge and

    coordination in geographically distributed software development. *Journal of*

    Management Information Systems, *24*(1), 135-169.

Fiore, S. M., Salas, E., Cuevas, H. M., & Bowers, C. A. (2003). Distributed coordination space:

    Toward a theory of distributed team process and performance. *Theoretical Issues in*

    Ergonomics Science, *4*(3-4), 340-364.

Feldman, D. C. (1984). The development and enforcement of group norms.*Academy of*

    management review, *9*(1), 47-53.

Fleishman, E. A., & Zaccaro, W. J. (1992). Toward a taxonomy of team performance functions.

    In R.W. Swezey & E. Salas (Eds.), *Teams: Their training and performance* (pp.31-56).

    Norwood, NJ: Ablex.

Fuller, M. A., Hardin, A. M., & Davison, R. M. (2007). Efficacy in technology-mediated

    distributed teams. *Journal of Management Information Systems*, *23*(3), 209-235.

Gevers, J. (2004). It's about time that we align: meeting deadlines in project teams. Eindhoven, the Netherlands: Universiteitsdrukkerij Technische Unversiteit Eindhoven.

Gibson, C., & Vermeulen, F. (2003). A healthy divide: Subgroups as a stimulus for team learning behavior. *Administrative Science Quarterly*, *48*(2), 202-239.

Griffith, T. L., & Neale, M. A. (2001). 8. Information processing in traditional, hybrid, and virtual teams: From nascent knowledge to transactive memory.*Research in organizational behavior*, *23*, 379-421.

Giffith, T. L., Sawyer, J. E., & Neale, M. A. (2003). Virtualness and knowledge in teams: Managing the love triangle of organizations, individuals, and information technology. *MIS Quarterly, 27*(2), 265-287.

Gruenfeld, D. H., Mannix, E. A., Williams, K. Y., & Neale, M. A. (1996). Group composition and decision making: How member familiarity and information distribution affect process and performance. *Organizational Behavior and Human Decision Processes*, *67*(1), 1-15.

Johnson, P., Heimann, V., O'Neill, K. (2001). The "wonderland" of virtual teams. *Journal of Workplace Learning, 13*(1), 24-29.

Govindarajan, V., & Gupta, A. K. (2001). Building an effective global business team. *MIT Sloan Management Review*, *42*(4), 63-71.

Gruenfeld, D. H., Mannix, E. A., Williams, K. Y., & Neale, M. A. (1996). Group composition and decision making: How member familiarity and information distribution affect process and performance. *Organizational Behavior and Human Decision Processes*, *67*(1), 1-15.

Hayes, A. F. (2012). PROCESS: A versatile computational tool for observed variable mediation,

moderation, and conditional process modeling [White paper]. Retrieved from

http://www.afhayes.com/public/process2012.pdf.

He, J., Butler, B. S., & King, W. R. (2007). Team cognition: Development and evolution in

software project teams. *Journal of Management Information Systems*, *24*(2), 261-292.

Herbsleb, J. D., Mockus, A., Finholt, T. A., & Grinter, R. E. (2000, December). Distance,

dependencies, and delay in a global collaboration. In *Proceedings of the 2000 ACM*

conference on Computer supported cooperative work (319-328). Philidelphia: PA.

Hertel, G., Konradt, U., & Orlikowski, B. (2004). Managing distance by interdependence: Goal

setting, task interdependence, and team-based rewards in virtual teams. *European*

Journal of Work and Organizational Psychology, *13*(1), 1-28.

Hinds, P. J., & Bailey, D. E. (2003). Out of sight, out of sync: Understanding conflict in

distributed teams. *Organization science*, *14*(6), 615-632.

Hinds, P., & McGrath, C. (2006). Structures that work: social structure, work

structure and coordination ease in geographically distributed teams. In *Proceedings of the*

20th anniversary conference on Computer supported cooperative work (343-352). Banff,

Alberta, Canada.

Hogg, M. A. (2006). Social identity theory. In P. J. Burke (Ed.), Contemporary social

psychological theories (pp. 111–136). Palo Alto, CA: Stanford University Press.

Hollingshead, A. B., (1998a). Retrieval processes in transactive memory systems. *Journal of*

Personality and Social Psychology, *74*(3), 659.

Hollingshead, A. B. (1998b). Distributed knowledge and transactive processes in decision-

making groups. In M. A. Neale, E. A. Mannix, & D. H. Gruenfeld (Eds.), *Research on*

managing groups and teams:(1st ed.: pp. 105–125). Greenwich, CT: JAI Press.

Hollingshead (1998a). Retrieval processes in transactive memory systems. *Journal of Personality and Social Psychology*, *74*(3), 659.

Holton, J. A. (2001). Building trust and collaboration in a virtual team. *Team Performance Management*, *7*(3/4), 36-47.

Jarvenpaa, S. L., Knoll, K., & Leidner, D. E. (1998). Is anybody out there? Antecedents of trust in global virtual teams. *Journal of management information systems*, *4*(4)29-64.

Johnson, P., Heimann, V., & O'Neill, K. (2001). The "wonderland" of virtual teams. *Journal of workplace learning*, *13*(1), 24-30.

Kanawattanachai, P., & Yoo, Y. (2007). The impact of knowledge coordination on virtual team performance over time. *MIS Quarterly*, 31(4), 783-808.

Kelly, J. R., & Loving, T. J. (2004). Time pressure and group performance: Exploring underlying processes in the attentional focus model. *Journal of Experimental Social Psychology*, *40*(2), 185-198.

Kirkman, B. L., & Mathieu, J. E. (2005). The dimensions and antecedents of team virtuality. *Journal of Management*, *31*(5), 700-718.

Kirkman, B. L., Rosen, B., Gibson, C. B., Tesluk, P. E., & McPherson, S. O. (2002). Five challenges to virtual team success: Lessons from Sabre, Inc. *The Academy of Management Executive,* 16(3), 67-79.

Kotlarsky, J., & Oshri, I. (2005). Social ties, knowledge sharing and successful collaboration in globally distributed system development projects. *European Journal of Information Systems*, *14*(1), 37-48.

Kozlowski, S. W., & Bell, B. S. (2003). Work groups and teams in organizations. In W. C. Borman, D. R. Ilgen, & R. J. Klimoski (Eds.), *Handbook of psychology: Industrial and organizational psychology, (Vol* 12: pp. 333-375). London: Wiley.

Kozlowski, S. W., & Klein, K. J. (2000). A multilevel approach to theory and research in organizations: Contextual, temporal, and emergent processes. In K. J. Klein & S. W. J. Kozlowski (Eds.), *Multilevel theory, research, and methods in organizations: Foundations, extensions, and new directions* (pp. 3-90). San Francisco, CA: Jossey-Bass.

Lau, D. C., & Murnighan, J. K. (1998). Demographic diversity and faultlines: The compositional dynamics of organizational groups. *Academy of Management Review*, *23*(2), 325-340.

Lau, D. C., & Murnighan, J. K. (2005). Interactions within groups and subgroups: The effects of demographic faultlines. *Academy of Management Journal*, *48*(4), 645-659.

Lengel, R. H., & Daft, R. L. (1984). *An exploratory analysis of the relationship between media richnes and managerial information processing. Technical reportTexas A&M University.*

Lewis, K. (2003). Measuring transactive memory systems in the field: Scale development and validation. *Journal of Applied Psychology, 4,* 587-604.

Lewis, K. (2004). Knowledge and performance in knowledge-worker teams: A longitudinal study of transactive memory systems. *Management Science*, *50*(11), 1519-1533.

Lewis, K., Lange, D., & Gillis, L. (2005). Transactive memory systems, learning, and learning transfer. *Organization Science*, *16*(6), 581-598.

Lewis, K., & Herndon, B. (2011). Transactive memory systems: Current issues and future research directions. *Organization Science*, *22*(5), 1254-1265.

Li, J., & Hambrick, D. C. (2005). Factional groups: A new vantage on demographic faultlines,

conflict, and disintegration in work teams. *Academy of Management Journal*, *48*(5), 794-813.

Liang, D. W., Moreland, R., & Argote, L. (1995). Group versus individual training and group performance: The mediating role of transactive memory. *Personality and Social Psychology Bulletin*, *21*(4), 384-393.

Lin, C., Standing, C., & Liu, Y. C. (2008). A model to develop effective virtual teams. *Decision Support Systems*, *45*(4), 1031-1045.

Lipnack, J., & Stamps, J. (1997). *Virtual teams: Reaching across space, time, and organizations with technology.* New York: John Wiley & Sons, Inc.

Mannix, E. A., T. Griffith, M. A. Neale. 2002. The phenomenology of conflict in distributed work teams. In P. J. Hinds, S. Kiesler, (Eds.), *Distributed Work* (213-232). MIT Press, Cambridge, MA, 213–233.

Manser, T. (2009). Teamwork and patient safety in dynamic domains of healthcare: A review of the literature. *Acta Anaesthesiologica Scandinavica*, *53*(2), 143-151.

Marks, M. A., Mathieu, J. E., & Zaccaro, S. J. (2001). A temporally based framework and taxonomy of team processes. *Academy of Management Review, 26,* 356–376.

Mathieu, J., Maynard, M. T., Rapp, T., & Gilson, L. (2008). Team effectiveness 1997-2007: A review of recent advancements and a glimpse into the future. *Journal of Management*, *34*(3), 410-476.

Maynard, M. T., Mathieu, J. E., Rapp, T. L., & Gilson, L. L. (2012). Something (s) old and something (s) new: Modeling drivers of global virtual team effectiveness. *Journal of Organizational Behavior*, *33*(3), 342-365.

McGrath, J. E. (1984). *Groups: Interaction and performance* (Vol. 14). Englewood Cliffs, NJ: Prentice-Hall.

Mesmer-Magnus, J. R., & DeChurch, L. A. (2009). Information sharing and team performance: A meta-analysis. *Journal of Applied Psychology*, *94*(2), 535.

Meyer, B., & Schermuly, C. C. (2012). When beliefs are not enough: Examining the interaction of diversity faultlines, task motivation, and diversity beliefs on team performance. *European Journal of Work and Organizational Psychology*, *21*(3), 456-487.

Michinov, E., Olivier-Chiron, E., Rusch, E., & Chiron, B. (2008). Influence of transactive memory on perceived performance, job satisfaction and identification in anaesthesia teams. *British Journal of Anaesthesia*, *100*(3), 327-332.

Minton-Eversole, T. (2012). Virtual team used most by organizations, survey says. *Society Human Resource Management*. Retrieved from http://www.shrm.org/hrdisciplines/orgempdev/articles/Pages/VirtualTeamsUsedMostbyGlobalOrganizations,SurveySays.aspx.

Mortensen, M., & Hinds, P. J. (2001). Conflict and shared identity in geographically distributed teams. *International Journal of Conflict Management*, *12*(3), 212-238.

Muethel, M., & Hoegl, M. (2010). Cultural and societal influences on shared leadership in globally dispersed teams. *Journal of International Management*, *16*(3), 234-246.

Nishii, L. H., & Goncalo, J. A. (2008). Demographic faultlines and creativity in diverse groups. *Research on managing groups and teams*, *11*, 1-26.

Okhuysen, G. A., & Eisenhardt, K. M. (2002). Integrating knowledge in groups: How formal interventions enable flexibility. *Organization Science*, *13*(4), 370-386.

O'Leary, M. B. (2002). *Geographic dispersion in teams: Its history, experience, measurement, and change.* (Doctoral dissertation, Massachusetts Institute of Technology)

O'Leary, M. B., & Cummings, J. N. (2007). The spatial, temporal, and configurational characteristics of geographic dispersion in teams. *MIS Quarterly*, *31*(3), 433-452.

O'Leary, M. B., & Mortensen, M. (2005). Subgroups with attitude: Imbalance and isolation in geographically dispersed teams. In *Presented at the Academy of Management Conference*. Honolulu, Oahu, HI.

O'Leary, M. B., & Mortensen, M. (2010). Go (con) figure: Subgroups, imbalance, and isolates in geographically dispersed teams. *Organization Science*, *21*(1), 115-131.

O'Leary, M. B., Orlikowski, W., & Yates, J. (2002). Distributed work over the centuries: Trust and control in the Hudson's Bay Company, 1670–1826. In P Hinds & S. Kiesller (Eds.), *Distributed work*, (pp. 27-54). Cambridge, MA: MIT Press.

Pascual, R. G., Mill, M. C., & Blendell, C. (1999). Supporting distributed and ad-hoc team interaction. *Proceedings from the 4th Joint GAF/RAF/USAF Workshop on Human-Computer Teamwok,* pg. 64-71.

Pearsall, M. J., & Ellis, A. P. (2006). The effects of critical team member assertiveness on team performance and satisfaction. *Journal of Management*, *32*(4), 575-594.

Pearsall, M. J., Ellis, A. P., & Stein, J. H. (2009). Coping with challenge and hindrance stressors The effects of critical team member assertiveness on team performance and satisfaction in teams: Behavioral, cognitive, and affective outcomes. *Organizational Behavior and Human Decision Processes*, *109*(1), 18-28.

Pelled, L. H. (1996). Demographic diversity, conflict, and work group outcomes: An intervening process theory. *Organization Science*, *7*(6), 615-631.

Politis, J. D. (2003). The connection between trust and knowledge management: what are its implications for team performance. *Journal of Knowledge Management*, *7*(5), 55-66.

Polzer, J. T., Crisp, C. B., Jarvenpaa, S. L., & Kim, J. W. (2006). Extending the faultline model to geographically dispersed teams: How colocated subgroups can impair group functioning. *Academy of Management Journal*, *49*(4), 679-692.

Powell, A., Piccoli, G., & Ives, B. (2004). Virtual teams: a review of current literature and directions for future research. *ACM Sigmis Database*, *35*(1), 6-36.

Prince,C., & Salas, E. (1993). Training and research for teamwork in the military aircrew. In E. Wiener, B. Kanki, & R. Helmreich (Eds.), *Cockpit resource management* (pp. 337-366). San Diego, CA: Academic.

Pulakos, E. D., Arad, S., Donovan, M. A., & Plamondon, K. E. (2000). Adaptability in the workplace: Development of a taxonomy of adaptive performance. *Journal of Applied Psychology*, *85*, 612-624.

Rau, D. (2005). The influence of relationship conflict and trust on the transactive memory performance relation in top management teams. *Small Group Research*, *36*(6), 746-771.

Ren, Y., & Argote, L. (2011). Transactive memory systems 1985–2010: An integrative framework of key dimensions, antecedents, and consequences. *The Academy of Management Annals*, *5*(1), 189-229.

Rico, R., Molleman, E., Sánchez-Manzanares, M., & Van der Vegt, G. S. (2007). The effects of diversity faultlines and team task autonomy on decision quality and social integration. *Journal of Management*, *33*(1), 111-132.

Saunders, C. S., & Ahuja, M. K. (2006). Are all distributed teams the same? Differentiating

between temporary and ongoing distributed teams. *Small Group Research*, *37*(6), 662-

700.

Saunders, C., Van Slyke, C., & Vogel, D. R. (2004). My time or yours? Managing time visions

in global virtual teams. *The Academy of Management Executive*, *18*(1), 19-31.

Schraw, D., Dunkle, M.E., & Bendixen, L. D. (1995). Cognitive processes in well-defined and

ill-defined problem solving. *Applied Cognitive Psychology, 9*(6), 523-538.

Schraw, G., Dunkle, M. E., & Bendixen, L. D. (1995). Cognitive processes in well-defined and

ill-defined problem solving. *Applied Cognitive Psychology*, *9*(6), 523-538.

Salas, E., Burke, C. S., & Fowlkes, J. E. (2006). Measuring team performance "in the wild:"

Challenges and tips. *Performance measurement: Current perspectives and future

challenges*, 245-272.

Salas, E. Cooke, N. J., & Rosen, M. A. (2008). On teams, teamwork, and team performance:

Discoveries and developments. *Human Factors, 50*(3), 540-547.

Salas, E., DiazGranados, D., Klein, C., Burke, C. S., Stagl, K. C., Goodwin, G. F., & Halpin, S.

M. (2008). Does team training improve team performance? A meta-analysis. *Human

Factors, 50* (6), 903-933.

Salas, E., Dickinson, T. L., Converse, S. A., & Tannenbaum, S. I. (1992). Toward an

understanding of team performance and training. In R. W. Swezey, E. Salas (Eds.),

Teams: Their training and performance (pp. 3-29). Westport, CT US: Ablex Publishing.

Salas, E., Fowlkes, J. E., Stout, R. J., Milanovich, D. M., & Prince, C. (1999). Does CRM

training improve teamwork skills in the cockpit?: Two evaluation studies. *Human

Factors: The Journal of the Human Factors and Ergonomics Society*, *41*(2), 326-343.

Salas, E., Goodwin, G. F., & Burke, C. S. (2009). *Team effectiveness in complex organizations: Cross-disciplinary perspectives and approaches*. New York, NY: Routledge/Taylor & Francis Group.

Salas, E., Stagl, K. C., & Burke, C. S. (2004). 25 years of team effectiveness in organizations: Research themes and emerging needs. *International review of industrial and organizational psychology*, *19*, 47-92.

Smith-Jentsch, K. A., Kraiger, K., Cannon-Bowers, J. A., & Salas, E. (2009). Do familiar teammates request and accept more backup? Transactive memory in air traffic control. *Human Factors: The Journal of the Human Factors and Ergonomics Society*, *51*(2), 181-192.

Sole, D., & Edmondson, A. (2002). Situated knowledge and learning in dispersed teams. *British journal of management*, *13*(S2), S17-S34.

Stagl, K. C., Salas, E., Rosen, M. A., Priest, H. A., Burke, C. S., Goodwin, G. F., & Johnston, J. H. (2007). Distributed team performance: A multi-level review of distribution, demography, and decision making. *Research in Multi Level Issues*, *6*, 11-58.

Stasser, G., Stewart, D. D., & Wittenbaum, G. M. (1995). Expert roles and information exchange during discussion: The importance of knowing who knows what. *Journal of Experimental Social Psychology*, *31*(3), 244-265.

Staw, B. M. (1975). Attribution of the "causes" of performance: A general alternative interpretation of cross-sectional research on organizations.*Organizational Behavior and Human Performance*, *13*(3), 414-432.

Stout, R. J., & Salas, E. (1993). The role of planning in coordinated team decision making: Implications for training. In *Proceedings of the Human Factors and Ergonomics Society*

37th Annual Meeting (pp. 1238–1242). Santa Monica, CA: Human Factors and Ergonomics Society.

Tajfel, H. & Turner, J.C. (1986). The social identity theory of intergroup behavior. In S. Worchel and W. G. Austin (Eds.), *Psychology of Intergroup Relations* (pp. 7-24). Chicago: Nelson-Hall Publishers.

Tajfel, H., & Turner, J. C. (2004). The social identity theory of intergroup behavior. In J. T. Jost, J. Sidnaius (Eds.), *Political psychology: Key readings* (pp. 7-24). New York, NY: Psychology Press.

Thatcher, S. M., Jehn, K. A., & Zanutto, E. (2003). Cracks in diversity research: The effects of diversity faultlines on conflict and performance. *Group Decision and Negotiation*, *12*(3), 217-241.

Thatcher, S., & Patel, P. C. (2011). Demographic faultlines: A meta-analysis of the literature. *Journal of Applied Psychology*, *96*(6), 1119.

Thomas-Hunt, M. C., & Phillips, K. W. (2004). When what you know is not enough: Expertise and gender dynamics in task groups. *Personality and Social Psychology Bulletin*, *30*(12), 1585-1598.

Townsend, A. M., DeMarie, S. M., & Hendrickson, A. R. (1998). Virtual teams: Technology and the workplace of the future. *The Academy of Management Executive*, *12*(3), 17-29.

Turner, J. C., Brown, R. J., & Tajfel, H. (1979). Social comparison and group interest in ingroup favouritism. *European Journal of Social Psychology*, *9*(2), 187-204.

Turner, J. C., Hogg, M. A., Oakes, P. J., Reicher, S. D., & Wetherell, M. S. (1987). *Rediscovering the social group: A self-categorization theory*. Cambridge, MA: Basil Blackwell.

Turner, J. C., Oakes, P. J., Haslam, S. A., & McGarty, C. (1994). Self and collective: Cognition and social context. *Personality and social psychology bulletin*, *20*, 454-454.

Turner, J. C., & Onorato, R. S. (1999). Social identity, personality, and the self-concept: A self-categorization perspective. In TR Tyler, RM Kramer, & OP John (Eds.), *The psychology of the social self* (pp. 11-46). Mahwah, NJ: Lawrence Earlbaum Associates.

Tziner, A. (1982). Differential effects of group cohesiveness types: A clarifying overview. Social Behavior and Personality: an international journal, 10(2), 227-239.

van Knippenberg, D., Dawson, J. F., West, M. A., & Homan, A. C. (2011). Diversity faultlines, shared objectives, and top management team performance. *Human Relations*, *64*(3), 307-336.

Van Knippenberg, D., De Dreu, C. K., & Homan, A. C. (2004). Work group diversity and group performance: an integrative model and research agenda.*Journal of applied psychology*, *89*(6), 1008-1022.

Walther, J. B. (1996). Computer-mediated communication: Impersonal, interpersonal, and hypersonal interaction. *Communication Research, 23*(1), 3-43.

Wegner, D. M., Giuliano, T., & Hertel, P. T. (1985). Cognitive interdependence in close relationships. In W. Ickes (Ed.),*Compatible and incompatible relationships* (pp. 253-276). New York: Springer-Verlag.

Wegner, D. M. (1986). Transactive Memory: A contemporary analysis of the group mind. In B. Mullen & G. Goethals (Eds.), *Theory of group behavior* (pp. 185-208). New York: Springer-Verlag.

Wegner, D. M., Erber, R., & Raymond, P. (1991). Transactive memory in close

    relationships. *Journal of personality and social psychology*, *61*(6), 923-929.

Widmeyer, W. N., Brawley, L. R., & Carron, A. V. (1985). The measurement of cohesion in

    sport teams: The group environment questionnaire, *Journal of Sport Psychology, 7,* 244-

    266.

Wildman, J. L., Thayer, A. L., Pavlas, D., Salas, E., Stewart, J. E., & Howse, W. R. (2012).

    Team knowledge research emerging trends and critical needs. *Human Factors: The*

    Journal of the Human Factors and Ergonomics Society, *54*(1), 84-111.

Yoo, Y., & Kanawattanachai, P. (2001). Developments of transactive memory systems and

    collective mind in virtual teams. *International Journal of Organizational Analysis*, *9*(2),

    187-208.

Zaccaro, S. J. (1991). Nonequivalent associations between forms of cohesiveness and group-

    related outcomes: Evidence for multidimensionality.*The Journal of Social*

    Psychology, *131*(3), 387-399.

Zaccaro, S. J., Gualtieri, & Minionis D. (1995). Task Cohesion as a facilitator of team decision

    making uder temporal urgency. *Military Psychology, 7*(2),77-93.

Zaccaro, S. J., & Lowe, C. A. (1988). Cohesiveness and performance on an additive task:

    Evidence for multidimensionality. *The Journal of Social Psychology*, *128*(4), 547-558.

Zanutto, E. L., Bezrukova, K., & Jehn, K. A. (2011). Revisiting faultline conceptualization:

    Measuring faultline strength and distance. *Quality & Quantity*, *45*(3), 701-714.

Zhang, Z. X., Hempel, P. S., Han, Y. L., & Tjosvold, D. (2007). Transactive memory system

links work team characteristics and performance. *The Journal of applied psychology*, *92*(6), 1722.