EXAMINING THE INFLUENCE OF SHARED MENTAL MODELS AND TRANSACTIVE MEMORY SYSTEMS ON THE EFFECTIVENESS OF SERVICE MANAGEMENT TEAMS

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by

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Examining the Influence of Shared Mental Models and Transactive Memory Systems on the Effectiveness of Service Management Teams

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Abstract

The study examined the combined influence of two types of team cognitions (shared mental models and transactive memory systems) on team adaptability, team performance, and team member satisfaction. Furthermore, this study highlighted team learning behavior and team engagement as mediators on the relationship between team cognitions and team outcomes. Twenty seven teams involving 178 members in a food service management laboratory participated in the study. Hierarchical linear modeling results indicate that team cognitions predict self-rated and instructor-rated team performance, team adaptability, and team member satisfaction. The mediating effects of team learning behavior and team engagement were found in this study. Finally, the interaction effects of shared mental models and transactive memory systems on team outcomes were found, followed by a partial mediated-moderation relationship. The implications of the findings and directions of future research are discussed.
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CHAPTER 1

INTRODUCTION

1.1 Problem Statement

Service organizations are increasingly using self-managing teams (SMTs) at all hierarchical levels to improve productivity and service quality and to enhance organizational competitiveness (De Jong, Wetzels, & DeRuyter, 2008). Organizational success depends on the ability of teams to collaborate effectively and work efficiently (DeChurch & Mesmer-Magnus, 2010). SMT refers to groups of interdependent employees who are collectively responsible for decision-making and developing work routines, planning, and monitoring team performance (De Jong et al., 2008). Organizations including Taco Bell, Prudential, Welch Foods, and Cigna have successfully utilized SMTs in their customer service operations (Cohen, Chang, & Ledford, 1997). Research lists several benefits that accrue to organizations from using front-line SMTs, including efficient use of the knowledge and experience of front-line employees who are closest to the customer (Batt, 1999), increased learning and adaptability (Wageman, 1997), enhanced employee motivation, and higher productivity (Cohen et al., 1997). Given the increased adoption of front-line SMTs in service operations, it is important to investigate the determinants and underlying mechanisms that impact team effectiveness and organizational productivity. (Henceforth, SMTs will be referred to as “teams”).

An abundance of research has been conducted to examine factors that contribute to high team performance (e.g., Salas, Dickinson, Converse, & Tannenbaum, 1992). Among these factors, team cognition has received much research attention because it is considered to be a central driver of team-related processes and behaviors (Cannon-Bowers & Salas, 2001; Chou, Wang, Wang, Huang, & Cheng, 2008; DeChurch & Mesmer-Magnus, 2010). Team cognition has been referred to as an emergent state, in which knowledge important for team functioning is
mentally organized, represented, and distributed within the team (Kozlowski & Ilgen, 2006). It has been used as a mechanism to explain how successful teams accurately predict and execute actions (Mohammed & Hamilton, in press).

Research has commonly explored two types of team cognitions: shared mental models and transactive memory systems (DeChurch & Mesmer-Magnus, 2010). Shared mental models (SMM) refer to “team members’ shared, organized understanding and mental representation about the key elements of the team’s relevant environment” (Mohammed & Dumville, 2001, p. 90). The second type of team cognition, transactive memory systems (TMS), is a set of individual memory systems that combine the knowledge possessed by particular members with a shared awareness of who knows what (Wegner, 1987). Research in SMM and TMS has been conducted in diverse settings across a variety of team types using various measures and various team criteria (e.g., Cooke, Kiekel, & Helm, 2001; Ellis, 2006; Mathieu, Heffner, Goodwin, Salas, & Cannon-Bowers, 2000; Rentsch & Klimoski, 2001). A significant number of these studies have firmly established the positive relationship between team cognition (SMM and TMS) and team outcomes (e.g., Austin, 2003; Lewis, 2004; Lim & Klein, 2006; Mathieu, Heffner, Goodwin, Cannon-Bowers, & Salas, 2005).

Although extensive research has been conducted in this area, several research questions need further investigation. Research within the shared mental models and transactive memory traditions demonstrates the importance of collective cognition. Specifically, these research streams have progressed separately, and scholars have noted the need to integrate the two streams in order to explain team effectiveness (DeChurch & Mesmer-Magnus, 2010; Mohammed & Dumville, 2001; Mohammed, Ferzandi, & Hamilton, 2010; Salas & Wildman, 2009). Further, scholars have suggested that effective teamwork requires members not only to hold “similar
cognitive structures” (SMM) but also hold distinctive knowledge configurations” (TMS) (DeChurch & Mesmer-Magnus, 2010, p. 3). Fulfilling this gap in the literature, the current study presents an integrated model examining the combined influence of shared mental models and transactive memory systems on team outcomes.

The current study investigates the differential effects of each independent variable on various team outcomes. Few studies have investigated the influence of multiple mental models on team outcomes (Lim & Klein, 2006). SMM has been categorized into two categories: task SMM, and team SMM; and have been proposed to impact team outcomes. However, recently scholars have noted the need to investigate whether different mental models have different impacts on various team outcomes (DeChurch & Mesmer-Magnus, 2010). In order to bridge this gap in the literature, the current study not only investigates the differential effects of task and team SMM, but also the differential effects of SMM and TMS on team outcomes.

Though the impact of team cognition on team performance is well established, there is little research explaining how and why team cognition affects team performance. There is a lack of research examining the underlying mechanisms that explain the relationship between TMS and team outcomes. Research on SMM has used the I-P-O (Input-Process-Outcome) framework to investigate the mediating effects of team processes (communication, coordination, cooperation, strategy) on the relationship between SMM and team outcomes (performance) (Mathieu et al., 2005; Mathieu et al., 2000). However, beyond team processes, few studies have considered other underlying mechanisms that might explain the relationship between SMM and team outcomes. To broaden the range of important mediating variables other than team processes, Ilgen, Hollenbeck, Johnson, and Jundt (2005) suggested the IMOI framework as a replacement for the processes with mediating variables (2005). Based on this Input-Mediator-
Outcome framework the current study makes a contribution to the literature by examining the mediating effects of team learning behavior and team engagement on the relationship between team cognition and team outcomes. Team learning behavior, which refers to an ongoing process of reflection and action (Edmondson, 1999), will have an important effect on the relationship between team cognition and performance. Similarly, team engagement, which refers to the extent to which team members are vigorous, dedicated, and absorbed in performing the required collaborative tasks (Salanova, Llorens, Cifre, Martinez, & Schaufeli, 2003), will influence the relationships.

Research on team cognition has focused on team performance as a measure of team outcome (e.g., Austin, 2003; Cannon-Bowers et al., 1993; Mathieu et al., 2000). Outcomes are results and by-products of team activity that are valued by one or more constituencies (e.g., customers, organizations) (Mathieu et al., 2000). Responding to recent calls from scholars (Mohammed et al., 2010), the current study investigates multiple measures of team outcomes: (a) team performance and team adaptability (performance outcomes), and (b) member satisfaction (members’ affective reactions and willingness to work together again in the future).

The shared mental model theory was developed based on observations of teams engaging in dynamic and time-stressed environments (e.g., cockpit crews, military training) (Cannon-Bowers & Salas, 1990; Cannon-Bowers, Salas, & Converse, 1993). The research in shared mental models is dominated by laboratory studies (e.g., Mathieu et al., 2000). The few field studies that have been conducted (e.g., Lim & Klein, 2006; Smith-Jentsch, Campbell, Milanovich, & Reynolds, 2001) used samples composed of action teams. Recent research has called for investigating the SMM construct with samples of teams focusing on project, management, decision-making, and service (Chou et al., 2008). Early research in transactive memory systems
involved couples rather than teams/groups and was conducted in the laboratory using contrived tasks (Mohammed & Dumville, 2001). Recent work has investigated organizational teams (Austin, 2003; Lewis, 2004); however, more research is needed in field contexts in order to extend the generalizability of the findings in team cognition (Badke-Schaub, Neumann, Lauche, & Mohammed, 2007; Chou et al., 2008; Mohammed & Dumville, 2001). Responding to the call in the literature, this study investigates the role of team cognition in service-management teams in a field setting.

1.2 Purpose of Study

To sum up, first, the study explores the impact of time on the development of team cognitions, team learning behaviors, team engagement, and team outcomes. It is argued that each of the study variables should increase over time as a result of team experience. Second, the study examines the differential effects of task SMM, team SMM, and TMS on team outcomes and mediating variables. Third, the mediating role of team engagement and team learning behaviors on the relationship between team cognitions and team outcomes is investigated. Fourth, the interaction effect of SMM and TMS on team outcomes and mediating variables is investigated. Finally, the mediated-moderation relationships are tested.

1.3 Hypotheses

Twelve hypotheses with sub-hypotheses are proposed as follows:

*Hypothesis 1:* Task SMM will be more positively related to team performance than will team SMM.

*Hypothesis 2:* Team SMM will be more positively related to team adaptability than will task SMM.
Hypothesis 3: Team SMM will be more positively related to member satisfaction than will task SMM.

Hypothesis 4a: Task SMM will be more positively related to member satisfaction than will TMS.

Hypothesis 4b: Team SMM will be more positively related to member satisfaction than will TMS.

Hypothesis 5. Team learning behavior will partially mediate the relationship between task SMM and (a) team performance, (b) member satisfaction, and (c) team adaptability.

Hypothesis 6. Team learning behavior will partially mediate the relationship between team SMM and (a) team performance, (b) member satisfaction, and (c) team adaptability.

Hypothesis 7. Team learning behavior will partially mediate the relationship between TMS and (a) team performance, (b) team adaptability, and (c) member satisfaction.

Hypothesis 8. Team engagement will partially mediate the relationship between task SMM and (a) team performance, (b) team adaptability, and (c) member satisfaction.

Hypothesis 9. Team engagement will partially mediate the relationship between team SMM and (a) team performance, (b) team adaptability, and (c) member satisfaction.

Hypothesis 10. Team engagement will partially mediate the relationship between TMS and (a) team performance, (b) team adaptability, and (c) member satisfaction.

Hypothesis 11. TMS will moderate the relationships between task SMM and (a) team performance, (b) team adaptability, (c) member satisfaction, (d) team learning behavior, and (e) team engagement.
Hypothesis 12. TMS will moderate the relationships between team SMM and (a) team performance, (b) team adaptability, (c) member satisfaction, (d) team learning behavior, and (e) team engagement.
1.4 Significance of the Research

This project will add to the theoretical understanding in this area by modeling and testing the direct and differential effects of task SMM, team SMM, and TMS, on team outcomes and also the interactional effects of SMM and TMS on team outcomes. Further, the mediation effects of team learning behavior and team engagement on the relationship between the predictors (task SMM, team SMM, and TMS) and the team outcomes are investigated. An understanding of the combined effects of SMM and TMS in teams will lead to the development of more directed and effective training programs. Further, an understanding of underlying mechanisms will improve understanding of effective team functioning. Finally, the project will inform managers regarding whether team cognitions develop overtime, consequently improving team outcomes.

1.5 Outline of Subsequent Chapters

This dissertation comprises five chapters. In Chapter 1 along with an explanation of the purpose of the study, information is provided on the basis of which the conceptual model is developed for the study. In Chapter 2 a review is provided of the available literature on shared mental models, transactive memory systems, team learning behavior, team engagement, team performance, team adaptability, and team member satisfaction. The literature review focuses on the above variables and the linkages between each variable. Hypotheses are developed based on previous findings and theories, and the conceptual model is developed based on the hypotheses. Chapter 3 provides a detailed discussion of the methodology used to test the proposed hypotheses. This section focuses on measurement of variables, and the validity and reliability of the survey instruments are also discussed. Additionally, this section also presents the discussion of data collection procedures, context, and statistical analyses. Chapter 4 examines the model and
the hypotheses and presents the results of the statistical analyses. Chapter 5 provides a discussion of the results, followed by limitations, and directions for future research.
CHAPTER 2  
LITERATURE REVIEW  

2.1 Introduction

Fast-moving and challenging business environments have induced organizations to adopt flexible structural forms designed to reduce costs while simultaneously responding to changing customer demands (Donnelon, 1996). Increased consumer demands and technology have contributed to the complexity of many tasks performed in the workplace, such that it is difficult for employees to complete their tasks independently (Mathieu et al., 2000). Teams are viewed as more suitable for such structural forms, as they allow team members to deal with change and complexity more effectively (Chou et al., 2008). That is, in teams, members can share the workload, monitor the work behaviors of other members, and develop and contribute to expertise on subtasks (Mathieu et al., 2000). A team has been defined as “a distinguishable set of two or more people who interact dynamically, interdependently, and adaptively toward a common and valued goal/object/mission, who have been assigned specific roles or functions to perform, and who have a limited life span of membership” (Salas et al., 1992, p. 126–127).

An abundance of research has been conducted to examine factors that contribute to high team performance (Salas et al., 1992). Although cognition has traditionally been addressed at the individual level of analysis, group-level cognitive structures are receiving greater research attention because of the increased emphasis on teams in research and in organizations (Mohammed & Hamilton, in press). Team cognitions are considered to be central drivers of team performance (DeChurch & Mesmer-Magnus, 2010) and are recognized as one of the hallmarks of expert teams (Salas, Rosen, Burke, Goodwin, & Fiore, 2006). A recent meta-analysis found that team cognition predicted team motivational states, processes, and performance (DeChurch &
Mesmer-Magnus, 2010). Team cognition is a broad term that refers to the collective cognitions of a group (Tindale, Meisenhelder, Dykema-Engblade, & Hogg, 2001) and explains how successful teams accurately predict team functioning and coordinate without explicit communication (Cannon-Bowers & Salas, 2001). Research in team cognition has explored various constructs (e.g., schema agreement, shared situation awareness, strategic consensus), but has most commonly explored two constructs: shared mental models and transactive memory systems. A review of the literature relating to shared mental models and transactive memory systems is presented in this chapter.

In the following section, the definitions of the variables of interest in this project are provided (Table 1). Team cognition—shared mental models and transactive memory systems—is modeled as a determinant of team performance, team adaptability, and member satisfaction. Additionally, the mediating effects of team learning behavior and team engagement on the relationship between team cognition and team outcomes are investigated.
Table 1

Definitions of Variables in Study

<table>
<thead>
<tr>
<th>Variables</th>
<th>Definition</th>
<th>Key citations</th>
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</thead>
<tbody>
<tr>
<td><strong>Independent Variables</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shared mental models</td>
<td>Team members’ shared, organized understanding and mental representation of the key elements of the team’s relevant environment (or shared knowledge of teamwork and taskwork).</td>
<td>Klimoski &amp; Mohammed, (1994), Mathieu et al. (2000); Cannon-Bowers &amp; Salas(2001)</td>
</tr>
<tr>
<td>Transactive memory systems</td>
<td>Transactive memory systems (TMS) refers to team members dividing the cognitive labor for their tasks and relying on one another to learn, remember, and communicate information, with each team member responsible for specific expertise such that collectively the team possesses all the information needed for the tasks.</td>
<td>Lewis (2003, 2004)</td>
</tr>
<tr>
<td></td>
<td>Transactive memory is a set of individual memory systems that combines the knowledge possessed by particular members with a shared awareness of who knows what.</td>
<td>wegner(1987)</td>
</tr>
<tr>
<td><strong>Mediating Variables</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Team learning behavior</td>
<td>Team learning is defined as the collective acquisition, combination, creation, and sharing of knowledge by teams.</td>
<td>Argote (1999)</td>
</tr>
<tr>
<td></td>
<td>Team learning behavior includes seeking feedback, discussing errors, experimentation, seeking information and feedback from customers and others.</td>
<td>Edmondson (1999).</td>
</tr>
<tr>
<td>Variables</td>
<td>Definition</td>
<td>Key citations</td>
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</tr>
<tr>
<td>Team engagement</td>
<td>The extent to which team members are vigorous, dedicated, and absorbed in performing the required collaborative tasks (taskwork and teamwork).</td>
<td>Salanova, Llorens, Cifre, Martinez, &amp; Schaufeli (2003)</td>
</tr>
<tr>
<td>Dependent Variables</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Team performance</td>
<td>Team performance reflects the quality and timeliness of deliverables (reports, food and service quality) and about meeting customer needs.</td>
<td>Lewis (2004)</td>
</tr>
<tr>
<td>Team adaptability</td>
<td>The extent to which teams effectively adapt their routines in response to unforeseen changes in their work environment.</td>
<td>LePine (2003)</td>
</tr>
<tr>
<td>Member satisfaction</td>
<td>The extent to which being in the group/team contributes to members’ satisfaction with the team.</td>
<td>Hackman (1987), Bushe &amp; Coetzer (2007), Lewis (2004)</td>
</tr>
</tbody>
</table>
Theoretical Background

The following section includes a review and discussion of relevant theory and empirical work related to the concepts described in the previous section and Table 1. Based on this information, hypotheses are developed.

2.2 Mental Models

Traditionally, mental models have been studied at the individual level (Wilson & Rutherford, 1989) and have been used as a cognitive terminology to help explain the process by which individuals make sense of and interpret their surroundings (Rouse & Morris, 1986). A mental model is a “psychological representation of the environment and its expected behavior” (Holyoak, 1984, p. 193), and are organized as knowledge structures that allow individuals to interact with their environment (Mathieu et al., 2000). Specifically, mental models provide a conceptual framework that individuals employ to describe, explain, and predict events in their environment (Klimoski & Mohammed, 1994).

2.3 Shared Mental Models

Developing on the individual perspective, Cannon-Bowers and Salas (1990) introduced the concept of shared mental models based on their observations of expert teams – high performance teams often coordinate behavior without the need to communicate. Shared mental models function to allow team members to draw on their own mental models as a basis for selecting actions that are consistent and coordinated with those of their teammates (Mathieu et al., 2000). Scholars argued that expert teams develop compatibility in members’ cognitive understanding of key elements of their performance environment, which helps them operate efficiently without the need for explicit coordination, and thus results in high performance (Cannon-Bowers et al., 1993; Cooke, Gorman, Duran, & Taylor, 2007).
The shared mental model (SMM) was defined as “team members’ shared, organized understanding and mental representation of knowledge about the key elements of the team’s relevant environment” (Mohammed & Dumville, 2001, p. 90). In similar contexts, SMM has frequently been referred to as shared knowledge, shared cognition, shared understanding, and schema agreement (Cooke et al., 2000; Ensley & Pearce, 2001; Johnson & O’Connor, 2008; Rentsch & Klimoski, 2001). Shared knowledge organization is at the core of the SMM construct (Cannon-Bowers et al., 1993). “Sharedness” refers to “having in common” (Mohammed et al., 2010); that is, it refers to the degree to which team members’ mental models are consistent with one another (Cannon-Bowers et al., 1993). Terms such as similarity, convergence, agreement, commonality, overlap, compatibility, and consensus have all been used to capture sharedness (Mohammed et al., 2010). Therefore, the crucial implication of the shared mental model theory is that team members hold compatible mental models or common knowledge that leads to common expectations for the taskwork and teamwork (Cannon-Bowers et al., 1993; Kozlowski & Ilgen, 2006); these mutual expectations allow teams to coordinate and make predictions about the behavior and needs of their teammates (Cooke et al., 2000).

SMM fulfill multiple functions, as they allow team members to describe, explain, and predict events in a similar manner (Mathieu et al., 2000). That is, team members are likely to interpret information in a similar way (description), explain situations similarly (explanation), and have similar expectations about future events (prediction) (Mohammed et al., 2010; Rouse, Cannon-Bowers, & Salas, 1992). Essentially, teams with well-developed SMM have a common/shared view of “what is happening, why it is happening, and what is likely to happen next” (Mohammed et al., 2010, p.4).
Many studies have argued that SMM do not refer to a unitary concept (Cannon-Bowers et al., 1993). Multiple mental models coexist among team members at a given point in time (Cannon-Bowers & Salas, 2001; Klimoski & Mohammed, 1994; Mathieu et al., 2000). SMM are conceptualized to represent various types of knowledge (Mohammed et al., 2010). Cooke et al. (2000) argued that the knowledge associated with SMM can be declarative (knowledge of what: facts, rules, regulations, and concepts in the task domain), procedural (knowledge of how: steps, procedures, sequences, and actions), and strategic (knowledge of the context and application: the overriding task strategies and knowledge of when they apply). Team members hold multiple mental models simultaneously (Rouse et al., 1992). Cannon-Bowers et al. (1993) originally proposed four non-independent SMM content domains: an equipment model (knowledge about tools and technology), a task model (understanding of work procedures, strategies, and contingency plans), a team interaction model (awareness of member responsibilities, role interdependencies, and communication patterns), and a team model (understanding of teammates’ preferences, skills, and habits).

Though early work has focused on knowledge structures (Cannon-Bowers et al., 1993), scholars have noted that the SMM construct is incomplete without a treatment of the notion of shared evaluative belief structures (Mohammed, Klimoski & Rentsch, 2000). That is, knowledge structures refer to descriptive states of nature believed to be true, whereas belief structures refer to desired states of nature that are preferred or expected (Mohammed et al., 2000). Accordingly, Cannon-Bowers and Salas (2001), proposed four types of mental models including ‘shared beliefs’: (1) task-specific knowledge (knowledge about specific procedures, sequences, actions, and strategies that are necessary to perform a task), (2) task-related knowledge (knowledge of information about member roles, responsibilities, role interdependencies, and interaction
patterns), (3) knowledge of teammates (knowledge of each other: preferences, strengths, weaknesses, and tendencies to maximize team performance), and (4) knowledge of attitudes or beliefs (knowledge of teammates’ general attitudes, values, or beliefs regarding work tasks, working environments, or the work itself).

Recent research has collapsed SMM content into teamwork and taskwork categories (Cooke et al., 2001; Mathieu et al., 2000). Researchers suggest that task-focused mental models include work goals and performance requirements, and team-focused mental models include the interpersonal interaction requirements and skills of team members (Mohammed et al., 2010).

Scholars suggest that both components of SMM, namely taskwork and teamwork, help a team “to be on the same page” in regard to knowing what to expect, anticipating what team members need, and explaining what is observed, which enables the team to coordinate actions and adapt behavior to task demands, leading to enhanced decision-making and higher performance (Cannon-Bowers et al., 1993). Therefore, the general thesis of this emerging literature is that when team members are mentally congruent and have an adequate understanding of taskwork and teamwork, the result is high team effectiveness (Mohammed & Hamilton, in press).

Although team mental model similarity has received more emphasis in the literature, scholars have also focused on the accuracy of team mental models. According to Mathieu et al. (2000), “similarity does not equal quality” (p. 281). The authors explained that “teammates may share a common vision of their situation yet be wrong about the circumstances they are confronting” (p. 281). Because task SMM and team SMM may be erroneous (inaccurate), highly convergent mental models, in combination with those that are high quality (accurate) are expected to yield the greatest team performance benefits (Mathieu et al., 2005).
Empirical work supporting this conceptualization shows that SMM influences team effectiveness (Lim & Klein, 2006; Marks, Zaccaro, & Mathieu, 2000; Mathieu et al., 2000) including team performance measured as scores from computer simulations (Mathieu et al., 2000), in field research as client satisfaction (Rentsch & Klimoski, 2001), decision quality (Kellermanns, Floyd, Pearson, & Spencer, 2008), military assessments (Lim & Klein, 2006), and safety and efficiency (Smith-Jentsch, Mathieu, & Kraiger, 2005). Recent studies have associated SMM with engagement (Miles & Kivlighan, 2008), collective efficacy (Mathieu, Rapp, Maynard, & Mangos, 2010), and individual-level outcomes (such as member trustworthiness, performance, and satisfaction) (Chou et al., 2008; Rentsch & Klimoski, 2001). Apart from outcomes, SMM is also positively related to team processes (e.g., strategy formation, cooperation, back-up behavior, coordination, and communication) (Marks, Sabella, Burke, & Zaccaro, 2002; Mathieu et al., 2000). Researchers focusing on the accuracy of mental models found a significant positive relationship between accuracy and performance (Marks et al., 2000) and a significant interaction effect between teamwork mental model similarity and teamwork mental model accuracy (Mathieu et al., 2005). The next section more closely discusses the relationship of SMM with outcomes of interest in this study, namely, team performance, team adaptability, and member satisfaction.

2.4 Shared Mental Models and Team Performance

Each component of SMM namely task SMM and team SMM have been associated with team performance. More sharedness/similarity of knowledge and understanding among team members in these two domains promotes higher levels of performance (Cannon-Bowers et al., 1993; Cannon-Bowers & Salas, 2001; Cooke et al., 2000; Lim & Klein, 2006; Mathieu et al., 2000; Mohammed et al., 2010; Smith-Jentsch et al., 2005).
Few studies have examined the influence of multiple mental models on team performance (e.g., Lim & Klein, 2006). Scholars have collapsed multiple mental models into two content areas: taskwork and teamwork (Mathieu et al., 2000). In the current study, the taskwork category includes the first mental model suggested by Cannon-Bowers and Salas (2001): task-specific knowledge. The teamwork category comprises the last three mental models suggested by Cannon-Bowers and Salas (2001): task-related knowledge, knowledge of teammates, and knowledge of attitudes or beliefs.

Research has shown that task SMM and team SMM improve timeliness of work, quality of outcomes, work efficiency, customer satisfaction, and decision quality (Chou et al., 2008; Mohammed et al., 2010). In the current study, the team performance measure includes the quality of the team’s deliverables, time management, ability to meet deadlines, quality of customer service, and ability to pay attention to detail.

This study examines the relationship between SMM and team performance. The impact of SMM on both self-rated and instructor-rated team performance is examined. The current study incorporates the “shared beliefs” component in the SMM construct as suggested by Cannon-Bowers and Salas (2001; Chou et al., 2008). Moreover, the influence of both task SMM and team SMM on team performance is examined. Most research suggests that both task SMM and team SMM will impact team performance. However, recent research suggests that the particular way in which SMM is conceptualized affects what it impacts (i.e., task-specific outcomes such as quality of output and timeliness are expected to be influenced by taskwork mental models) (Cannon-Bowers & Salas, 2001). DeChurch and Mesmer-Magnus (2010) argued that task SMM will have a greater influence on team performance than will team SMM—a position that will also be examined in this study. The following hypothesis is proposed:
Hypothesis 1: Task SMM will be more positively related to team performance than will team SMM.

Several studies have found a positive relationship between SMM and team performance in diverse settings with various team types with various measures and both in laboratory settings and fieldwork (e.g., Lim & Klein, 2006; Marks et al., 2000). However, beyond team performance, other measures of team effectiveness have received little attention (Mohammed et al., 2010). Researchers have recognized team adaptability as an under-researched but critical dimension of team effectiveness (Lepine, 2003; Mohammed et al., 2010). Therefore, team adaptability is included as a dependent variable in this study. The next section explains the relationship between SMM and team adaptability.

2.5 Team Adaptability

Today’s organizations are characterized by changing, dynamic environments in which the need for adaptive workers has become increasingly important (Pulakos, Arad, Donavan, & Plamondon, 2000). Organizations are structuring work around teams to achieve increased flexibility and adaptability in order to remain competitive in today’s work environment (Ilgen, 1999). Scholars have been trying to understand how teams make adjustments/adapt to unprogrammed changes, which continues to be considered one of the least-understood phenomena in task-oriented team performance (Behling, Coady, & Hopple, 1967; LePine, 2003).

With experience, as in all organizational systems, teams develop habitual patterns of behavior that are sometime called “routines” (Gersick & Hackman, 1990). Routines help team members anticipate other members’ actions, resulting in increased efficiency and reduced uncertainty (LePine, 2003). However, the most critical challenges facing teams is the occasional need to change their routines in order to respond to changes in their task environment (LePine,
Routine behavior has been characterized as mechanical; thus, it is likely to be applied inappropriately in a changing situation (Cohen & Bacdayan, 1996). Scholars have noted that teams that are able to deal with unanticipated change and modify their routines are more effective (Argote & McGrath, 1993).

Team adaptability enables team members to anticipate “the actions and needs of their colleagues and task demands and dynamically adjust their own behavior accordingly, without having to communicate directly with each other or plan the activity” (Rico, Sanchez-Manzanares, Gil, & Gibson, 2008, p.164). Researchers have suggested that adaptability is an important skill in high-performance teams (Cannon-Bowers, Tannenbaum, Salas, & Volpe, 1995). Studies have associated team adaptability with high team performance, especially under time pressure (Entin, Serfaty, Entin, & Deckert, 1993). The importance of team adaptability to performance indicates the need to investigate factors that allow teams to effectively adapt their routines in response to unforeseen changes in their work environment (LePine, 2003).

2.6 Shared Mental Models and Team Adaptability

According to Cannon-Bowers et al. (1993), teams that must adapt quickly to changing task demands draw on SMM. Cannon-Bowers et al.’s rationale was that in order to effectively adapt, team members must predict what their teammates are going to do and what they will need (i.e., information and resource requirements of teammates) in order to do it (Mathieu et al., 2000). SMM in teams help team members predict their teammates’ behaviors and adapt their own behaviors based on teammates’ needs (Cannon-Bowers &Salas, 2001; Entin & Serfaty, 1999). Therefore, it is argued that teams with task SMM and team SMM will be able to adapt quickly and efficiently.
Team adaptability involves interpreting task information similarly and based on that information anticipate their own behaviors needed, but also anticipate other member behaviors and their needs. Therefore, task SMM, which include work goals and performance requirements, will influence team adaptability. However, team SMM, which include the interpersonal interaction requirements and skills of other team members, is more likely to drive team adaptability. The following hypothesis is proposed:

*Hypothesis 2: Team SMM will be more positively related to team adaptability than will task SMM.*

Team outcomes or team effectiveness are results and by-products of team activity that are valued by one or more constituencies (Mathieu et al., 2000). Scholars have suggested that team member satisfaction is a critical component of team effectiveness along with performance outcomes (Bushe & Coetzer, 2007; McGrath, 1984; Campion, Medsker, & Higgs, 1993; Sundstrom, De Meuse, & Futrell, 1990; Tekleab, Quigley, & Tesluk, 2009). Team effectiveness can be both behavioral and attitudinal (Chou et al., 2008). Behavioral effectiveness includes performance, adaptability, and creativity, and attitudinal effectiveness refers to team members’ psychological states such as satisfaction and commitment (Chou et al., 2008). The relationship between SMM and performance outcomes (team performance and adaptability) was discussed earlier. In the following section, the relationship between SMM and team member satisfaction is discussed.

### 2.7 Member Satisfaction

Team member satisfaction and team viability are important measures of team effectiveness and were first introduced by Hackman and colleagues (Hackman, 1987; Hackman, 1990; Hackman & Morris, 1975). They suggested that the extent to which being part of the team
contributes to members’ satisfaction with the team (team member satisfaction) and the extent to which team members wish to work together as a team in the future (viability), are two key critical measures of effectiveness (Campion, Medsker, & Higgs, 1993; Sundstrom, De Meuse, & Futrell, 1990; Tekleab et al., 2009).

2.8 Shared Mental Models and Member Satisfaction

Chou et al. (2008) found direct positive relationships between shared work values (a representation of the SMM construct) and team members’ satisfaction. The authors argued that shared work values in teams help team members to understand each others’ behavior precisely, which enhances the quality of interpersonal relationships among the team members and consequently positively influences team members’ satisfaction levels. Therefore, there is evidence of a direct positive relationship between SMM and team member satisfaction.

Building on past research, the current study argues that both task SMM and team SMM will have a positive influence on member satisfaction with team membership or team experience. When team members have a similar understanding of their taskwork (task SMM: which includes work goals and performance requirements), they are likely to accurately predict other teammates’ behaviors and their potential needs. This results in team members obtaining required support from other members easily (Chou et al., 2008). Such support makes it convenient for members to accomplish their individual subtasks, which improves team members’ satisfaction levels (satisfaction with team).

However, when team members have a similar understanding of teamwork (team SMM: which involves interpersonal interaction requirements, cooperation, communication, and knowledge about teammates’ beliefs, values, skills, and preferences), interpersonal relationships are likely to develop. Such high-quality interpersonal relationships are expected to enhance
member satisfaction with the team experience and the membership (Chou et al., 2008). Therefore, team SMM is expected to have a greater influence on member satisfaction than is task SMM. The following hypothesis is proposed:

_Hypothesis 3: Team SMM will be more positively related to member satisfaction than will task SMM._

The current study proposes the influence of two types of team cognitions on team outcomes: shared mental models and transactive memory systems. In the previous sections, the concept of shared mental models was discussed. In the following sections, the concept of transactive memory systems is presented and its relationship with the team outcomes of interest in this project explained.

2.9 Transactive Memory Systems

Transactive memory is defined as “a set of individual memory systems which combines the knowledge possessed by particular team members with a shared awareness of who knows what” (Mohammed & Dumville, 2001, p. 94; Wegner, 1987). The concept refers to the idea that memory is a social phenomenon, such that members in one team utilize each other as external memory aids to supplement their own limited and unreliable memories (Mohammed & Dumville, 2001; Wegner, 1987). Transactive memory systems (TMS) was conceptualized by Wegner (1987), who observed that members of long-tenured groups tend to rely on one another to obtain (learn), process (remember), and communicate information from diverse knowledge domains (Lewis, 2003) i.e., they are cognitively interdependent. TMS allows team members to divide among themselves the cognitive labor for their tasks, with each member specializing in different domains (Lewis, 2004).
Apart from knowing who is expert in specific knowledge areas, transactive memory also involves distributing incoming information among individuals who have matching domains of expertise and accessing relevant material from others in the system (Wegner, 1987). Because of the encoding and information allocation processes, individual memories become progressively more specialized, resulting in a differentiated collective memory useful to the group (Mohammed & Dumville, 2001).

TMS improves team outcomes, as it allows quicker access to a greater amount of deep expertise and also improves integrative processes (Hollingshead, 2001; Moreland, 1999). Lewis (2004) presented three reasons for these effects (p.1520): (1) the division of knowledge responsibilities allows members to focus on developing deep expertise in their respective knowledge domains, while still maintaining ready access to task-relevant knowledge possessed by others; (2) as team members are clear about who is responsible for knowing and remembering what expertise, they can spend less time searching for necessary information during actual task processing; and (3) a shared understanding of member-expertise associations (i.e., shared understanding of knowledge distribution in teams) helps team members better anticipate other team members’ behavior, which results in coordinated, efficient interactions.

Moreland and colleagues (e.g., Moreland & Myaskovsky, 2000) proposed three dimensions of TMS, specialization, credibility, and coordination behaviors, which reflect the distributed and cooperative memory characteristics of TMS. Researchers note that the presence of the three dimensions is evidence of well-developed TMS (Liang, Moreland, & Argote, 1995). Specialization refers to the development of different but complementary knowledge (Lewis, 2003). Explaining the importance of credibility, Lewis (2003) argued that members will develop specialized knowledge only when they can rely on other team members to remember other task-
critical information. The absence of credibility results in the development of redundant knowledge instead of differentiated expertise. Finally, Lewis (2003) explains the importance of coordination for the development of TMS in teams. Whereas transactive memory exists in the minds of individuals, TMS exists among individuals as a function of their individual transactive memories (Lewis, 2003). Therefore, besides specialization and credibility, effective coordinated action among team members (to combine their transactive knowledge) is important (Wegner, 1987).

Building on prior research (Hollingshead, 1998; Lewis, 2003; Moreland, 1999; Wegner, 1995), Austin (2003) conceptualized transactive memory differently as a combination of four dimensions: group knowledge stock, consensus about knowledge sources, specialization of expertise, and accuracy of knowledge identification. Knowledge stock of a team refers to the combination of individual knowledge held by the team. Transactive memory consensus refers to the extent to which group members agree about “who has what knowledge.” Specialization enables groups to make better use of individual members as each member can build on deeper knowledge in a narrowly defined area of expertise. Finally, accuracy involves the extent to which individuals identified by others in the group as possessing particular knowledge/expertise actually possess that knowledge (p. 867).

TMS has been examined in laboratory and field settings and linked to team performance (Austin, 2003; Hollingshead, 1998a, 1998b, 2001; Lewis, 2004; Pearsall & Ellis, 2006). The experimental studies (e.g., Hollingshead, 1998a, 1998b) focused on demonstrating evidence of differentiated memory structures (as specialization among group members should lead to more efficient information processing), and used one of two experimental paradigms. In the first group of studies, individuals worked on a task that required either learning or retrieving information in
different knowledge areas with an assigned partner. It was found that participants who knew each other had more shared agreement about relative expertise, and performed better than did pairs of strangers (Hollingshead, 1998a, 1998b, 2001). In the second group of studies, the impact of individual and group training methods on transactive memory was examined (Hollingshead, 2001). Liang et al. (1995) found that members who were trained together developed stronger TMS: they specialized in remembering different aspects of the task, coordinated behaviors more effectively, and displayed greater trust in each other’s expertise. Therefore, prior studies demonstrated the existence of transactive memory and the encoding, storage, and retrieval mechanisms through which it operates.

2.10 Transactive Memory Systems and Team Performance

Recent studies have examined TMS within groups (Lewis, 2003, 2004; Pearsall, Ellis, & Bell, 2010). The positive influence of TMS on group performance is well established in group behavior literature (Akgun, Byrne, Keskin, Lynn, & Imamoglu, 2005). For example, in a study using virtual experiments, Ren, Carley and Argote (2006) found that transactive memory decreases group response time by facilitating knowledge-retrieval processes and improves decision quality through task coordination and evaluation. Along with experimental studies, recent work has begun to utilize organizational teams in field settings (e.g., Austin, 2003; Lewis, 2004). Austin (2003) examined the relationship between TMS and performance in mature continuing groups in a large apparel and sporting-goods company. Well-developed TMS, measured as a combination of knowledge stock, knowledge specialization, transactive memory consensus, and transactive memory accuracy had a positive relationship with group goal performance, external group evaluations, and internal group evaluations. Using MBA consulting teams in a longitudinal study, Lewis (2004) found that the development of TMS in teams results
in improved team performance. Yoo and Kanawattanachai (2001) found a positive relationship between TMS and team performance measured as profit, ROA, ROE, stock price, and market share. Akgun et al. (2005) found that TMS influences team learning (level of knowledge that the team gains in performing a new product action), speed to market (how fast a new product is developed), and new product success (market performance of a new product).

Researchers have argued that TMS improves team effectiveness, as it provides team members with quick and coordinated access to one another’s specialized expertise, encourages members to cultivate specialized expertise, ensures that more-unique/nonredundant information relevant to team tasks is shared, and facilitates access to a greater amount of knowledge (Lewis, 2004). Prior studies have found that TMS results in high-quality products, high-quality service that meets clients’ needs, effective time management, and timely delivery of products and services (Lewis, 2004). Therefore, there is substantial evidence that TMS influences team performance. This relationship will be re-examined in the current context as part of mediation tests. The current study examines the impact of TMS on both self-rated and instructor-rated team performance.

Team cognition literature (including TMS) has mostly focused on team performance as a measure of team effectiveness (DeChurch & Mesmer-Magnus, 2010). Although, a few studies have focused on other measures of team effectiveness such as viability (Lewis, 2004), time and quality (Ren, Carley, & Argote, 2006), and learning (London, Polzer, & Omorogie, 2006; Lewis, Lange, & Gillis, 2005), researchers have called for investigation of other important measures of team effectiveness (for example, team adaptability) (DeChurch & Mesmer-Magnus, 2010). The concept of team adaptability was defined earlier and the conceptualization remains the same. The following section explains the relationship between TMS and team adaptability.
2.11 Transactive Memory Systems and Team Adaptability

TMS in teams helps team members better anticipate how fellow members will behave (Cannon-Bowers et al., 1993); therefore, members are able to adapt their own behaviors based on fellow members’ needs (Entin & Serfaty, 1999). Argote and McGrath (1993) noted that teams must be able to deal with unanticipated change and modify their routines quickly and efficiently (i.e., adapt), or team effectiveness will suffer. TMS helps team members divide up knowledge responsibilities, thus allowing members to focus on developing deep expertise in their individual domains (Hollingshead, 1998a). This division of labor provides team members with a clear idea about who is responsible for remembering and knowing what expertise (Lewis, 2004).

Essentially, this knowledge/expertise diversity in teams and the shared understanding of “who knows what” helps team members spend less time searching for necessary information during task processing and more importantly to do so while dealing with unanticipated change.

Building on existing theory, it is argued that TMS helps team members adapt (team-level behavior) quickly and efficiently. The relationship will be examined as part of mediation tests.

Although, team member satisfaction is a critical measure of team effectiveness, as discussed earlier, the relationship between TMS and team member satisfaction has not been empirically examined. Studies have associated TMS with team performance and team viability (Lewis, 2004), both of which are critical components of team effectiveness (Hackman, 1987). Along with the team’s willingness and ability to work well in the future, team viability also refers to members’ satisfaction with team membership or the team experience; that is, team viability has an affective component (Bushe & Coetzer, 2007). Therefore, prior studies indicate that TMS tends to increase team member satisfaction. The current study explains the relationship between TMS and member satisfaction in the following section.
2.12 Transactive Memory Systems and Member Satisfaction

TMS has been associated with team viability (i.e., a team’s ability to perform similar or other tasks in the future) (Lewis, 2004). TMS has broader benefits beyond the task for which it was first developed because it affects member’s ability to apply prior learning and develop a collective, abstract understanding of the task domain (Lewis, Lange, & Gillis, 2005). TMS influences group learning that transfers to similar tasks in the future (Lewis et al., 2005). In a laboratory study, it was found that teams with developed TMS on one task performed better on a subsequent task, especially when the division of cognitive labor remained stable across tasks (Lewis, Gillis, & Lange, 2003). It was argued that if team members maintain their specializations across projects, they may be able to leverage the TMS they have already developed to enhance performance on another project (Lewis, 2004) (i.e., TMS developed in one project can be utilized to enhance team performance in a similar project or different project in the future.

In order to develop TMS in teams, each team member makes contributions (encodes and stores) to create a pool of knowledge so that they can use it as a resource (retrieve knowledge) when they need it. Moreover, teams with well-developed TMS are more likely to predict member behaviors and coordinate accordingly, as members have a shared understanding of who knows what (Lewis, 2004). Therefore, teams with developed TMS are more willing to work with the same team for projects, whether similar or different, in the future, as they would like to maintain their investments and the resources available in the team’s TMS. It is also argued that team members will experience greater satisfaction.

Additionally, in developed TMS, there is a (balanced) cognitive division of labor, availability of knowledge resources, shared understanding among team members about who
knows what, and effective communication/coordination channels (Lewis, 2003). The availability of such resources in teams is likely to result in members’ satisfaction with the team.

Building on existing theory, the current study argues that TMS in teams is likely to have an influence on team member satisfaction. However, while TMS emphasizes members’ expertise and the common understanding of who holds what expertise (relevant to the team’s tasks), SMM emphasizes the extent to which members hold similar task-relevant knowledge (i.e., work goals, performance requirements) and team-relevant knowledge (i.e., interpersonal interaction requirements, shared values, and shared beliefs). Therefore, SMM is expected to have greater influence on member satisfaction than does TMS. The following hypothesis is proposed:

*Hypothesis 4a: Task SMM will be more positively related to member satisfaction than will TMS.*

*Hypothesis 4b: Team SMM will be more positively related to member satisfaction than will TMS.*

**Mediating effects.** The nature of teams and teamwork as represented by the I-P-O model implies that the impact of team cognition on team effectiveness may be indirect and mediated by team processes (Mathieu et al., 2000). DeChurch and Mesmer-Magnus (2010) provided empirical evidence that team cognition relates to team process; other studies have focused on the relationship between team process and team outcomes (e.g., Campion et al., 1993). Limited research has examined the role of team processes in the relationships between team cognition and performance (Klimoski & Mohammed, 1994; Mathieu et al., 2000). For example, Mathieu et al. (2000) found a mediating effect of team processes (e.g., communication, cooperation) on the relationship between team cognition (SMM) and team effectiveness. However, as discussed earlier, there is a lack of research explaining the mediating effects of variables other than team
processes. Using an IMO framework, the current study examines the mediating effect of team learning behavior and team engagement.

In the following section the concept of team learning behavior is discussed, followed by explanations of the relationships between team learning behavior and team outcome variables. Further, the relationship between team cognition (shared mental models and transactive memory systems) and team learning behavior is discussed. Based on this evidence, finally, explanations of the mediating relationships are considered.

2.13 Team Learning Behavior

Organizational learning has been presented in the literature in two different ways: learning as an outcome, and learning as a process. Argote, Gruengeld, and Naquin (1999) defined group learning as both processes and outcomes of group interaction activities through which individuals acquire, share, and combine knowledge. Although scholars have examined learning at various levels within organizations, it has been suggested that the best place to start is at the team level, as most learning within an organization takes place in groups or teams (Brown & Duguid, 1991).

The first area of research in this area conceptualizes team learning as an outcome. Ellis et al. (2003) defined team learning as “a relatively permanent change in the team’s collective level of knowledge and skill produced by the shared experience of the team members” (p. 822) (i.e., team members’ collective ability to encode, store, and retrieve information over time. Ellis and Bell (2005) adopted the perspective that learning reflects changes in both knowledge and behavior. Team members work in an interdependent, interactive setting, allowing members to complete tasks as a collective unit (Hackman & Morris, 1975). Recently, scholars interested in socially shared cognition and information-processing systems have argued that because team
members can interact with one another, knowledge and skill gathered by one team member can be transferred to/shared by his/her teammates, which can affect the efficiency and effectiveness of team’s collective learning process (Ellis et al., 2003). Therefore, team learning is defined as “a relatively permanent change in team’s collective level of knowledge and skill produced by shared experience of the team members” (Ellis et al., 2003, p. 822). Recently, scholars who conceptualize learning as an outcome have focused on learning curves at the team level, thereby documenting a robust link between cumulative team experience and performance improvement (Pisano, Bohmer, & Edmondson, 2001; Reagans, Argote, & Brooks, 2005). This work has mostly focused on testing for and explaining differences in rates of improvement across teams (with respect to communication, coordination, efficiency, learning rate, and so on) (Edmondson, Dillon, & Roloff, 2007).

As discussed earlier, the second area of research conceptualizes team learning as a group process rather than as a group or team outcome. In this work, researchers attempt to measure or observe the processes of learning instead of relying on performance improvement as evidence that learning has occurred (Edmondson et al., 2007). Argyris and Schon (1978) defined learning as a process of detecting and correcting error. Building on this approach, Edmondson (1999) conceptualized “team learning behavior” as an “ongoing process of reflection and action, characterized by asking questions, seeking feedback, experimenting, reflecting on results, and discussing errors or unexpected outcomes of actions” (p. 353). Team learning behavior refers to the group interaction activities through which individuals in teams acquire, share, and combine knowledge (Argote et al., 1999). This approach to team learning behavior as a process is adopted in the current study.
It is also important to consider the difference between formal and informal learning. Formal learning is typically institutionally sponsored, classroom-based, and highly structured (Marsick & Watkins, 1990). Informal learning on the other hand may occur in institutions, but is not typically classroom-based or highly structured, and control of learning rests primarily in the hands of the learner (Marsick & Watkins, 2001). The team learning behavior concept is related to informal learning, as both concepts may involve learning informally by reflection and action, learning from mistakes, self-directed learning, action learning, and experiential learning.

The process of learning consists of multiple interdependent team actions, because solutions have to be searched for, chosen, and implemented (Gibson, 2001). Scholars have described team learning behavior as a cycle of activities that a team engages in to process knowledge that allow teams to adapt and improve (Gibson & Vermeulen, 2003). In the management literature, learning has been associated with attention to feedback (Schon, 1983), discussion of failure (Sitkin, 1992), experimentation (Henderson & Clark, 1990), and reflective communication (Gibson & Vermeulen, 2003).

Recent studies have investigated team learning and its influence on team outcomes. In a laboratory setting, Argote et al. (1995) found that performance of groups increased with increased group learning. Using work teams in a manufacturing company, Edmondson (1999) found that team learning behavior results in effective performance by allowing teams to adapt to changes. Using staff from various departments, in a medium-size Australian hospital, Chan, Cecil, and Entrekin (2003) also found that team learning behavior has a significant influence on team performance. Edmondson and colleagues (2002, 2006) examined the differential effects of different types of learning behaviors on team performance. Team learning behavior helps teams understand their environment and their customers and to coordinate members’ actions effectively.
(Edmondson, 1999). Enhancing team learning behavior is critical for organizations, as learning has been associated with reduced organization costs, increased team performance (Edmondson, et al., 2001; Edmondson, 1999), improved quality of products or services (Chan, 2002), and increased customer satisfaction (Edmondson, 1999). It has, therefore, been held to be a major source of competitive advantage (Rulke, Zaheer, & Anderson, 2000). Thus, team learning behavior is expected to influence team performance. Although no separate hypothesis is proposed, the current study examines the influence of team learning behavior on both self-rated and instructor-rated team performance.

Team learning behavior consists of interdependent activities carried out by team members through which teams obtain and process data that allow it to adapt (Edmondson, 1999; Edmondson et al., 2001). The focus of adaptation is on team-level behavior. Adaptation is consistent with research demonstrating that team effectiveness after an unanticipated change in the task context may depend on the effectiveness with which members collectively adapt their roles (behaviors) (Hutchins, 1996). Adaptation has been defined as “reactive and nonscripted adjustments to a team’s system of member roles that contribute to team effectiveness” (LePine, 2003, p. 28). Whereas team learning behavior is about how teams continue to acquire, share, and combine new knowledge (process), adaptation is about change/adjustment in task-related behaviors in teams (based on these processes). Thus, adaptation focuses on changes in patterns of task-related activity or behavior among interdependent individuals. Team learning behavior influences a team’s ability to adapt to new ways of working (Edmondson et al., 2001). Although researchers have stated that team learning behavior influences team adaptability, such relationships have not been explicitly/empirically examined. Therefore, team learning behavior is expected to influence team adaptability.
High-quality teamwork processes have been associated not only with team performance but also with team member perceptions of satisfying team experience (LePine et al., 2008; McGrath, 1964). Team learning behavior incorporates several team process variables: (a) communication processes such as open communication (e.g., discussing or communicating differences of opinion openly, asking for help, discussing errors) and communication frequency (e.g., seeking continuous feedback and information); (b) coordinated use of resources (i.e., acquiring unique knowledge from individuals, sharing the knowledge, and combining the knowledge that is made available to all team members). Moreover, mutual respect and trust among team members is a necessary condition for teams to engage in team learning behavior (Edmondson, 1999). It is suggested here that as team learning behavior occurs because of mutual trust and respect, and subscribes to positive team processes including open communication, it is likely to result in members’ satisfaction with the team. Therefore, team learning behavior is expected to influence team member satisfaction.

2.14 Shared Mental Models and Team Learning Behavior

As team processes are likely to be influenced by SMM (Mathieu et al., 2000), team learning behavior is likely to be influenced by SMM. One of the four types of mental models that can be shared by team members is knowledge of attitudes or beliefs, which refers to knowledge of teammates’ general attitudes, values, or beliefs regarding work tasks, working environments, or work itself (Cannon-Bowers & Salas, 2001; Chou et al., 2008) (discussed earlier). Similarity of values or beliefs among team members is considered an important shared cognition (Ilgen et al., 2005).

Cannon and Edmondson (2001) argued that teams develop shared beliefs about interpersonal consequences of failure (about appropriate responses to mistakes, errors, and
failures) and that these beliefs constitute a central feature of shared beliefs in work groups. These shared beliefs vary in the extent to which they take a learning approach and influence the team’s ability to respond constructively to failure. The authors suggest that shared beliefs about failure in work groups mitigate barriers to productive identification, discussion, and analysis of mistakes and problems (i.e., team learning behavior).

On similar lines, Edmondson (1999) explained the relationship between team psychological safety and team learning behavior. Psychological safety was defined as “a shared belief held by members of a team that the team is safe for interpersonal risk taking” (Edmondson, 1999, p.350), that is, there is a sense of confidence, interpersonal trust, and mutual respect that the team will not embarrass, reject, or punish someone for speaking up or admitting mistakes. She explained that team members are more likely to share unique information, discuss errors, and seek feedback when they believe that there are few risks involved in doing so. Team psychological safety was found to influence team learning behavior, which leads to higher team performance (Edmondson, 1999).

Cannon and Edmondson (2001) examined shared beliefs about failures, and Edmondson (1999) examined shared beliefs about safety (team psychological safety), both representations of SMM, and linked with team learning behavior. On similar lines, Chou et al. (2008) considered shared work values as a representation of SMM and referred to internalized beliefs about what is worth doing at work (Kilmann, Saxton, & Serpa, 1985). The current study adopts this definition to describe the “shared beliefs” component in the SMM construct.

This study considers shared beliefs as a sub-dimension of teamwork SMM (suggested by Cannon-Bowers and Salas, 2001). Based on past research, it is argued that both task SMM and team SMM will result in team learning behavior.
2.15 Shared Mental Models, Team Learning Behavior, and Team Outcomes

The current study uses the IMO framework to explain that the impact of SMM on team effectiveness is indirect and mediated by team learning behavior. Based on existing theory and discussions presented in the previous sections, and following Ilgen et al. (2005) it is argued that task SMM and team SMM encourage teams to engage in team learning behavior, which in turn influences team outcomes. The following hypotheses are proposed:

Hypothesis 5. **Team learning behavior will partially mediate the relationship between task SMM and (a) team performance, (b) member satisfaction, and (c) team adaptability.**

Hypothesis 6. **Team learning behavior will partially mediate the relationship between team SMM and (a) team performance, (b) member satisfaction, and (c) team adaptability.**

In the previous section, the mediation effect of team learning behavior on the relationship between SMM and team outcomes was explained. The next section discusses the mediation effect of team learning behavior on the relationships between transactive memory systems and team outcomes. The concept of transactive memory systems was discussed earlier and the conceptualization of the construct remains the same.

2.16 Transactive Memory Systems and Team Learning Behavior

Team learning behavior consists of activities through which teams obtain and process data that, in turn, allows them to adapt and improve (Edmondson, 1999). Team learning behavior is effective only when unshared information (information uniquely held by one team member) is discussed in teams (Edmondson, 1999). When teams utilize members’ distinctive and unique knowledge sets for the team’s benefit the pool of knowledge available for processing is expanded (Mesmer-Magnus & DeChurch, 2009). One critical reason team learning behavior is often not
effective in teams is that team members tend not to share their unique knowledge, such that group discussions consist primarily of jointly held information (Stasser & Titus, 1987).

In well-developed TMS, team members are aware of the availability and distribution of expertise in their team and are less likely to share redundant information at the expense of pooling unshared information (Mohammed & Dumville, 2001). Consequently, teams with well-developed TMS are more likely to acquire, share, and combine unique knowledge (i.e., engage in effective team learning behavior).

2.17 Transactive Memory Systems, Team Learning Behavior, and Team Outcomes

Similar to SMM, the IMO framework is used to explain that the impact of TMS on team effectiveness is indirect and mediated by team learning behavior. The current study builds on existing theory and discussions presented in the previous sections, and argue that TMS encourages teams to engage in team learning behavior, which in turn influences team outcomes.

The following hypothesis is proposed:

_Hypothesis 7. Team learning behavior will partially mediate the relationship between transactive memory systems and (a) team performance, (b) team adaptability, and (c) member satisfaction._

In the previous section, the concept of team learning behavior was discussed and the mediating effect of team learning behavior on the relationship between team cognition and team outcomes was explained. In the following sections, the concept of engagement is presented, followed by an explanation of the mediating effect of team engagement on the relationship between team cognitions (SMM and TMS) and team outcomes.

First, the concept of work engagement and its relevance to teams is discussed. Second, the relationships between team cognitions (SMM and TMS) and team engagement are presented.
Third, the relationships between team engagement and team outcomes are discussed. Finally, the mediating relationships are explained.

2.18 Work Engagement

Work engagement has recently emerged as an important psychological concept because of its influence on the optimal functioning of employees in organizations (Schaufeli & Salanova, 2007). Employee engagement is becoming more appealing to researchers and practitioners because of claims that engagement drives bottom-line results and that it is associated with increased profitability through higher productivity, sales, customer satisfaction, and employee retention (Macey & Schneider, 2008).

Kahn (1990) introduced the concept of personal engagement at work. Engagement refers to how individuals employ their self during the performance of their jobs (May, Gilson, & Harter, 2004). Employees use varying degrees of their selves, physically, cognitively, and emotionally, in the roles they perform. Further, the more they draw on their selves to perform their roles, the better are their performances (Kahn, 1990). The author associated engagement with moments of task performances and considered engagement to be psychologically present in particular (discrete) moments and situations of role performances that make up employees’ work lives. According to Kahn (1990), employees bring themselves into particular task behaviors in certain moments (engaged) whereas they remove themselves from particular task behaviors in other moments (disengaged).

Engaged individuals are likely to become involved in tasks, whether alone or with team members, are cognitively vigilant (questioning others’ decisions and assumptions), and are empathically connected to others in the workplace (Kahn, 1990). On the other hand, personal disengagement is defined as “the uncoupling of selves from work roles [such that] in
disengagement, people withdraw and defend themselves physically, cognitively, or emotionally during role performances” (p. 694).

A different approach was adopted by another group of scholars who considered work engagement as the positive antithesis of burnout (Maslach, Schaufeli, & Leiter, 2001). Differing from those who suffer from burnout, engaged employees have a sense of energetic and effective connection with their work activities, and they see themselves as able to deal well with the demands of their jobs (Schaufeli, Bakker, & Salanova, 2006). Work engagement is defined as “a positive, fulfilling, work-related state of mind that is characterized by vigor, dedication, and absorption” in work activities (Schaufeli, Salanova, Gonzalez-Roma, & Bakker, 2002, p.74). Vigor is characterized by “high levels of energy and mental resilience while working, the willingness to invest effort in one’s work, and persistence even in the face of difficulties” (Schaufeli & Salanova, 2007, p. 141). Dedication refers to “being strongly involved in one’s work and experiencing a sense of significance, enthusiasm, inspiration, pride, and challenge” (Schaufeli et al., 2006, p. 702). Absorption refers to “being fully concentrated and happily engrossed in one’s work, whereby time passes quickly and one has difficulties detaching oneself from work” (Schaufeli et al., 2006, p. 702). Therefore, engagement includes three components: vigor (behavioral), dedication (emotional), and absorption (cognitive) (Schaufeli & Salanova, 2007).

Therefore, although two different approaches exist to understand the concept of engagement—engagement at work through harnessing of organizational members’ selves to their work roles and engagement as positive antithesis of burnout—the definition and operationalization is very similar (Schaufeli & Salanova, 2007). Both approaches include the
three components of engagement: physical (vigor), cognitive (absorption), and emotional (dedication) (Schaufeli & Salanova, 2007).

2.19 Team Engagement

Schaufeli and Salanova (2007) stated that work engagement is not only an individual phenomenon, but also occurs in groups/teams. Engagement can be shared within and vary between organizational work groups (Salanova, Agut, & Peiro, 2005). Schaufeli and Salanova (2007) argued that one team member “catches” the high level of engagement of the other team member through the process of emotional contagion, resulting in the emergence of collective forms of engagement. The more engaged the team, the more engaged its members, and vice versa.

Limited research exists in this area; one study examined the relevance of collective engagement in a laboratory study (Salanova, Llorens, Cifre, Martinez, & Schaufeli, 2003). Team members were asked the extent to which they perceived the team to be vigorous, dedicated, and absorbed in performing a collaborative laboratory task. Salanova et al. (2003) found that collective efficacy boosts team engagement and so results in high team performance. The study found, however, that team engagement and performance depends on the time available to complete a task and team competence.

2.20 Engagement and Team Outcomes

Work engagement has been associated with employee effectiveness (performance, learning), affective outcomes (commitment, satisfaction), and turnover (Schaufeli & Bakker, 2003). Work engagement has also been associated with extra-role behaviors. That is, engaged employees are more likely to exhibit personal initiative and proactive behavior (Salanova & Schaufeli, 2005; Schaufeli & Salanova, 2007), and they are more likely to adapt (alter their own
behaviors) based on coworkers’ needs. This suggests that more-engaged individuals are likely to be more adaptable.

Salanova et al. (2005) examined the collective engagement of customer contact employees in hotels and restaurants. Collective engagement refers to the extent to which members of the work unit feel vigorous, dedicated, and absorbed in their tasks. The results indicated that when employees perceive an availability of organizational resources (e.g., training, autonomy) to remove obstacles at work, they feel more engaged. This collective engagement had a positive influence on customers’ appraisal of employee performance and service quality (Salanova et al., 2005). In another study, Harter et al. (2002) showed that levels of employee engagement were positively related to business-unit performance (i.e., customer satisfaction and loyalty, profitability, productivity, turnover, and safety).

Research has concentrated on the relationship between employee engagement and outcomes at an individual level, as described earlier. Few studies have examined the impact of collective engagement on group effectiveness (i.e., performance and service quality) (Salanova et al., 2003). However, team engagement is expected to have an impact on team effectiveness: team performance, team adaptability, and member satisfaction.

2.21 Shared Mental Models and Team Engagement

Miles and Kivlighan (2008) linked SMM and engagement. The authors examined the influence of similarity of mental models of group members on group climate and group effectiveness. The “group climate” construct consists of three dimensions: engagement (the importance of the group to the members, sense of closeness, group cohesion, etc.); avoidance (the extent to which group members avoid dealing with their own and group members’ problems); and conflict (interpersonal conflict and distrust). Results showed that SMM resulted
in increased group engagement. However, Miles and Kivlighan (2008) explained “engaged” as one dimension of group climate, which is different from the engagement construct conceptualized by Kahn (1990) and Schaufeli, Salanova, and colleagues (e.g., Maslach, Schaufeli, & Leiter, 2001; Schaufeli et al., 2006). The three-dimensional concept of team engagement, consisting of vigor, dedication, and absorption is adopted in the current study, to examine the relationship between SMM and team engagement.

Shared mental models consist of multiple mental models: mental models about taskwork, teamwork, and team members (Cannon-Bowers & Salas, 2001). Miles and Kivlighan (2008) examined how coleader teams’ mental models of their groups influence group engagement. Thus, the authors focused on one component of SMM—the mental model about members.

In the current study, the mental model about members is considered as a sub-dimension of team SMM. Building on existing theory, the current study argues that both task SMM and team SMM will have an influence on team engagement.

As explained earlier, this study focuses on two types of team cognitions. Whereas the relationship between SMM and team engagement was discussed in the previous section, the relationship between TMS and team engagement is presented in the following section. The conceptualization of TMS and team engagement remains the same as discussed previously.

2.22 Transactive Memory Systems and Team Engagement

As SMM has been linked with engagement; it is proposed that TMS will be positively related to team engagement. Kahn (1990) proposed “meaningfulness” as a psychological condition that results in work engagement. Meaningfulness refers to “sense of return on investments of self in role performances” (p. 705). Work elements, such as tasks, roles, and work interactions, shape the meaningfulness employees experience in work situations (Kahn, 1992).
Teams that develop TMS are more likely to fully use members’ expertise and understand the value of embedded team knowledge (Lewis, 2004). Such teams divide the cognitive labor for a task, making each individual responsible for learning, remembering, and communicating information in one domain and relying on others for information in other domains (Lewis, 2003). It is argued that when TMS is developed in teams, each team member is more likely to feel worthwhile, useful, and valuable, as they are able to contribute to and also draw from the pool of knowledge to accomplish team tasks. Therefore, TMS in teams is likely to make the taskwork and teamwork more meaningful for team members, thus resulting in engagement.

Kahn (1990) also proposed “availability” as a psychological condition that results in work engagement. Availability refers to the sense of possessing the physical, emotional, and psychological resources necessary for personal engagement (Kahn, 1990). Work engagement is positively associated with job resources (Schaufeli & Salanova, 2007). Job resources are those aspects of the job that have the capacity to reduce job demand and are functional in achieving work goals (Schaufeli & Salanova, 2007). Work engagement has been associated with job resources such as social support from coworkers and superiors, performance feedback, coaching, job control, task variety, and training facilities. However, knowledge as a resource needs attention. TMS refers to the distributed knowledge in teams (DeChurch & Mesmer-Magnus, 2010). Individuals develop specialized knowledge within a TMS, which reduces the cognitive load of individuals, provides easy access to an expanded pool of expertise, and decreases the redundancy of effort (Hollingshead 1998; Mohammed & Dumville, 2001). When such resources are available in teams, team members are more likely to be collectively engaged. Schaufeli and Salanova (2007) further argued that team members may feel engaged when their members closely collaborate to accomplish particular tasks. Effective communication and coordination are
critical components in developed TMS, as members need to closely collaborate and coordinate in order to use each other’s expertise as resources to accomplish team tasks.

Therefore, the current study proposes that TMS in teams will result in enhanced team engagement.

In the previous sections, the relationship between team engagement and team outcomes, and team cognition and team engagement was discussed. Based on existing theory and using the IMO framework, it is argued that team cognitions (SMM and TMS) will have an influence on team engagement, which in turn will affect team outcomes. Work engagement has been explained as a motivational construct such that when job resources are available to individuals, individuals are likely to be engaged, which consequently results in high job performance and employee satisfaction (Schaufeli & Salanova, 2007). The current work argues that team cognitions (SMM and TMS) are valuable resources available to teams, which is likely to enhance collective team engagement, consequently improving team effectiveness. The following hypotheses are proposed:

*Hypothesis 8.* Team engagement will partially mediate the relationship between task SMM and (a) team performance, (b) team adaptability, and (c) member satisfaction.

*Hypothesis 9.* Team engagement will partially mediate the relationship between team SMM and (a) team performance, (b) team adaptability, and (c) member satisfaction.

*Hypothesis 10.* Team engagement will partially mediate the relationship between TMS and (a) team performance, (b) team adaptability, and (c) member satisfaction.

In the previous sections, the influence of each type of team cognition (SMM and TMS) on team outcomes was explained. The following section includes (a) the differences between SMM and TMS and (b) the interaction effect of SMM and TMS on team outcomes.
2.23 Interaction of SMM and TMS

Team cognition is a bottom-up emergent construct that originates in the cognition of individuals; these individual cognitions manifest as a pattern, which ultimately make up the team cognition construct (Kozlowski & Klein, 2000). Describing different forms of emergence, Kozlowski and Klein (2000) differentiate between compositional emergence (where the cognitions at the individual level are similar in form and function to cognitions at the team level) and compilational emergence (where the cognitions at the team level are different from cognitions at the individual level).

Researchers have provided evidence that SMM and TMS are conceptually and empirically distinct constructs (Ellis, 2006; Mohammed & Dumville, 2001). The SMM literature is largely representative of compositional emergence, examining the degree of similarity of cognitive content (or mental models or knowledge) of individuals (Kozlowski & Klein, 2000; DeChurch & Mesmer-Magnus, 2010; Mathieu et al., 2005). SMM primarily serves to integrate team members’ perceptions (Ellis, 2006) (integrative function).

The transactive memory literature is more consistent with compilational emergence, where a team-level memory system emerges that consists of differentiated individual knowledge sets along with an awareness of who knows what (DeChurch & Mesmer-Magnus, 2010). TMS primarily serves to capitalize on distribution or differences among team members’ expertise, knowledge, roles, and responsibilities (Ellis, 2006) (differentiation function). TMS emphasizes members’ expertise and mental representations of that expertise but not other mental representations that team members might share about the task, team, or situation (Lewis, 2003) (included in SMM). Rentsch, Small, and Hanges (2008) considered TMS as representing
complementarity, the extent to which team members’ cognitions are “complementary in structure and/or content fitting together like puzzle pieces” (DeChurch & Mesmer-Magnus, 2010, p. 11).

It is noted that unlike SMM, which refers to the extent to which knowledge about taskwork and teamwork is shared by team members, TMS refers to the expertise uniquely held by each team member (i.e., all team members need not be experts in every content/knowledge domain). The only knowledge that team members have in common in a TMS is the knowledge about who possesses what knowledge/expertise in the team.

Recent studies have focused on the accuracy/quality of team mental models and its influence on team performance (Lim & Klein, 2006). Considering mental model accuracy different from mental model similarity, Marks et al. (2000) explained that although teammates might have a shared understanding about task priorities, these can be misguided because of lack of accuracy/quality, affecting team performance. However, the empirical findings are mixed. Marks et al. (2000) found a significant positive relationship between accuracy and performance, but Webber, Chen, Payne, Marsh, and Zaccaro (2000) did not find significant relationships. Mathieu et al. (2005) did not find significant relationships between taskwork or teamwork mental model accuracy and team performance; however, they did find a significant interaction effect of teamwork mental model similarity and teamwork mental model accuracy on team performance. It was argued that teams exhibit the best processes and performance when they share high-quality teamwork mental models (Mathieu et al., 2005). Mathieu et al. (2005) found this significant relationship in a laboratory study; however, in testing this relationship in a field study, Lim and Klein (2006) failed to obtain significant results.

Although results are mixed, scholars agree that only task SMM and team SMM do not necessarily result in high performance. Researchers agree that “effective teamwork requires
members to hold similar cognitive structures (degree of similarity/sharedness of knowledge or mental representations), but also possess distinctive knowledge configurations” (distributed knowledge/expertise across team members) (DeChurch & Mesmer-Magnus, 2010, p. 3). Recent studies have called for an examination of the interaction effects of these two forms of emergent team cognitions—compilational (TMS) and compositional (SMM) emergent cognitions (DeChurch & Mesmer-Magnus, 2010). The current study builds on existing theory to propose that TMS in teams will complement SMM and have a strong effect on team outcomes (i.e., the beneficial effects of SMM on team outcomes will be more when TMS is developed in teams). If team members have similar mental models but the team transactive memory is not developed, team members may experience little conflict, be less engaged, and may not participate in team learning behavior. Consequently, team effectiveness will be low. The current work examines the interaction effect of SMM and TMS. It is expected that the interactions will evidence a disordinal (i.e., crossover) form where teams will exhibit best team learning behavior, team engagement, team performance, team adaptability, and member satisfaction when both SMM and TMS are high in teams. The following hypotheses are proposed:

Hypothesis 11. TMS will moderate the relationships between task SMM and (a) team performance, (b) team adaptability, (c) member satisfaction, (d) team learning behavior, and (e) team engagement. It is expected that the interactions will evidence a disordinal (i.e., crossover) form, where team outcomes will be highest when both team SMM and TMS are high.
Hypothesis 12. TMS will moderate the relationships between team SMM and (a) team performance, (b) team adaptability, (c) member satisfaction, (d) team learning behavior, and (e) team engagement. It is expected that the interactions will evidence a disordinal (i.e., crossover) form, where team outcomes will be highest when both team SMM and TMS are high.
Figure 1. Conceptual model.
CHAPTER 3

METHODOLOGY

3.1 Introduction

This chapter addresses the methodology used to examine the hypotheses developed in the preceding chapter. The first section of this chapter restates the purpose of the study. In the second and third sections, the sample and the context are discussed, respectively. The fourth section presents the data-collection procedure, item generation, and instrumentation. The fifth section presents the reliability scores of all the variables used in this study, the number of items used to measure each variable, the scale of measurement of each variable, and the intraclass correlation coefficient and $r_{wg}$ indices to justify aggregation. The final section presents the data-analysis procedures.

3.2 Purpose of Study

The purposes of this study are as follows:

1. Describe the impact of time that may influence the development of task SMM, team SMM, TMS, team learning behavior, team engagement, team performance, team adaptability, and member satisfaction.

2. Describe the differential effects of task SMM, team SMM, and TMS on mediating variables and outcomes.

3. Describe the differential mediating effects of team learning behavior and team engagement.

4. Describe the moderating effect of TMS on the relationship between SMM (task and team) and team outcomes and mediating variables.

5. Describe the mediated-moderation relationships.
3.3 Sample

The participants comprised 83 male and 94 (53%) female undergraduate students enrolled in a restaurant management class in a Northeastern university in the US. Their ages ranged from 20 to 47 years (M = 22.37, SD = 2.26). The majority of the respondents were white (138; 78%) followed by Asian (23; 13%). In this course the students were required to identify a theme, create a menu, and prepare, market, and operate a restaurant open to the public as part of their coursework. For the class, the students were divided into management teams. The sample consisted of 27 teams with a total of 178 members. Team size ranged from 4 to 9. Team GPA ranged from 2.62 to 3.46 (M = 3.02, SD = .19). Team experience (which included experience working in teams, working as managers, working front-of-house and back-of-house; on a scale of 1 to 5) ranged from 3.22 to 4.42 (M = 3.71, SD = .34). There were no significant effects arising from team size, team GPA, and team experience on the relationships reported here. To test the conceptual model, a two-stage investigation using a combination of qualitative and quantitative methods was adopted.

3.4 Context

The context of this study was a food service management laboratory. As part of the project, the participants were required to work in teams. Each team created a marketable theme restaurant and a full business plan, and they opened and managed their restaurant for two nights. Twice during the semester, each student team planned and supervised the preparation and service of meals in a restaurant setting that was open to the public. Students were expected to create a marketable theme and then develop, produce, and evaluate an authentic dining experience. Each team provided service to 90 to 140 customers for each dinner. These teams were ideal for the study, as the team members depended on each other to accomplish tasks. These teams can be
best described as self-managed service teams, as each team member was responsible for performing technical-administrative tasks (e.g., budgeting, purchasing, menu planning, cost accounting) as well as leadership tasks (e.g., decision-making, developing strategy, supervising employees).

The teams were evaluated based on their performance for those two nights. The team task performance was evaluated based on (1) preparing a pre-production report (business plan), (2) managing meal 1, (3) preparing post-production report (analyzing data, conducting marketing and financial analysis, analyzing how meal 1 went (how they performed on meal 1), performing the set up for meal 2, and (4) managing meal 2. Each management team evaluated its own performance, and their performances were also evaluated by the instructors (managers).

The teams received a general outline of the project about what needed to be done and then they were responsible for deciding on the processes and figuring out ways to achieve the objectives. The team self-selected a general manager. The rest of the team consisted of kitchen managers (back-of-house) and dining room (service) managers. The task was to write the plan for both back-of-house and front-of-house operations, supervise employees, and handle customers. The management teams did everything that a restaurant manager would do to open and run a restaurant which involves ordering food, writing job descriptions, checking seating arrangements, training workers (leading formal training sessions), interacting with guests, hosting, and dealing with customer complaint. They also, interacted with instructors.

The team responsibilities were divided based on team members’ strengths; for example, students with back-of-house experience, culinary experience, and front-of-house experience. The division of labor was decided on by each of the team members. The interdependency among team members was very high. In order to be successful, team members needed to work
interdependently (together), which involved communicating, decision-making, being on the same page (minimizing contradictions among managers in terms of delegating tasks to workers), and team interactions. Teams usually faced challenges when members worked independently and tried to bring their work together later. Division of labor was critical, as it was impossible to complete tasks individually because of the volume of the tasks. No single team member could dominate; therefore, teamwork was critical in this setting. Some examples of the interdependent tasks follow: (a) write a recipe with the financials: writing the menu led to writing the recipes, which led to consideration of the finances; (b) create a marketing plan to work hand-in-hand with the reservations, leading to the dining room diagram (seating arrangements), and then to the service set up; (c) explain the recipe: kitchen managers to apprise dining room managers to enable the latter to answer customer queries about the menu and recipe. The key to team success was getting along, but also challenging each other. The teams usually handled problems and conflicts on their own, although they did receive guidelines from the instructors. The general task requirements for all teams were the same except for the fact that they chose different themes. However, teams differed based on how they collaborated, the processes they followed, and the ways in which they coordinated.

3.5 Procedure

Phase 1: Qualitative research. In the first phase, focus group interviews were conducted with three teams (20 members) recruited from the spring 2010 session of the restaurant management class. The interviews, conducted in the months of April and May, were semi-structured and lasted approximately 30 minutes each. Course instructors, responsible for reviewing the work of the service teams, were also interviewed to validate the team members’ responses. Observations were made both during planning (e.g., theme development, menu
development, pricing, forecasting, pre-production reporting, post-production reporting) and execution stages (when the teams managed the meals). Observations were related to the tasks team members performed: how team members communicated, coordinated, and shared information, delegated tasks, trained employees, managed time, forecasted, ensured service quality, and handled customer complaints.

This phase of the study was conducted to meet two objectives. First, to verify whether the theoretical constructs proposed in the study could be operationalized at the restaurant. This phase helped in developing/adapting survey items to assess the constructs of interest in a language meaningful in the restaurant setting (Alderfer & Brown, 1972). Second, this phase of the study helped to collect and validate data about required tasks and teamwork that contributed to team success in this particular context. Therefore, this phase was also critical in developing scale items to measure context-specific constructs (e.g., SMM).

**Shared mental models–item generation.** Items were generated to measure task SMM and team SMM. Based on interviews and observations, 20 items were generated to measure task SMM. Similarly, 27 items were generated/adapted to measure team SMM (Appendix A).

Cannon-Bowers and Salas (2001) proposed four types of knowledge that can be shared by team members: task-specific knowledge (about specific procedures, strategy), task-related knowledge (of member responsibilities and role interdependencies), knowledge of teammates (preferences, strengths), and knowledge of teammates’ attitudes, beliefs, or values (in regard to work tasks). The participants were asked to provide a list of items based on these knowledge types that should be shared by team members in order to succeed.

The number of items to assess task SMM and team SMM was higher than the number desired. Moreover, some items were redundant, and some were not as important as others. To
reduce the number of items, remove the unimportant and redundant items and retain the most important items, respondents were asked to rate each item on a scale of 1 (not at all important) to 10 (very important). Additionally, respondents were asked to suggest a list of taskwork elements and a list of teamwork elements from most to least important. After this procedure, redundant items and less important items were omitted, and the most important items retained. Fourteen items were retained to measure the task SMM (Table 2) and 16 were retained to measure the team SMM (Table 3).
Table 2

*Task Shared Mental Model Items*

<table>
<thead>
<tr>
<th>Our team members..........</th>
<th>1. are in agreement about how best to manage the staff during our meal night.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2. have similar understanding about how best to serve the guest.</td>
</tr>
<tr>
<td></td>
<td>3. are in agreement about how best to ensure the highest-quality food and beverage.</td>
</tr>
<tr>
<td></td>
<td>4. have a common understanding about how best to ensure that the service standards are maintained.</td>
</tr>
<tr>
<td></td>
<td>5. are in agreement about how best to ensure that we meet the time goals.</td>
</tr>
<tr>
<td></td>
<td>6. have a shared understanding about how best to ensure that we meet our sales goals.</td>
</tr>
<tr>
<td></td>
<td>7. are in agreement about how best to handle potential “crises” that may arise during our night.</td>
</tr>
<tr>
<td></td>
<td>8. are in agreement about how best to ensure that we have sufficient inventory and sufficient replacement.</td>
</tr>
<tr>
<td></td>
<td>9. have a common understanding about how best to train our employees.</td>
</tr>
<tr>
<td></td>
<td>10. are in agreement about how best to ensure food cost is managed efficiently.</td>
</tr>
</tbody>
</table>
Table 3

*Team Shared Mental Model Items*

<table>
<thead>
<tr>
<th>Our team members …</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. work well together.</td>
</tr>
<tr>
<td>2. often disagree with each other on issues faced by the team.</td>
</tr>
<tr>
<td>3. accept decisions made by the general manager.</td>
</tr>
<tr>
<td>4. communicate openly with each other.</td>
</tr>
<tr>
<td>5. agree on decisions made in the team.</td>
</tr>
<tr>
<td>6. back each other up in carrying out team tasks.</td>
</tr>
<tr>
<td>7. are aware of other team members’ abilities.</td>
</tr>
<tr>
<td>8. trust each other.</td>
</tr>
<tr>
<td>9. treat each other as friends.</td>
</tr>
<tr>
<td>10. value achievement orientation.</td>
</tr>
<tr>
<td>11. value being efficient.</td>
</tr>
<tr>
<td>12. value being cost-effective.</td>
</tr>
<tr>
<td>13. value being highly organized.</td>
</tr>
<tr>
<td>14. value being precise.</td>
</tr>
<tr>
<td>15. value being result oriented.</td>
</tr>
<tr>
<td>16. value paying attention to detail</td>
</tr>
</tbody>
</table>
**Phase 2: Survey research.** Data was collected by administering survey questionnaires. The first part of the team survey questionnaire was administered to the teams one week prior to their actual meal delivery, when their pre-production reports were due (during the planning stage) (Survey 1). This time frame was adopted to make sure that the team members got an opportunity to work together as a team before asking them to answer survey questionnaires based on their teams. At this time, each member had been working with the team for approximately two months. This part of the team survey questionnaire included measures of task SMM, team SMM, transactive memory systems, team learning behaviors, and team engagement (predictors and mediators). Conducting this part of the survey before the teams’ actual meal delivery also ensured that the teams’ outcomes did not influence the predictor variables.

The second part of the team survey questionnaire included measures of team adaptability, team performance, and team member satisfaction (dependent variables) (Survey 2). This survey was administered after the teams’ meal performance (execution stage; approximately one week after the meal performance, and two weeks after Survey 1).

Teams were required to complete the surveys during a team meeting. The course instructors, as independent and objective managers, were asked to complete a survey assessing team performance. Similar procedures were adopted to collect data at Time 2, approximately 6 weeks later (Survey 3 and 4).

### 3.6 Measures

**Independent variables.** Transactive memory system (TMS) was measured with 15 items adapted from a scale developed by Lewis (2003). The scale was validated in both laboratory and field samples. In accord with Lewis (2003), a five point scale (1=strongly disagree; 5 = strongly agree) was used, and member responses were averaged to form a composite TMS score (Lewis,
The alpha reliability was found to be acceptable ($\alpha = .83$). As the TMS measure was designed to be used at the team level, it is important to provide justification before aggregating individual scores to team-level scores. The homogeneity of member responses within the teams (intragroup agreement) was evaluated using the $r_{wg}$ index (George, 1990). The mean $r_{wg}$ for the TMS was found to be .91, with 100% of the estimates above the .70 threshold. A group-level variable must satisfy two criteria (Kenny & LaVoie, 1985). First, the concept must be conceptually meaningful at the group level, and second the data gathered from individual responses to assess the group attribute must converge, such that the intraclass correlation coefficient (ICC) is greater than zero (Edmondson, 1999). Intraclass correlation coefficients, measuring the extent to which team members’ responses agree with each other and differ from other teams, were collected. The ICC was found to be acceptable (.26) and significant at the .01 level (Table 7). These values suggested that the team members’ responses to the TMS items could be aggregated to the team level.

Task SMM was measured with 10 items. Because of the context-specific nature of the shared mental model construct, items were created specifically for this study (discussed earlier). Items were measured on a scale of 1 (strongly disagree) to 5 (strongly agree). The qualitative data collected during phase one of the study was used to make measures context-specific. There was internal consistency among the items ($\alpha = .85$). The mean $r_{wg}$ for task SMM was found to be .88, with 93% of the estimates above the .70 threshold (Lewis, 2004). The ICC was found to be acceptable (.13) and significant at the .05 level. These values suggested that the team members’ responses to the task SMM items could be aggregated to the team level. The team-level scale scores were computed as the mean of the member scores.
Similarly, team SMM was measured with 15 items. Cronbach’s alpha was found to be .93. The mean $r_{wg}$ for team SMM was found to be .86, with 93% of the estimates above the .70 threshold. The ICC was found to be acceptable (.28) and significant at the .01 level. Therefore, the team members’ responses on the team SMM items could be aggregated to the team level. The team-level scale scores were computed as the mean of the member scores. In addition to the means for team SMM, the standard deviation within the teams was measured.

**Mediators.** To measure team learning behavior, 12 items were adapted from the team learning behavior scale developed by Edmondson (1999). A 5-point disagree/agree scale was used (1=strongly disagree; 5=strongly agree). The alpha reliability was found to be acceptable ($\alpha = .83$). The mean $r_{wg}$ for team learning behavior was found to be .88, with 93% of the estimates above the .70 threshold. The ICC was found to be acceptable (.21) and significant at the .01 level. Therefore, the team members’ responses on team learning behavior items could be aggregated to the team level.

Team engagement was measured with 13 items adapted from a work engagement scale developed by Schaufeli et al. (2006). A 5-point disagree/agree scale was used (1=strongly disagree; 5=strongly agree) to measure team engagement. The internal consistency among the items was acceptable ($\alpha = .89$). The mean $r_{wg}$ for team learning behavior was found to be .84, with 93% of the estimates above the .70 threshold. The ICC was found to be acceptable (.16) and significant at .01 level. These values suggested that the team members’ responses on the team engagement items could be aggregated to the team level.

**Outcomes.** Team performance was measured with five items adapted from scales developed by Lewis (2004), and Bushe and Coetzer (2007). The internal consistency of the scale items (.82) was found to be acceptable. The mean $r_{wg}$ for team performance was .86, with 89% of
the estimates above the .70 threshold. The ICC was found to be acceptable (.38) and significant at the .01 level. Therefore, the team members’ responses on the team performance items could be aggregated to the team level.

Team adaptability was measured with eight items adapted from LePine (2003). The reliability of the scale was .91. The mean $r_{wg}$ for team adaptability was .86, with 89% of the estimates above the .70 threshold. The ICC was found to be acceptable (.30) and significant at the .01 level. Therefore, the team members’ responses on the team adaptability items could be aggregated to the team level.

Team member satisfaction was measured with six items adapted from Lewis (2004) and Bushe and Coetzer (2007). The satisfaction scale was found to be internally consistent ($\alpha = .94$). As member satisfaction was measured at an individual level, the $r_{wg}$ index and the ICC were not calculated.

The alpha reliability, the ICC, and the $r_{wg}$ were acceptable at both Time 1 and Time 2 (Table 4). All the items of the variables included in this study are presented in Appendix B.
### Table 4

**ICCs and $r_{wg}$ at Time 1 and Time 2**

<table>
<thead>
<tr>
<th></th>
<th>TIME 1 (27)</th>
<th></th>
<th>TIME 2 (22)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$r_{wg}$</td>
<td>ICC (Sig.)</td>
<td>$r_{wg}$</td>
<td>ICC (Sig.)</td>
</tr>
<tr>
<td><strong>Task SMM</strong></td>
<td>(.65-.98)</td>
<td>.13 (.05)</td>
<td>(.59-.96)</td>
<td>.22 (.01)</td>
</tr>
<tr>
<td></td>
<td>M = .88</td>
<td></td>
<td>M = .89</td>
<td></td>
</tr>
<tr>
<td><strong>Team SMM (M)</strong></td>
<td>(.65-.98)</td>
<td>.28 (.01)</td>
<td>(.74-.98)</td>
<td>.34 (.01)</td>
</tr>
<tr>
<td></td>
<td>M = .86</td>
<td></td>
<td>M = .88</td>
<td></td>
</tr>
<tr>
<td><strong>Team SMM (S.D.)</strong></td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>TMS</strong></td>
<td>(.70-.98)</td>
<td>.26 (.01)</td>
<td>(.81-.97)</td>
<td>.25 (.01)</td>
</tr>
<tr>
<td></td>
<td>M = .91</td>
<td></td>
<td>M = .92</td>
<td></td>
</tr>
<tr>
<td><strong>Team learning behaviors</strong></td>
<td>(.61-.98)</td>
<td>.21 (.01)</td>
<td>(.68-.99)</td>
<td>.19 (.01)</td>
</tr>
<tr>
<td></td>
<td>M = .88</td>
<td></td>
<td>M = .90</td>
<td></td>
</tr>
<tr>
<td><strong>Team engagement</strong></td>
<td>(.56-.97)</td>
<td>.17 (.01)</td>
<td>(.70-.98)</td>
<td>.37 (.01)</td>
</tr>
<tr>
<td></td>
<td>M = .84</td>
<td></td>
<td>M = .88</td>
<td></td>
</tr>
<tr>
<td><strong>Team performance (Self-rated)</strong></td>
<td>(.58-1.0)</td>
<td>.38 (.01)</td>
<td>(.77-.97)</td>
<td>.34 (.01)</td>
</tr>
<tr>
<td></td>
<td>M = .86</td>
<td></td>
<td>M = .85</td>
<td></td>
</tr>
<tr>
<td><strong>Team performance (Instructor-rated)</strong></td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>Team satisfaction</strong></td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>Team adaptability</strong></td>
<td>(.65-.99)</td>
<td>.30 (.01)</td>
<td>(.61-.98)</td>
<td>.32 (.01)</td>
</tr>
<tr>
<td></td>
<td>M = .86</td>
<td></td>
<td>M = .85</td>
<td></td>
</tr>
</tbody>
</table>
3.7 Analysis

Figure 1 shows the conceptual model developed to test the proposed hypotheses. Before an analysis to test the hypotheses was conducted, the data were examined for normality, linearity, and multicollinearity. The findings are presented in Appendix C.

The current study included three different criteria of team effectiveness: team performance, team adaptability and team member satisfaction. A confirmatory factor analysis (CFA) was conducted to examine the construct distinctiveness of the three variables. CFA results indicated acceptable model fit and evidenced construct distinctiveness ($\chi^2 = 305.51; \text{RMSEA} = .07; \text{CFI} = .93$). A second CFA was conducted with TMS, team learning behavior, and team engagement. The CFA results indicated that the model fit was good with three factors (dimensions) of team engagement, one factor for team learning behavior, and three factors (dimensions) of TMS ($\chi^2 = 474.60; \text{RMSEA} = .05; \text{CFI} = .94$). Finally, a third CFA was conducted with task SMM and team SMM. CFA results indicated that a three-factor model fitted the data well and evidenced construct distinctiveness (‘shared values’ items loaded on a separate factor) ($\chi^2 = 467.06; \text{RMSEA} = .07; \text{CFI} = .90$). CFA results indicate that the model fits were better than one factor models.

The first research objective was to describe the influence of time on all the variables included in this study, that is, to determine whether the study variables change overtime (from Time 1 to Time 2). The study proposed that each of the study variables should increase over time as a result of team experience. Repeated measures analyses of variance (RM-ANOVA) was used to test such differences.

Hierarchical linear modeling was used to address all the research objectives and to test the hypotheses. As discussed, in the current study, data were collected at two time periods
(longitudinal data). Each team member completed the survey at two time periods. All individual-level scores were aggregated to team-level scores based on $r_{wg}$ indices and the ICCs, as discussed above. Member satisfaction is the only dependent variable in this study at an individual level.

The first part of the analysis includes all team-level variables measured at two time periods. Longitudinal data possess a hierarchical data structure, as the repeated measurements are considered as a separate level nested within each team (or individuals because the individual-level scores were aggregated to team-level scores) (MacCallum & Kim, 2000). As Time 1 and Time 2 data are not independent, hierarchical linear models incorporate this dependence into the model (Muthen & Satorra, 1989). The repeated measures are the first-level unit, and the teams are the second-level unit (Hox, 2000). Therefore, the current two-level hierarchical linear model consists of two submodels: time (repeated measurements: level 1) and team (level 2) (Ker, Wardrop, & Anderson, 2001). The level-1 model is within-teams, and the level 2 model is a between-teams model (Anderson, 2001). Hierarchical linear modeling in STATA was used to test the hypothesized relationships. In this analysis, in order to take care of the dependence the repeated measurement (time) was specified as random (time was treated as a random effect) (in STATA). Task SMM, team SMM, TMS, team learning behavior, and team engagement were analyzed at the team level of analysis (level 2), and time (repeated measures) at level 1.

The command .xtmixed in STATA was used to estimate multilevel models. The .xt prefix signifies that the command belongs to the larger class of commands used to estimate models for longitudinal data. This reflects the fact that panel data or longitudinal data (in this case) can be thought of as multilevel data in which observations at multiple time points are nested within an individual (Albright & Marinova, 2010).
The second part of the analysis involves member satisfaction, as the dependent variable was measured at an individual level. It was hypothesized that the independent variables (task SMM, team SMM, and TMS) (team-level variables) would be positively related to member satisfaction (individual-level work outcome) through the mediation of team engagement and team learning behavior (team-level variables). In this instance, the longitudinal data possess a three-level hierarchical data structure: the repeated measurements (time) are considered as the level-1 unit nested within each individual; the individual is considered as the level-2 unit nested within each team (178 members nested within 27 teams); the team is considered the level-3 unit (MacCallum & Kim, 2000). Therefore, the repeated measures are the first level, the individuals are the second level, and the teams are the third-level units (Hox, 2000). The level-1 model is within-individual, the level 2 model is between-individuals and within-team, and the level-3 model is a between-teams model (Anderson, 2001). Therefore, hierarchical linear modeling was adopted to analyze the multilevel data. Task SMM, team SMM, TMS, team learning behavior, and team engagement were analyzed at the team level of analysis (level 3), member satisfaction at the individual level of analysis (level 2), and repeated measures (time) at level 1.

AIC statistics were used to obtain improvement in the model fit; smaller AIC statistics indicated a better model (fit) (Albright & Marinova, 2010).
CHAPTER 4

RESULTS

4.1 Introduction

The first section of this chapter discusses the change over time and a descriptive summary of variables. The descriptive summary includes the means and the standard deviations of all the variables used in this study. The second section presents the results of the correlation matrix. In the third section, the results of the hypothesis testing are presented.

4.2 Change over Time

The first objective of the study was to examine whether the study variables change over time. The study proposed that each of the study variables should increase over time as a result of team experience. Repeated measures analyses of variance (RM-ANOVA) was used to test such differences. The RM-ANOVA results indicated whether there were significant differences across time for each of the variables. The RM-ANOVA results along with means and standard deviations for all variables are presented in Table 5.

The ANOVA results showed that team adaptability and task SMM significantly increased over time and that self-rated team performance marginally increased over time (Table 5).
Table 5

*Change over Time*

<table>
<thead>
<tr>
<th></th>
<th>Time 1 Mean (S.D.)</th>
<th>Time 2 Mean (S.D.)</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Task SMM</td>
<td>3.94 (.25)</td>
<td>4.04 (.28)</td>
<td>$F(1,21) = 4.17, p &lt; .05$</td>
</tr>
<tr>
<td>Team SMM (Mean)</td>
<td>3.92 (.36)</td>
<td>3.99 (.40)</td>
<td>$F(1,21) = 1.24, n.s$</td>
</tr>
<tr>
<td>Team SMM similarity (1-S.D.)</td>
<td>.50 (.18)</td>
<td>.53 (.15)</td>
<td>$F(1,21) = .39, n.s$</td>
</tr>
<tr>
<td>TMS</td>
<td>3.69 (.30)</td>
<td>3.74 (.25)</td>
<td>$F(1,21) = 1.15, n.s$</td>
</tr>
<tr>
<td>Team learning behaviors</td>
<td>3.57 (.31)</td>
<td>3.6 (.28)</td>
<td>$F(1,21) = .38, n.s$</td>
</tr>
<tr>
<td>Team engagement</td>
<td>3.67 (.27)</td>
<td>3.7 (.40)</td>
<td>$F(1,21) = .21, n.s$</td>
</tr>
<tr>
<td>Team performance (self)</td>
<td>3.86 (.42)</td>
<td>4.01 (.39)</td>
<td>$F(1,20) = 3.12, p &lt; .1$</td>
</tr>
<tr>
<td>Team performance (Instructors)</td>
<td>3.66 (.90)</td>
<td>3.77 (.74)</td>
<td>$F(1,17) = 1.35, n.s$</td>
</tr>
<tr>
<td>Member satisfaction</td>
<td>3.95 (.90)</td>
<td>3.91 (.90)</td>
<td>$F(1,135) = .59, n.s$</td>
</tr>
<tr>
<td>Team adaptability</td>
<td>3.97 (.39)</td>
<td>4.05 (.37)</td>
<td>$F(1,20) = 4.43, p &lt; .05$</td>
</tr>
</tbody>
</table>
Table 6

**Variable Correlations and Descriptive Statistics Per Time**

| Time 1 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| TaskSMM | .70 | | | | | | | | | | | | | | | | | | |
| TeamSMM | .72 | .73 | .25 | | | | | | | | | | | | | | | | |
| SMM | .27 | .41 | | | | | | | | | | | | | | | | | |
| TMS | .65 | .74 | .29 | .72 | | | | | | | | | | | | | | | | |
| LB | .63 | .71 | .16 | .64 | .67 | | | | | | | | | | | | | | | |
| ENG | .41 | .63 | .18 | .46 | .39 | .29 | .22 | .18 | .31 | .36 | .31 | .45 | | | | | | | |
| Perftime | .44 | .58 | .22 | .58 | .49 | .47 | .56 | .63 | .64 | .60 | .61 | .75 | .45 | | | | | | |
| Perfins | .16 | .25 | .18 | .50 | .37 | .62 | .48 | .53 | .68 | .41 | .64 | | | | | | | |
| Adapt | .38 | .53 | .31 | .40 | .64 | .71 | .67 | .52 | | | | | | | | | | |
| Satis | .38 | .62 | .40 | .50 | .49 | .52 | .61 | .62 | .72 | | | | | | | | | |

| Time 2 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| TaskSMM | .50 | .45 | -.01 | .41 | .37 | .44 | .42 | .52 | .60 | .49 | | | | | | | | | |
| TeamSMM | .41 | .63 | .15 | .45 | .50 | .51 | .64 | .52 | .74 | .74 | .63 | | | | | | | | |
| SMM | .59 | .35 | .18 | .46 | .39 | .29 | .22 | .18 | .31 | .36 | .31 | .45 | | | | | | | |
| TMS | .44 | .58 | .22 | .58 | .49 | .47 | .56 | .63 | .54 | .60 | .61 | .75 | .45 | | | | | | |
| LB | .42 | .53 | -.02 | .42 | .61 | .45 | .50 | .37 | .62 | .48 | .53 | .68 | .41 | .64 | | | | |
| ENG | .37 | .50 | -.04 | .41 | .53 | .62 | .53 | .40 | .61 | .63 | .57 | .75 | .33 | .59 | .67 | | | | |
| Perfteam | .23 | .37 | -.05 | .26 | .23 | .30 | .53 | .25 | .59 | .46 | .55 | .64 | .30 | .58 | .54 | .55 | | | |
| Perfins | .70 | .66 | .01 | .56 | .68 | .57 | .75 | .92 | .63 | .63 | .70 | .64 | .19 | .76 | .54 | .50 | .46 | | |
| Adapt | .36 | .47 | .20 | .36 | .40 | .38 | .48 | .35 | .72 | .61 | .55 | .75 | .47 | .65 | .57 | .68 | .71 | .51 | |
| Satis | .38 | .63 | .16 | .44 | .45 | .47 | .52 | .58 | .62 | .80 | .47 | .77 | .43 | .66 | .54 | .66 | .56 | .70 | .67 |

| M | 3.94 | 3.92 | .50 | 3.69 | 3.57 | 3.67 | 3.86 | 3.66 | 3.97 | 3.95 | 4.04 | 3.99 | .53 | 3.74 | 3.60 | 3.70 | 4.01 | 3.77 | 3.91 | 4.05 |
| S.D. | .25 | .36 | .19 | .30 | .31 | .27 | .42 | .90 | .39 | .90 | .28 | .40 | .15 | .25 | .28 | .40 | .39 | .74 | .90 | .37 |

**Note:** Italic = non-significant; 1=task SMM; 2=team SMM (Mean); 3=SMM (1-S.D.); 4=TMS; 5=Team learning behavior; 6=Team engagement; 7=self-rated team performance; 8=instructor-rated team performance; 9=Team adaptability; 10=Member satisfaction.
4.3 Correlations

The correlation matrix is presented in Table 6. As shown in Table 6, task SMM was significantly positively related to team SMM ($r = .70, p < .05$), suggesting that teams high in task SMM are likely to be high in team SMM. The results are consistent with the findings in previous studies (Lim & Klein, 2006). Further, TMS was significantly positively related to task SMM and team SMM respectively ($r = .72, p < .05; r = .73, p < .05$). The results indicated that teams high in task-and team SMM also tend to be high in TMS. The results are consistent with previous findings (Ellis, 2006). The results were consistent at both Time 1 and Time 2 (Table 6).

The correlations between the same task SMM, team SMM, and TMS indices over time were significant and moderately high (task SMM at Time 1 and Time 2: $r = .50, p < .05$; team SMM at Time 1 and Time 2: $r = .63, p < .05$; TMS at Time 1 and Time 2: $r = .58, p < .05$). The results indicate that teams initially high in task SMM, team SMM, and TMS continued to be so. Although task SMM significantly improved over time, teams with high task SMM continued to be high.

Similar to these results, the mediating variables (team learning behavior: $r = .61, p < .05$; team engagement: $r = .62, p < .05$) and outcome variables (team adaptability: $r = .72, p < .05$; self-rated team performance: $r = .53, p < .05$; instructor-rated team performance: $r = .92, p < .05$; member satisfaction: $r = .80, p < .05$) exhibited high significant correlations over time. These findings along with the results discussed above indicate that although team adaptability improved significantly and self-rated team performance improved marginally over time, teams that were adaptable and did better initially continued to be superior.

Finally, as expected, task SMM, team SMM, and TMS were significantly positively related to team outcomes (self-rated and instructor-rated team performance, team adaptability,
and member satisfaction), and mediating variables (team learning behavior and team engagement). Moreover, the mediating variables exhibited significant correlations with team outcomes. The results were consistent at both Time 1 and Time 2 (Table 6).

**4.4 Hypothesis Testing**

**Differential effects.** Hypothesis 1 stated that task SMM would be more positively related to team performance than would team SMM. This hypothesis was not supported. The correlation matrix (Table 6) indicates that at Time 1 team SMM was more strongly related to self-rated \((r=.53, p<.05)\) and instructor-rated team performance \((r=.67, p<.05)\) compared to task SMM (self-rated \((r=.35, p<.05)\) and instructor-rated team performance \((r=.61, p<.05)\). At Time 2, team SMM was more strongly related to self-rated team performance \((r=.64, p<.05)\) compared to task SMM \((r=.55, p<.05)\). However, interestingly, task SMM was more strongly related to instructor-rated team performance \((r=.70, p<.05)\) than was team SMM \((r=.64, p<.05)\). The equality of two correlations was tested using Williams’s (1959) formula (Steiger, 1980). The two correlations were not significantly different \((t=.58, p>.05)\). Therefore, Hypothesis 1 was not supported.

Hypothesis 2 stated that team SMM would be more positively related to team adaptability than will task SMM. The hypothesis was supported by the current data. Correlation results in Table 6 indicated that team SMM was more strongly related to team adaptability \((r=.75, p<.01)\) as compared to task SMM \((r=.55, p<.01)\). The equality of two correlations was tested using Williams’s (1959) formula (Steiger, 1980). The two correlations were significantly different \((t=2.37, p<.05)\). Therefore, Hypothesis 2 was supported.

Hypothesis 3 stated that team SMM will be more positively related to member satisfaction than will task SMM. The hypothesis was supported by the current data. Correlation results in Table 6 indicated that team SMM was more strongly related to member satisfaction
as compared to task SMM \( (r = .38, p < .01) \). The equality of the two correlations was tested using Williams’s (1959) formula (Steiger, 1980). Significant differences were found between the two correlations \( (t = 2.61, p < .05) \). Therefore, Hypothesis 3 was supported.

Hypothesis 4a stated that task SMM would be more positively related to member satisfaction than would TMS. The hypothesis was not supported by the current data. Correlation between TMS and member satisfaction \( (r = .50, p < .01) \) was higher than the correlation between task SMM and member satisfaction \( (r = .38, p < .01) \). Therefore, Hypothesis 4a was not supported.

Hypothesis 4b stated that team SMM would be more positively related to member satisfaction than would TMS. Correlation results in Table 6 indicated that team SMM was more strongly related to member satisfaction \( (r = .62, p < .01) \) as compared to TMS \( (r = .50, p < .01) \). The equality of the two correlations was tested using Williams’s (1959) formula (Steiger, 1980). Significant differences were found between the two correlations \( (t = 2.61, p < .05) \). Therefore, Hypothesis 4b was supported.

Mediation tests. To test the hypothesized mediation effects, Baron and Kenny’s (1986) mediation test and Sobel test were used. The mediation test involves three steps: in step 1, the relationship between the independent variable and the outcome is investigated; in step 2, the relationship between the independent variable and mediator is examined; and in step 3 the independent variable is added to the equation that contains the mediator-outcome relationship. To establish mediation, the following conditions must hold: (1) the independent variable must affect the dependent variable; (2) the independent variable must affect the mediator; and (3) the mediator must affect the dependent variable in the third equation. If all these conditions hold in the predicted direction, then the effect of the independent variable on the dependent variable
must be less in the third equation than in first. If the relationship between the independent variable and the outcome is insignificant, full mediation is indicated.

Hypothesis 5 stated that team learning behavior would mediate the relationship between task SMM and (a) self-rated and instructor-rated team performance, (b) member satisfaction, and (c) team adaptability (Table 7). The mediation test was conducted using the steps suggested by Baron and Kenny (1986) (discussed earlier). First, significant positive relationships were found between task SMM and team outcomes: self-rated team performance ($\beta=.99, p<.01$), instructor-rated team performance ($\beta=1.15, p<.01$), member satisfaction ($\beta=.92, p<.01$), and team adaptability ($\beta=.36, p<.01$). Second, a significant positive relationship was found between task SMM and team learning behavior ($\beta=.79, p<.01$). Third, significant positive relationships were found between team learning behavior and team outcomes: self-rated team performance ($\beta=.97, p<.01$), instructor-rated team performance ($\beta=.95, p<.01$), member satisfaction ($\beta=.86, p<.01$), and team adaptability ($\beta=.38, p<.01$). Finally, the beta coefficients for task SMM on team outcomes were insignificant (self-rated team performance ($\beta=.17, p>.05$), instructor-rated team performance ($\beta=.42, p>.05$), member satisfaction ($\beta=.54, p>.05$), and team adaptability ($\beta=.14, p>.05$). A full mediation effect of team learning behavior on the relationship between task SMM and team outcomes were found. Sobel tests further confirmed the significant mediation effect of team learning behavior on the relationship between task SMM and team outcomes (self-rated team performance (Sobel test, $t = 3.29, p<.01$), instructor-rated team performance (Sobel test, $t = 2.53, p<.01$), member satisfaction (Sobel test, $t = 2.59, p<.01$), and team adaptability (Sobel test, $t = 2.13, p<.01$). The findings support Hypotheses 5a, 5b, and 5c.

Hypotheses 6 stated that team learning behavior would mediate the relationship between team SMM and (a) self-rated and instructor-rated team performance, (b) member satisfaction,
and (c) team adaptability (Table 7). Similar procedures were followed as earlier to test the hypotheses. First, significant positive relationships were found between team SMM and team outcomes: self-rated team performance ($\beta = .88$, $p < .01$), instructor-rated team performance ($\beta = .71$, $p < .01$), member satisfaction ($\beta = 1.34$, $p < .01$), and team adaptability ($\beta = .69$, $p < .05$).

Second, team SMM had a significant influence on team learning behavior ($\beta = .66$, $p < .01$). Third, team learning behavior was found to have a significant influence on self-reported team performance ($\beta = .84$, $p < .01$), but not on instructor-rated team performance ($\beta = .56$, $p > .05$), member satisfaction ($\beta = -.04$, $p > .05$), or team adaptability ($\beta = .07$, $p > .05$). Finally, the beta coefficients for team SMM on self-rated and instructor-rated team performance were insignificant ($\beta = .24$, $p > .05$; $\beta = .58$, $p > .05$); however, they were significant for member satisfaction ($\beta = 1.34$, $p < .01$) and team adaptability ($\beta = .63$, $p < .01$). The findings indicate a complete mediation effect of team learning behavior on the relationship between team SMM and self-rated team performance (Sobel test, $t = 2.99$, $p < .01$). However, the mediation effect of team learning behavior on the relationship between team SMM and instructor-rated team performance was not found. Therefore, Hypothesis 6a, which held that team learning behavior would mediate the relationship between team SMM and team performance, was partially supported. The mediation effect of team learning behavior on the relationship between team SMM and member satisfaction was not found; therefore, Hypothesis 6b was not supported. Similarly, the mediation effect of team learning behavior on the relationship between team SMM and team adaptability was not found; therefore, Hypothesis 6c was not supported.

Hypotheses 7 stated that team learning behavior would partially mediate the relationship between TMS and (a) self-rated and instructor-rated team performance, (b) team adaptability, and (c) member satisfaction (Table 7). Following a similar procedure as before, first, TMS was
found to have a significant influence on self-rated team performance ($\beta = 1.04, p < .01$) and instructor-rated team performance ($\beta = 1.18, p < .01$), team adaptability ($\beta = .38, p < .01$), and member satisfaction ($\beta = 1.17, p < .01$). Second, a significant positive relationship between TMS and team learning behavior was found ($\beta = .83, p < .01$). Third, team learning behavior was found to have a significant impact on self-rated team performance ($\beta = .83, p < .01$) and a marginal impact on instructor-rated team performance ($\beta = .62, p < .06$). A complete mediation effect of team learning behavior on the relationship between TMS and self-reported team performance was found, as the relationship between TMS and self-reported team performance became insignificant ($\beta = .34, p > .05$; Sobel test, $t = 3.23, p < .01$). A partial mediation effect of team learning behavior on the relationship between TMS and instructor-rated team performance was found, as the effect of TMS on instructor-rated team performance was no longer significant ($\beta = .73, p > .05$). Additionally, the Sobel test was marginally significant (Sobel test, $t = 1.49, p < .06$). Therefore, the findings provide sufficient support for Hypothesis 7a, which stated that team learning behavior would mediate the relationship between TMS and team performance. Results did not completely support Hypothesis 7b. The relationship between TMS and team adaptability became insignificant ($\beta = .15, p > .05$) (third equation), and the Sobel test was significant (Sobel test, $t = 1.62, p < .05$). However, the impact of team learning behavior on team adaptability was not found ($\beta = .33, p > .05$) (third equation). Overall, the mediation effect of team learning behavior on the relationship between TMS and team adaptability was not found. Thus, Hypothesis 7b was not completely supported. Sufficient support was found for Hypothesis 7c. The impact of team learning behavior on member satisfaction was significant ($\beta = .66, p < .05$), and the beta coefficient of TMS reduced in the third equation compared to the first equation ($\beta = .71, p < .05$). The Sobel test was also significant (Sobel test, $t = 1.95, p < .05$). The results
indicated a partial mediation effect. Therefore, Hypothesis 7c, which stated that team learning behavior would mediate the relationship between TMS and member satisfaction, was supported.

Hypotheses 8 stated that team engagement would mediate the relationship between task SMM and (a) self-rated and instructor-rated team performance, (b) team adaptability, and (c) member satisfaction (Table 7). A similar procedure was followed as above to test the mediating effects. Step 1, which involves the relationship between task SMM and team outcomes, was discussed earlier. Second, a significant positive relationship was found between task SMM and team engagement ($\beta = .97, p < .01$). Third, significant positive relationships were found between team engagement and self-rated team performance ($\beta = .44, p < .01$), team adaptability ($\beta = .50, p < .01$), and member satisfaction ($\beta = .82, p < .01$); however, the relationship was not significant for instructor-rated team performance ($\beta = .04, p > .05$). Finally, the beta coefficients for task SMM on self-rated team performance ($\beta = .17, p > .05$), team adaptability ($\beta = .25, p > .05$), and member satisfaction ($\beta = .53, p > .05$) were insignificant, but it was significant for instructor-rated team performance ($\beta = .99, p < .05$). A full mediation effect of team engagement on the relationship between task SMM and self-rated team performance (Sobel test, $t = 3.28, p < .01$), team adaptability (Sobel test, $t = 3.08, p < .01$), and member satisfaction (Sobel test, $t = 3.25, p < .01$) were found. A mediation effect of team engagement on the relationship between task SMM and instructor-rated team performance was not found. Therefore, the findings partially support Hypothesis 8a (mediation effect of team engagement on the relationship between task SMM and team performance), and completely support both Hypothesis 8b (mediation effect of team engagement on the relationship between task SMM and team adaptability) and Hypothesis 8c (mediation effect of team engagement on the relationship between task SMM and member satisfaction).
Hypothesis 9 stated that team engagement would mediate the relationship between team SMM and (a) team performance, (b) team adaptability, and (c) member satisfaction. Similar procedures were followed to test the mediation effect of team engagement on the relationship between team SMM and team outcomes (Table 7). Step 1 results were already discussed earlier (team SMM-team outcomes). Second, a significant positive relationship was found between team SMM and team engagement ($\beta = .79, p < .01$). Third, team engagement was found to have a significant impact on self-rated team performance ($\beta = .49, p < .05$) but not on instructor-rated team performance ($\beta = -.61, p > .05$). A complete mediation effect of team engagement on the relationship between team SMM and self-reported team performance was found (the beta coefficient for team SMM decreased from $\beta = .88, p < .01$ to $\beta = .49, p < .05$; Sobel test, $t = 2.01$, $p < .01$) but not for instructor-rated team performance. Therefore, Hypothesis 9a was partially supported that team engagement will mediate the relationship between team SMM and team performance. The mediation effect of team engagement on the relationship between team SMM and team adaptability was not found (team engagement was not significantly related to team adaptability in the third equation ($\beta = .25, p > .05$). Thus, Hypothesis 9b was not supported. Similarly, the mediation effect of team engagement on the relationship between team SMM and member satisfaction was not found (team engagement was not significantly related to member satisfaction in the third equation ($\beta = .14, p > .05$). Thus, Hypothesis 9c was not supported.

Hypothesis 10 stated that team engagement would mediate the relationship between TMS and (a) self-rated and instructor-rated team performance, (b) team adaptability, and (c) member satisfaction (Table 7). Step 1 was already discussed above (TMS-team outcomes). Second, TMS was found to have a significant influence on team engagement ($\beta = .85, p < .01$). Third, team engagement significantly influenced self-rated team performance ($\beta = .56, p < .01$), but not
instructor-rated team performance ($\beta = .03, p > .05$). Team engagement was significantly positively related to team adaptability ($\beta = .46, p < .01$), and member satisfaction ($\beta = .74, p < .01$). The results indicate a partial mediation effect of team engagement on the relationship between TMS and self-rated team performance as the beta coefficient for TMS decreased ($\beta = .59, p < .01$), and the Sobel test was significant (Sobel test, $t = 2.80, p < .01$). The mediation effect of team engagement on the relationship between TMS and instructor-rated team performance was not found. Therefore, Hypothesis 10a, which stated that team engagement would mediate the relationship between TMS and team performance was partially supported. A complete mediation effect of team engagement on the relationship between TMS and team adaptability was found, as the beta coefficient for TMS was no longer significant in the third equation ($\beta = .33, p > .05$). The Sobel test was also significant (Sobel test, $t = 2.93, p < .01$). Therefore, Hypothesis 10b was supported. A partial mediation effect of team engagement on the relationship between TMS and member satisfaction was found, as the beta coefficient for TMS was still significant in the third equation but it decreased from equation 1 ($\beta = .76, p < .01$). Also, team engagement was significantly positively related to member satisfaction ($\beta = .74, p < .01$). The Sobel test was also significant (Sobel test, $t = 2.88, p < .01$). Therefore, Hypothesis 10c was supported.
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Mediation Tests

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Note. TaskSMM = Task shared mental model; TeamSMM(M) = Team shared mental model; TMS = Transactive memory systems; LB = Team learning behavior; Eng = Team engagement; Performance(self) = Self-rated team performance; Performance(ins) = Instructor-rated team performance; Adaptability = Team adaptability; Satisfaction = Member satisfaction; TeamSMM(S) = Team shared mental model similarity

** p ≤ .01; * p ≤ .05; + p ≤ .1
Interaction effects: Task SMM and TMS. Hypothesis 11 stated that TMS would moderate the relationship between task SMM and (a) self-rated and instructor-rated team performance, (b) team adaptability, (c) member satisfaction, (d) team learning behavior, and (e) team engagement. To test these hypotheses, an interaction term of task SMM and TMS was entered as an independent variable along with the two predictors: task SMM and TMS.

Hypothesis 11a tested the moderating effect on team performance. As shown in Table 8, of the two predictors, only TMS had a significant impact on self-rated and instructor rated team performance ($\beta = .85, p < .01; \beta = .85, p < .01$). The interaction term was not significant ($\beta = -.81, p > .05; \beta = -.35, p > .05$). Therefore, Hypothesis 11a was not supported.

Hypothesis 11b tested the moderating effect on team adaptability. As shown in Table 8, of the two predictors, only TMS was marginally significant ($\beta = .85, p < .06$). The interaction term was not significant ($\beta = .38, p > .05$). Thus, Hypothesis 11b was not supported.

Hypothesis 11c tested the moderating effect on member satisfaction. As shown in Table 8, task SMM had a marginal impact and TMS had a significant impact on member satisfaction ($\beta = .64, p < .06; \beta = 1.04, p < .01$). However, the interaction term was not significant ($\beta = .66, p > .05$). Therefore, Hypothesis 11c was not supported.

Hypothesis 11d tested the moderating effect on team learning behavior. As shown in Table 8, both predictors—task SMM and TMS—had a significant impact on team learning behavior ($\beta = .34, p < .05; \beta = .58, p < .01$). However, the interaction term was not significant ($\beta = -.30, p > .05$). Therefore, Hypothesis 11d was not supported.

Hypothesis 11e tested the moderating effect on team engagement. As shown in Table 8, of the two predictors, only task SMM had a significant impact on team engagement ($\beta = .75,$
The interaction term was marginally significant ($\beta = .48, p > .06$). Therefore, Hypothesis 16e was not completely supported.

**Interaction Effects: Team SMM and TMS.** Hypothesis 12 stated that TMS would moderate the relationship between team SMM and (a) self-rated and instructor-rated team performance, (b) team adaptability, (c) member satisfaction, (d) team learning behavior, and (e) team engagement. To test these hypotheses, an interaction term of team SMM and TMS was entered as an independent variable along with the two predictors: team SMM and TMS. Hypothesis 12a tested the moderating effect on team performance. As shown in Table 8, both predictors had an influence on self-rated and instructor-rated team performance. Team SMM had a significant influence on self-rated team performance ($\beta = .51, p < .05$), and TMS had a marginal effect ($\beta = .52, p < .06$). Team SMM had a marginal effect on instructor-rated team performance ($\beta = .71, p < .06$), and TMS had a significant impact ($\beta = 1.07, p < .01$). However, the interaction term was not significant for either self-rated team performance ($\beta = -.22, p < .05$) or instructor-rated team performance ($\beta = -.68, p > .05$). Therefore, Hypothesis 12a was not supported.

Hypothesis 12b tested the moderating effect of TMS on the relationship between team SMM and team adaptability. As shown in Table 8, of the two predictors, team SMM had a significant influence on team adaptability ($\beta = .75, p < .05$). Additionally, the interaction term was significant ($\beta = .51, p < .05$). The moderated team SMM $\times$ TMS relationship was plotted and appears in Figure 2. As predicted, the form of interaction was disordinal. As illustrated, team adaptability increased with increased team SMM; however, team adaptability was higher for teams which were high on TMS compared to teams which were low on TMS. Further, simple slope analysis was performed to determine which line was significant. The slope of each line was
found to be significant (when TMS was low: \( t = 3.83, p < .01 \); when TMS was high: \( t = 5.83, p < .01 \)). Therefore, Hypothesis 12b was supported.

Figure 2. Team SMM × TMS interaction as related to team adaptability.

Hypothesis 12c tested the moderating effect of TMS on the relationship between team SMM and member satisfaction. As shown in Table 8, of the two predictors, team SMM had a significant influence on member satisfaction (\( \beta = 1.34, p < .01 \)). Additionally, the interaction term was marginally significant (\( \beta = .60, p < .06 \)). The moderated team SMM × TMS relationship was plotted and appears in Figure 3. As predicted, the form of interaction was disordinal. As illustrated, member satisfaction increased with increased team SMM; however, member satisfaction was higher for teams which were high on TMS compared to teams which were low on TMS. Therefore, although results provided some evidence, Hypothesis 12c was not completely supported.
Figure 3. Team SMM × TMS interaction as related to member satisfaction.

Hypothesis 12d tested the moderating effect of TMS on the relationship between team SMM and team learning behavior. As shown in Table 8, both predictors were significantly positively related to team learning behavior—team SMM ($\beta = .37, p < .01$); TMS ($\beta = .45, p < .01$). However, the interaction term was not significant ($\beta = -.22, p > .05$). Therefore, Hypothesis 12d was not supported.

Hypothesis 12e tested the moderating effect of TMS on the relationship between team SMM and team engagement. As shown in Table 8, of the two predictors, team SMM had a significant influence on team engagement ($\beta = .82, p < .01$). Additionally, the interaction term was significant ($\beta = .39, p < .05$). The moderated team SMM × TMS relationship was plotted and appears in Figure 4. The disordinal form of interaction illustrated that team engagement increased with increased team SMM; however, team engagement was higher for teams which
were high on TMS compared to teams which were low on TMS. Further, simple slope analysis indicated that both lines were significant (when TMS was low: \( t = 5.20, p<.01 \); when TMS was high: \( t = 5.66, p<.01 \)). Therefore, Hypothesis 12e was supported.

![Graph showing Team SMM x TMS interaction as related to team engagement.](image)

*Figure 4. Team SMM \( \times \) TMS interaction as related to team engagement.*

**Mediated moderation.** As the interaction effect of team SMM and TMS on team adaptability (outcome) and team engagement (mediator) were significant, some additional analyses were conducted to determine whether team engagement fully mediated the influence of team SMM and TMS variables on team adaptability (James & Brett, 1984). The current study also hypothesized mediated-moderation relationships, in that the multiplicative effects between team SMM and TMS, as related to team adaptability (team outcome), would be mediated by team engagement (mediator) (Table 8). Tests of mediation require four types of evidence (Mathieu et al., 2005). First, when considered alone, the independent variables (i.e., team SMM
and TMS) must be significantly related to the dependent variable (i.e., team adaptability). Second, when considered alone, the mediator (i.e., team engagement) must be significantly related to the dependent variable. Third, the independent variables must be significantly related to the mediator. These three conditions need to be satisfied as a precondition of mediation. Finally, the independent variables are entered into the equation which already has the mediator-outcome relationship. If the independent variables are not significant in the last analysis there is evidence of full mediation. If the independent variables still have significant influence on the dependent variable even when the mediator-outcome variable relationship is significant, a partial mediation is indicated.

The first and third conditions were satisfied as shown before: team SMM and team SMM × TMS (interaction term) were significantly related to team adaptability and team engagement. The second condition was also satisfied, as team engagement was found to be significantly related to team adaptability ($\beta = .63, p < .01$). Thus, all three preconditions for the test of mediation were fulfilled. In the final analysis, the relationships between the independent variables and team adaptability were insignificant (team SMM: $\beta = .22, p > .05$; team SMM × TMS: $\beta = -.40, p > .05$). The relationship between team engagement and team adaptability remained marginally significant ($\beta = .42, p < .06$). Therefore, team engagement partially mediated the linear effects of team SMM and the team SMM × TMS interaction on team adaptability.
Table 8

*Interactions and Mediated Moderation*

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<th>Variables</th>
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<th>Step1 Eng</th>
<th>Step2 Perf (self)</th>
<th>Step2 Perf (ins)</th>
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</table>

| Intercept | 3.61**  | 3.69**    | 3.94**           | 3.64**           | 3.86**      | 4.03**      | -           |
| TeamSMM(sim) | .30*    | .21       | .20              | .53+             | .75+        | .46*        | -           |
| TMS       | .82**   | .77**     | .98**            | .87**            | 1.37**      | .57**       | -           |
| TeamSMM(sim)×TMS | -.16   | .62       | .45              | 2.37*            | .17         | -.44        | -           |
| TMS       |         |           |                  |                  |             |             |             |

| Intercept | 1.68**  | .63**     | .42+             |                  |             |             |             |

*Note.* TaskSMM = Task shared mental model; TeamSMM = Team shared mental model; TMS = Transactive memory systems; LB = Team learning behavior; Eng = Team engagement; Perf(self) = Self-rated team performance; Perf(ins) = Instructor-rated team performance; Adapt = Team adaptability; Satis = Member satisfaction; TeamSMM(sim) = Team shared mental model similarity

**p ≤ .01; * p ≤ .05; + p ≤ .1
**Other observations.** Although not hypothesized, several interesting patterns were found based on the mediation results. First, team SMM tends to impact team outcomes directly. Of all the mediating relationships involving team SMM, only one complete mediation effect (team learning behavior mediated the relationship between team SMM and self-rated team performance) and one partial mediation effect (team engagement mediated the relationship between team SMM and self-rated team performance) was found (Table 8 and Table 9). As indicated in Table 8 and Table 9, team SMM had significant direct relationships with team outcome variables and mediating variables. In contrast, all mediating relationships involving task SMM were significant except for one (the mediating effect of team engagement on the relationship between task SMM and instructor-rated team performance). Therefore, task SMM tends to impact team outcomes through mediating variables. Similarly, results indicate that TMS tends to impact team outcomes through mediating variables (Table 8 and Table 9).

Second, the relationship between team learning behavior and team performance (self-rated and instructor-rated team performance) was found to be stronger than the relationship between team engagement and team performance (self-rated and instructor-rated team performance) (Table 9). Further, team learning behavior tends to mediate the relationships between the predictors (task SMM, team SMM, and TMS) and team performance. In contrast, team engagement was found to have stronger relationships with team adaptability and member satisfaction. Further, team engagement tends to mediate the relationships between predictors and team adaptability and member satisfaction (Table 9). Therefore, the findings suggested that team learning behavior and team engagement have distinct effects on different outcomes.
Table 9

*Mediation Tests with Both Mediators*

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Note. TaskSMM = Task shared mental model; TeamSMM(M) = Team shared mental model; TMS = Transactive memory systems; LB = Team learning behavior; Eng = Team engagement; Perf(self) = Self-rated team performance; Perf(ins) = Instructor-rated team performance; Adapt = Team adaptability; Satis = Member satisfaction; TeamSMM(S) = Team shared mental model similarity

**p ≤ .01; *p ≤ .05; +p ≤ .1**
Similarity of team SMM. This section reports all the analysis involving team SMM (similarity). Instead of using the mean/aggregate scores of all members in a team (as used for other team-level variables), the within-team standard deviation was used to measure team SMM similarity at the team level. The within-team standard deviation indicated the variability in each team with respect to team SMM. A high standard deviation indicated high team variability (or low similarity) of team SMM within the teams. Therefore, team SMM similarity scores were computed by subtracting the standard deviation from 1 (1-S.D.) to reverse the scale so that greater values represented higher levels of team SMM similarity.

Differential effects. Hypothesis 1 stated that task SMM would be more positively related to team performance than would team SMM. The correlation matrix (Table 6) indicated that at both Time 1 and Time 2, task SMM was strongly related to self-rated team performance (Time 1: \( r = .35, p < .01 \); Time 2: \( r = .55, p < .01 \)) and instructor-rated team performance (Time 1: \( r = .61, p < .01 \); Time 2: \( r = .70, p < .01 \)), whereas team SMM was not significantly related to self-rated team performance (Time 1: \( r = .10, p > .05 \); Time 2: \( r = .30, p > .05 \)), or instructor-rated team performance (Time 1: \( r = .05, p > .05 \); Time 2: \( r = .19, p > .05 \)). Therefore, Hypothesis 1 was supported.

Hypothesis 2 stated that team SMM would be more positively related to team adaptability than will task SMM. Correlation results in Table 6 indicated that the relationship between task SMM and team adaptability (\( r = .55, p < .01 \)), was stronger than the relationship between team SMM and team adaptability (\( r = .47, p < .01 \)). Therefore, Hypothesis 2 was not supported.

Hypothesis 3 stated that team SMM would be more positively related to member satisfaction than would task SMM. Correlation results in Table 6 indicated that the relationship between task SMM and member satisfaction (\( r = .38, p < .01 \)), and team SMM similarity and
member satisfaction \( r = 40, p < .01 \) were similar (results were consistent for Time 2 as well). Therefore, Hypothesis 3c was not supported.

Hypothesis 4b stated that team SMM would be more positively related to member satisfaction than would TMS. Hypothesis 4b was not supported, as correlation results indicate that TMS was more positively related to member satisfaction \( r = .68, p < .05 \) in comparison to the relationship between team SMM and member satisfaction \( r = .40, p < .05 \).

**Mediation tests.** Hypotheses 6 stated that team learning behavior would mediate the relationship between team SMM and (a) self-rated and instructor-rated team performance, (b) member satisfaction, and (c) team adaptability (Table 7). Similar procedures were followed as before to test the hypotheses. First, the relationships between team SMM and team outcomes were examined. Significant positive relationships were found between team SMM and team adaptability \( \beta = .43, p < .01 \), and between team SMM and member satisfaction \( \beta = .72, p < .01 \). However, relationships with self-rated team performance \( \beta = .51, p > .05 \) and instructor-rated team performance \( \beta = -.18, p > .05 \) were not significant. Second, team SMM was found to be significantly positively related to team learning behavior \( \beta = .50, p < .01 \). Third, team learning behavior was found to have a significant influence on self-reported team performance \( \beta = 1.12, p < .01 \), instructor-rated team performance \( \beta = 1.15, p < .05 \), member satisfaction \( \beta = 1.07, p < .01 \), and team adaptability \( \beta = .38, p < .01 \). Finally, the beta coefficients for team SMM on self-rated and instructor-rated team performance \( \beta = -.08, p > .05; \beta = -.33, p > .05 \) remained insignificant. The beta coefficients of team SMM for member satisfaction \( \beta = .67, p < .05 \) and team adaptability \( \beta = .40, p < .05 \) decreased. The Sobel test was significant for both self-rated and instructor-rated team performance (Sobel test, \( t = 2.50, p < .01 \); Sobel test, \( t = 2.09, p < .01 \)), indicating the existence of a mediating effect. Recent scholars have suggested that the first pre-
condition of the mediation test can be ignored to test mediation effects. Therefore, the mediation effect of team learning behavior on the relationship between team SMM and team performance received support. Thus, Hypothesis 6a was supported. The mediation effect of team learning behavior on the relationship between team SMM and member satisfaction was found (Sobel test, $t = 2.29, p < .01$). Therefore, Hypothesis 6b was supported. Finally, the mediation effect of team learning behavior on the relationship between team SMM and team adaptability was found (Sobel test, $t = 1.90, p < .05$); therefore, Hypothesis 6c was supported.

Hypothesis 9 stated that team engagement would mediate the relationship between team SMM and (a) self-rated and instructor-rated team performance, (b) team adaptability, and (c) member satisfaction (Table 7). Step 1 results were already discussed above (team SMM–team outcomes). Second, the relationship between team SMM and team engagement was found to be marginally significant ($\beta = .41, p < .06$). Third, team engagement was found to have a significant impact on self-rated team performance ($\beta = .93, p < .01$) and instructor-rated team performance ($\beta = 1.03, p < .01$). The beta coefficient for team SMM decreased (from $\beta = .51, p > .05$ to $\beta = .05, p > .05$), and the Sobel test was marginally significant for self-rated team performance (Sobel test, $t = 1.53, p < .06$). Similarly, the beta coefficient for team SMM decreased (from $\beta = .53, p > .05$ to $\beta = .26, p > .05$), and the Sobel test was marginally significant for instructor-rated team performance (Sobel test, $t = 1.42, p < .07$). Although there is an indication of a partial mediation effect, Hypothesis 9a, which stated that team engagement would mediate the relationship between team SMM and team performance, was not completely supported. Hypothesis 9b, which tested the mediation effect of team engagement on the relationship between team SMM and team adaptability, was supported. Team engagement was significantly related to team adaptability in the third equation ($\beta = .55, p < .01$), along with team SMM similarity (which reduced from $\beta = \ldots$
The Sobel test was marginally significant (Sobel test, $t = 1.51$, $p < .06$). Therefore, there was some support for Hypothesis 9b. Finally, Hypothesis 9c, which tested the mediation effect of team engagement on the relationship between team SMM and member satisfaction, was supported. Team engagement was significantly related to member satisfaction in the third equation ($\beta = 1.05$, $p < .01$), along with team SMM (which reduced from $\beta = .72$, $p < .01$ to $\beta = .67$, $p < .05$). The Sobel test was marginally significant (Sobel test, $t = 1.53$, $p < .06$). Therefore, there was some support for Hypothesis 9c.

**Interactions: Team SMM similarity and TMS.** Hypothesis 12 stated that TMS would moderate the relationship between team SMM and (a) self-rated and instructor-rated team performance, (b) team adaptability, (c) member satisfaction, (d) team learning behavior, and (e) team engagement. It was expected that the interactions would evidence a disordinal form. To test these hypotheses, an interaction term of team SMM and TMS was entered as an independent variable along with the two predictors: team SMM and TMS. Hypothesis 12a tested the moderating effect of TMS on the relationship between team SMM and team performance. As shown in Table 8, of the two predictors, TMS had an influence on self-rated team performance ($\beta = .98$, $p < .01$). TMS was also strongly positively related to instructor-rated team performance ($\beta = .87$, $p < .01$). The relationship between team SMM and instructor-rated team performance was marginally supported ($\beta = .53$, $p < .06$). The interaction term was not significant for self-rated team performance ($\beta = .22$, $p > .05$). However, the interaction term was marginally significant for instructor-rated team performance ($\beta = 2.37$, $p < .06$). The moderated team SMM $\times$ TMS relationship was plotted and appears in Figure 5. As illustrated, the relationship between team SMM and instructor-rated team performance was positive when TMS was high; however, the relationship became negative when TMS was low. Overall, Hypothesis 12a was not supported.
Although the findings were not significant in the current study, the results call for more investigation.

**Figure 5.** Team SMM \(\times\) TMS interaction as related to team performance.

Hypothesis 12b tested the moderating effect of TMS on the relationship between team SMM and team adaptability. As shown in Table 8, both predictors—team SMM (\(\beta = .46, p < .05\)), and TMS (\(\beta = .57, p < .01\))—had a significant influence on team adaptability. However, the interaction term was not significant (\(\beta = -.44, p > .05\)). Therefore, Hypothesis 12b was not supported.

Hypothesis 12c tested the moderating effect of TMS on the relationship between team SMM and member satisfaction. As shown in Table 8, team SMM had a marginal impact on member satisfaction (\(\beta = .75, p < .06\)), and TMS had a significant impact on member satisfaction.
(β = 1.37, p < .01). However, the interaction term was not significant (β = .17, p > .05). Therefore, Hypothesis 12c was not supported.

Hypothesis 12d tested the moderating effect of TMS on the relationship between team SMM and team learning behavior. As shown in Table 8, both predictors were significantly positively related to team learning behavior—team SMM (β = .30, p < .05) and TMS (β = .82, p < .01). However, the interaction term was not significant (β = -.16, p > .05). Therefore, Hypothesis 12d was not supported.

Hypothesis 12e tested the moderating effect of TMS on the relationship between team SMM and team engagement. As shown in Table 8, of the two predictors, TMS had a significant influence on team engagement (β = .77, p < .01). However, the interaction term was not significant (β = .62, p > .05). Therefore, Hypothesis 12e was not supported.
CHAPTER 5

DISCUSSION AND CONCLUSION

5.1 Introduction

This chapter summarizes and discusses the study’s findings. The first section presents a summary of the findings, the second discusses the theoretical contributions, and the third section addresses limitations. The concluding section presents a number of recommendations for future study.

5.2 Summary of the Study

This study investigated the combined effects of SMM and TMS on team outcomes. The fundamental objective of the study was to study the moderating effect of TMS on the relationship between SMM and team outcomes. The study made a contribution by investigating the mediating effects of team learning behavior and team engagement on the relationship between team cognitions (task SMM, team SMM, and TMS) and team outcomes (team performance, team adaptability, and member satisfaction). Furthermore, the research examined the differential effects of task SMM, team SMM, and TMS on team outcomes.

The first goal of the study was to examine the influence of time on the development of task SMM, team SMM, TMS, team learning behavior, team engagement, team performance, team adaptability, and member satisfaction. It was proposed that each of the study variables should increase over time as a result of team experience. The findings indicated that of all the variables, task SMM and team adaptability significantly increased over time and self-rated team performance marginally increased over time. Although there is an indication that variables increase over time because of team experience, the results show that teams might need more time to develop.
The second goal of the study was to investigate the direct effects of task SMM, team SMM, and TMS on team outcomes (team performance, team adaptability, and member satisfaction) and on mediating variables (team learning behavior and team engagement). The results indicated that teams with high task SMM, team SMM, and TMS are likely to perform well and, be adaptable. Furthermore, team members are likely to be satisfied.

The third goal was to examine the mediating effects of team learning behavior and team engagement on the relationship between team cognitions (task SMM, team SMM, and TMS) and team outcomes. It was found that task SMM and TMS are more likely to have an impact on team learning behavior and team engagement, which consequently impacts team outcomes. However, team SMM is more likely to have a direct effect on team outcomes.

The fourth goal was to investigate the differential effects of task SMM, team SMM, and TMS on mediating variables and team outcomes. It was found that team SMM has a stronger influence on team outcomes than does either task SMM or TMS.

The fifth goal was to explore the differential mediating effects of team learning behavior and team engagement. It was found that team learning behavior and team engagement has differential effects on different team outcomes. Furthermore, results indicated that team cognitions are likely to have an impact on different dimensions of team effectiveness through different channels (mediators).

The sixth goal of the study was to examine the moderating effect of TMS on the relationship between SMM and team outcomes. It was proposed that the beneficial effects of SMM on team outcomes would be strong when TMS was high. TMS and team SMM were found to have an interaction effect on team engagement (mediator) and team adaptability (outcome).
Finally, the study examined the mediated-moderation relationships. It was proposed that SMM and TMS would have an interaction effect on mediating variables, which as a consequence would have an impact on team outcomes. It was found that SMM and TMS have an interaction effect on team engagement, which as a consequence affected team adaptability.

A total of 12 hypotheses along with sub-hypotheses were developed in this study, and these were tested using hierarchical linear modeling. The summaries of findings from testing the hypotheses are presented in the following section (see Table 10).

5.3 Theoretical Contributions

The findings of the current study contribute to the existing literature on organizational behavior as follows. First, though some research has demonstrated that both task SMM and team SMM results in team effectiveness, recent scholarship has suggested that the particular way in which SMM is conceptualized affects what it impacts (Cannon-Bowers & Salas, 2001). It has been suggested that task-specific outcomes such as quality of output and timeliness are likely to be affected by task SMM, and accordingly, DeChurch and Mesmer-Magnus (2010) proposed that task SMM will be more positively related to team performance than will team SMM. Therefore, to address this gap in the literature, the current work examined the differential effects of not only task SMM and team SMM but also TMS on team outcomes.

In accord with earlier studies, the current work found that task SMM, team SMM, and TMS each impacts team outcomes. However, uniquely, the current work demonstrated that compared to task SMM and TMS, team SMM has a stronger influence on team outcomes. Additionally, the results indicate that TMS has a stronger influence on team outcomes (satisfaction) compared to task SMM. Task SMM is about performance requirements and work goals, whereas interpersonal relationships are more likely to develop through TMS given its
focus on specialization, credibility, and coordination in teams. This might explain why TMS had a stronger influence on member satisfaction compared to task SMM in the current work. The differential effects of task SMM and TMS on member satisfaction have not been examined in the literature; therefore, there is no basis for comparison.

Further, contrary to expectations established in the literature, the current work found that team SMM is more likely than task SMM to impact team performance. In the context of the current study, though all the teams received an equal amount and level of training on taskwork, they received no training on teamwork. Therefore, it is possible that the difference in team performances because of team SMM was more than because of task SMM. Therefore, this relationship needs further investigation.

Second, though the impact of team cognitions (SMM and TMS) on team performance is well established, there is a lack of research examining the underlying mechanisms that explain the relationship between team cognitions and team performance. Few research initiatives have been taken in the area of TMS to explain the mediation effects. Research in the area of SMM has focused on team processes (e.g., communication and coordination) to explain mediation effects (Mathieu et al., 2005; Mathieu et al., 2000). However, beyond team processes, there is a scarcity of research examining other underlying mechanisms that might explain the relationships between team cognitions and team effectiveness. Based on suggestions made by Ilgen et al. (2005) to broaden the list of variables beyond team processes, the current work makes a contribution by examining the mediating effects of emergent states. The study examined the mediating effects of team learning behavior and team engagement. Further, the study presented the differential effects of team learning behavior and team engagement on different team outcome variables, and thus differential mediating effects. The findings indicate that different mediating variables have
different effects on various team outcomes. Moreover, various team cognitions (task SMM, team SMM, TMS) have an impact on different team outcomes through different channels (mediators). Team learning behavior and team engagement were found to have differential effects on team outcomes in the current study: team learning behavior is more likely to influence team performance than is team engagement, whereas team engagement is more likely to influence team adaptability and member satisfaction than is team learning behavior. The findings indicate that team learning behavior and team engagement have distinct effects on different outcomes. Additionally, the findings indicate that team learning behavior tends to mediate the relationship between team cognitions and team performance, whereas team engagement tends to mediate the relationship between team cognitions and team adaptability and member satisfaction. These differential effects need to be further investigated in detail in future studies.

Given that team learning behavior and team engagement were found to have differential effects on team outcomes, future research should investigate the interrelationships between the two constructs. It is expected that when team members are collectively engaged they are likely to participate in team learning behaviors. It is also expected that when teams participate in learning behaviors, their members are likely to be collectively engaged. Further, reciprocal relationships may also exist between the two constructs.

Moreover, it was found that team SMM is more likely to have direct relationships with team outcomes, whereas task SMM and TMS are each more likely to have an influence on team outcomes through mediating variables. Though these results are useful to better understand how team cognitions influence team outcomes, these relationships require further investigation.

Third, whereas studies have largely considered the impact of shared mental models and transactive memory systems on team outcomes separately, the current work combined these two
research streams to present an integrated model of the combined influence of SMM and TMS on team outcomes. This study, therefore, constitutes the first attempt to examine the interaction effect of SMM and TMS on team outcomes as suggested by DeChurch and Mesmer-Magnus (2010). The research found the interaction effect of team SMM and TMS on team adaptability (outcome) and team engagement (mediator). The interaction plots indicate similar patterns. The findings indicate that team adaptability and team engagement are highest when along with team SMM, TMS is high in teams. Therefore, the results of this study provide empirical support for the argument that effective teamwork requires members to have both “similar cognitive structures” (SMM) and “distinctive knowledge configurations” (TMS) (DeChurch & Mesmer-Magnus, 2010, p. 3).

Additionally, a significant mediated-moderation relationship was found in this study. The findings indicate that team adaptability and team engagement are likely to be high when both team SMM and TMS are present in a team. As the interaction effect of team SMM and TMS on team adaptability (outcome) and team engagement (mediator) were significant, the study examined team engagement to determine whether it mediates the influence of team SMM and TMS on team adaptability. The results support a mediated-moderation relationship. It was found that team SMM and TMS have a significant interaction effect on team engagement, which has a further positive impact on team adaptability. Uniquely, the study found that team SMM and TMS have a combined influence on a team’s emergent state (team engagement), which consequently affects team adaptability. The findings can help researchers understand how different team cognitions can complement each other and thus impact team effectiveness.

Fourth, the literature on team cognition has focused on team performance as a measure of team effectiveness. In response to recent calls from scholars (Mohammed et al., 2010), the
current work asked whether team cognitions influenced team adaptability and found that they do exert an influence in this regard. Furthermore, recent studies have also indicated that team-level variables (e.g., shared values) influence individual-level outcomes (satisfaction with cooperation and member performance) (Chou et al., 2008). Similarly, the current study found that task SMM, team SMM, and TMS (team-level variable) each influences member satisfaction (individual-level variable). These findings provide support for earlier studies in which it was concluded that team cognitions significantly impact both team-level and individual-level outcomes.

Fifth, the majority of studies in the SMM area were conducted in laboratories, and the limited number of field studies that are in existence used combat teams or aviation control teams (Mathieu et al., 2000; Lim & Klein, 2006). Earlier work in the TMS area was conducted with couples in laboratories, though recent studies have taken knowledge-worker teams as their sample groups (Lewis, 2004). Scholars have indicated the need to study team cognitions in field studies and in different contexts such as project management or service management teams. The field study using service management teams conducted for the present research means that this research has extended the generalizability of the SMM and TMS theories.

Sixth, whereas most studies in this area have used a cross-sectional design, which tends to weaken causal inferences, the current work used a longitudinal design, which strengthens causal inferences.
### Table 10

*Summary of the Results of Testing the Hypotheses*

<table>
<thead>
<tr>
<th>Hypotheses</th>
<th>Supported</th>
</tr>
</thead>
<tbody>
<tr>
<td>H1  Task SMM will be more positively related to team performance than will team SMM</td>
<td>No</td>
</tr>
<tr>
<td>H2  Team SMM will be more positively related to team adaptability than will task SMM</td>
<td>Yes</td>
</tr>
<tr>
<td>H3  Team SMM will be more positively related to member satisfaction than will task SMM</td>
<td>Yes</td>
</tr>
<tr>
<td>H4a Task SMM will be more positively related to member satisfaction than will TMS</td>
<td>No</td>
</tr>
<tr>
<td>H4b Team SMM will be more positively related to member satisfaction than TMS</td>
<td>Yes</td>
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<tr>
<td>H5a Team learning behavior will mediate the relationship between task SMM and team performance</td>
<td>Yes</td>
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<tr>
<td>H5b Team learning behavior will partially mediate the relationship between task SMM and member satisfaction</td>
<td>Yes</td>
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<tr>
<td>H5c Team learning behavior will partially mediate the relationship between task SMM and team adaptability</td>
<td>Yes</td>
</tr>
<tr>
<td>H6a Team learning behavior will partially mediate the relationship between team SMM and team performance</td>
<td>Yes</td>
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<tr>
<td>H6b Team learning behavior will partially mediate the relationship between team SMM and member satisfaction</td>
<td>No</td>
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<tr>
<td>H6c Team learning behavior will partially mediate the relationship between team SMM and team adaptability</td>
<td>No</td>
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<tr>
<td>H7a Team learning behavior will partially mediate the relationship between TMS and team performance</td>
<td>Yes</td>
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<tr>
<td>H7b Team learning behavior will partially mediate the relationship between TMS and team adaptability</td>
<td>No</td>
</tr>
<tr>
<td>H7c Team learning behavior will partially mediate the relationship between TMS and member satisfaction</td>
<td>Yes</td>
</tr>
<tr>
<td>H8a Team engagement will partially mediate the relationship between task SMMs and team performance</td>
<td>Yes</td>
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<tr>
<td>H8b Team engagement will partially mediate the relationship between task SMM and team adaptability</td>
<td>Yes</td>
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<tr>
<td>H8c Team engagement will partially mediate the relationship between task SMM and member satisfaction</td>
<td>Yes</td>
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<tr>
<td>H9a Team engagement will partially mediate the relationship between team SMM and team performance</td>
<td>Yes</td>
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<tr>
<td>H9b Team engagement will mediate partially the relationship between team SMM and team adaptability</td>
<td>No</td>
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<tr>
<td>H9c Team engagement will partially mediate the relationship between team SMM and member satisfaction</td>
<td>No</td>
</tr>
<tr>
<td>Hypotheses</td>
<td>Supported</td>
</tr>
<tr>
<td>------------</td>
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<tr>
<td>H10a</td>
<td>Team engagement will partially mediate the relationship between TMS and team performance.</td>
</tr>
<tr>
<td>H10b</td>
<td>Team engagement will partially mediate the relationship between TMS and team adaptability.</td>
</tr>
<tr>
<td>H10c</td>
<td>Team engagement will partially mediate the relationship between TMS and member satisfaction.</td>
</tr>
<tr>
<td>H11a</td>
<td>TMS will moderate the relationships between task SMM and team performance.</td>
</tr>
<tr>
<td>H11b</td>
<td>TMS will moderate the relationships between task SMM and team adaptability.</td>
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<tr>
<td>H11c</td>
<td>TMS will moderate the relationships between task SMM and member satisfaction.</td>
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<tr>
<td>H11d</td>
<td>TMS will moderate the relationships between task SMM and team learning behavior.</td>
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<tr>
<td>H11e</td>
<td>TMS will moderate the relationships between task SMM and team engagement.</td>
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<tr>
<td>H12a</td>
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<tr>
<td>H12b</td>
<td>TMS will moderate the relationships between team SMM and team adaptability.</td>
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<td>H12d</td>
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<tr>
<td>H12e</td>
<td>TMS will moderate the relationships between team SMM and team engagement.</td>
</tr>
</tbody>
</table>

5.4 Limitations

First, recent scholars have highlighted the point that shared mental model measures should include both content and structure (DeChurch & Mesmer-Magnus, 2010). Content refers to the knowledge that comprises cognition, and structure represents how the contents/concepts are organized in the minds of the participants (Mohammed & Hamilton, in press). Though elicitation techniques (such as Likert-type scale questionnaires) can be used to measure content, questionnaires do not capture the structure of organized knowledge (Mohammed et al., 2010). However, SMM has been measured using Likert-type scale questionnaires (Levesque et al., 2001; Ensley & Pearce, 2001; Chou et al., 2008). The current study uses Likert-type scale
items to measure task SMM and team SMM content. Therefore, structure (examining the relationship between concepts) was not measured in the current study. Future research could test the model using SMM measures that include both content and structure. In order to measure both content and structure, SMM measurement techniques such as concept mapping or paired comparison ratings can be used.

Second, recent literature has proposed two primary properties of SMM: sharedness and accuracy. Sharedness refers to the “degree to which members’ mental models are consistent with one another,” and accuracy refers to the “degree to which members’ mental models converge with experts’ mental models or a true score” (Mohammed et al., 2010, p.5). It was argued that shared taskwork and teamwork knowledge may have errors, and that shared mental models along with high quality (accurate) mental models may have the greatest impact on team performance (Edwards et al., 2006; Mathieu et al., 2005). The current study focused on sharedness of taskwork and teamwork, and accuracy was not measured. Therefore, future research could test the model including SMM accuracy.

Third, hierarchical linear modeling was used to test the multilevel model. However, the impact of predictors on outcome variables was tested independently for each outcome variable. A more appropriate approach would be a multilevel analysis using structural equation modeling (SEM). A multilevel analysis using SEM could not be performed in the current study because of the small sample size.

Fourth, the current study does not control for or take into consideration the effects of individual differences. Individual differences such as tenure and experience, educational and organizational level, and team general mental ability have been found to have an influence on SMM similarity and accuracy (Rentsch & Klimoski, 2001) and, therefore, team outcomes.
Fifth, the model needs to be tested in different contexts. Studies that measured multiple SMM types (Lim & Klein, 2006; Smith-Jentsch et al., 2005) obtained mixed results. Though some studies found positive relationships between task SMM and team SMM (Lim & Klein, 2006), other studies found negative relationships (Smith-Jentsch et al., 2005). It was suggested that task SMM and team SMM may be more highly correlated in laboratory contexts where novice students are obtaining experience of both task SMM and team SMM simultaneously, in comparison to organizational teams where employees may be knowledgeable about the tasks but not their team members (Smith-Jentsch, 2009). This might explain the positive relationships between task SMM, team SMM, and TMS in the current study. However, the results might be different with organizational teams, and this requires further investigation.

5.5 Future Directions

The current findings highlight a number of areas that need future research. Future research could further investigate (a) the interaction effects of team SMM and TMS on team outcomes (not found in the current study, e.g., team performance); and the interaction effects on other team-effectiveness criteria not included in this study (e.g., viability, creativity). Further, the interaction effects of TMS with other forms of mental models (e.g., task SMM) can be investigated followed by testing the three-way interaction effects of task SMM, team SMM, and TMS on outcomes. It may be that the beneficial effects of one type of SMM depend on the presence or absence of the other (Mohammed et al., 2010). An examination of three-way interaction effects might provide a clearer picture of the findings.

A second fruitful area of future research would be to investigate the differential effects of mediating variables and team cognitions. It is possible that certain team cognitions strongly influence certain team-effectiveness criteria, whereas other team cognitions (or mental models)
have an impact on other team-effectiveness criteria. Further, various team cognitions (task SMM, team SMM, TMS) may have an impact on different team outcomes through different channels (mediators). The current work focused on team-level mediating variables. Recent work demonstrated the evidence of the mediating effects of individual-level variables: trustworthiness and trustfulness (Chou et al., 2008). Future studies could investigate other important mediating variables both at the team level (e.g., team efficacy, psychological safety) and at the individual level (e.g., self-esteem, self-efficacy). Further, it can be investigated if, team-level predictors impact team outcomes through individual-level mediating variables (individual engagement, self-efficacy, and satisfaction). These investigations might help researchers better understand how team cognitions influence team outcomes.

A third area of research would be to investigate the impact of team cognitions on other team effectiveness criteria both at the team level (e.g., team creativity) and the individual level (member creativity, individual member performance, turnover in teams). It is critical to examine the relationships between team cognitions and team member turnover. This research will be valuable for practitioners. It is expected that members of groups/teams with higher levels of shared mental models and transactive memory systems are less likely to leave the organization due to (1) the presence of similar understanding among each other, which assists in providing and receiving help, (2) the availability of knowledge resources to accomplish individual and group/team goals, and (3) the development of interrelationships among team/group members. Research on turnover has concentrated on organizational support and supervisor support. However, coworker support, as a result of the development of team cognitions (SMM, TMS), has not been investigated as a predictor of turnover.
A fourth area of research would be to examine specific training methods to develop team cognitions. Research on SMM has focused heavily on training interventions to enhance team mental model development (Cannon-Bowers, 2007). Various types of team training (including self-correction training, team-interaction training) have been found to influence team mental model similarity and accuracy (Mohammed et al., 2010). However, research in TMS has not focused on training interventions. It would be worthwhile to consider whether training interventions develops TMS in teams. Further, do the same training methods develop both SMM and TMS in teams or is a variety of training methods required to develop each? Further, the results of the study indicate the mediating influence of team learning behaviors and team engagement; researchers, therefore, could further focus on training interventions to improve team learning behaviors and team engagement through team cognitions, which would consequently impact team effectiveness.

Finally, the current work did not focus on the predictors of team cognitions. The literature investigated the influence of team interventions (e.g., leader and training interventions, planning and reflexivity) (Cooke et al., 2003; Marks et al., 2000), team member characteristics (e.g., cognitive ability, age) (Rentsch & Klimoski, 2001), and contextual factors (e.g., stress, workload) (Ellis, 2006). Although, research in SMM has focused on predictors of SMM (including team interventions, team member characteristics (e.g., cognitive ability), and contextual factors (e.g., stress)), researchers have called for further investigation of predictors (e.g., personality homogeneity, trust). Recent studies in the area of turnover have called for an investigation of the impact of turnover consequences on the development of team cognitions (Holtom et al., 2008). This area of research needs attention. There is a scarcity of research
examining predictors of TMS. It would be worthwhile to consider whether same or different predictors influence SMM and TMS.

5.6 Practical Implications

The study presents a conceptual model explaining the mechanisms that result in team effectiveness. The research provides empirical evidence of the importance of team cognitions in influencing effectiveness of team projects. The study demonstrates that in order to be effective, team members need to have a similar understanding of taskwork and teamwork (SMM); however, on the other hand, each team member needs to possess a distinct specialization in one domain with a shared awareness of who knows what, such that collectively the team possesses all the necessary information (TMS). Managers/trainers need to understand that the development of these two types of team cognition is essential for team functioning.

Detailed team task analysis needs to be performed in order to identify the team-cognitive demands of tasks (DeChurch & Mesmer-Magnus, 2010). HR practices such as selection, staffing, and placement could be utilized to assist development of team cognitions (e.g., TMS). Cognitive ability, expertise, and prior experience can be assessed to make sure that individuals possess expertise in a particular domain (i.e., knowledge distribution in teams). Additionally, socialization might further support member interaction, which would further develop TMS as members get to know about each other.

Trainers could also develop training methods to build team cognitions (i.e., SMM). Training interventions such as team interaction training and self-correction training have been associated with the development of SMM (Mohammed et al., 2010). Further, organizations could design support systems (e.g., measurement, performance appraisal, rewards) to develop and shape the collective cognition needed for successful teamwork (DeChurch & Mesmer-Magnus,
Therefore, HR practices could be used as a powerful tool to support the development of team cognitions.

Furthermore, practitioners also need to make sure that the team interventions result in learning behaviors and collective engagement in teams in order to yield effective team outcomes.

5.7 Conclusion

The present study identified a psychological process by which SMM and TMS affects team effectiveness through the mediation of team learning behavior and team engagement. In a longitudinal study with service management teams, the current study found the differential and interaction effects of SMM and TMS on team outcomes. Further, the differential mediation effects of team learning behavior and team engagement were found. The study also extends the generalizability of SMM and TMS theories. Therefore, the study fills several gaps in the organizational behavior literature and provides important directions for future research.
REFERENCES


Mohammed, S., Klimoski, R., & Rentsch, J. R. (2000). The measurement of team mental models: We have no shared schema. *Organizational Research Methods, 3*, 123.


APPENDIX A
ITEM GENERATION

Taskwork Mental Model

Task-focused mental models include work goals and performance requirements:

1. Team members understand to have a well-stocked inventory of the appropriate items needed to serve the forecasted number of guests.
2. Team members understand to have contingency plans (e.g., in case the team runs out of food items, making sure there is something else to substitute).
3. Team members understand to have a safe work environment for all employees with no injuries during preparation of food, during the meal, or throughout restaurant clean up.
4. Team members understand to maintain a clean dining room and kitchen.
5. Team members have a good understanding of being organized in service and product.
6. Team members have a good understanding of being consistent in service and product.
7. Team members understand team’s goals (e.g., serve 120 covers).
8. Team members understand team’s performance requirements (e.g., achieve check average of $24).
9. Team members have a good understanding of minimizing breakage and food spoilage.
10. Team members have a good understanding of solving any problems before guests depart from the restaurant.
11. Team members understand the use of MICROS POS system.
12. Team members understand other members’ tasks.
13. Team members agree on a strategy to carry out the team’s task.
14. Team members understand the team’s task (planning, budgeting).
15. Tasks in the teams are assigned according to individual team member’s ability.
16. The team is highly effective.
17. Team members have a good understanding of organizing.
18. Team members have a good understanding of planning.
19. Team members have a good understanding of quality of output.
20. Team members have a good understanding of business judgment.
Teamwork Mental Model (Team-focused models include the interpersonal interaction requirements and skills of team members; values, and beliefs). This list includes items generated through interviews, and items adapted from Lim and Klein (2006), and Chou et al. (2008).

1. Team members work well together.
2. Team members often disagree with each other on issues faced by the team.
3. Team members are open to challenge each other for improvement.
4. Team members trust each other.
5. Team members accept decisions made by the general manager.
6. Team members communicate openly with each other.
7. Team members agree on decisions made in the team.
8. Team members treat each other as friends.
9. Team members interact with one another outside the restaurant.
10. Team members back each other up in carrying out team tasks.
11. Team members are similar to each other (e.g., personality, temperament, and abilities).
12. Team members are aware of other team members’ abilities.
13. Team members are aware of other team members’ personal backgrounds (e.g., hobbies, and habits).
14. Team members value achievement orientation.
15. Team members have a competitive spirit.
16. Team members value being cost-effective.
17. Team members value being efficient.
18. Team members value being highly organized.
19. Team members value being precise.
20. Team members value being result oriented.
21. Team members value being rule oriented.
22. Team members value paying attention to detail.
23. Team members take initiative.
24. Team members are social.
25. Team members like to have fun.
26. There is a lack of interest among team members regarding this course.
27. Most of our team’s communication is about technical issues.
APPENDIX B

SURVEY

Background Information

Gender

☐ Male    ☐ Female

Age ______

Ethnic Background

☐ African American/Black    ☐ Asian/Pacific Islander

☐ Caucasian/White    ☐ East Indian

☐ Hispanic/Latino    ☐ Native American/American Indian

☐ Other
TEAM SURVEY

Task Shared Mental Model

Our team members _______________________.

1. are in agreement about how best to manage the staff during our meal night.
2. have similar understanding about how best to serve the guest.
3. are in agreement about how best to ensure the highest-quality food and beverage.
4. have a common understanding about how best to ensure the service standards are maintained.
5. are in agreement about how best to ensure we meet the time goals.
6. have a shared understanding about how best to ensure we meet our sales goals.
7. are in agreement about how best to handle potential “crises” that may arise during our night.
8. are in agreement about how best to ensure we have sufficient inventory and sufficient replacement.
9. have a common understanding about how best to train our employees.
10. are in agreement about how best to ensure food cost is managed efficiently.

Team Shared Mental Model

Our team members _______________________.

1. work well together.
2. often disagree with each other on issues faced by the team.
3. accept decisions made by the general manager.
4. communicate openly with each other.
5. agree on decisions made in the team.
6. back each other up in carrying out team tasks.
7. are aware of other team members’ abilities.
8. trust each other.
9. treat each other as friends.
10. value achievement orientation.
11. value being efficient.
12. value being cost-effective.
13. value being highly organized.
14. value being precise.
15. value being result oriented.
16. value paying attention to detail.
Transactive Memory Systems

1. Each team member has specialized knowledge of some aspect of our project.
2. I have knowledge about an aspect of the project that no other team member has.
3. Different team members are responsible for expertise in different areas.
4. The specialized knowledge of several different team members is needed to complete the project deliverables.
5. I know which team members have expertise in specific areas.
6. I was comfortable accepting procedural suggestions from other team members.
7. I trusted that other members’ knowledge about the project was credible.
8. I was confident relying on the information that other team members brought to the discussion.
9. When other members gave information, I wanted to double-check it for myself. (R)
10. I did not have much faith in other members’ “expertise.” (R)
11. Our team worked together in a well-coordinated fashion.
12. Our team had very few misunderstandings about what to do.
13. Our team needs to backtrack and start over a lot. (R)
14. We accomplish tasks smoothly and efficiently.
15. There is much confusion about how we would accomplish our tasks. (R)
Team Learning Behavior

1. This team regularly takes time to figure out ways to improve its work performance.
2. In our team, people discuss ways to prevent and learn from mistakes.
3. We regularly take time to figure out ways to improve our work processes.
4. Problems and errors in our team are never communicated to the appropriate people so that corrective action can be taken. (R)
5. This team tends to handle differences of opinion privately, rather than addressing them directly as a group.
6. In this team, someone always makes sure that we stop to reflect on the team’s work process.
7. People in this team often speak up to test assumptions about issues under discussion.
8. My team keeps instructors informed about what we plan and accomplish.
9. Team members go out and get all the relevant work information they possibly can.
10. This team actively reviews its own progress and performance.
11. This team ignores feedback from instructors. (R)
12. This team asks for help from instructors when something comes up that team members don’t know how to handle.
13. This team does its work without stopping to consider all the information team members have. (R)
Team Engagement

1. As a team we find the work that we do full of meaning and purpose.
2. We are enthusiastic about the work that we do.
3. Our work inspires us.
4. The team is proud of the work that we do.
5. To us, the work that we do as a team is challenging.
6. At our work, the team always perseveres, even when things do not go well.
7. At our work, the team is able to rebound after mistakes or difficulties.
8. Our team can continue working for very long periods at a time.
9. When the team is working, the team is bursting with energy.
10. When the team is working, the team feels strong and vigorous.
11. Time flies when we are working as a team.
12. When the team is working, we forget everything else around us.
13. Our team is happy when we are working intensely.
Team Performance (Self-Rating) (Team Level)

1. The team’s deliverables were of excellent quality.
2. The team managed time effectively.
3. The team met important deadlines on time.
4. I am satisfied with the pre-production report of this team.
5. Team’s pre-production report was better than what I could have done on my own.

Member Satisfaction (Individual Level)

1. This team would perform well together in the future.
2. If I had a choice of working on this team again, I would do it.
3. If we were assigned to another project, I am confident that this team would work well together.
4. Being a member of this team has been personally satisfying.
5. I would choose this team to work with on similar tasks in the future.
6. Being a member of this team was a positive experience.
Team Adaptability

1. Our team developed a routine to accomplish the team’s work.
2. Our team was flexible about changing the way it performed tasks.
3. Our team members accommodated other members’ needs.
4. Our team members coordinated the exchange of required information.
5. Members of this team settled into a smooth pattern of communicating necessary information.
6. Members of this team found a way to get information to the right members.
7. Members of this team learned how to adapt to changing circumstances.
8. Members of this team found a way to accomplish their responsibilities.

Team Performance (Instructor-Rating) (Lewis, 2004)

1. The team’s deliverables were of excellent quality.
2. The team managed time effectively.
3. The team met important deadlines on time.
4. The team provided quality customer service.
5. The team paid attention to detail.
APPENDIX C

Preliminary Analysis

C.1 Skewness and Kurtosis
Figure C1. Normality curves

Table C1

Skewness and Kurtosis of the Constructs

<table>
<thead>
<tr>
<th>Variables</th>
<th>n</th>
<th>Skewness</th>
<th>Kurtosis</th>
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<tbody>
<tr>
<td>Task SMM</td>
<td>27</td>
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<td>0.01</td>
</tr>
<tr>
<td>Team SMM</td>
<td>27</td>
<td>-.16</td>
<td>0.01</td>
</tr>
<tr>
<td>TMS</td>
<td>27</td>
<td>.17</td>
<td>-0.16</td>
</tr>
<tr>
<td>LB</td>
<td>27</td>
<td>.10</td>
<td>0.33</td>
</tr>
<tr>
<td>Performance</td>
<td>27</td>
<td>-.15</td>
<td>0.27</td>
</tr>
<tr>
<td>Satisfaction</td>
<td>27</td>
<td>.26</td>
<td>-1.09</td>
</tr>
<tr>
<td>Adaptability</td>
<td>27</td>
<td>.26</td>
<td>2.04</td>
</tr>
<tr>
<td>Engagement</td>
<td>27</td>
<td>.95</td>
<td>2.04</td>
</tr>
</tbody>
</table>

The data collected for testing the hypotheses was examined for normality. Multivariate normality was examined by normal probability plots, skewness, and kurtosis. A descriptive analysis of variables was employed to estimate kurtosis and skewness. A critical value of ±1.96 corresponding to a .05 error level was used in this study. Any $Z_{\text{skewness}}$ or $Z_{\text{kurtosis}}$ value exceeding
the critical value indicates the rejection of the assumption about the normality of the distribution at the .05 probability level (Hair et al., 2010). The skewness for all variables ranged from -.34 to .95, and kurtosis for all variables ranged from -1.09 to 2.04 (Table 3).

\[ Z_{\text{skewness}} = \frac{\text{skewness}}{\sqrt{6/N}} \]

It was found that the \( Z_{\text{skewness}} \) value of team engagement was above the critical value, but only slightly so; therefore, the variable was not excluded from the study.

\[ Z_{\text{kurtosis}} = \frac{\text{kurtosis}}{\sqrt{24/N}} \]

Normal probability plots were examined to evaluate the normality of the variables. The normal probability plots are presented below. The plots indicate acceptable normal distributions among the variables.
C.2. Normal Probability Plots

Figure C2. Normal probability plots
C.3 Linearity

All the relationships in this study were examined for linearity. Linearity was assessed by examining the scatter plots of the variables. All the scatter plots follow a linear pattern. Some of the scatter plots are presented below.

![Scatter plots](image)

*Figure C3. Linearity*

The study examined multicollinearity by tolerance values. Tolerance is the amount of variability of the selected independent variable not explained by other independent variables. Thus, very small tolerance values denote high collinearity. If the tolerance value is less than some cut-off value, usually .10, the independent variable should be dropped from the analysis due to multicollinearity (Hair et al., 2010). As Table 4 shows, it was found that none of the tolerance values was below the cut-off value; therefore, none of the independent variables were dropped from the analysis.
Table C2

*Tolerance Levels of Variables*

<table>
<thead>
<tr>
<th>Variables</th>
<th>Performance (Self)</th>
<th>Performance (Instructor)</th>
<th>Adaptability</th>
<th>Satisfaction</th>
<th>LB</th>
<th>Eng</th>
</tr>
</thead>
<tbody>
<tr>
<td>Team SMM</td>
<td>.28</td>
<td>.29</td>
<td>.28</td>
<td>.28</td>
<td>.28</td>
<td>.28</td>
</tr>
<tr>
<td>TMS</td>
<td>.21</td>
<td>.27</td>
<td>.21</td>
<td>.21</td>
<td>.21</td>
<td>.21</td>
</tr>
<tr>
<td>LB</td>
<td>.31</td>
<td>.40</td>
<td>.31</td>
<td>.31</td>
<td>.31</td>
<td></td>
</tr>
<tr>
<td>Eng</td>
<td>.31</td>
<td>.40</td>
<td>.31</td>
<td>.31</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
VITA

PRIYANKO GUCHAIT

EDUCATION

Ph.D., The Pennsylvania State University, University Park, PA. December 2011
School of Hospitality Management
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Minor: Industrial/Organizational Psychology (Department of Psychology)

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Human Resources and Employment Relations (Concurrent degree with Ph.D.)
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M. S., University of Missouri, Columbia, MO. August 2007
Hotel and Restaurant Management Program
Focus: Human Resource Management, Organizational Behavior

B. E. (Mechanical), University of Pune, India. December 2003

RESEARCH INTERESTS

- **Team/Group dynamics and Leadership** - team cognitions, learning behaviors, team engagement, time management, knowledge management, and empowerment

- **Employee Relations** - influence of team cognitions, group cohesion, co-worker support, group efficacy, and job embeddedness on retaining service employees

- **Training** - training strategies to improve team cognitions, processes, and effectiveness

- **Management of Services** - influence of perceived control and fairness, empowerment, and employee-customer interactions on customer satisfaction and behavioral intentions

- **Service Relationships** - customer knowledge and relationship management, social networks

TEACHING INTERESTS

- Human Resource Management
- Organizational Behavior
- Strategic Management
- Teams and Leadership
- Training and Development
- Marketing
- Research Methods