COGNITIVE DIVERSITY AND TEAM PERFORMANCE: THE ROLES OF TEAM MENTAL MODELS AND INFORMATION PROCESSING MECHANISMS

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Maria Catharine (Marieke) Schilpzand

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COGNITIVE DIVERSITY AND TEAM PERFORMANCE: THE ROLES OF TEAM MENTAL MODELS AND INFORMATION PROCESSING MECHANISMS

Approved by:

Dr. Terry Blum, Co-Chair
College of Management
Georgia Institute of Technology

Dr. Luis Martins, Co-Chair
McCombs School of Business
University of Texas at Austin

Dr. Christina Shalley
College of Management
Georgia Institute of Technology

Dr. Charles Parsons
College of Management
Georgia Institute of Technology

Dr. Benjamin Herndon
College of Management
Georgia Institute of Technology

Date Approved: August 25, 2010

To my parents –
for providing me with opportunities which have allowed me to always follow my dreams

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LIST OF SYMBOLS AND ABBREVIATIONS

+	Statistically Significant Positive Relationship
-	Statistically Significant Negative Relationship
ns	Statistically Non Significant Relationship
TMM	Team Mental Model
MMS	Mental Model Similarity
MMA	Mental Model Accuracy
C	Control
IS	Information Surfacing
II	Information Integration
IS/II	Information Surfacing + Information Integration
CD	Cognitive Diversity
CFA	Confirmatory Factor Analysis
F	F Ratio statistic
M	Mean
SD	Standard Deviation
CI	Confidence Interval

SUMMARY

There are two important trends in organizations today: 1) the increasing use of teams and 2) the increasing diversity in the workforce. The literature is in tune with these organizational trends, evidenced by a dramatic increase in research on team performance and the effects of diversity. However, there are still contradictory findings of the effects of team diversity on team processes and outcomes. To shed light on these inconsistencies, the cognitive construct of team mental model is introduced as a mediator of the relationship between team cognitive diversity and team performance. Team mental model is an emergent cognitive state that represents team members' organized understanding of their task environment (e.g., Klimoski & Mohammed, 1994) and has been shown to improve team performance (e.g., Edwards, Day, Arthur, & Bell, 2006; Mathieu, Heffner, Goodwin, Salas, & Cannon-Bowers, 2000). Specifically, with a sample of 94 student teams I investigated how team cognitive diversity affects team mental model similarity and accuracy, and through them, team performance. In addition, I examined team information processing mechanisms as moderators of the relationships between team cognitive diversity and team mental model similarity and accuracy. The results suggest that cognition at the team level plays an important role in the effective functioning of decision making teams. Specifically, the combination of team mental model similarity and accuracy predicts levels of team performance and information integration is an important moderator linking cognitive style diversity to task mental models, team processes, and team performance. The research model developed and tested seeks to advance understanding of the "black box" linking team diversity to team outcomes

(Lawrence, 1997) and to provide guidance to managers leading cognitively diverse teams.

CHAPTER 1

INTRODUCTION

1.1 Motivation

There are two trends in organizations today that are important for organizational performance, namely teamwork and workforce diversity. First is the increasing use of teams as the organizational unit of work. This stems from an increasing competitive landscape which forces organizations to become leaner and which shifts power and decision-making down to the employee team level (Kellermanns, Floyd, Pearson, & Spencer, 2008; Townsend, DeMarie, & Hendrickson, 1998). Using organizational teams thus has not only been a necessity, but also an advantage as teams have been found to increase productivity, decision-making accuracy, creativity, and employee satisfaction (e.g., Guzzo & Dickson, 1996; Katzenbach & Smith, 1993; Stewart, Manz, & Sims, 1999; Tjosvold & Tjosvold, 1991).

Second, globalization drives more diversity in the workforce and organizations. Organizations believe it is a source of advantage to achieving higher performance and therefore currently a vast majority of *Fortune* 1000 firms conduct diversity management training (Grensing-Pophal, 2002). This sustained investment in diversity training has not gone unnoticed, since over the last decades, the link between diversity and team performance has been the subject of many theoretical and empirical studies.

Increased use of teams with diverse membership is not only a result of these naturally occurring workforce trends, it also makes organizational sense. Organizations use diverse teams to take advantage of different viewpoints that can be brought to bear on the task, and this is expected to improve creativity and decision-making quality. Diversity research to date has looked mainly at demographic characteristics such as race or sex while generally ignoring calls for understanding the effects of cognitive diversity (Miller, Burke, & Glick, 1998), which is defined as differences in knowledge, perspectives, or ideas (e.g., van Knippenberg & Schippers, 2007). This is curious as cognitive diversity is believed to have a greater bearing on knowledge tasks like decision-making, than demographic diversity (Jehn, Northcraft, & Neale, 1999). In addition, of the two types of diversity, cognitive diversity is assumed to be a more proximal variable to team performance, meaning that demographic diversity is supposed to have an indirect effect on team outcomes via cognitive diversity (Glick, Miller, & Huber, 1993; Kilduff, Angelmar, & Mehra, 2000; Miller et al., 1998). The literature on cognitive diversity is not only small; it is also troubled by a methodological issue. Kilduff et al. (2000) note that instead of directly measuring cognitive diversity, this research has often used demographics such as race and gender, and background variables such as functional background and educational background, as proxies for cognitive differences in perspectives, beliefs, and information (e.g., Hambrick, Cho, & Chen, 1996; Jackson, 1992). In this study I will examine cognitive style diversity as a more direct measure of cognitive diversity. Cognitive style diversity concerns differences among people with regards to their preference for the type of information they process which leads to differences in perspectives and ideas, rather than differences in the content of the information itself.

I am basing this research on the information/decision-making perspective of diversity (Williams & O'Reilly, 1998), which proposes that cognitively diverse teams possess a broad range of perspectives, ideas, and opinions thereby increasing the pool of available information and knowledge. This increased amount of cognitive resources should help diverse teams to outperform homogeneous teams. However, research has found contradictory results of the effects of team cognitive diversity on team processes and performance (Harrison & Klein, 2007; Jackson, Joshi, & Erhardt, 2003; Joshi & Roh, 2007; Milliken & Martins, 1996; van Knippenberg & Schippers, 2007). Thus, more research is needed to understand how and when cognitively diverse teams can take advantage of their diversity when performing decision-making tasks.

To this end, this study seeks to explain the inconsistent and at times contradictory results by examining task-focused team mental models as the mediating mechanism of the cognitive diversity-performance relationship, thereby answering the calls for understanding the “black box” of this link (Lawrence, 1997; van Knippenberg, De Dreu, & Homan, 2004). A team mental model (TMM) is an emergent cognitive state that represents team members’ organized understanding of their task environment (e.g., Klimoski & Mohammed, 1994). Researchers have differentiated between team mental model accuracy (MMA) and team mental model similarity (MMS) as important aspects of the TMM affecting team performance. Using the diversity literature, I argue that teams with diverse perspectives have a greater chance to develop an accurate mental model of the task’s problem space, but at the same time they have a more difficult time developing a similar representation of the team task.

Since team mental model accuracy and similarity have been shown to positively affect how a team functions and performs, it is also important to understand the conditions under which cognitively diverse teams can develop more similar and accurate team mental models. Here I argue that for mental models to emerge, cognitively diverse teams must both surface and integrate the varying perspectives, opinions, and information that they collectively possess. With this I help to answer the call for process-oriented diversity research (e.g., Lawrence, 1997; Pelled, Eisenhardt, & Xin, 1999; van Knippenberg, et al., 2004) by exploring whether information processing mechanisms, in particular information surfacing mechanisms and information integration mechanisms, function as moderators of the effects of cognitive diversity on team mental model accuracy and similarity. More generally, in this dissertation, I sought to answer the following research questions:

1. How does cognitive diversity affect team mental model similarity and accuracy?
2. How do team mental model similarity and accuracy affect team performance?
3. What are the moderating effects of team information processing mechanisms on the relationships between cognitive diversity and team mental model similarity and accuracy?

1.2 Overview of Proposed Research Model

Figure 2 depicts the proposed research model based on the literature review. In sum, I propose that team cognitive diversity affects a team's mental model similarity and accuracy about the task, which in turn will influence team performance. The relationships between cognitive diversity and team mental model similarity and accuracy will depend on the extent to which the team uses information surfacing and integration mechanisms.

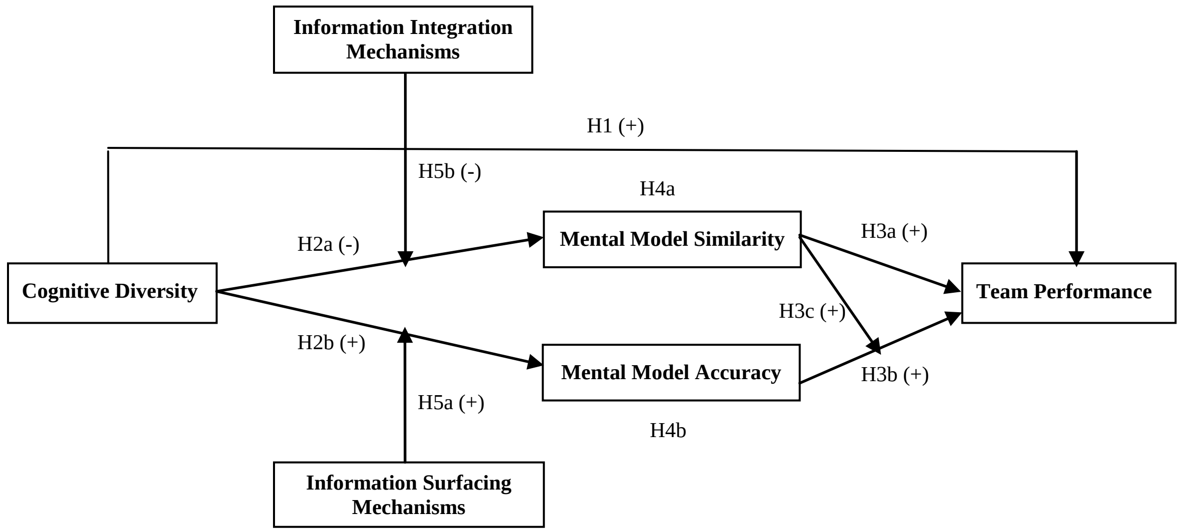

Figure 1. Proposed Research Model

1.3 Contributions

There are several theoretical contributions of this proposed research project. First, I try to explain ambiguities in the diversity-team performance link by focusing on the cognitive mediator of team mental models, thereby answering the call for more research into the cognitive workings of diversity. Second, this research helps to partly uncover the “black box” of diversity (Lawrence, 1997) by investigating an important cognitive process by which diversity affects performance. Third, I examine the effect of team cognitive diversity on the accuracy of team mental models, which remains an understudied dimension of team mental models. Fourth, both mental model similarity and accuracy and their combined effect on team performance were assessed as researchers have emphasized the need for the measurement of both team mental model components. Fifth, research on team mental models has almost exclusively looked at action teams, and since task or team type has been recognized as an important boundary condition in the teams literature, I studied these constructs in the context of another important type of organizational team, a decision-making team. Finally, I have extended the literature by exploring team information processing mechanisms that may influence the circumstances under which cognitively diverse teams develop team mental model similarity and accuracy while indicating which processes are advantageous for developing mental model similarity and which ones are valuable for generating mental model accuracy.

This research also contributes to practice by providing guidance for managers who want to increase the performance and minimize productivity loss of their diverse organizational teams. Likewise, this study provides some process interventions that managers can undertake to stimulate the development of a team mental model in teams with diverse knowledge bases.

1.4 Organization of the Research

This dissertation is divided into several chapters. Chapter 1 includes an introduction to the concepts used in this research, research questions based on previous research conducted in this literature stream, a model of the proposed study, and a discussion of the contributions of this study.

Chapter 2 contains an examination of the relevant literature on teams, cognitive diversity, and TMMs. Following this theoretical overview, several direct-effect, mediating, and moderating hypotheses are developed to address current issues in these literatures.

Chapter 3 presents an overview of the methodology and research design that was used to empirically test the framework proposed. The methodology section includes: the sampling frame and characteristics of the sample, the task, the study procedures, and a discussion of the measures.

Chapter 4 reports on the data analysis and the results of this study. In particular the data aggregation to the team level, correlations, and multiple regression analyses and results will be discussed.

Chapter 5 includes a general discussion of the findings, reintroduces the research questions of the study, and gives a detailed account of the theoretical and practical contributions. In addition, this chapter will assess the limitations of this study and propose future research avenues. Finally, some high level conclusions of this research will be drawn.

CHAPTER 2

LITERATURE REVIEW AND HYPOTHESES

This chapter is divided into several sections. First, the theories and research relevant to this study will be reviewed. Gaps in the literature will be outlined and discussed. The literature review will provide the theoretical underpinnings for the proposed model of team diversity, TMMs, and team performance. Second, specific hypotheses to be tested in this study will be presented.

2.1 Teams

Teams are increasingly being used in organizations today, and with good reason. Researchers have found teams to increase performance, decision-making accuracy, and creativity, while team-based organizations also have reported numerous benefits from using teams such as reduced absenteeism and turnover, enhanced quality decisions, and increased productivity (e.g., Guzzo & Dickson, 1996; Katzenbach & Smith, 1993; Nahavandi & Aranda, 1994; Stewart et al., 1999). The main reason for using teams, rather than individuals, on complex decision-making tasks is that they expand the pool of task-related knowledge and expertise thereby increasing team performance (Mesmer-Magnus & DeChurch, 2009; van Knippenberg et al., 2004). However, not all teams seem to reap these benefits, in fact many of them fail to reach their objectives (Allen & Hecht, 2004; Nahavandi & Aranda, 1994). Thus, the need remains to better understand the factors and circumstances under which teams can increase their performance.

2.1.1 Groups and Teams

Researchers have distinguished between groups and teams. Teams are a type of group, but a group may not be a team (Klimoski & Mohammed, 1994). Teams differ from groups in that they are a collective of individuals who have interdependent tasks, have common goals, and share responsibility for task completion (e.g., Cohen & Bailey, 1997; Sundstrom, De Meuse, & Futrell, 1990). This distinction is important because teams are more likely to need team mental models to help coordinate their actions because of their interdependence. In a study of software teams, Levesque, Wilson, and Wholey (2001) found that, over time, as team members became less dependent on each other's contribution they developed more divergent task-focused mental models. Therefore this research will focus on teams instead of groups. However, a large portion of the research on diversity and decision-making is labeled in the literature as *group* diversity or *group* decision-making (Ilgen, Major, Hollenbeck, & Sego, 1995). Similar to the approach taken by Ilgen et al. (1995), I included this research if these *groups* fit the above definition of a *team*, so as not to exclude important research, and even though both terms are used in the literature, in this manuscript I refer to all these entities as *teams.*

2.1.2 Team Effectiveness Models

Over the years many models of team effectiveness have been developed (e.g., Hackman, 1987; Hackman & Morris, 1975). Older team effectiveness models mainly excluded social processes (e.g., coordination) and cognitive processes in groups (e.g., problem solving). Newer models (e.g., Cohen & Bailey, 1997; Tannenbaum, Beard, & Salas, 1992) have expanded to include these social processes as well as some team cognitive processes. Specifically, Cohen and Bailey's (1997) heuristics model of team effectiveness includes team psychological processes, such as team mental models, as a mediator between team inputs and outputs. Their model suggests that group psychological traits are influenced by team design factors such as team composition and that these traits directly influence team outcomes and also indirectly via their influence on team processes. In their model of team performance, Klimoski and Mohammed (1994) posit that mental models both influence and are influenced by team processes and that they act as a moderator between team capacity and team processes. Finally, Ilgen, Hollenbeck, Johnson, and Jundt (2005) proposed an inputs-mediators-outputs-inputs (IMOI) model and suggested that many of the mediational factors that intervene and transmit the influence of inputs to outcomes are not processes, but emergent affective and cognitive states, such as team mental models. Even though these newer models recognize the important part that team cognition may play in team effectiveness, research has only just recently begun to investigate this.

Another trend in recent years is that, instead of trying to discover the best way to ensure team effectiveness, researchers now are trying to identify the *enabling conditions* (Hackman, 1990) that increase teams' probability of being successful (Crown, 2007). Crown (2007) further points out that, in his normative model of team effectiveness, Hackman (1987) proposes that the three enabling conditions that promote teams to capitalize on their variety of perspectives and expertise are: 1) organizational context, 2) team design, in particular team composition, and 3) team synergy. However, in today's organizations it may not be possible to "compose" teams and/or change organizational context, thus managers will have to work with the situation and people at hand. With this research I hope to provide guidance to managers as to what team process interventions they can do to create the conditions under which teams can take advantage of their cognitive diversity.

2.1.3 Types of Teams

Organizations may use many different types of teams to achieve their objectives. Four general types of work teams are: advice teams, production teams, project teams, and action teams (e.g., Sundstrom et al., 1990). These teams vary in their purpose, degree of member differentiation, their degree of coordination with other work units, work cycles, and outputs. Advice teams serve to broaden the information base for managerial decisions, production teams perform day-to-day routine tasks, project teams require creative problem solving, while action teams have brief performance events where they exhibit peak performance on demand such as a cockpit crew or a hospital surgery team (Kreitner & Kinicki, 2007; Sundstrom et al., 1990).

Most organizations use project teams that are assigned to a particular task or project for a limited amount of time and they are thus an important topic for research. Project teams are generally not existing teams but are constructed based upon a specific need. An example of a temporary project team may be a cross-functional development team. These teams typically require decision making, problem-solving, and application of diverse perspectives. However, even though these teams have the potential for greater performance because of their cognitive advantages over individuals, it is not clear how these various viewpoints translate into better performance on team decision-making and problem solving tasks. Thus, the need to better understand team functioning and decision-making remains strong (Ilgen et al., 1995). To shed some light on this issue I will examine team mental model similarity and accuracy as the vehicles via which decision-making project teams can capitalize on their cognitive diversity.

2.2 Diversity

The U.S. workforce is seeing a dramatic growth in diversity due to several main demographic trends such as an increase in workforce participation by women, minorities, immigrants, and elderly people, as well as due to the effects of a global market place. In addition, work arrangements increasingly emphasize cross-unit collaboration within organizations (Jackson, May, & Whitney, 1995). Along with these trends in the workforce and organizations, naturally comes increased diversity in work teams. Team diversity is conceptualized as an "aggregate group-level construct that represents differences among members of a [team] with respect to a specific personal attribute" (Joshi & Roh, 2007, p. 3). Team diversity research generally examines whether and how the team's heterogeneity (or homogeneity) of individual characteristics relates to team processes and outcomes.

2.2.1 Types of Diversity

Diversity in teams and groups has received a lot of research attention over the last decades (van Knippenberg et al., 2004), however, scholars still have not identified recurrent patterns on whether diversity is beneficial or harmful (e.g., Milliken & Martins, 1996; Williams & O'Reilly, 1998). To potentially discover these patterns, and to explain the mixed results in the literature, a common approach was to distinguish between types of diversity and in turn link these diversity types to team processes and outcomes (Jackson et al., 2003). Within this research stream, two common types of team diversity were identified: surface-level and deep-level diversity (e.g., Harrison, Price, & Bell, 1998; Milliken & Martins, 1996). Surface-level diversity is diversity in visibly detectable attributes including age, ethnicity, and sex. Since they are so obviously apparent, most people would reach consensus on these demographic attributes (Harrison et al., 1998). Deep-level diversity on the other hand means diversity in the underlying attributes such as attitudes, values, skills, knowledge, personality, and beliefs. These attributes cannot be easily detected and become apparent only after interaction with the particular person (Harrison et al., 1998). The idea is that deep-level diversity variables are more job-related and have a positive effect on team dynamics and outcomes, whereas surface-level diversity variables are less job-related and tend to have a negative impact on teams' workings. There is indeed evidence that this distinction between surface-level and deep-level diversity is warranted and that it increases our understanding of diversity effects in teams. For example, two studies by Harrison and colleagues (Harrison et al., 1998; Harrison, Price, Gavin, & Florey, 2002) showed that deep-level and surface-level have a differential effect on team outcomes at different times. However, meta-analytic studies (Bowers, Pharmer, & Salas, 2000; Webber & Donahue, 2001) indicate that this categorization of diversity variables does not clarify the existing mixed results.

2.2.2 Theories of Diversity in Teams

At the same time, researchers have also tried to explain the mixed effects of diversity on team dynamics and outcomes via several different theories. This literature focuses on explaining why team heterogeneity (or homogeneity) leads to positive or negative outcomes (Joshi & Roh, 2007). There are several theoretical bases underlying the effects of diversity on team functioning and outcomes: 1) social categorization and similarity/attraction perspective, 2) the information/decision making perspective, and 3) the justice perspective (Harrison & Klein, 2007).

The first perspective draws on self/social categorization (Turner, 1987), similarity-attraction paradigm (Byrne, 1971), social identity theory (Tajfel & Turner, 1979), and the attraction-selection-attrition framework (Schneider, 1987). This perspective posits that teams share a social identity that is based on their social category membership. Members are attracted to and exhibit favoritism toward other members who share their salient traits and then tend to form in-groups. In teams, large diversity may cause friction, conflict, and turnover (Pelled et al., 1999; Wagner, Pfeffer, & O'Reilly, 1984) and lead to a negative relationship with team outcomes such as commitment, social integration, cohesion, and performance (O'Reilly, Caldwell, & Barnett, 1989; Riordan & Shore, 1997; Tsui, Egan, & O'Reilly, 1992; Williams & O'Reilly, 1998).

The second perspective builds on the information processing and decision making literatures. This perspective suggests that teams can take advantage of the differences in backgrounds, viewpoints, knowledge, skills, and experiences of their members to increase the amount of information available in the team. This diversity in information and cognitive resources is proposed to have a positive relationship with team constructs such as creativity, decision-making quality, and performance (Bantel & Jackson, 1989; Williams & O'Reilly, 1998).

Third, the justice perspective draws on equity theory/distributive justice theory (Adams, 1963, 1965). This perspective proposes that differences among team members in valued assets and resources (e.g., pay, power, prestige) may result in negative inequity which promotes internal competition and conflict (Harrison & Klein, 2007). This perspective also seems to indicate a negative effect of team diversity on team processes and outcomes.

Researchers have found support for each of these perspectives. However, more than half of the studies investigating team heterogeneity and team outcomes have reported null effects (Joshi & Roh, 2007). The above discussion seems to indicate that previous research has not yet found an adequate solution to account for the mixed effects on organizational teams (van Knippenberg et al., 2004). Thus, it is still not clear how team diversity influences team outcomes and the circumstances under which team diversity harms or helps team outcomes.

This study proposes that to get a better understanding of this issue and to reconcile the mixed findings in the literature, researchers should examine the mediating variable of team cognition, in particular team mental models, while also including team process variables in their research models. Hereby, I hope to contribute to theory by helping to open the "black box" of diversity (Lawrence, 1997). In particular, I will argue that teams can take advantage of their cognitive differences by coming to a common understanding of the team's task and by developing an accurate representation of the team performance environment.

2.2.3 Cognitive Diversity

Differences in the perspectives and expertise that people bring to the task is especially important for project teams charged with a complex decision-making task. Complex decisions often have many contingencies and consequences, so it is important for the decision-maker to take as many of those contingencies into consideration. Humans have a limited cognitive capacity (e.g., Halford, Wilson, & Phillips, 1998) and since they cannot identify all relevant information and thus select the best solution, individuals tend to simplify the decision process by "satisficing" rather than "optimizing"

(March & Simon, 1958). Multiple people thus have a higher probability of defining and considering all the possible aspects of the decision and therefore complex decision-making is not a task that benefits from an individual perspective. Often, teams are formed as a means to tap the various kinds of cognitive perspectives of the team members thereby increasing decision-making quality (Mohammed & Ringseis, 2001; Nahavandi & Aranda, 1994). Therefore it would make sense to study cognitive diversity since it is a relevant type of diversity for decision-making teams. Cognitive diversity is defined here as the extent to which the group reflects differences in knowledge, including beliefs, ideas, viewpoints, opinions, assumptions, preferences, and perspectives (e.g., Kilduff et al., 2000; Miller et al., 1998). Researchers have long been interested in how diversity in cognitive resources influences team decision-making quality (Bunderson, 2003), however a clear and consistent pattern has not been identified (Milliken & Martins, 1996; Miller et al., 1998), therefore it remains important to examine how cognitive diversity impacts decision-making (Olson, Parayitam, & Bao, 2007).

Authors who have studied cognitive diversity typically have used proxy variables (Kilduff et al., 2000) such as functional background, educational level, and educational background to measure cognitive diversity (e.g., Bantel & Jackson, 1989; Hambrick et al., 1996). Some exceptions to this practice have been Mohammed and Ringseis (2001) who measured variance in assumptions regarding the task’s framing and Olson et al. (2007) who measured top management team diversity with regards to the preferences and beliefs of their firms’ goals and long-term viability. Researchers have noted that the inconsistent findings may be related to the fact that these proxy measures do not accurately capture the extent of the cognitive diversity present in the teams (Kilduff et al., 2000, Olson et al., 2007). For this particular study I chose to examine cognitive style[1] diversity as a more direct measure of cognitive diversity.

Cognitive Style Diversity

"People think about things in different ways. [Cognitive] style is an interactive mix of inherited tendencies and conditioned responses to early behavioral experiences. As a result, each person favors a particular method of thinking. Our thinking style greatly affects how we approach the world, relate to others, reason, attain goals, organize, manage, solve problems, lead, and communicate" (Golian, 1998, p. 1). Cognitive style is defined as an individual's consistent preference for manipulating and processing information (Harrison & Bramson, 1984; Mayer, 1983). Cognitive styles are stable over time and highly resistant to change (Riding & Pearson, 1994). Thus, cognitive style diversity concerns differences among people with regards to how they process information rather than diversity in the content of the information they bring to the team due to their prior experiences, education, etc.

One of the most recognized cognitive styles is the Visual-Verbal cognitive style (e.g., Richardson, 1977) which classifies individuals as either visualizers or as verbalizers. Visualizers (or imagers) have a dominant preference for imagery whereas verbalizers rely primarily on verbal-analytic strategies when performing cognitive tasks (e.g., Blazhenkova & Kozhevnikov, 2009). Modern cognitive science, however, indicates that humans process visual information in two separate ways, via object imagery and

[1] In addition to *cognitive* style, the term *thinking* styles has also been used to describe the way in which people acquire and process information. Thus, these two terms will be used interchangeably in this manuscript.

spatial imagery. Individuals with an object visualization cognitive style tend to use imagery to represent and process colorful, detailed images and those with a spatial visualization have a preference for representing and processing schematic images and spatial relationships (Blajenkova, Kozhevnikov, & Motes, 2006).

Cognitive styles bring different perspectives and information to the cognitive foreground. “Even when team members have access to the same exact information, they may evaluate, weigh, [and process] it much differently” (Ilgen et al., 1995, p. 117). The type of cognitive style influences the preference for the type of information that will be extracted and processed – verbalizers will more easily process verbal information whereas visualizers will more readily process visual information (Blajenkova et al., 2006). Thus, within teams, it follows that team members with different cognitive styles will likely extract different information about, and pay attention to, different aspects of the team task, and will therefore develop different perspectives on the task based on their information processing. Consequently, a variety of cognitive styles should be beneficial to teams in facilitating attention to a wide range of information about the team task, particularly when the information contains a variety of formats such as verbal and visual, as is typical in organizational documents and reports.

Although previous studies argue that cognitive differences may affect work outcomes, most of the research within management does not directly assess cognitive style diversity. Rather, researchers have assessed proxy variables such as functional background and educational background, and have assumed that these lead to variety in cognitive styles in approaching a team’s task (Kilduff et al., 2000; Priem, Lyon, & Dess, 1999). Since individuals vary on the extent to which they use the cognitive styles, cognitive style diversity can be viewed as a "separation" type of diversity (Harrison & Klein, 2007). The key assumption of diversity as separation is that members of a team vary from one another in their position that they hold on a continuous attribute (Harrison & Klein, 2007). This type of diversity is at its maximum when members of the team hold radically different positions on the particular variable's continuum and is at its minimum when all members hold the same position along the variable's continuum (Harrison & Klein, 2007). Cognitive style is suggested to be critical for decision-making teams (Armstrong & Priola, 2001) since it is assumed to be (mostly positively) associated with problem solving and team decision-quality because it 'broadens the cognitive…repertoire of the unit" (Harrison & Klein, 2007, p. 1204). Thus, cognitive style diversity is best understood via the information/decision-making perspective of diversity, an approach that I will follow in this research. As discussed above, this perspective rests on the idea that diversity of cognitive resources gives a team a greater depth and breadth of information and thus increases the team's overall problem-solving capacity (Hambrick et al., 1996; Hoffman & Maier, 1961).

In contrast to this popular perspective, cognitive diversity does not always seem to have positive consequences. For example, Hambrick and colleagues (Hambrick et al., 1996) found that while top management teams that varied in cognitive resources (based on educational, functional, and tenure differences) were more likely to undertake bold competitive action, they also exhibited friction and were slower in decision-making. Similarly, Miller et al. (1998) found that cognitive diversity hurt, rather than helped, comprehensive decision-making and long-term planning in executive teams. Thus, since diverse decision-making teams seem to need more time to explore their differences and quite possibly work though conflict and disagreements (Hambrick et al., 1996), diversity of perspectives can become a liability, especially when under time pressure (Jackson et al., 1995). Thus, there is evidence for both the positive and negative impacts of cognitive diversity on performance which makes the examination of moderators an important next step. However, on average, most researchers using the information/decision-making perspective argue that cognitive diversity should be beneficial for team performance (van Knippenberg & Schippers, 2007); in keeping with this view, I propose a positive impact of cognitive diversity on performance, while acknowledging that under some circumstances this positive effect might not materialize or could be negative.

2.2.5 Cognitive Diversity and Team Performance

Building on the information/decision-making perspective, I suggest that team diversity on thinking styles is beneficial for team performance. Individuals are often selected for organizational teams, such as cross-functional teams (Mohammed & Ringseis, 2001) because of their diverse cognitive resources. Bringing a variety of cognitive resources to the team, team members have a greater depth and variety of perspectives at their disposal which they can use in decision making and problem solving (Bunderson, 2003; Hoffman & Maier, 1961). Teams charged with a complex decision-making task need to consider the problem from different points of view and thus should benefit from cognitive diversity based on thinking styles. Heterogeneity of perspectives about the team's task should increase the likelihood that all relevant information is attended to and all relevant contingencies are being considered. Applying a wide range of viewpoints and ideas to the task, cognitively diverse teams should be more likely to make better informed decisions and thus increase their performance.

HYPOTHESIS 1: *High cognitive diversity will be positively related to team performance in decision-making teams.*

The information/decision-making perspective within the diversity literature (Williams & O'Reilly, 1998), on which Hypothesis 1 is based, is really about the relationship between the *potential* information resources contained in a cognitively diverse team and team performance. However, most of the research on this link has not examined whether and under what circumstances the potential information resources are actually tapped and utilized to impact team performance. This omission might account for the mixed findings regarding the relationship, which have been noted in the literature. In this study, I propose that team mental models are a critical link connecting the cognitive diversity to team performance. Several scholars have suggested that a team's cognitive diversity may have important effects on team mental models (e.g., Klimoski & Mohammed, 1994; Rentsch & Klimoski, 2001; Rico, Sanchez-Manzanares, Gil, & Gibson, 2008) and team mental models have been found to significantly affect team performance (e.g., Mathieu et al., 2000). In the following sub-section, I discuss the concept of team mental models and its relationship with team cognitive diversity as well as team performance.

2.3 Team Mental Models

To perform, teams manage their efforts both *explicitly*, via direct communication, schedules, plans, and procedures, but also *implicitly* via team cognition mechanisms (Espinosa, 2002) such as team mental models[2]. Team mental models have received a considerable amount of attention in the literature in recent years. Mental models are a special kind of knowledge, stored in cognition (Rouse & Morris, 1986). They help individuals to interact with their environment (Norman, 1983) by describing, explaining, and predicting the world around them (Rouse & Morris, 1986), which enables them to take appropriate action (Klimoski & Mohammed, 1994).

With the increasing use of organizational teams, more attention is being paid to the extent to which individuals in a team decision making context develop similar and accurate mental models (Orasanu & Salas, 1993). This increased attention to team cognition “stems from the emerging notion that cognition is a social phenomenon” (Resick, 2004, p. 25). The main premise is that team members develop individual specialized knowledge structures of the performance environment that helps them coordinate their efforts with other members in a social (team) context (Resick, 2004). Here, I use a definition of team mental model by Mohammed and Dumville (2001, p. 90, but which was based on Klimoski & Mohammed, 1994): “team members' shared, organized understanding and mental representation of knowledge about key elements of the team's relevant environment”. Thus, mental models capture more than just declarative knowledge; they also include an “organized understanding or mental representation of that knowledge” (Edwards et al., 2006, p. 727).

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[2] In addition to the label *team mental model*, the label of *shared mental model* has also been used to describe this construct. I chose not to use the term “shared” as it may be interpreted to only account for the mental model similarity and not the mental model accuracy dimension.

Teams whose members have similar mental models are thought to increase team process effectiveness, thereby enhancing team performance (Klimoski & Mohammed, 1994). Indeed, Mathieu et al. (2000) found that similarity in mental models about the team's task and about how to work as a team were significantly positively related to team process (e.g., coordination, communication, cooperation) which in turn was significantly related to team performance.

2.3.1 Distinguishing the Team Mental Model

A team's mental model is a construct that is distinct from yet similar to other team cognitive constructs such as team cognition and transactive memory (see Mohammed & Dumville, 2001 for a review). Team cognition is generally viewed as an overarching term including the team's cognitive processes, thoughts, understandings, interpretations, beliefs, schemas, and mental models. Team transactive memory is suggested to be a component of team mental models because it only deals with how team members process information and "who knows what" in the team (Moreland, 1999). Also, whereas information sharing, collective learning, and team situation models are dynamic cognitive processes, team mental models and transactive memory are thought of as emergent characteristics of teams. The terms mental model and schema are sometimes used interchangeably, however they are actually quite different. Schemas are generalized templates that are used across situations while mental models refer to a specific situation, event, or team (Cronin & Weingart, 2007). Mental models also differ from team norms since they "go beyond consensus around actions and involve a conceptualization of the bases for that action" (Klimoski & Mohammed, 1994, p. 417). Finally, team mental models are also different from representational gaps in that the latter assumes that individuals' views of key issues are incompatible, whereas for mental models this is not the case (Cronin & Weingart, 2007).

2.3.2 Team Mental Model Types and Content

Cannon-Bowers, Salas, and Converse (1993, p. 233) proposed four generic types of mental models in teams that are useful for effective team performance: teamwork mental model, team interaction mental model, task mental model, and equipment mental model. The *team[work]* mental model refers to information about knowledge, skills, abilities, preferences, behavioral tendencies, and background of the team members. The *team interaction* mental model relates to the roles and responsibilities, information sources, patterns of interaction and communication, and role interdependencies among the team members. The *task* mental model contains knowledge about the task procedures, likely contingencies and scenarios, task strategies, and environmental constraints, while the *equipment* mental model contains knowledge regarding the equipment functioning, operating procedures, equipment limitations, and likely failures. More recently, mental models are examined as consisting of only two main content domains: team-focused (combines team[work] and team interaction mental models) and task-focused (combines task and equipment mental models) which has been empirically confirmed by Mathieu et al. (2000). This is a common dichotomy used in teams research.

Team mental models may also contain different kinds of information content. Converse and Kahler (1992) posit that team mental models have three different forms of knowledge: 1) "*Declarative*, which is information about concepts and elements in the domain and about relationships between them, 2) *Procedural*, which is information about the steps, and the order of the steps, that must be taken to accomplish certain activities, and 3) *Strategic*, which is information that provides the basis for problem solving, including action plans to meet specific goals, knowledge of the context in which procedures should be implemented, actions to be taken if a proposed solution fails, and how to respond if necessary information is absent" (Webber, Chen, Payne, Marsh, & Zaccaro, 2000, p. 309). Thus, team mental models are more than just shared task knowledge (Edwards et al., 2006). Webber and colleagues (2000) stated that researchers have suggested that declarative knowledge is most useful in decision-making teams, procedural knowledge is best used by production or assembly teams, and team mental models containing strategic information is most advantageous to action and negotiation teams (e.g., Cannon-Bowers, Tannenbaum, Salas, & Volpe, 1995).

Research on mental models has almost exclusively looked at action teams, which are teams that have short high intensity performance events, such as teams charged with combat or flight simulation tasks (e.g., Ellis, 2006, Mathieu et al., 2000; Mathieu, Heffner, Goodwin, Cannon-Bowers, & Salas, 2005). In contrast, this research examined decision-making/problem solving teams, a different type of team that plays an important role in organizational contexts.

The type of team has consequences for the type and content of the mental model that should be studied (Webber et al., 2000). Whereas both task- and team-focused mental models are equally important for action teams, for decision-making teams, a mental model related to the task at hand may be more essential than a mental model that helps anticipate the actions of other team members. "Task-based cognitions are especially relevant because decision-making is an information-intensive activity" (Jackson et al., 1995, p. 230). Similarly, cognitive diversity may be more relevant for task-focused mental models than for team-focused ones. Since cognitive diversity deals with differences regarding viewpoints, ideas, and knowledge of the team's task, "working through cognitive-based differences is a central activity" in decision-making teams (Jackson et al., 1995, p. 230). Thus, I expect that task-focused mental models are the relevant type of team mental model in examining the effects of team cognitive diversity in decision-making teams.

Whereas action teams benefit most from mental models focused on strategic knowledge, decision-making teams should profit most from declarative knowledge (e.g., Cannon-Bowers et al., 1995; Webber et al., 2000). Therefore, this research focused on investigating task-focused mental models that contain mostly declarative knowledge.

2.3.3 Mental Model Similarity and Accuracy

Research has also indicated that team mental models have two main dimensions: 1) similarity or convergence, which is the amount of overlap between the individual mental models of the team members and 2) accuracy or quality of the mental models, which is the relationship between the team members' representations and a target or "true score" (Rentsch & Hall, 1994). This assumes that there is an external correct definition of the mental model, so it refers to the "degree to which members' mental models adequately represent a given knowledge or skill domain" (Edwards et al., 2006, p. 727).

An important issue to address is the notion of what is meant by the 'similarity' of mental models. Researchers have suggested that one should indicate whether this means overlapping, similar, or distributed (e.g., Klimoski & Mohammed, 1994). Nandkeolyar (2008) proposed that mental models can be meaningfully captured as a continuum with overlapping (i.e., identical) mental models on one end and distributed (i.e., distinct) mental models on the other end. Even though it is possible that some teams possess completely overlapping mental models or that some teams have completely complementary knowledge, and thus a lack of mental model similarity, most teams will fall somewhere in between the extremes. On this continuum, the more the team falls toward the overlapping extreme, the more akin the team members' knowledge and perspectives are and the more similar the team's mental models are (Nandkeolyar, 2008).

Mental model similarity has been found to positively influence team processes and outcomes (e.g., Mathieu et al., 2000; Rentsch & Klimoski, 2001); however, the support for mental model accuracy is not so clear. Some studies have found a significant effect of mental model accuracy (Edwards et al., 2006; Marks, Zaccaro, & Mathieu, 2000), whereas others have not (Mathieu et al., 2005; Webber et al., 2000).

In addition, there is also conflicting evidence on whether mental model similarity and accuracy together predict team outcomes. Some studies have found significant interaction effects (e.g., Marks et al., 2000; Mathieu et al., 2005) indicating that teams exhibited the best processes and performance when they shared high-quality (i.e., similar and accurate) mental models, while others have not found such significant interaction effects (e.g., Lim & Klein, 2006). With this research I hope to shed some more light on the relationship between mental model similarity and accuracy and performance.

2.3.4 Cognitive Diversity and Team Mental Models

It may seem logical that team members' mental models should become more similar as they continue to work together. However, this may not always be the case as evidenced by Mathieu et al. (2000; 2005) who investigated team members' mental models over time and found that both task and team mental models converged only slightly across several trials during a time span of several hours. In addition, Edwards and colleagues (2006) examined 83 dyadic teams and found that the similarity and accuracy of the task work mental model did not significantly increase over two days of training. These findings seem to indicate that "mental models… may be related to characteristics that individual members bring with them to the team and characteristics of the team's composition that are present at the team's formation" (Resick, 2004, p. 34). This view echoes statements by other researchers such as Klimoski and Mohammed (1994), Rentsch and Klimoski, (2001), and Rico et al., (2008) who posited that the existence of team mental models is determined in part by team composition and by Kraiger and Wenzel (1997) who argued that of all the theoretical antecedents of team mental models, "individual differences are the most proximal variables to shared mental models and thus may have an important impact in their development" (p. 77). To this end, there have only been a few studies done on the effects of individual factors such as personality (Resick, 2004), cognition (Edwards et al., 2006), and demographics (Rentsch & Klimoski, 2001) on the formation of team mental models.

Even though researchers (e.g., Mathieu et al., 2000) have called for "more research that describes effective team composition strategies for the development of team mental models" (Edwards et al., 2006, p. 728), relatively few studies have examined the relationship of team composition, or diversity, and team mental models. Overall, this scant research indicates that team diversity is harmful for the development of team mental models. Rentsch and Klimoski (2001) found that in teams with a higher percentage of team members who were similar with regards to age, gender, education, and organizational level, members were more likely to develop similar team mental models. However, Resick (2004) did not find a significant relationship between team diversity on extraversion and mental model similarity. Levesque and colleagues (2001) found that increased role differentiation in teams led to decrease in interaction and to a corresponding decline in mental model similarity. This information is summarized below in Table 1. One thing that should be noted is that the majority of this research looks at the similarity component. Only one empirical study by Edwards and colleagues (2006) also looks at accuracy. In addition to examining the impact of cognitive diversity on the development of mental model similarity, another contribution of the current research is that the effect of team cognitive diversity on mental model accuracy will be assessed.

Cognitive Diversity and Mental Model Similarity

As discussed above, the information/decision making perspective of team diversity posits that teams with diverse members bring a variety of viewpoints to a task, increasing the amount of knowledge in the team, and thereby generating the potential for superior performance. However, teams that have members with varied cognitive resources such as ideas, values, backgrounds, skills, personalities and attitudes, seem to have increased difficulty working together (e.g., Epton, Payne, & Pearson, 1984) and often cannot capitalize on the potential of diverse perspectives and information (e.g., Hambrick et al., 1996; Webber & Donahue, 2001).

Cognitive diversity should generate differences in views, languages, symbols, assumptions, and interpretations (Dougherty, 1992). This not only makes intuitive sense, but also previous research has supported the idea that members of diverse teams have different individual mental models. For example, several studies suggested that employees from different functional backgrounds have a dissimilar way of viewing the same organizational issues (e.g., Dearborn & Simon, 1958; Lawrence & Lorsch, 1969; Melone, 1994; Waller, Huber, & Glick, 1995). In addition, an individual's organizational tenure and functional unit are thought to be related to the varying content of individuals' mental models (Hambrick & Mason, 1984; Ginsberg, 1990; see Kilduff et al., 2000 for an opposing view). Similarly, individuals with different cognitive styles extract different information and ideas from the same set of data. As discussed above, when individuals process different information this will lead to a variety of individual perspectives.

Seeing things differently may affect how the team works and thinks together. Because of their differences, team members may have a more difficult time communicating and exchanging information leading to disorganization, and misunderstandings (Jackson, 1992). Misunderstandings due to cognitive diversity reduce the "common premise for decision making" (Michel & Hambrick, 1992, p. 18), complicate consensus forming (Adler, 1997; Priem, 1990), and increase the time and effort spent on communication (Mohammed & Ringseis, 2001). In a student team context, Mohammed and Ringseis (2001) found that individuals with cognitive diversity of assumptions had less consensus on key decision issues.

On the other hand there is evidence that members' homogeneous cognitive resources helps in the development of team mental models (e.g., Michel & Hambrick, 1992; Rico et al., 2008). Indeed, cognitive similarity among team members has been found to lead to schema agreement (Rentsch & Klimoski, 2001) and may result in analogous task definitions (Bettenhausen & Murnighan, 1985). Thus, when individuals extract similar information from a set of data, due to the similarity in their cognitive styles, it is likely that they will develop similar task perspectives and thus similar mental models regarding a particular problem or decision.

In sum, research suggests that teams with members who have different cognitive styles will have greater variety in perspectives about the team task and will have less overlap in their individual knowledge structures of the team task, compared to those teams who have similar cognitive styles. Thus, the formation of mental model similarity will be more problematic in these teams. Therefore,

HYPOTHESIS 2a: *High cognitive diversity will be negatively related to mental model similarity in decision-making teams.*

Table 1. Studies Examining the Relationship between Team Diversity and TMMs.

Study	Type of Research: Empirical or theoretical	Diversity Measure	Types of diversity studied	MMS or MMA	Type of TMM studied
Edwards, Day, Arthur, & Bell (2006)	Empirical	Manipulated composition via uniformly high (HH), low (LL), and mixed teams (HL)	• General Mental Ability (+) but stronger for MMA than for MMS and for HH teams > HL teams > LL teams	• MMS • MMA	Task-focused
Levesque, Wilson, & Wholey (2001)	Empirical	Variance	• Role Differentiation (-)	• MMS	Team-focused
Qui, Zhang, & Liu (2006)	Theoretical	N/A	• Cultural diversity (+ with MMA, curvilinear with MMS)	• MMS • MMA	Task-focused and Team-focused
Rentsch & Klimoski (2001)	Empirical	The percentage of members similar	• age (+) • gender (+) • education (+) • organizational level (+) • team experience (+)	• MMS	Team-focused
Resick (2004)	Empirical	Variance	• Extraversion (ns)	• MMS	Task-focused and Team-focused

Cognitive Diversity and Mental Model Accuracy

Organizations use team decision making largely because the cognitive resources of the members will give teams access to an increased breath of information that could be brought to bear on the task (Bunderson, 2003; van Knippenberg et al., 2004). The presence of different task perspectives, a variety of approaches to a problem, and the focus on different aspects of the problem due to differences in cognitive style should result in better coverage of the task's problem space (See Figure 2B) (Williams & O'Reilly, 1998). When teams have greater coverage about the task problem space, they collectively have more information to work with, a greater chance of identifying all relevant task contingencies as a team, and a higher probability to make the right decision(s) and thus enjoy higher accuracy of their mental model. As an example, if each team member has a part of a puzzle, together the team members have information about the complete problem space. Each member will have their own mental model of their puzzle piece, their perspective, and how it fits into the problem environment. Collectively all team members have information about the complete task problem space which should result in higher mental model accuracy[3].

Conversely, when team members have homogeneous cognitive styles, they are likely to attend to similar information about a task and to process it in similar ways. As a consequence, they are likely to focus on a more limited portion of the problem space, or to utilize a more limited set of perspectives in analyzing the problem; i.e., they may pay

[3] I am arguing here that collectively, as a team, members will be able to identify all the relevant perspectives necessary to complete the task, not that each member by his or her self will be able to identify all task-related information required.

attention only to a certain portion of the puzzle pieces at their disposal, so partial coverage of the problem space can be expected. Again, while all members may have their own mental model which can be accurate in relation to a part of the problem, the team's relative homogeneity in cognitive style may result in the team's task mental model being incomplete because their cognitive style homogeneity is likely to result in team members collectively focusing on a limited portion of the problem space, thus missing important task perspectives. As a consequence, teams made up of members with more homogeneous cognitive styles are less likely than teams diverse in cognitive styles, to identify all task relevant information, thus demonstrating lower team mental model accuracy.

HYPOTHESIS 2b: *High cognitive diversity will be positively related to mental model accuracy in decision-making teams.*

2.3.5 Team Mental Models and Performance

Empirical research has found that, over time, teamwork has become equated with high performance; however, empirical research has also pointed out that, unfortunately, not all teams are able to realize these advantages (e.g., Allen & Hecht, 2004), with many actually failing. Therefore it remains critical to find ways to improve team performance. One of the ways that team performance can be enhanced is via team members' overlap and accuracy of cognitive resources (i.e., team mental models). Team mental models have been viewed as one of the underlying mechanisms that encourage effective team processes (Mathieu et al., 2000) such as communication, coordination, and cooperation and they have been empirically shown to enhance team effectiveness (e.g., Marks et al., 2000; Mathieu et al., 2000; Rentsch & Klimoski, 2001).

Mental Model Similarity

Mental model similarity is thought to be the underlying mechanism to ensure effective team processes, such as the ability to coordinate more effectively (e.g., Cannon-Bowers et al., 1993) and therefore outperform those teams without or with a lesser degree of mental model similarity (e.g., Stout, Cannon-Bowers, Salas, & Milanovich, 1999; Klimoski & Mohammed, 1994). Teams with low mental model similarity may have a higher probability of generating process losses due to miscommunication and disorganization because of different perspectives on key task-relevant issues and problems which may mean that team members are working towards different objectives (e.g., Jackson et al., 1995; Kraiger & Wenzel, 1997). When team members are solving a different problem or attending to a different decision, as a result of varying task-focused mental models, this should reduce team performance.

In addition to the issue of differing task objectives, mental models may also impact the way that the team works together. Mohammed and Ringseis (2001) suggest that teams are likely to make multiple decisions during their project life (e.g., Minzberg & Waters, 1985), and that those teams that have developed a similar task mental model should have fewer problems resolving future decisions (Mohammed & Ringseis, 2001). While for teams with divergent mental models "it is likely that differences in assumptions and perceptions will surface again in discussions of related issues" (Mohammed & Ringseis, 2001, p. 317). Thus, teams with high mental model similarity should have a greater single task focus and experience less process losses, all of which should have positive effects on team performance. Indeed, numerous studies have pointed out that teams perform better when they share similar mental models (e.g., Lim & Klein, 2006; Marks et al., 2000; Mathieu et al., 2005). Thus,

HYPOTHESIS 3a: *High mental model similarity will be positively related to performance in decision-making teams.*

Mental Model Accuracy

Teams with accurate mental models should be more likely to interpret and respond to a situation more appropriately than those who possess an inaccurate mental model. As argued above, teams with a more accurate mental model about the team task collectively have greater coverage of the problem space. Thus, the more coverage of the task's problem space, the more accurate the team's mental model about the task environment, the more likely it is that potential superior performance will be actually realized.

In support, Marks et al. (2000) found that mental model accuracy was significantly positively related to team performance. Edwards et al. (2006) found that the relationship between team mental model accuracy and performance was stronger than that of the team mental model similarity-performance relationship at two different points in time. They also found a significant difference between the similarity and accuracy correlations at Time 2 (training day 4); however those correlation differences at Time 1 (training day 2) were not significant.

While in general there is thus support for mental model accuracy increasing team performance, this link has not always been found. Several studies (Marks et al., 2000; Mathieu et al., 2005; Webber et al., 2000) did not find a predictive performance advantage of team mental model accuracy over similarity. Edwards et al. (2006) believe that this is a consequence of the type of task that was used. They argue that in tasks where a right (or series) of right answers exist, team mental model accuracy should be more predictive of team performance than team mental model similarity. Given that a task with a defined right answer will be used in this study and given the theory development above, I suggest that mental model accuracy is an important factor that increases team performance.

HYPOTHESIS 3b: *High mental model accuracy will be positively related to performance in decision-making teams.*

In addition to the direct relationships between mental model similarity and accuracy and team performance, there is also evidence that mental model similarity and accuracy interact to affect team performance (Marks et al., 2000; Mathieu et al., 2005). Just because team members have a similar vision of their task environment does not mean that this vision is correct (Mathieu et al., 2005). Alternatively, each member could have dissimilar (i.e., complementary) perspectives, but in the aggregate, the team could be highly accurate (Qui, Zhang, & Liu, 2006). Thus at the extremes, there are four situations that a team can find itself in: 1) A team's task mental model can be similar but not accurate (See Figure 2A), 2) a team can have an accurate task mental model but not a similar one (See Figure 2B), 3) a team holds an accurate and similar task mental model (See Figure 2C), and 4) a team holds neither a similar nor an accurate model about the team task (See Figure 2D).

Similar not Accurate *B. Accurate not Similar* *C. Accurate and Similar* *D. not Accurate nor Similar*

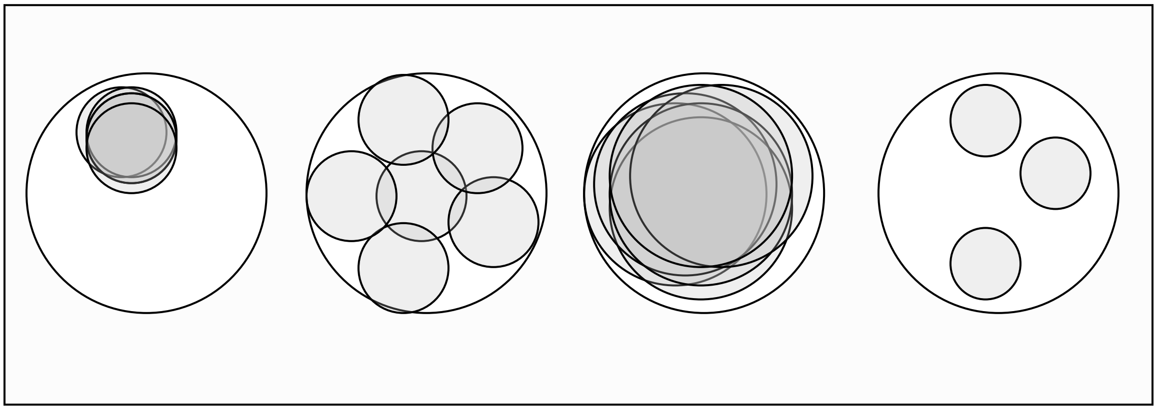

Figure 2. Team Mental Model Similarity and Accuracy in Relation to the Problem Space

Since it is possible for team members to have similar but not accurate, and accurate but not similar, mental models, I suggest that both conditions need to be present to achieve the highest performance. As argued above, mental model accuracy has a positive effect on performance because of the increased probability of identifying the right solution(s). However, accuracy alone does not necessarily translate into the 'highest' performance. Teams need mental model similarity to turn mental model accuracy into the best possible performance. As empirical evidence suggests, similarity in mental models about the team's task should lead to better processes like communication and coordination (Espinosa, 2002; Marks et al., 2000; Mathieu et al., 2000). When teams have an accurate idea of the problem space and accurate solutions to the problem, mental model similarity will help with the efficient coordination and implementation of the solutions, thereby realizing the largest gains in team performance (See Table 2). Thus mental model accuracy results in higher team *effectiveness* while mental model similarity results in higher team *efficiency* (e.g., Smith-Jentsch, Campbell, Milanovich, & Reynolds, 2001). In support, Mathieu and colleagues (2005) found a significant interaction effect of team-focused mental model accuracy and similarity on performance, indicating that team performance was greater among teams who shared highly accurate team-focused mental models (Figure 2C) than among those teams who evidenced either low mental model similarity (Figure 2B) or low mental model accuracy (Figure 2A). The combination of mental model accuracy and similarity is particularly important for cognitively diverse decision-making teams because task-focused mental model similarity helps assure that team members are solving the same problem and teams can thus capitalize on the various cognitive perspectives of the entire team (Orasanu, 1990).

HYPOTHESIS 3c: *Team mental model similarity will moderate the team mental model accuracy-performance relationship, such that high mental model similarity augments the positive effect of high mental model accuracy on performance in decision-making teams.*

Table 2. Relationship between Mental Model Accuracy, Similarity, and Performance in Decision-Making Teams

		MM Similarity	
		Yes	*No*
MM Accuracy	*Yes*	Best performance	Medium performance
	No	Medium performance	Worst performance

2.3.6 TMM as Mediator of the Cognitive Diversity-Performance Relationship

Notwithstanding the numerous advantages that diverse teams bring to the workplace, “the team literature is replete with evidence of the many obstacles that prevent teams from fully capitalizing on their members' diversity and knowledge due primarily to the members' inability to work together" (Levin, 1992; Bergiel, 2006, p. 3). Some of these obstacles include conflict (e.g., Li & Hambrick, 2005) and increased time and resource demands (e.g., Dumaine, 1994; Mohammed & Ringseis, 2001) which may lead to suboptimal team outcomes. Bergiel (2006) further points out that TMMs are considered to be a way to reduce these obstacles, thus generating higher team effectiveness (e.g., Cannon-Bowers et al., 1993; Klimoski & Mohammed, 1994).

TMMs have been theorized and researched as either a team process or an emergent state that occurs before team processes, as a mediator between inputs and outputs, as a mediator between inputs and processes, or as a moderator between the team processes and team outputs.

In Hypotheses 1-3, I proposed that cognitive diversity is related both to team performance and task-focused mental models and that there is a positive relationship between team mental models and performance. Guided by these previous theoretical arguments, here I propose that a team's task mental model is a significant mediator between team input (i.e., cognitive diversity) and team outcome (performance).

Cognitively heterogeneous project teams that work on a complex decision-making task should have access to an increased amount of perspectives that is also more diverse but this does not necessarily mean that these teams will experience superior performance. In fact, while diverse teams have a higher potential for superior performance they have been found to experience increased process losses because of misunderstandings and the inability to form consensus or make decisions (Adler, 1997; Michel & Hambrick, 1992).

A team mental model may be an important "mediating state" which emerges in teams that can explain how diverse teams improve their performance (Jackson et al., 1995, p. 228).

Mental Model Similarity as Mediator

Similarity with regards to the task-focused mental models will help cognitively diverse teams increase their performance by giving team members a common understanding regarding the task requirements. Having a shared representation of the task should reduce misunderstandings, varying assumptions, and conflict, which are all factors that result as a consequence from team cognitive diversity, and that detract from generating high team performance.

I must note here that guided by the literature I have proposed a negative path from cognitive style diversity to MMS but a positive path from MMS to team performance. Thus, it may be difficult to find a significant effect for this mediation since the coexistence of both a positive and negative effect may cancel each other out.

Mental Model Accuracy as Mediator

As mentioned above, the whole premise of using diverse teams for decision-making is that the individual members have different perspectives about the task environment which should give rise to better decisions since more relevant contingencies are taken into consideration. However, this can only materialize if the individual perspectives together accurately represent the problem space. Thus, the different perspectives give the *potential* for higher performance but will yield *actual* higher performance only when the mental models are accurate – i.e., when the variety of perspectives and ideas adequately cover the various parts of a decision-making problem.

There has been some research done on the mediating role of team mental models between team composition and team performance. For example Rentsch and Klimoski (2001) found that team mental model similarity was a significant mediator between organizational level similarity and team member growth and between the percentage of members with greater team experience and member growth, team viability, client satisfaction, and overall effectiveness. The only other empirical study that looked at the mediating effects of team mental models on the diversity-performance relationship found that team mental model accuracy (but not similarity) partially mediated between team general mental ability composition and team performance (Edwards et al., 2006). In light of the theoretical underpinnings and the empirical evidence, I propose:

HYPOTHESIS 4a: *Team mental model similarity will mediate between team cognitive diversity and performance in decision-making teams.*

HYPOTHESIS 4b: *Team mental model accuracy will mediate between team cognitive diversity and performance in decision-making teams.*

2.4 Team Information Processing Mechanisms as Moderators

Ilgen et al. (1995) note that research on team decision-making is part of the larger research area of information processing (Lachman, 1987), which is typically defined as a series of activities in the human brain that acquire, retain, and use information. Studies in this research stream investigate "how individuals select and process information to be used… to make decisions" (Ilgen et al., 1995, p.116). Even though information processing is fundamentally an individual activity, more recently, researchers have viewed teams as important processors of information (e.g., Ellis, 2006; Hinsz, Tindale, & Vollrath, 1997). Hinsz et al. (1997) suggested that information processing at the team level involves “the degree to which information, ideas, or cognitive processes are shared, and are being shared, among the [team] members” (p. 53). Ellis (2006) points out that information processing is especially important for teams performing knowledge tasks such as decision-making and problem solving because, for these tasks, members’ abilities to process information is critical for team performance. Teams can establish mechanisms that facilitate team information processing, and in particular, mechanisms that relate to the sharing of information by group members, and the integration of that information into member’s thinking about the group task. Researchers have argued that such mechanisms should enable cognitively diverse teams to benefit from their cognitive diversity in terms of team performance (e.g., Simons, Pelled, & Smith, 1999).

While there is a wide range of potential mechanisms that researchers have found to facilitate group information processing in diverse teams, they share two common elements: they are either focused on surfacing information (e.g., Schweiger, Sandberg, & Rechner, 1989) or on information integration (e.g., Mohammed & Ringseis, 2001), or both (e.g., Homan, van Knippenberg, Van Kleef, & De Dreu, 2007). In this study, I propose that information surfacing mechanisms and information integration mechanisms will facilitate the functioning of cognitively diverse teams by influencing the effects of cognitive diversity on team mental model accuracy and similarity. Specifically, I argue that information integration will moderate the cognitive diversity-MMS link whereas information surfacing will moderate the relationship between cognitive diversity and team mental model accuracy.

2.4.1 Information Surfacing Mechanisms

As mentioned above, for teams to benefit from their advantage of diverse insights, it is necessary that these perspectives come to light. There is plenty of evidence in the literature that teams have difficulty tapping into unique task knowledge and perspectives possessed by their members as evidenced by research on hidden profile, common knowledge effect, and psychological safety (Edmondson, 1999; Gigone & Hastie, 1993; Stasser & Stewart, 1992). One way that teams may overcome these hurdles is to actively try and surface this information.

It has been suggested that communication may be the underlying mechanism by which individual mental models converge over time (e.g., Klimoski & Mohammed, 1994) however; communication is too broad of a term since it may or may not include information that is relevant to the team's task. In a similar vein, mainly sharing of information is also not enough, since it may only involve sharing of information that other members already know (i.e., common knowledge problem, Gigone & Hastie, 1993). Instead, I suggest that the most relevant process, that gets teams diverse in thinking styles to realize their potential coverage of the problem space, is the surfacing of unique task-relevant perspectives.

Back to my earlier analogy, cognitively diverse teams that engage in information surfacing to a higher extent should expose more pieces of the puzzle via mechanisms of exchanging, discussing, and asking questions about task related information possessed by the different members[4]. When actively surfacing information, team members may realize

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[4] This conceptualization of mental model accuracy is different from the construct of transactive memory (Moreland, 1999). Transactive memory is concerned with members' knowledge of "who knows what". Even though this is a relevant concept for studying cognition in teams, in the context of this study it

that insights they have, but they deemed not to be important, actually *do* have relevance to the task. These additional ideas would not have come to light without team members who volunteer, clarify, and discuss their way of thinking about the task. Thus, if the team creates an environment where the elicitation of unique perspectives is important, cognitively diverse teams will be able to uncover more of the puzzle pieces and thus actually realize the potential full coverage of the problem space.

In contrast, teams that utilize information surfacing mechanisms to a lesser degree may forego important task-relevant perspectives which most likely results in an incomplete coverage of the problem space. Teams that do not surface as many diverse perspectives or discuss conflicting opinions should have a less comprehensive picture of the task and its possible solutions and less than full consideration of the task's possible consequences (Jackson et al., 1995; Schweiger et al., 1989). All of this leads to a task-focused mental model that is less accurate than one where all unique perspectives have been brought out in the open via the utilization of effective information surfacing mechanisms.

HYPOTHESIS 5a: *The extent of use of team information surfacing mechanisms will moderate the relationship between cognitive diversity and team mental model accuracy, such that greater use of information surfacing mechanisms will augment the positive effect of cognitive diversity on mental model accuracy in decision-making teams.*

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is not necessary to know which team member introduced a particular insight. What is important to know, however, is the extent to which a unique perspective is actually surfaced, regardless of who surfaced it.

2.4.2 Information Integration Mechanisms

Not only do diverse teams need to access the available pool of insights they possess, teams also need to integrate these different perspectives to make the best use of their diversity. I argued above that the surfacing of diverse information should result in a greater coverage of the problem space, thus increasing team mental model accuracy. Here I propose that the integration of diverse perspectives should result in increased similarity of the team's task mental model[5].

Some degree of information integration is likely to occur in a team as a consequence of working together for a long period of time. However, teams often have difficulty in integrating diverse information and perspectives (e.g., Anand, Clark, & Zellmer-Bruhn, 2003; Hinsz, 1990). Prior research suggests that teams with diverse perspectives benefit from mechanisms designed to bring those perspectives together. For example, Simons and colleagues (1999) found that top management teams (TMT) that had effective debate and discussion mechanisms were able to arrive at consensus better than TMTs without effective debate mechanisms. Similarly, I propose that effective information integration mechanisms will enable a group with diverse perspectives on the team task, based on their diverse cognitive styles, to bring together the diverse information and viewpoints of its members, resulting in greater similarity of mental

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[5] I must note here that I am not specifying a causal relationship between information surfacing and information integration since I believe that they are processes that can also be simultaneous and reciprocal. The relationship between the two may be reciprocal if someone surfaces information and another may verbally integrate this information with his or her existing perspective, which then prompts another to volunteer a unique perspective that had not been considered relevant before. The two processes may also occur coincidently as someone within the team listens to the conversation and recalls and surfaces a unique viewpoint while integrating it with already surfaced information.

models. That is, compared to teams without structured mechanisms to integrate the informational inputs of its members, teams with such information integration mechanisms in place will create a context in which members examine their thinking about the problem based on the information and perspectives expressed by other team members. This in turn should result in greater mental model similarity.

Essentially, integrating the various perspectives of team members involves discussion of the members' viewpoints, influencing others' thinking, evaluating new information, "trying on" different perspectives, and reconciling conflicting viewpoints (e.g., Mohammed & Ringseis, 2001). These mechanisms should lead the various team members to seize the same ideas and pieces of information (and keep those they already have) that are most relevant to the performance of the task. By adding to, re-thinking, and modifying their original views and perspectives, these new ideas are then entered into the existing task mental model. In teams with high information integration mechanisms, the members have a better chance to perceive the same perspectives and ideas that come up during discussion, as valuable, and thus are more likely to integrate these same pieces of information into their original mental models. The resulting mental models should thus have more similar information than before the team started working together on their decision-making task.

On the other hand, team members may not use information integration mechanisms enough. Mental models have the tendency to remain steadfast until contradicted by incoming data (Fiske & Taylor, 1991; Johnson-Laird, 1983). Team members may be resistant to new information, remain unconvinced by others' arguments, or may simply not realize the importance of their team mates' unique perspectives so that when this new knowledge is not recognized as such, it does not get included in the person's existing representation of the task environment. When effective integration mechanisms are not used, not all task-relevant information that other team members have included in *their* mental models is integrated into the individual's existing mental model, and this means that there is less overlap in mental models than when all relevant perspectives are integrated by all team members. Thus, when members do not integrate all the task-relevant information that has come to light, they should have less overlap in their individual mental models and, as a consequence, less similarity of the team's task-focused mental model.

Following my puzzle example, cognitively diverse teams cannot simply bring all of the puzzle pieces (i.e., various task-focused perspectives) to the table; in addition, they need to try to fit those pieces together so that the puzzle picture becomes clear and everyone can interpret the picture in a similar way. Once members start connecting their puzzle pieces via information integration mechanisms, the task problem becomes increasingly more apparent to the individual members and thus their individual mental models of the task will also converge. Structured information integration mechanisms should enable this to a higher degree than when such mechanisms are absent.

> HYPOTHESIS 5b: *The extent of use of team information integration mechanisms will moderate the relationship between cognitive diversity and team mental model accuracy, such that greater use of information integration mechanisms will ameliorate the negative effect of cognitive diversity on mental model similarity in decision making teams.*

An overview of the proposed hypotheses is given in Table 3.

Table 3. Overview of Hypotheses

Hypothesis	Relationship	Direction
1	Cognitive Style Diversity relates to Team Performance	+
2a	Cognitive Style Diversity relates to MMS	-
2b	Cognitive Style Diversity relates to MMA	+
3a	MMS relates to Team Performance	+
3b	MMA relates to Team Performance	+
3c	MMS moderates the MMA and Team Performance relationship	+
4a	MMS mediates the Cognitive Style Diversity and Team Performance relationship	
4b	MMA mediates the Cognitive Style Diversity and Team Performance relationship	
5a	Information Integration Mechanisms moderate the Cognitive Style Diversity and MMS relationship	-
5b	Information Surfacing Mechanisms moderate the Cognitive Style Diversity and MMA relationship	+

CHAPTER 3

METHODOLOGY

3.1 Overview

This study was conducted using student teams working on a complex decision-making simulation exercise, in which the team members are required to work together to come up with a solution to a business problem. In addition to the simulation data, primary survey data was collected. The hypotheses were tested via multiple regression. In this chapter, I will discuss the study sample, the task and procedure, the measures used in this research.

3.2. Sample

3.2.1 Participants

For this research I used a sample of student teams. I had several reasons for selecting this sample. First, to conduct meaningful team analyses on the construct of team mental models, ideally, all teams should make similar decisions, which means that the teams should conduct identical tasks. This is extremely difficult to achieve in an organizational setting. Second, to assess the accuracy of the mental model, it is preferable that the team task has one, or a series of, right answers. Again, in organizations the concept of a single right answer is much more difficult to realize.

280 undergraduate students in the College of Management participated in the simulation as a part of their course requirement for which they receive course credit. The characteristics of the sample were as follows: the average age was 20.52 years old, 38.7% were female, 2.9% were Freshmen, 28.3% were Sophomores, 50.5% were Juniors, and

18.3% were Seniors. The racial makeup of the sample was 6.9% African American/black, 16.6% Asian/Pacific Islander, 69.7% Caucasian/white, 1.8% Hispanic/Latino/a, .4% Native American, 2.9% Multiracial, and 1.8% Other. The sample reported their major of study to be 84.8% Management, 6.8% Engineering, 5.4% Building Construction, 2.2% International Affairs, .4% Computer Science, and .4% Biology.

Because of the voluntary nature of the study, it was not possible to form teams of an equal number of participants. Of the total sample of 280 participants, 270 were part of a team, specifically 82 teams of three, and 12 teams of two. Ten participants were not part of a team so they completed the task on their own and were excluded from the data analysis for a final sample of 94 teams.

3.3 Procedures

The present study investigated student teams as they participate in an organizational decision-making simulation in a laboratory environment. This research incorporated a combination of experimental and survey methods to assess the relationship between cognitive diversity, team mental models, and information processes in decision-making teams.

3.3.1 Task

The selection of the team task is very important since researchers have found that the team task is one of the central variables to understanding team effectiveness (e.g., Hackman, 1987; Ilgen et al., 2005; Kozlowski & Ilgen, 2006). For purposes of this research, the task should be representative of knowledge tasks in organizations, it should be sufficiently interdependent by involving a fair amount of communication and sharing of unique perspectives so that the team is able to develop mental model similarity, while at the same time there needs to be a demonstrable right answer so that the teams' mental model accuracy can be measured. To select a task, I consulted McGrath's Group Task Circumplex (1984). McGrath (1984) proposed 8 task types which are organized in a circular pattern: decision making, intellective, creative, planning, performance/ psychomotor, competitive, mixed motive, and cognitive conflict. Three task types from this classification fit this study's requirements best: intellective, decision-making, and cognitive conflict tasks. According to McGrath (1984), intellective tasks have a correct answer which is based on expert consensus. Decision making tasks involve selecting a preferred solution, or set of solutions, to a specific problem or scenario based on peer consensus. Often team performance is assessed on the quality of team decisions (Prewett, Gray, Stilson, Rossi, & Brannick, 2007). Finally, cognitive conflict tasks deal with resolving conflicting viewpoints. An intellective or decision making task in a diverse team can often result in a cognitive conflict task (Dzindolet, Pierce, & Dixon, 2008) and is thus particularly well suited for this research project. McGrath's (1984) task types "are not mutually exclusive, but rather capture the predominant requirements of the task" (Prewett et al., 2007, p. 11). The closer the positions of the tasks on the circumplex (like the adjacent intellective, decision-making and cognitive conflict task types) the more similar they are (Dzindolet et al., 2008). Therefore, it is possible, and for this research it is preferred, to have elements from intellective, decision-making and cognitive conflict task types represented in a single task.

For these reasons I chose the Farm E-Z task (Joyce, 2003 but originally published in Pfeiffer & Jones, 1974). Farm E-Z is a small producer of agricultural equipment that has recently introduced a new product. "The decision concerns how to reverse losses attributable to this new product in the near term and how to sustain profits in the long run" (Stumpf, Freeman, & Zand, 1979, p. 773). The Farm E-Z task is a complex problem-solving/decision-making task which requires the evaluation of a large amount of complex information, and was presented in various formats, so that team members can help each other to incorporate all given information into a team decision. The task contains elements from intellective, decision-making and cognitive conflict task types which is important for the development of mental models, and includes a correct decision classification scheme which will be used to compute the mental model accuracy score. Due to the variety in the content and format of the information that team members need to work through in performing the task, team members' cognitive styles were expected to be important in determining the range and quality of information that is extracted and used by the team members. Farm E-Z is also representative of an organizational task since it involves the solving of a common organizational problem and the making of organizational decisions.

3.3.2 Procedure

Participants were randomly assigned to teams. After informed consent was obtained, the participants filled out a small survey about their demographics and cognitive style. Then the task was introduced to participants as an organizational team decision-making task. Participants are told that they are part of a consulting team that was hired by the General Manager of Farm E-Z, a small producer of agricultural equipment, to investigate the declining profit margins of their newest grinder-blower product. The purpose of the consulting team was to understand the root causes of the decline in profits for this innovative product.

All team members were given the content of 27 short emails that represent the correspondence between the General Manager and four of his senior managers, the New Products Coordinator, the Manager of Accounting, the Chief Engineer, the Sales Manager, and the Manufacturing Superintendent. The emails contain a wide range of information about the company's new grinder-blower product including customer complaints, production capability concerns, sales and profit/loss data, distributor advice, and repair problems which were presented in both visual and verbal form. The participants then had 20 minutes to study the information given to them. After the designated study period, the researcher handed out a Problem Classification Sheet which the participants individually filled out by indicating to what extent they perceived the 24 problem areas that were identified in the task as being a true problem, a symptom, a future problem, or irrelevant.

Teams then received verbal and written task instructions and were assigned to teams and given a private workroom. The team instructions were used to manipulate the information processing mechanisms which will be discussed in more detail below. Teams were instructed to work together for the next 20 minutes by discussing, evaluating, and deciding on root causes of Farm E-Z's problem. After the 20 minutes, the individual participants then again filled out the Problem Classification Sheet provided with the exercise by the authors. At this time the questions that served as the manipulation checks were also given. Then, teams were instructed to take 15 minutes to come up with their recommendations as a team. Teams were asked to write down their proposed recommendation(s), the problems that it (they) is (are) supposed to solve, and whether they foresee any future problems or consequences associated with their recommendations

(See Appendix A for the solution sheet). At this time, teams were reminded of the $150 cash reward that they could win if their team is one of the three teams who provides Farm E-Z with the best recommendations. After task completion, students filled out a last survey about team process and outcome variables. Finally, participants were thanked for their participation and urged not to divulge the details of the study with classmates who had not yet participated. The simulation took approximately 1.75 - 2 hours to complete. (See Figure 3 for the experiment time line and Table 6 for an overview of which measures were taken during what point in time).

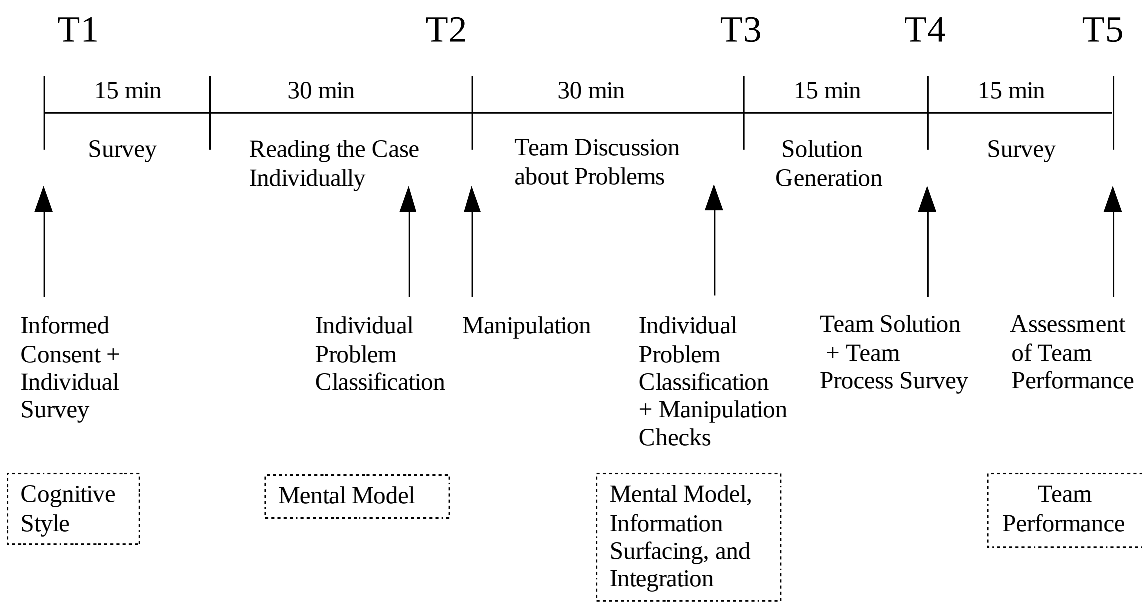

Figure 3. Timing of Measurements

3.3.3 Design and Manipulations

This study had 4 experimental conditions: an information surfacing only condition, an information integration only condition, an information surfacing *and* information integration condition, and a control condition. The teams were randomly assigned to experimental conditions. The team information processing mechanisms were manipulated by using different instructions for the team task. In the information surfacing condition, participants were instructed that the objective of the discussion is to surface as many ideas and viewpoints as possible regarding the issues facing the company. To do this, teams were told that they should encourage all team members to share their ideas, make sure that every team member voices his or her perspective on the task, work together to uncover a wide range of ideas and perspectives, ask for elaboration of unique ideas and opinions expressed by others, give everyone in the team the opportunity to share his or her perspective, and to surface as many ideas as possible before critiquing or discussing these ideas.

For the information integration condition, participants are instructed that the objective of the discussion is to develop an integrated picture of Farm E-Z’s situation as a team by incorporating the ideas and opinions of all team members. To do this, teams were told that they should be open to rethink and adjust their own views and assumptions based on the views of the other members of their team, consolidate and integrate the ideas and opinions from other team members into one’s own perspective, and to try to effectively connect each other’s viewpoints into an integrative picture of the issues facing Farm E-Z.

For the information surfacing and integration condition, the instructions of the information surfacing and those of information integration conditions were combined. In contrast, teams in the control condition received generic task instructions. The manipulation instructions are listed in Appendix B.

To control for possible order effects, the order of the conditions were randomized across the study days so that, for example, not all control conditions would be given early in the morning. (See Table 4 for an overview of the study conditions).

Table 4. Randomized Order of Study Conditions

		Number of Teams in Time Period			
		9:30-11:30	12:30-2:30	3:30-5:30	Total
Condition	Control	8	7	6	**21**
	IS	7	9	9	**25**
	II	6	8	9	**23**
	IS/II	8	8	9	**25**
	Total	**29**	**32**	**33**	**94**

3.4 Measures

3.4.1 Cognitive Diversity

Cognitive diversity on thinking styles was measured via the Object-Spatial Imagery and Verbal Questionnaire (OSIVQ) developed by Blazhenkova and Kozhevnikov (2009). This measure distinguishes between three types of cognitive styles: object imagery, spatial imagery, and verbal preference. The dimensions of the OSIVQ have demonstrated acceptable test-retest reliability and they have been found to correlate significantly with other measures and tests of these dimensions (Blazhenkova & Kozhevnikov, 2009). Example items of the verbal style are: "I would rather have a verbal description of an object or person than a picture" and "When explaining something, I would rather give verbal explanations than make drawings or sketches" ($\alpha = .80$). Sample items of the object style include: "I can easily remember a great deal of visual details that someone else might never notice" and "I remember everything visually" ($\alpha = .83$). I can recount what people wore to a dinner and I can talk about the way they sat and the way they looked probably in more detail than I could discuss what they said". Example items of the spatial style include: "When reading a textbook, I prefer schematic illustrations (e.g., diagrams and sketches) instead of colorful pictures" and "I find it difficult to imagine how a three –dimensional geometric figure would exactly look like when rotated (reverse coded)" (α = .88).

Confirmatory factor analysis (CFA) indicated that all items had high loadings on their respective scales (with the exception of five of the verbal items which loaded at 0.04, 0.10, 0.05, 0.11, and -.019 and one item in the object scale that had a loading of .10 and which were subsequently deleted from their respective scales). The confirmatory model for the three-factor solution also indicated an adequate overall fit with the data (χ^2 = 1789.29, df = 699, p < .01, RMSEA = .078, NNFI = .85, CFI = .86), and indicated a better fit than for a two-factor solution, by combining the object and spatial imagery cognitive styles, or a one-factor solution which combines all three styles.

Table 5. CFA Results of the Cognitive Style Dimensions

Model	***df***	***X^2***	***p***	***$\Delta X^{2\,a}$***	***p***	***NNFI***	***CFI***	***RMSEA***
3 Factor Model	699	1789.29	.000	---	---	.85	.86	.078
2 Factor Model	701	3590.47	.000	1801.18	<.001	.75	.76	.126
1 Factor Model	702	4735.70	.000	2946.41	<.001	.66	.68	.149

[a] ΔX2 from Hypothesized model.
[b] NNFI = LISREL Non-Normed Fit Index; CFI = Comparative Fit Index; RMSEA = Root Mean Square Error of Approximation
[c] N = 259

Most researchers measuring team diversity use variance-based measures of individual characteristics to form team-level indicators. These measures include the standard deviation, variance, proportions, Blau (1977) index, or coefficient of variation. It is important to choose the right measure of team diversity so that it matches the type of diversity studied otherwise one may draw erroneous conclusions (Harrison & Klein, 2007). Since the three cognitive styles have an assumed measurement scale of interval data, defined by Harrison and Klein (2007) as a separation type of diversity, the standard deviation was used to calculate a measure of dispersion of each cognitive style in each team. Overall, team cognitive style diversity was then calculated as the average standard deviation of the three cognitive styles of the team members.

3.4.2 Team Task Mental Model

There are numerous ways to measure team mental models. Because there is not yet agreement in the field of how to best assess mental models, and their level of convergence, several methods have been used including concept mapping, similarity ratings, and survey data (See Langan-Fox, Code, & Langfield-Smith, 2000; Klimoski & Mohammed, 1994 for reviews).

Mental Model Accuracy

I assessed the task-focused mental models with the use of matrices filled out by every individual team member. For the MMA, a matrix was used with potential problem areas down the side and the categories across the top. Participants were asked to classify each of 24 attributes in one of four categories: 1) symptoms, 2) true problems, 3) future problem, and 4) irrelevant information. This matrix was provided by the designers of the task and is based on expert assessments of the situation described in the task (Pfeiffer & Jones, 1974). Task MMA was measured by assessing to what extent the team members collectively identify all the objective criteria needed to perform the task correctly. That is, can the team, as a whole, identify Farm E-Z's true problems, symptoms, future problems, and irrelevant information for solving the problem? The mental models of the participants was compared with the correct problem categorization developed by the task authors (Pfeiffer & Jones, 1974) which serves as the expert referent mental model to calculate to what extent the team collectively has correctly classified all the potential problem areas. Thus, MMA is the number of items correctly classified by the team members combined compared to the expert classification of the 24 items, where the higher the score, the more accurate the team's mental model. For example, if in team A team member 1 correctly classified 6 problem areas, team member 2 has classified 5 other problem areas correctly, and team member 3 has correctly categorized yet 4 other problem areas, the team as a whole has correctly classified 15 problem areas. On the other hand, team B has 3 members who each have classified the same 10 items correctly. Team A's classification would give a MMA score of 15, while team B yielded a MMA score of 10 and thus team A would have a more accurate mental model than team B.

Each team member's responses was put in matrix-form in the Microsoft Excel software, this matrix consisting of the 24 problem areas along one side and the categories along the other side. The cells in the matrix included either a "1" for when the problem area was classified as a certain category or a "0" when the problem area was not classified as such. The individual ratings were aggregated to the team level by counting the number of problem areas that the team collectively classified correctly, to develop an indicator of the extent to which the aggregate team classifications correspond to the expert categorizations. The teams' MMA scores ranged from 10 to 21 at time 1 and from 10 to 22 at time 2.

Mental Model Similarity

The task MMS was assessed as the extent to which there is agreement and overlap in the individual knowledge structures of the team members and was developed solely for this study. The MMS measure asked the participants to rate on a scale from 1-7, the extent to which they saw the relationship between each combination of 7 main overarching problem areas (pricing, training, production, management, demand, parts & components, and external issues), stemming from the Farm E-Z case, as related to each other.

To calculate MMS, an index of agreement needed to be obtained. This analysis was carried out using a network analysis program, UCINET (Borgatti, Everett, & Freeman, 2002). Each team member's responses were put in matrix-form in the Microsoft Excel software, this matrix consisting of the 7 problem area pairs along both sides. The cells in the matrix included a rating from 1-7. These individual matrices form the inputs for the UCINET software program. An index of similarity, the quadratic assignment proportion (QAP correlation), was then generated for each pair of team members' mental model of the team task. QAP correlations are equivalent to Pearson correlations and range from –1 (complete dissimilarity) to +1 (complete overlap). This QAP correlation "captures the extent to which team member's models exhibit similar patterns of relationships" (Mathieu et al., 2005, p. 43). These correlations were then averaged to form the team MMS and became the input variable for the SPSS software program. The teams' MMS QAP correlations ranged from -.063 to .760 at time 1 and from -.174 to .913 at time 2. (See Appendix C for the MMS measure).

3.4.3 Team Performance

Team performance was assessed by rating the task solution by subject matter experts. A panel of three experts was used to develop a measure of an effective solution to Farm E-Z's true problems. The experts, using the same information given to the experimental teams, individually analyzed the Farm E-Z situation and created a set of dimensions they deemed appropriate to evaluate performance on the E-Z task. The three experts then discussed the three sets of performance dimensions and collectively decided on the following dimensions: Feasibility, efficiency, accuracy, comprehensiveness, novelty, logic, and awareness, for rating the effectiveness of the decision of each experimental group. In addition, they provided examples of superior and below average recommendations on these dimensions.

A group of three judges then analyzed the solution of each experimental team using the dimensions above to rate the effectiveness of each decision. The raters, who were employed specifically for this task, received special training on the case and the solution measure. They were instructed to rate highest those decisions that most clearly satisfy the criteria. The scores for each dimension were then averaged to get a team performance score for each rater. The scores of the three judges were subsequently averaged to get an overall team performance score for each team. The judges worked with the written decisions provided by each experimental group. The reliability of this measure was very low ($\alpha = .46$) and will thus not be used for further analyses.

In addition, each rater responded individually to five overall performance questions using a 7-point Likert scale from 1 (strongly disagree) to 7 (strongly agree): (a) "Overall, I feel confident that following the recommendations in this team's solution will solve the problem stated in the case exercise", (b) "Overall, I think that this team's solution is a good one for the problem described in the case exercise", (c) "Overall, I think this team's solution may cause more problems than it will solve" (reverse scored), (d) "Overall, I think this team's solution satisfied the stated or implied goals in the case exercise", and (e) "Overall, I expect this team's solution to be effective". An overall rating of team effectiveness was calculated by averaging the raters' responses to all questions ($\alpha = .95$). (See Appendix D for the team performance measures).

In addition, I have also assessed the team members' perception of their performance by asking the participants to rate the by Hackman (1987) suggested three components of team effectiveness: team performance, team viability and team satisfaction in the post-task survey. Perceived team performance was assessed via an adapted three-item scale by Kellermanns et al. (2008) on a scale of 1 (strongly disagree) to 7 (strongly agree). Example items were: "The final team decision reflected the best that could be extracted from the group" and "The final team decision was of much higher quality than the initial proposals of individual members" ($\alpha = .77$). Team viability was measured with a scale by Tekleab and colleagues (2009) which was adapted from an original scale by DeStephen and Hirokawa (1988). Sample items were: "I would be happy to work with the team members on other projects in the future" and "This team should not have continued to function as a team" (reverse scored) ($\alpha = .85$). Finally, satisfaction with the team was assessed on a scale of 1 (very dissatisfied) to 7 (very satisfied) via a scale constructed by Tekleab, Quigley and Tesluk (2009) who for this measure adapted scales from Van der Vegt, Emans, and Van de Vliert (2001) and Chatman and Flynn (2001). Sample items from this scale were: "I am satisfied with my present team members" and "I am very satisfied with working in this team" ($\alpha = .96$).

3.4.4 Manipulation Checks

The manipulation checks were assessed via Likert-type scales rated by the participants on a scale from 1 (strongly disagree) to 5 (strongly agree).

Information Surfacing Manipulation Check

Each individual indicated the extent to which they and their team mates communicated unique perspectives, discussed different viewpoints, and asked questions to better understand other members' points. Information surfacing was measured via a three-item scale that was specifically developed for this study, based on prior similar scales (e.g., Homan et al., 2007). Sample items included: "The team was encouraged to make sure that each team member voices his or her perspective on the task" and "My team members and I were told to share our ideas and viewpoints" ($\alpha = .85$).

Information Integration Manipulation Check

The participants reported on the extent to which they incorporated other's perspectives into their own interpretation of the team task. Sample items of this three-item scale include: "Team members were instructed to adjust their own perspectives on some of the issues to incorporate the views of other team members" and "My team members were encouraged to integrate the ideas and opinions of other team members into their own thinking on the Farm E-Z situation". These items were adapted from ones used in a scale by Mohammed and Ringseis (2001) ($\alpha = .91$).

ANOVA Analyses

To test the efficacy of the manipulations a one-way ANOVA was used. The ANOVA for the IS manipulation check indicated that it differed significantly across the four conditions $F(3, 269) = 22.42$, $p < .001$. The ANOVA for the II manipulation check also indicated that it differed significantly across the four conditions $F(3, 269) = 44.40$, $p < .001$. Tukey post-hoc comparisons of the four conditions indicated that for the IS manipulation check scale, the IS condition group ($M = 4.74$, 95% CI [4.60, 4.89]) differed significantly from the control group ($M = 3.84$, 95% CI [3.59, 4.08]) and from the II condition group ($M = 4.39$, 95% CI [4.18, 4.59]). Comparisons between the IS and II/IS condition groups were not statistically significant $p < .05$ for the IS manipulation check. So the participants in the control condition and the II condition reported to significantly lesser degree that they were instructed to share information than those in the IS condition. Whereas the participants in the IS condition and the IS/II conditions reported being told to share information to the same degree.

For the II manipulation check scale, the II condition group ($M = 4.51$, 95% CI [4.36, 4.65]) differed significantly from the control group ($M = 2.91$, 95% CI [2.64, 3.18]) and from the IS group ($M = 3.55$, 95% CI [3.26, 3.84]). Comparisons between the II and II/IS condition groups were not statistically significant at $p < .05$ for the II manipulation check. This means that the participants in the control condition and the IS condition reported to significantly lesser degree that they were instructed to integrate information than those in the II condition. Whereas the participants in the II condition and the IS/II conditions reported being told to integrate information to the same degree. Thus, the manipulations worked as intended.

3.4.5 Control Variables

The main hypothesized relationships between diversity and SMMs and between SMMs and team outcomes alternatively may be explained by enhanced team processes, prior experience with teams, familiarity with the task, history with the team members, or cognitive ability (e.g., Rentsch & Hall, 1994; Kraiger & Wenzel, 1997). To rule this out, in this research I also measured the main team processes of team cohesion, social integration, psychological safety, and conflict, as well as competitive and cooperative behaviors. In addition, participants were asked about their previous experience with this and similar tasks and to what extent they know their other team members via scales developed for this study.

Team conflict was measured by a 9-item scale by Jehn and Mannix (2001), which contains three subscales – task conflict ($\alpha = .80$), process conflict ($\alpha = .75$), and relationship conflict ($\alpha = .47$). An example item of task conflict subscale was: "How often do you have disagreements within your team about the task of the project you are working on?" and was rated on a scale from 1 (never) to 7 (very often). A sample item of the process conflict subscale was: "How often are there disagreements about who should do what in your team?" and an example item of relationship conflict was: "How often do people get angry while working in your team?"

Team cohesion was assessed by an adapted version of a measure developed by Dobbins and Zaccaro (1986) ($\alpha = .78$), rated on a scale from 1 (strongly disagree) to 7 (strongly agree). An example item of this scale was: "The team to which I belong is a close one."

Social integration was assessed via a measure by O'Reilly and colleagues (1989) ($\alpha = .84$) and rated on a scale from 1 (strongly disagree) to 7 (strongly agree). A sample item was: "Members of this team work together well".

Psychological safety was measured by a 7-item scale by Edmondson (1999) (α = .66). This measure was assessed on a rating scale from 1 (strongly disagree) to 7 (strongly agree) and an example item was: "Members of this team are able to bring up problems and tough issues with other team members".

Cooperative and competitive behaviors were measured with scales by Fisher and Gregoire (2006) and were rated on a scale from 1 (strongly disagree) to 5 (strongly agree). An example item of the cooperative behavior measure was: "My team members and I cooperated when we made the decisions" (α = .89). A sample item of the competitive behavior scale was: "I tried to get my teammates to "see things my way" by pressuring him or her to go along with what I wanted" (α = .76).

Task familiarity and team member familiarity were assessed via measures developed for this study. An example item of task familiarity was: "I have experience with exercises like this one" (α = .77). Team member familiarity was assessed with two questions developed for this study. The first question asked the participants: "How many of your teammates did you know before this exercise?" and a subsequent question tried to gauge the level of team member familiarity by asking: If you answered "one" or "both" in the previous question, how long, and in what capacity (friend, sports team member, coworker, classmate etc.) have you known the member(s) of your team?"

Prior team experience was measured via a measure by Eby and Dobbins (1997). This measure asks two questions: "Has your general experience working with teams been..?", which was rated on a scale from 1 (very negative) to 5 (very positive) and the following open ended question: "Approximately how many different teams have you worked on in the last five years?"

Cognitive style is not an ability, but rather a cognitive preference for how to use one's abilities – i.e., a form of preference for how one absorbs and processes information. Thus, empirical research has reported very low correlations between cognitive style and cognitive ability (Riding & Pearson, 1994). In summarizing this research, Sadler-Smith (2000, p. 192) observed that "empirical research supports the view that cognitive styles are…independent of intelligence." However, in order to verify that there is no confound between cognitive style and cognitive ability in this study, I assessed the students' general intelligence (*g*) as a measure of cognitive ability. General intelligence will be assessed using scores on the Scholastic Aptitude Test (SAT), which prior research has found to be an appropriate indicator of *g* (Frey & Detterman, 2004).

Finally, since surface-level (e.g., demographics) and deep-level (e.g., cognitive style) diversity variables have been found to relate differently to team outcomes (Harrison et al., 1998, 1999), the demographic variables of sex, race, age, and class year were collected from the participants to potentially include as control variables, should they be significantly associated with team performance. Since sex, race, and major are categorical variables, diversity on these categories was measured via the Blau (1977) index, whereas age and class year diversity were measured via the standard deviation.

3.4.6 Common Method Variance

This study was partially conducted using surveys. Although not uncommon for organizational studies, survey methodology is subject to common method bias. One could argue that the potentially significant relationships may be due to common method variance (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003) since the independent variable (cognitive diversity), moderating variables (information surfacing and integration mechanisms), and the mediating variable (mental models) were all measured as individual perceptions with a common source. To minimize this potential problem I used a different source to assess the dependent variable, I used a different method to measure the team mental models, and the surveys took place at different points in time (Podsakoff et al., 2003) (See Table 6 for an overview of the timing of the study measures). In addition, I used a data aggregation technique to reduce spurious effects by aggregating the variables to the team level.

Table 6. Overview of the Timing of Study Measures

Variable	Level of Analysis	Time of Assessment
Demographics	Individual	Time 1
Cognitive style diversity	Individual	Time 1
Task MMA and MMS	Individual	Time 2 and Time 3
Information Surfacing	Individual	Time 3
Information Integration	Individual	Time 3
Team Processes:		
Conflict, Social Integration, Psychological Safety, Cohesion, Cooperation, Competition	Team	Time 4
Other Team Outcomes:		
Perceived Performance, Satisfaction with Team and Decision, Viability	Team	Time 4
Task and Team Member Familiarity	Individual	Time 4
Team Performance	Team	Time 5

CHAPTER 4

ANALYSIS AND RESULTS

4.1 Data Analysis

4.1.1 Aggregation

This research examines variables at the team level of analysis, yet most of the team constructs investigated in this study are measured at the individual level. "Conceptually, this makes sense, given that individual team members are most familiar with the extent to which the team exhibits these attributes" (Gibson & Gibbs, 2006, p. 470). However, I needed to empirically establish appropriateness to aggregate them to the team level. For aggregation, first, the construct needs to be meaningful at the team level. Secondly, I needed to show statistically that team members have agreement on the extent to which the variables are present within their teams (i.e., within-team agreement) and also that there exist larger differences in these team constructs between teams than within teams (i.e., between-team variance) (Kenny & LaVoie, 1985; Klein et al., 2000).

Within-team agreement is the degree to which ratings from individuals are interchangeable. I estimated within-team agreement with the $r_{wg(j)}$ statistic of interrater reliability which ranges from 0 (no agreement) to 1 (complete agreement) (James, Demaree, & Wolf, 1984, 1993). It has been suggested that an indication of within-team agreement means a cutoff $r_{wg(j)}$ value of .70 (Bliese, 2000; Klein et al., 2000), and the higher the value of the $r_{wg(j)}$, the stronger is the agreement of the construct (James et al., 1984). Table 7 below gives an overview of the aggregation statistics for each team variable. The mean and median r_{wg} values (mean r_{wg} = .75-.97 and median r_{wg} = .89-.99) indicate strong within-team agreement about the team process and outcome variables.

Between-team variance was calculated via the intraclass correlation coefficients, $ICC_{(1)}$ and $ICC_{(2)}$. Between-team difference exists when the ICC(1) – the proportion of the total variance accounted for by group membership – is greater than zero. Scholars have suggested that when an $ICC_{(1)}$ value ranges from .05 to .20 and also has a significant ANOVA F-value, this shows that a statistically significant proportion of the variance across individuals is accounted for by group membership (Kenny & LaVoie, 1985; Bliese, 2000; James, 1982). Significant F values give an additional measure of interrater reliability amongst the raters (Edmondson, 1999). $ICC_{(2)}$ is the reliability of group means (Bliese, 2000) and a cutoff value of .60 is deemed acceptable for this statistic (Glick, 1985).

With the exception of process conflict ($ICC_{(1)}$ = .09; $ICC_{(2)}$ = .23), relationship conflict ($ICC_{(1)}$ = .10; $ICC_{(2)}$ = .25), and competitive behavior ($ICC_{(1)}$ = .03; $ICC_{(2)}$ = .09), Table 7 indicates that the variables have high $ICC_{(1)}$ values and have significant F values at the p <. 01 level. The $ICC_{(2)}$ values are a little on the low side, but this is probably due to the small team size (Bliese, 2000). Thus, since most of the constructs met the above criteria, I aggregated these individual-level data to the team level by calculating the mean across individuals in a team for each variable.

Table 7. Aggregation Statistics[a]

Variables	Mean Rwg	Median Rwg	$ICC_{(1)}$	$ICC_{(2)}$	*p*
Study Variables:					
IS Manipulation check	.75	.96	0.36	0.62	**
II Manipulation check	.89	.93	0.43	0.69	**
Information Surfacing	.92	.95	0.27	0.51	**
Information Integration	.92	.95	0.25	0.49	**
Team Performance	.94	.91	0.39	0.65	**
Other Team Variables:					
Team Cooperative Behavior	.97	.98	0.33	0.59	**
Team Competitive Behavior	.93	.89	0.03	0.09	ns
Team Decision Satisfaction	.93	.96	0.17	0.36	**
Team Cohesion	.93	.95	0.31	0.56	**
Team Social Integration	.94	.96	0.29	0.54	**
Team Psychological Safety	.89	.93	0.19	0.41	**
Team Decision Making Quality	.97	.93	0.15	0.34	**
Team Task Conflict	.91	.95	0.28	0.53	**
Team Process Conflict	.96	.99	0.09	0.23	ns
Team Relationship Conflict	.89	.98	0.10	0.25	ns
Team Viability	.99	.98	0.14	0.33	*
Satisfaction with Team Members	.81	.98	0.30	0.55	**

[a]N = 94, n = 270

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

4.2 Results

4.2.1 Control Variables

The zero-order correlations, means, and standard deviations for the team level variables are presented in Table 8. The correlations indicate that cognitive style diversity is not significantly associated with MMA, MMS, or team performance variables. The correlations also show that MMA and MMS are significantly negatively correlated, which may indicate that teams whose mental models are accurate, are not similar and vice versa. MMA is positively correlated with the team performance measures whereas MMS is negatively correlated with these measures. This may mean that accuracy of the task mental model enhances performance but similarity of the mental model harms performance.

Since the sample includes teams of two and three members, team size was used as a control variable. Also, Harrison and Klein (2007) argue for including the mean level as a control variable when calculating the standard deviation operationalization of diversity. Therefore, I controlled for the mean level of all three cognitive styles. In addition, the correlations show that team major diversity, team average class year, and the team average SAT score are significantly correlated with the independent and/or dependent variables in this study and could be considered as alternative explanations for the effects, thus these variables are also controlled for in subsequent analyses.

The other control variables tested (sex-, race-, age-, and class year diversity; experience with team work; team member- and task familiarity; team cooperative- and competitive behavior; team cohesion; team social integration; team psychological safety; team task-, process-, and relationship conflict) were not significantly related to the independent or dependent variables (team cognitive style diversity, MMA, MMS, or team performance) and thus were not controlled for in any subsequent analyses.

Table 8. Correlations, Means, Standard Deviations, and Reliabilities[a]

Variables[bc]	Mean	SD	1	2	3	4	5	6	7	8
1. Team size	2.87	.34	---							
2. Sex diversity (1=male)	.30	.22	.27	---						
3. Race diversity	.31	.23	.20	-.10	---					
4. Age diversity	1.34	2.33	-.18	.05	-.16	---				
5. Class year diversity	.39	.22	.04	-.09	-.08	.04	---			
6. Major diversity	.14	.24	-.02	-.03	-.05	.10	.15	---		
7. Average age (years)	20.50	1.12	.09	.10	-.04	.39	.20	-.04	---	
8. Average class year[d]	2.82	.47	.16	.19	-.00	-.05	.14	.04	.50	---
9. Average GPA score (out of 4)	3.05	.35	.04	.06	-.09	.17	-.04	-.13	-.01	-.06
10. Average SAT score (out of 2400)	1925.72	131.22	.09	-.18	-.03	.01	.04	.05	.07	.15
11. Average team experience (affective)	3.60	.55	-.08	.12	.23	-.05	-.03	-.16	-.01	-.08
12. Average team experience (number of teams)	5.63	3.85	.08	-.10	.14	-.05	-.00	.04	.17	-.02
13. Average team member familiarity (months)	1.81	4.23	.16	.06	.06	.03	.13	.14	.25	.22
14. Average team member familiarity (capacity)[e]	.31	.65	.17	-.03	.08	.09	.14	.10	.29	.13
15. Average Verbal Cognitive Style	3.25	.37	.11	.05	-.04	.17	-.03	.12	-.10	-.05
16. Average Object Imagery Cognitive Style	3.48	.34	-.15	-.02	-.04	.15	.07	.07	.08	-.03
17. Average Spatial Imagery Cognitive Style	2.91	.36	-.11	-.13	.02	.03	.17	.23	.26	.20
18. Verbal Cognitive Style Diversity	.57	.26	-.01	.10	.10	.10	.08	.05	.12	.09
19. Object Imagery Cognitive Style Diversity	.49	.30	-.04	.10	.05	-.18	-.20	-.16	-.06	.01
20. Spatial Imagery Cognitive Style Diversity	.52	.26	.08	.12	-.08	.10	.17	.15	.20	.06
21. Team Cognitive Style Diversity	.52	.16	.02	.19	.03	.00	.02	.01	.14	.09
22. Team Mental Model Accuracy	16.68	2.32	.46	.00	.09	-.13	-.04	.21	.11	.25
23. Team Mental Model Similarity	.26	.19	-.33	.05	-.11	.02	.16	.07	-.08	-.12
24.Team Information Surfacing	4.38	.39	-.10	-.05	.06	-.11	-.08	.03	-.01	-.03
25.Team Information Integration	4.38	.40	.07	-.04	.21	.03	-.06	.01	.11	.08
24. Team Cooperative Behavior	4.67	.33	-.01	.01	.07	.05	-.05	.03	.03	.01
25. Team Competitive Behavior	1.79	.45	-.02	.00	.10	-.10	-.05	.05	.02	.11
26. Team Task Familiarity	2.79	.60	.01	-.09	.15	.14	.19	.10	.15	.02
27. Team Solution Satisfaction	4.43	.41	-.06	-.06	.06	.08	-.21	-.04	.04	-.09
28. Team Cohesion	5.33	.59	-.02	-.09	.04	.04	.04	-.04	.14	.08
29. Team Social Integration	6.16	.56	-.09	.01	.08	.05	-.02	.04	.04	-.06
30. Team Psychological Safety	5.77	.51	.04	-.02	.19	-.06	-.07	-.02	.01	-.04
31. Team Perceived Solution Quality	6.00	.62	-.13	-.23	.27	.04	-.11	.07	-.08	-.27
32. Team Task Conflict	1.85	.61	.01	.03	.14	-.11	.05	.01	.13	.01
33. Team Process Conflict	1.30	.39	-.12	-.10	-.04	-.14	.12	.16	-.02	.12
34. Team Relationship Conflict	1.32	.35	-.19	.01	-.07	-.13	.13	.03	-.01	.08
35. Team Viability	6.30	.50	.07	.01	.12	-.05	.02	-.05	.05	.06
36. Satisfaction with the Team	6.26	.74	.16	-.01	.08	.08	-.07	-.05	.10	.01
37. Team performance	4.42	1.09	.15	.05	-.04	.00	.05	-.03	.18	.24

[a] $N = 94$

[b] Coefficient alphas appear in parentheses on the diagonal

[c] Correlations greater than .21 are significant at the $p < .05$ level.

[d] Class year: 1= Freshman, 2= Sophomore, 3= Junior, 4=Senior

[e] Team member familiarity (capacity): 0= don't know, 1= classmate, 2= mutual friends, 3= sports team member/coworker, 4= fraternity/sorority co-member, 5=friend

[f] Variables 23-25 are on a 5 point scale, variables 26-37 are on a 7-point scale

Table 8 (Continued). Correlations, Means, Standard Deviations, and Reliabilities[a]

Variables[bc]	9	10	11	12	13	14	15	16	17	18	19
1. Teamsize											
2. Sex diversity (1=male)											
3. Race diversity											
4. Age diversity											
5. Class year diversity											
6. Major diversity											
7. Average age (years)											
8. Average class year[d]											
9. Average GPA score (out of 4)	---										
10. Average SAT score (out of 2400)	.13	---									
11. Average team experience (affective)	-.03	-.29	---								
12. Average team experience (number of teams)	-.01	-.01	.11	---							
13. Average team member familiarity (months)	.04	.02	-.03	.15	---						
14. Average team member familiarity (capacity)[e]	.07	-.12	-.02	.27	.74	---					
15. Average Verbal Cognitive Style	.15	.35	-.10	.17	-.14	-.02	---				
16. Average Object Imagery Cognitive Style	-.04	-.03	.07	.12	.11	.08	-.06	(.80)			
17. Average Spatial Imagery Cognitive Style	-.12	.00	-.04	.31	.11	.20	-.06	.21	(.83)		
18. Verbal Cognitive Style Diversity	.03	.08	-.07	-.08	-.01	.09	.20	-.05	.06	(.88)	
19. Object Imagery Cognitive Style Diversity	-.02	-.15	-.03	-.04	-.00	-.03	-.16	-.04	-.15	-.05	---
20. Spatial Imagery Cognitive Style Diversity	.06	.11	-.02	.05	.09	.11	.09	.32	.17	.19	-.09
21. Team Cognitive Style Diversity	-.03	.01	-.07	-.04	.04	.09	.06	.13	.03	.61	.55
22. Team Mental Model Accuracy	.12	.09	.02	.08	.13	.07	.12	.09	.05	.03	-.13
23. Team Mental Model Similarity	.03	-.05	.04	-.03	-.03	-.10	-.08	.07	-.16	-.09	.18
24.Team Information Surfacing	.08	.02	.12	.03	.13	.11	.03	.01	-.22	.03	.21
25.Team Information Integration	.13	.17	.03	.15	.14	.09	.09	-.08	-.15	.08	.24
24. Team Cooperative Behavior	.16	.00	.04	.07	.10	.05	.15	.17	-.17	.01	.12
25. Team Competitive Behavior	-.02	-.00	.09	.08	.10	.04	-.01	-.14	.16	.02	-.04
26. Team Task Familiarity	-.19	-.09	.04	.29	.13	.08	.00	.33	.25	-.02	.32
27. Team Solution Satisfaction	.10	.01	.17	.23	.09	.16	.27	.15	-.01	-.06	.16
28. Team Cohesion	.17	-.16	.13	.27	.31	.46	.12	.20	-.05	.01	.12
29. Team Social Integration	.13	-.10	.21	.23	.09	.17	.13	.18	-.16	-.08	.14
30. Team Psychological Safety	.17	-.05	.08	.13	.12	.24	.17	.07	-.14	.07	.19
31. Team Perceived Solution Quality	-.01	-.07	.20	.26	.04	.12	.17	.08	.00	.01	.08
32. Team Task Conflict	.03	.21	.16	-.05	.10	.02	-.11	.19	.04	.12	-.06
33. Team Process Conflict	-.03	-.01	-.03	-.10	-.03	-.08	-.12	-.31	.13	.04	-.10
34. Team Relationship Conflict	-.10	-.13	.07	.03	.07	-.02	-.19	.13	.10	-.11	.01
35. Team Viability	.06	-.07	.11	.08	.05	.13	.10	.17	-.13	-.01	.14
36. Satisfaction with the Team	.15	-.08	.06	.12	.10	.20	.15	.10	-.22	.04	.13
37. Team performance	.04	.21	-.04	.06	.03	.02	.19	-.08	.20	.15	.03

[a] $N = 94$
[b] Coefficient alphas appear in parentheses on the diagonal
[c] Correlations greater than .21 are significant at the $p < .05$ level.
[d] Class year: 1= Freshman, 2= Sophomore, 3= Junior, 4=Senior
[e] Team member familiarity (capacity): 0= don't know, 1= classmate, 2= mutual friends, 3= sports team member/coworker, 4= fraternity/sorority co-member, 5=friend
[f] Variables 23-25 are on a 5 point scale, variables 26-37 are on a 7-point scale

Table 8 (Continued). Correlations, Means, Standard Deviations, and Reliabilities[a]

Variables[bc]	20	21	22	23	24	25	26	27	28	29
1. Teamsize										
2. Sex diversity (1=male)										
3. Race diversity										
4. Age diversity										
5. Class year diversity										
6. Major diversity										
7. Average age (years)										
8. Average class year[d]										
9. Average GPA score (out of 4)										
10. Average SAT score (out of 2400)										
11. Average team experience (affective)										
12. Average team experience (number of teams)										
13. Average team member familiarity (months)										
14. Average team member familiarity (capacity)[e]										
15. Average Verbal Cognitive Style										
16. Average Object Imagery Cognitive Style										
17. Average Spatial Imagery Cognitive Style										
18. Verbal Cognitive Style Diversity										
19. Object Imagery Cognitive Style Diversity										
20. Spatial Imagery Cognitive Style Diversity	---									
21. Team Cognitive Style Diversity	.60	---								
22. Team Mental Model Accuracy	.19	.04	---							
23. Team Mental Model Similarity	-.20	-.05	-.43	---						
24.Team Information Surfacing	-.06	.11	.05	.02	(.69)					
25.Team Information Integration	-.11	.13	.00	.02	.67	(.77)				
24. Team Cooperative Behavior	-.01	.07	.03	.01	.61	.57	(.89)			
25. Team Competitive Behavior	.11	.04	.09	-.12	-.14	-.16	-.26	(.76)		
26. Team Task Familiarity	.19	-.10	.07	-.18	-.01	-.08	.11	.14	(.77)	
27. Team Solution Satisfaction	-.10	.01	.01	.10	.41	.37	.65	-.26	.08	(.92)
28. Team Cohesion	.07	.12	.00	-.02	.50	.40	.59	-.21	.14	.59
29. Team Social Integration	.02	.06	.04	.06	.53	.45	.75	-.27	.07	.69
30. Team Psychological Safety	-.08	.11	.06	-.02	.51	.45	.59	-.36	-.06	.60
31. Team Perceived Solution Quality	-.13	-.02	-.02	.12	.44	.39	.51	-.18	.15	.67
32. Team Task Conflict	.00	.03	.08	-.03	-.01	.10	-.24	.28	-.17	-.21
33. Team Process Conflict	-.09	-.10	-.07	.08	-.09	-.13	-.32	.34	-.17	-.39
34. Team Relationship Conflict	-.02	-.06	-.12	.12	-.15	-.19	-.39	.32	-.07	-.43
35. Team Viability	.03	.10	.08	.04	.47	.44	.64	-.25	.10	.54
36. Satisfaction with the Team	.10	.16	.09	.06	.36	.46	.60	.18	.03	.58
37. Team performance	.04	.12	.10	-.13	.15	.09	.15	.03	-.01	.11

[a] $N = 94$
[b] Coefficient alphas appear in parentheses on the diagonal
[c] Correlations greater than .21 are significant at the $p < .05$ level.
[d] Class year: 1= Freshman, 2= Sophomore, 3= Junior, 4=Senior
[e] Team member familiarity (capacity): 0= don't know, 1= classmate, 2= mutual friends, 3= sports team member/coworker, 4= fraternity/sorority co-member, 5=friend
[f] Variables 23-25 are on a 5 point scale, variables 26-37 are on a 7-point scale

Table 8 (Continued). Correlations, Means, Standard Deviations, and Reliabilities[a]

Variables[bc]	30	31	32	33	34	35	36	37	38	39
1. Teamsize										
2. Sex diversity (1=male)										
3. Race diversity										
4. Age diversity										
5. Class year diversity										
6. Major diversity										
7. Average age (years)										
8. Average class year[d]										
9. Average GPA score (out of 4)										
10. Average SAT score (out of 2400)										
11. Average team experience (affective)										
12. Average team experience (number of teams)										
13. Average team member familiarity (months)										
14. Average team member familiarity (capacity)[e]										
15. Average Verbal Cognitive Style										
16. Average Object Imagery Cognitive Style										
17. Average Spatial Imagery Cognitive Style										
18. Verbal Cognitive Style Diversity										
19. Object Imagery Cognitive Style Diversity										
20. Spatial Imagery Cognitive Style Diversity										
21. Team Cognitive Style Diversity										
22. Team Mental Model Accuracy										
23. Team Mental Model Similarity										
24.Team Information Surfacing										
25.Team Information Integration										
24. Team Cooperative Behavior										
25. Team Competitive Behavior										
26. Team Task Familiarity										
27. Team Solution Satisfaction										
28. Team Cohesion	(.78)									
29. Team Social Integration	.74	(.84)								
30. Team Psychological Safety	.72	.75	(.66)							
31. Team Perceived Solution Quality	.50	.65	.59	(.77)						
32. Team Task Conflict	-.24	-.27	-.16	-.07	(.80)					
33. Team Process Conflict	.36	.48	-.42	-.33	.52	(.75)				
34. Team Relationship Conflict	-.33	-.43	.52	-.31	.38	.57	(.47)			
35. Team Viability	.75	.73	.68	.53	-.25	-.49	-.47	(.85)		
36. Satisfaction with the Team	.67	.71	.66	.52	-.32	-.50	-.51	.72	(.96)	
37. Team performance	.01	-.11	.00	-.00	.07	.17	-.01	-.01	.02	(.95)

[a] $N = 94$

[b] Coefficient alphas appear in parentheses on the diagonal

[c] Correlations greater than .21 are significant at the $p < .05$ level.

[d] Class year: 1= Freshman, 2= Sophomore, 3= Junior, 4=Senior

[e] Team member familiarity (capacity): 0= don't know, 1= classmate, 2= mutual friends, 3= sports team member/coworker, 4= fraternity/sorority co-member, 5=friend

[f] Variables 23-25 are on a 5 point scale, variables 26-37 are on a 7-point scale

4.2.1 Test of Hypotheses

The hypotheses were tested via a two-step hierarchical regression analysis. I entered the control variables in Step 1, the centered independent variables and interaction terms calculated by multiplying the centered independent variables and moderating variables in Step 2.

Table 9 below presents the results of tests of Hypothesis 1. Hypothesis 1 suggested a positive relationship between team cognitive style diversity and team performance. However, the regression analysis revealed no significant effect on team performance (β = .10, p > .10). Therefore, Hypothesis 1 is not supported.

Table 9. Regression Results for Cognitive Style Diversity and Team Performance[a]

Variables	Team Performance					
	Model 1			Model 2		
	B	*SE*	*β*	*B*	*SE*	*β*
Control Variables						
Team size	.33	.34	.10	.32	.34	.10
Average class year	.39	.24	.17	.37	.25	.16
Average SAT score	.00	.00	.12	.00	.00	.12
Verbal Cognitive style	.45	.32	.15	.42	.32	.14
Object Cognitive style	-.29	.34	-.09	-.34	.34	-.10
Spatial Cognitive style	.63†	.32†	.21†	.63†	.32†	.21†
Independent Variables						
Cognitive style diversity				.70	.69	.10
R^2			.16*			.17
Adjusted R^2			.10*			.10
ΔR^2			.16*			.01
F			2.71*			2.47*

[a] N = 94.
[b] *B* = unstandardized regression coefficients, *β* = standardized regression coefficients, *SE* = standard error.
* p < .05, ** p < .01, † p < .10

Table 10 presents the results of tests of Hypotheses 2a and 2b. Hypothesis 2a proposed team cognitive style diversity to have a negative effect on MMS and a positive effect on MMA. These results suggest that team cognitive style diversity had no significant effects on both MMA (β = -.01, $p > .10$) and MMS (β = -.04, $p > .10$). Since there were no significant direct effects between cognitive style diversity and MMA and MMS, Hypotheses 2a and 2b were not supported.

Table 10. Regression Results for Cognitive Style Diversity and Team Mental Models[a]

	Dependent Variables											
Variables	**Team Mental Model Accuracy**						**Team Mental Model Similarity**					
	Model 1			Model 2			Model 1			Model 2		
	B	*SE*	*β*	*B*	*SE*	*β*	*B*	*SE*	*β*	*B*	*SE*	*β*
Control Variables												
Team size	3.01**	.64**	.45**	3.01**	.65**	.45**	-.19**	.06**	-.34**	-.19**	.06**	-.34**
Major diversity	1.84*	.91*	.19*	1.84*	.92*	.19*						
Average class year	.86†	.46†	.18†	.86†	.46†	.18†						
Verbal Cognitive style	.41	.57	.06	.41	.58	.07	-.03	.05	-.05	-.03	.05	-.05
Object Cognitive style	1.04	.64	.15	1.04	.65	.15	.04	.06	.06	.04	.06	.07
Spatial Cognitive style	-.03	.62	-.00	-.03	.63	-.00	-.11*	.05*	-.22*	-.11*	.05*	-.21*
Independent Variables												
Cognitive style diversity				-.11	1.33	-.01				-.05	.12	-.04
R^2			.31**			.31			.16**			.16
Adjusted R^2			.26**			.25			.12**			.11
ΔR^2			.31**			.00			.16**			.00
F			6.41**			5.43**			4.04**			3.23*

[a] N = 94.

[b] *B* = unstandardized regression coefficients, *β* = standardized regression coefficients, *SE* = standard error.

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

Hypothesis 3a and 3b predicted that MMS and MMA would be positively related to team performance. Tables 11 and 12 shows the regression results for Hypotheses 3a, 3b, and 3c. The regression results indicate that both MMS and MMA are not significantly related to team performance (β = -.09, $p > .10$ for MMS and β = -.01, $p > .10$ for MMA)

Table 11. Regression Results for Team Mental Models and Team Performance[a]

Variables	Team Performance											
	Model 1			Model 2			Model 1			Model 2		
	B	*SE*	*β*	*B*	*SE*	*β*	*B*	*SE*	*β*	*B*	*SE*	*β*
Control Variables												
Team size	.32	.33	.10	.32	.38	.10	.41	.33	.13	.31	.35	.10
Major diversity	-.20	.47	-.04	-.20	.48	-.04						
Average class year	.46†	.24†	.20†	.47†	.25†	.20†						
Average SAT score	.00†	.00†	.17†	.00†	.00†	.17†	.00†	.00†	.19†	.00†	.00†	.18†
Independent Variables												
Team Mental Model Accuracy				-.00	.06	-.01						
Team Mental Model Similarity										-.53	.64	-.09
R^2			.10*			.10			.06†			.06
Adjusted R^2			.06*			.05			.03†			.03
ΔR^2			.10*			.00			.05†			.01
F			2.45*			1.94†			2.54†			1.92

[a] N = 94.
[b] *B* = unstandardized regression coefficients, *β* = standardized regression coefficients, *SE* = standard error.
* $p < .05$, ** $p < .01$, † $p < .10$

Hypothesis 3c proposed an interaction effect between MMA and MMS predicting a positive effect on team performance. The results indicate a significant moderated effect for team performance (β = .21, $p = .05$). In sum, the direct effect Hypotheses 3a and 3b are not supported, while the interaction Hypothesis 3c was supported.

Table 12. Regression Results for MMA x MMS and Team Performance[a]

Variables	Team Performance					
	Model 1			Model 2		
	B	*SE*	*β*	*B*	*SE*	*β*
Control Variables						
Team size	.30	.33	.09	.13	.38	.04
Major diversity	-.17	.47	-.04	-.17	.48	-.04
Average class year	.48*	.24*	.21*	.50*	.24*	.22*
Average SAT score	.00	.00	.16	.00	.00	.13
Independent Variables						
Team Mental Model Accuracy				-.05	.14	-.05
Team Mental Model Similarity				-.05	.13	-.04
Interaction Effect						
Team Mental Model Accuracy x Team Mental Model Similarity				.19†	.10†	.21†
R^2			.10†			.14†
Adjusted R^2			.06†			.07†
ΔR^2			.10†			.04†
F			2.32†			1.94†

[a] N = 94.
[b]*B* = unstandardized regression coefficients, *β* = standardized regression coefficients, *SE* = standard error.
* $p < .05$, ** $p < .01$, † $p < .10$

To examine the nature of the significant interaction effects, I plotted the MMA - team performance relationship for different levels of MMS – the mean, one standard deviation above the mean, and one standard deviation below the mean. Figure 4 shows a positive relationship between MMA and team performance when MMS is high and a negative relationship when MMS is low.

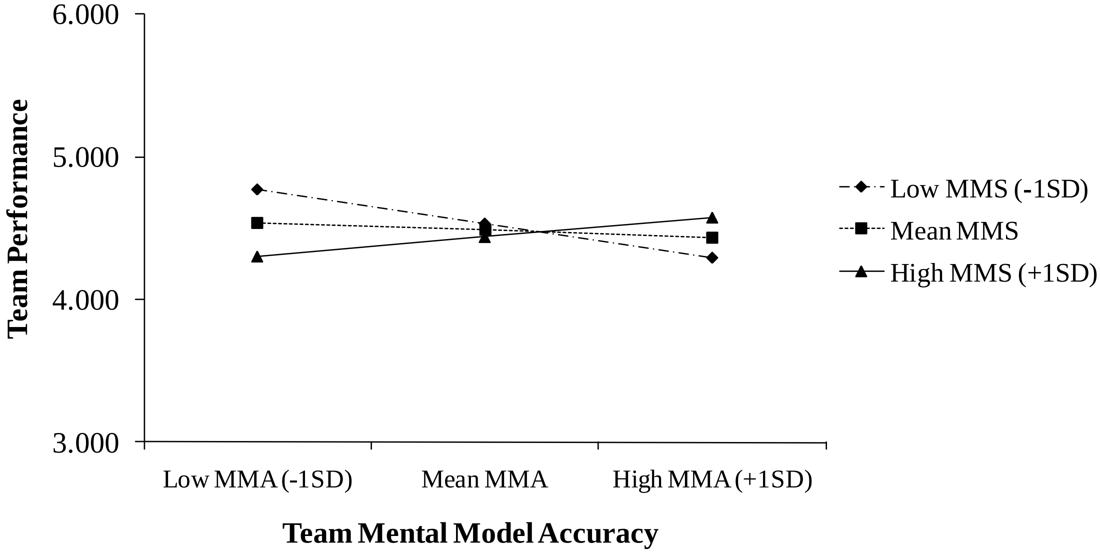

Figure 4. Interaction Effect of Mental Model Accuracy and Mental Model Similarity on Team Performance

Hypothesis 4 stated that MMA and MMS would mediate the relationship between cognitive style diversity and team performance. For a mediation analysis to be conducted, it is necessary that there is a significant effect for the independent variable (cognitive style diversity) on the mediators (MMA and MMS). Since no such significant effect existed in this study, it was not warranted to test for mediation effects. Therefore, Hypotheses 4a and 4b are not supported.

Tables 13 and 14 present the results of test of Hypotheses 5a and 5b. Hypothesis 5a proposed a moderating effect of team information integration mechanisms on the relationship between cognitive style diversity and MMS. Results indicate that the II condition did not significantly moderate the cognitive style diversity-MMS relationship ($\beta = .12$, $p > .10$). However, the interaction between team cognitive style diversity and the II condition did significantly impact MMA ($\beta = .24$, $p < .01$).

Table 13. Regression Results for the Effects of Cognitive Style Diversity x Information Integration Condition on Team Mental Models[a]

	Dependent Variables											
Variables	**Team Mental Model Accuracy**						**Team Mental Model Similarity**					
	Model 1			Model 2			Model 1			Model 2		
	B	*SE*	*β*	*B*	*SE*	*β*	*B*	*SE*	*β*	*B*	*SE*	*β*
Control Variables												
Team size	3.01**	.64**	.45**	3.31**	.63**	.48**	-.19**	.06**	-.34**	-.18**	.06**	-.32**
Major diversity	1.84*	.91*	.19*	1.88*	.88*	.19*						
Average class year	.86†	.46†	.18†	.85†	.45†	.17†						
Verbal Cognitive style	.41	.57	.06	.58	.56	.09	-.03	.05	-.05	-.02	.05	-.04
Object Cognitive style	1.04	.64	.15	1.13†	.62†	.16†	.04	.06	.06	.04	.06	.08
Spatial Cognitive style	-.03	.62	-.00	-.06	.60	-.01	-.11*	.05*	-.22*	-.12*	.05*	-.22*
Independent Variables												
Team cognitive style diversity				.03	.20	.01				-.01	.02	-.03
II condition				-.30	.20	-.13				.01	.02	.05
Interaction Effect												
Team cognitive style diversity x II condition				.57**	.21**	.24**				.02	.02	.12
R^2			.31**			.38*			.16**			.17
Adjusted R^2			.26**			.31*			.12**			.10
ΔR^2			.31**			.07*			.16**			.01
F			6.41**			5.69**			4.04**			2.53*

[a] N = 94.
[b]*B* = unstandardized regression coefficients, *β* = standardized regression coefficients, *SE* = standard error.
* $p < .05$, ** $p < .01$, † $p < .10$

The interaction was plotted in Figure 5. Instead of plotting the interaction at the mean and 1 standard deviation above and below the mean, only two slopes were plotted, one for the presence of the II condition and one for the absence of the II condition. The interaction plot shows a positive relationship between cognitive style diversity and MMA under the information integration condition and a negative relationship when the information integration condition was not present.

Hypothesis 5b proposed a moderating effect of team information surfacing mechanisms on the relationship between cognitive style diversity and MMA. Regression results indicate no significant interactions for team cognitive style diversity and the IS condition on either MMA (β = .08, p > .10) or MMS (β = -.16, p > .10).

Table 14. Regression Results for the Effects of Cognitive Style Diversity x Information Surfacing Condition on Team Mental Models[a]

	Dependent Variables											
Variables	**Team Mental Model Accuracy**						**Team Mental Model Similarity**					
	Model 1			Model 2			Model 1			Model 2		
	B	*SE*	*β*	*B*	*SE*	*β*	*B*	*SE*	*β*	*B*	*SE*	*β*
Control Variables												
Team size	3.01**	.64**	.45**	2.96**	.66**	.43**	-.19**	.06**	-.34**	-.17**	.06**	-.31**
Major diversity	1.84*	.91*	.19*	1.92*	.92*	.20*						
Average class year	.86†	.46†	.18†	.85†	.49†	.17†						
Verbal Cognitive style	.41	.57	.06	.46	.58	.07	-.03	.05	-.05	-.03	.05	-.07
Object Cognitive style	1.04	.64	.15	1.01	.67	.15	.04	.06	.06	.04	.06	.06
Spatial Cognitive style	-.03	.62	-.00	.04	.63	.01	-.11*	.05*	-.22*	-.13*	.05*	-.24*
Independent Variables												
Team cognitive style diversity				-.04	.22	-.02				-.01	.02	-.04
IS condition				-.18	.22	-.08				.01	.02	.05
Interaction Effect												
Team cognitive style diversity x IS condition				.19	.23	.08				-.03	.02	-.16
R^2			.31**			.32			.16**			.18
Adjusted R^2			.26**			.24			.12**			.12
ΔR^2			.28**			.01			.16**			.03
F			6.41**			4.34**			4.04**			2.72*

[a] N = 94.
[b] *B* = unstandardized regression coefficients, *β* = standardized regression coefficients, *SE* = standard error.
* p < .05, ** p < .01, † p < .10

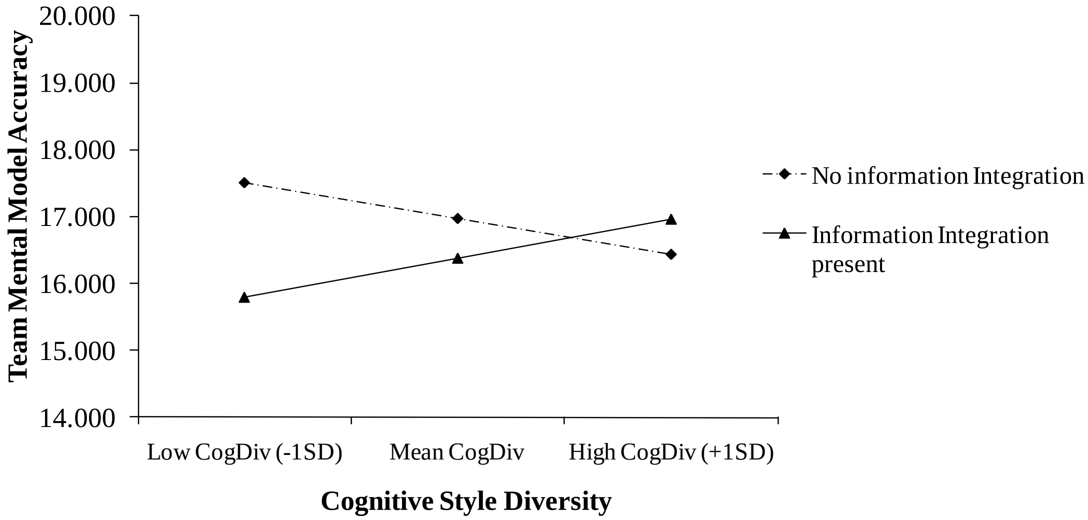

Figure 5. Interaction Effect of Cognitive Style Diversity and Information Integration Condition on Mental Model Accuracy

4.3 Post-hoc Analyses

4.3.1 Analyses of each cognitive style separately

To get a better idea of which cognitive style(s) makes the difference in the relationships that I have explored above, I ran these analyses again for each cognitive style separately. Task familiarity was significantly associated with object cognitive style diversity and will be controlled for in subsequent analyses. Tables 15-17 report on the direct effects of the different cognitive styles diversities on MMA, MMS, and team performance. Results indicate that there were no significant direct effects of diversity of any of the cognitive styles on MMA (β = -.00, p > .10 for verbal style, β = -.10, p > .10 for object imagery style, and β = .12, p > .10 for spatial imagery style), MMS (β = -.08, p > .10 for verbal style, β = .11, p > .10 for object imagery style, and β = -.14 p > .10 for spatial imagery style), or team performance (β = .10, p > .10 for verbal style, β = .07, p > .10 for object imagery style, and β = -.03, p > .10 for spatial imagery style).

Tables 18-23 below will report the results for the interaction effects of the three cognitive styles and the experimental conditions on MMA and MMS. The results indicate that there are no significant results for the interaction between verbal cognitive style and the information surfacing conditions on MMA (β =.06, p > .10), but there was a significant interaction effect for MMS (β = -.30, p < .01), which is not a result that was found in overall team cognitive style diversity results. Also, verbal cognitive style diversity interacted marginally significantly with information integration to affect MMA (β =.17, p < .10), but not MMS (β = -.04, p > .10). The interaction plot revealed a negative effect of verbal cognitive style diversity on MMS under information surfacing conditions, but a positive effect when information surfacing was not present (See Figure 6).

Team diversity on object cognitive style was not related to either MMA (β = -.00, p > .10) or MMS (β = .02, p > .10) when moderated by the IS condition. The interaction between object cognitive style diversity and II condition was marginally significant for MMA (β = -.15, p < .10) but not significant for MMS (β = .04, p > .10).

Spatial cognitive style diversity did not significantly interact with the IS condition for either MMA (β = .01, p > .10) or MMS (β = .03, p > .10). However, spatial cognitive style and the II condition together significantly predicted MMA (β = .17, p < .05), but not MMS (β = .06, p > .10). Figure 7 indicates a positive effect between spatial cognitive diversity and MMA under the information integration conditions and a more horizontal relationship when the information integration condition was not present.

These analyses indicate that under the information surfacing condition, only verbal cognitive style diversity has a significant impact on MMS, while in combination with the information integration condition, diversity of all three cognitive styles independently have an influence, although mostly marginal, on MMA, with spatial cognitive style diversity having the largest effect.

These analyses may thus also point to the fact that diversity of the three separate cognitive styles operate differently. To examine this claim, I looked at the patterns of relationships for these two significant interaction effects by plotting these interactions for the other cognitive styles (i.e., the effects of verbal and object cognitive style diversity in combination with the information integration condition on MMA; and the effects of object and spatial cognitive style diversity together with the information surfacing condition on MMS). I found that the patterns of relationships using the other cognitive styles were quite different from ones displayed in Figures 6 and 7, thus substantiating the argument that diversity on the three separate cognitive styles has different effects on the study variables.

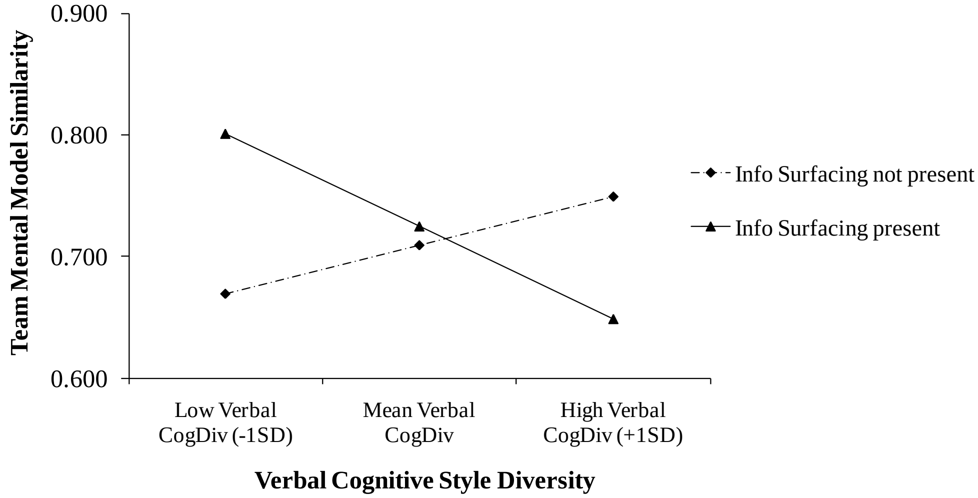

Figure 6. Interaction effect of Verbal Cognitive Style Diversity and Information Surfacing Condition on Mental Model Similarity

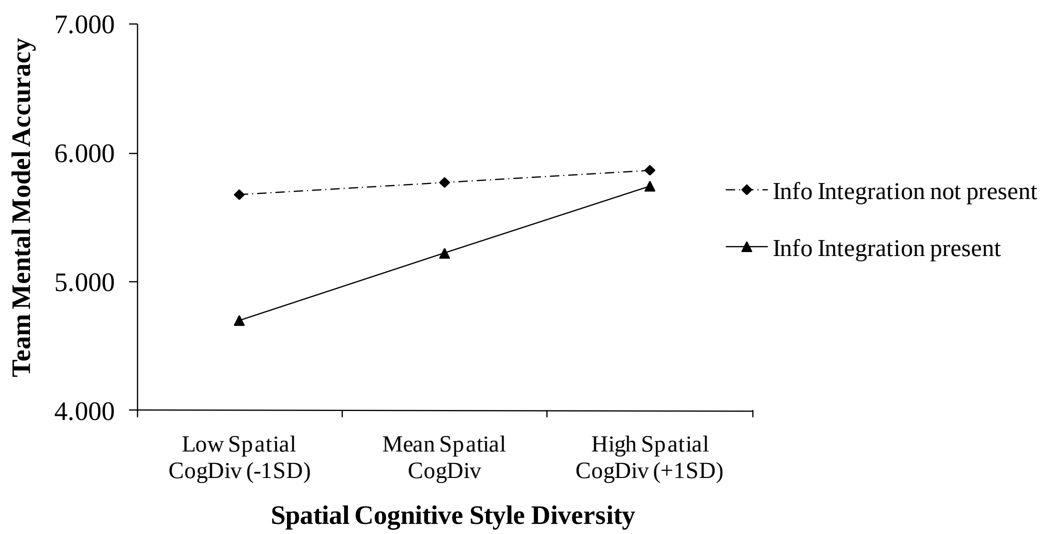

Figure 7. Interaction effect of Spatial Cognitive Style Diversity and Information Integration Condition on Mental Model Accuracy

Table 15. Regression Results for the Effects of Verbal Cognitive Style Diversity on Team Mental Models and Team Performance[a]

Variables	Dependent Variables																	
	Team Mental Model Accuracy						Team Mental Model Similarity						Team Performance					
	Model 1			Model 2			Model 1			Model 2			Model 1			Model 2		
	B	*SE*	*β*	*B*	*SE*	*β*	*B*	*SE*	*β*	*B*	*SE*	*β*	*B*	*SE*	*β*	*B*	*SE*	*β*
Control Variables																		
Team size	2.96**	.63**	.43**	2.96**	.64**	.43**	-.18**	.06**	-.33**	-.18**	.06**	-.33**	.27	.33	.08	.29	.33	.09
Major diversity	1.94*	.89*	.20*	1.94*	.89*	.20*												
Average class year	.85†	.45†	.17†	.85†	.45†	.17†							.50*	.24*	.22*	.48*	.24*	.21*
Average SAT score													.00	.00	.12	.00	.00	.12
Verbal cognitive style	.36	.57	.06	.36	.59	.06	-.02	.05	-.05	-.02	.05	-.03	.45	.32	.15	.39	.33	.13
Independent Variables																		
Verbal cognitive style diversity				-.02	.83	-.00				-.06	.07	-.08				.41	.43	.10
R^2			.29**			.29			.11*			.12			.12*			.13
Adjusted R^2			.25**			.24			.09*			.09			.08*			.08
ΔR^2			.29**			.00			.11*			.01			.12*			.01
F			8.86**			7.01**			5.61**			3.93*			2.94*			2.53*

[a] N = 94.

[b] *B* = unstandardized regression coefficients, *β* = standardized regression coefficients, *SE* = standard error.

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

Table 16. Regression Results for the Effects of Object Cognitive Style Diversity on Team Mental Models and Team Performance[a]

	Dependent Variables																	
Variables	**Team Mental Model Accuracy**						**Team Mental Model Similarity**						**Team Performance**					
	Model 1			Model 2			Model 1			Model 2			Model 1			Model 2		
	B	*SE*	*β*	*B*	*SE*	*β*	*B*	*SE*	*β*	*B*	*SE*	*β*	*B*	*SE*	*β*	*B*	*SE*	*β*
Control Variables																		
Team size	3.16**	.63**	.46**	3.14**	.63**	.46**	-.18**	.06**	-.31**	-.18**	.06**	-.31**	.28	.34	.09	.29	.34	.09
Major diversity	1.92*	.88*	.20*	1.79*	.89*	.20*												
Average class year	.83†	.44†	.17†	.85†	.44†	.17†							.46†	.24†	.20†	.46†	.24†	.20†
Average SAT score													.00†	.00†	.17†	.00†	.00†	.19†
Task Familiarity	-.04	.37	-.01	-.16	.39	-.01	-.07*	.03*	-.21*	-.05	.03	-.17	.03	.20	.02	.08	.21	.04
Object cognitive style	1.03	.66	.15	1.08	.66	.16	.05	.06	-.05	.05	.06	.09	-.22	.36	-.07	-.24	.37	-.07
Independent Variables																		
Object cognitive style diversity				-.75	.74	-.10				.07	.07	.11				.26	.40	.07
R^2			.30**			.31			.15**			.16			.10†			.11
Adjusted R^2			.26**			.26			.12**			.12			.05†			.04
ΔR^2			.30**			.01			.15**			.01			.10†			.00
F			7.63**			6.53**			5.15**			4.16**			1.98†			1.71

[a] N = 94.
[b] *B* = unstandardized regression coefficients, *β* = standardized regression coefficients, *SE* = standard error.
* $p < .05$, ** $p < .01$, † $p < .10$

Table 17. Regression Results for the Effects of Spatial Cognitive Style Diversity on Team Mental Models and Team Performance[a]

Variables	Dependent Variables																	
	Team Mental Model Accuracy						**Team Mental Model Similarity**						**Team Performance**					
	Model 1			Model 2			Model 1			Model 2			Model 1			Model 2		
	B	*SE*	*β*	*B*	*SE*	*β*	*B*	*SE*	*β*	*B*	*SE*	*β*	*B*	*SE*	*β*	*B*	*SE*	*β*
Control Variables																		
Team size	3.03**	.64**	.44**	2.95**	.64**	.43**	-.20**	.06**	-.35**	-.19**	.06**	-.34**	.42	.33	.13	.43	.34	.13
Major diversity	1.97*	.91*	.20*	1.84*	.91*	.19*												
Average class year	.80†	.46†	.16†	.80†	.46†	.16†							.35	.24	.15	.35	.24	.15
Average SAT score													.00†	.00†	.18†	.00†	.00†	.18†
Spatial cognitive style	.14	.61	.02	.02	.62	.00	-.11*	.05*	-.20*	-.09†	.05†	-.18†	.59†	.32†	.19†	.61†	.33†	.20†
Independent Variables																		
Spatial cognitive style diversity				1.05	.81	.12				-.10	.07	-.14				-.14	.42	-.03
R^2			.28**			.30			.15**			.17			.13*			.13
Adjusted R^2			.25**			.26			.13**			.14			.09*			.08
ΔR^2			.28**			.02			.15**			.02			.13*			.00
F			8.75**			7.39**			7.84**			5.95**			3.34*			2.67*

[a] N = 94.
[b] *B* = unstandardized regression coefficients, *β* = standardized regression coefficients, *SE* = standard error.
* $p < .05$, ** $p < .01$, † $p < .10$

Table 18. Regression Results for Verbal Cognitive Style Diversity x Information Surfacing Condition on Team Mental Models[a]

	Dependent Variables											
Variables	**Team Mental Model Accuracy**						**Team Mental Model Similarity**					
	Model 1			Model 2			Model 1			Model 2		
	B	*SE*	*β*	*B*	*SE*	*β*	*B*	*SE*	*β*	*B*	*SE*	*β*
Control Variables												
Team size	2.96**	.63**	.43**	2.85**	.65**	.41**	-.18**	.06**	-.33**	-.16**	.06**	-.29**
Major diversity	1.94*	.89*	.20*	2.02*	.90*	.21*						
Average class year	.85†	.45†	.17†	.78†	.48†	.16†						
Verbal cognitive style	.13	.21	.06	.13	.22	.06	-.01	.02	-.05	-.00	.02	-.00
Independent Variables												
Verbal cognitive style diversity				-.05	.23	-.02				-.02	.02	-.12
IS condition				-.25	.23	-.11				.01	.02	.04
Interaction Effect												
Verbal cognitive style diversity x IS condition				.15	.23	.06				-.06	.02	-.30**
R^2			.29**			.30			.11**			.21*
Adjusted R^2			.25**			.24			.09**			.16*
ΔR^2			.29**			.01			.11**			.10*
F			8.86**			5.24**			5.61**			4.50**

[a] N = 94.

[b] *B* = unstandardized regression coefficients, *β* = standardized regression coefficients, *SE* = standard error.

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

Table 19. Regression Results for Verbal Cognitive Style Diversity x Information Integration Condition on Team Mental Models[a]

Variables	Dependent Variables											
	Team Mental Model Accuracy						Team Mental Model Similarity					
	Model 1			Model 2			Model 1			Model 2		
	B	*SE*	*β*	*B*	*SE*	*β*	*B*	*SE*	*β*	*B*	*SE*	*β*
Control Variables												
Team size	2.96**	.63**	.43**	3.03**	.64**	.44**	-.18**	.06**	-.33**	-.19**	.06**	-.33**
Major diversity	1.94*	.89*	.20*	1.91*	.88*	.20*						
Average class year	.85†	.45†	.17†	.98	.45	.20						
Verbal cognitive style	.13	.21	.06	.21	.22	.09	-.01	.02	-.05	-.01	.02	-.04
Independent Variables												
Verbal cognitive style diversity				-.10	.22	-.04				-.01	.02	-.07
II condition				-.30	.21	-.13				.01	.02	.04
Interaction Effect												
Verbal cognitive style diversity x II condition				.39†	.22†	.17†				-.01	.02	-.04
R^2			.29**			.33			.11**			.12
Adjusted R^2			.25**			.27			.09**			.07
ΔR^2			.29**			.04			.11**			.01
F			8.86**			5.96**			5.61**			2.36**

[a] N = 94.

[b] *B* = unstandardized regression coefficients, *β* = standardized regression coefficients, *SE* = standard error.

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

Table 20. Regression Results for Object Cognitive Style Diversity x Information Surfacing Condition on Team Mental Models[a]

	Dependent Variables											
Variables	**Team Mental Model Accuracy**						**Team Mental Model Similarity**					
	Model 1			Model 2			Model 1			Model 2		
	B	*SE*	*β*	*B*	*SE*	*β*	*B*	*SE*	*β*	*B*	*SE*	*β*
Control Variables												
Team size	3.16**	.63**	.46**	3.09**	.65**	.45**	-.18**	.06**	-.31**	-.17**	.06**	-.31**
Major diversity	1.92*	.88*	.20*	1.81*	.91*	.19*						
Average class year	.83†	.44†	.17†	.74	.47	.15						
Task Familiarity	-.04	.37	-.01	-.17	.39	-.04	-.07*	.03*	-.21*	-.05	.04	-.17
Object cognitive style	.35	.22	.15	.33	.23	.14	.02	.02	.09	.02	.02	.09
Independent Variables												
Object cognitive style diversity				-.22	.22	-.10				.02	.02	.11
IS condition				-.18	.22	-.08				.01	.02	.06
Interaction Effect												
Object cognitive style diversity x IS condition				-.01	.22	-.00				.00	.02	.02
R^2			.30**			.32			.15**			.16
Adjusted R^2			.26**			.25			.12**			.11
ΔR^2			.30**			.02			.15**			.02
F			7.63**			4.90**			5.15**			2.79*

[a] N = 94.

[b] *B* = unstandardized regression coefficients, *β* = standardized regression coefficients, *SE* = standard error.

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

Table 21. Regression Results for Object Cognitive Style Diversity x Information Integration Condition on Team Mental Models[a]

	Dependent Variables											
Variables	**Team Mental Model Accuracy**						**Team Mental Model Similarity**					
	Model 1			Model 2			Model 1			Model 2		
	B	*SE*	*β*	*B*	*SE*	*β*	*B*	*SE*	*β*	*B*	*SE*	*β*
Control Variables												
Team size	3.16**	.63**	.46**	3.10**	.63**	.45**	-.18**	.06**	-.31**	-.17**	.06**	-.31**
Major diversity	1.92*	.88*	.20*	2.00*	.88*	.20*						
Average class year	.83†	.44†	.17†	.82†	.45†	.17†						
Task Familiarity	-.04	.37	-.01	-.19	-.38	-.05	-.07*	.03*	-.21*	-.05	.04	-.17
Object cognitive style	.35	.22	.15	.31	.22	.13	.02	.02	.09	.02	.02	.08
Independent Variables												
Object cognitive style diversity				-.20	.22	-.08				.02	.02	.11
II condition				-.28	.21	-.12				.00	.02	.02
Interaction Effect												
Object cognitive style diversity x II condition				-.36†	.21†	-.15†				.01	.02	.04
R^2			.30**			.35			.15**			.16
Adjusted R^2			.26**			.29			.12**			.10
ΔR^2			.30**			.05			.15**			.01
F			7.63**			5.67**			5.15**			2.75*

[a] N = 94.
[b]*B* = unstandardized regression coefficients, *β* = standardized regression coefficients, *SE* = standard error.
* $p < .05$, ** $p < .01$, † $p < .10$

Table 22. Regression Results for Spatial Cognitive Style Diversity x Information Surfacing Condition on Team Mental Models[a]

Variables	Dependent Variables											
	Team Mental Model Accuracy						Team Mental Model Similarity					
	Model 1			Model 2			Model 1			Model 2		
	B	*SE*	*β*	*B*	*SE*	*β*	*B*	*SE*	*β*	*B*	*SE*	*β*
Control Variables												
Team size	3.03**	.64**	.44**	2.90**	.65**	.42**	-.20**	.06**	-.35**	-.19**	.06**	-.34**
Major diversity	1.97*	.91*	.20*	1.88*	.92*	.19*						
Average class year	.80†	.46†	.16†	.69	.48	.14						
Spatial cognitive style	.05	.22	.02	.00	.22	.00	-.04*	.02*	-.20*	-.03†	.02†	-.17†
Independent Variables												
Spatial cognitive style diversity				.26	.22	.11				-.03	.02	-.14
IS condition				-.22	.22	-.10				.01	.02	.03
Interaction Effect												
Spatial cognitive style diversity x IS condition				.02	.22	.01				.01	.02	.03
R^2			.28**			.30			.15**			.17
Adjusted R^2			.25**			.25			.13**			.12
ΔR^2			.28**			.02			.15**			.02
F			8.75**			5.37**			7.84**			3.54**

[a] N = 94.
[b] *B* = unstandardized regression coefficients, *β* = standardized regression coefficients, *SE* = standard error.
* $p < .05$, ** $p < .01$, † $p < .10$

Table 23. Regression Results for Spatial Cognitive Style Diversity x Information Integration Condition on Team Mental Models[a]

	Dependent Variables											
Variables	**Team Mental Model Accuracy**						**Team Mental Model Similarity**					
	Model 1			Model 2			Model 1			Model 2		
	B	*SE*	*β*	*B*	*SE*	*β*	*B*	*SE*	*β*	*B*	*SE*	*β*
Control Variables												
Team size	3.03**	.64**	.44**	2.94**	.65**	.42**	-.20**	.06**	-.35**	-.19**	.06**	-.34**
Major diversity	1.97*	.91*	.20*	2.04*	.92*	.19*						
Average class year	.80†	.46†	.16†	.77†	.48†	.14†						
Spatial cognitive style	.05	.22	.02	-.02	.22	-.01	-.04*	.02*	-.20*	-.03†	.02†	-.18†
Independent Variables												
Spatial cognitive style diversity				.26	.21	.11				-.03	.02	-.14
II condition				-.27	.21	-.12				.01	.02	.04
Interaction Effect												
Spatial cognitive style diversity x II condition				.41*	.21*	.17*				.01	.02	.06
R^2			.28**			.34†			.15**			.17
Adjusted R^2			.25**			.29†			.13**			.12
ΔR^2			.28**			.06†			.15**			.02
F			8.75**			6.31**			7.84**			3.61**

[a] N = 94.
[b] *B* = unstandardized regression coefficients, *β* = standardized regression coefficients, *SE* = standard error.
* $p < .05$, ** $p < .01$, † $p < .10$

4.3.2 Information Surfacing and Information Integration Variables

Even though the manipulation check registered with the participants, the manipulation check does not guarantee that teams actually used these instructions in the process of interaction and work on the task. The correlations between the manipulation checks and the actual information surfacing and integration variables shows that teams did engage in more actual information surfacing when they recognized they needed to do the behaviors as described in the IS conditions ($r = .55$, $p < .01$) compared to those in the

II conditions (r = .33, p < .01). Similarly, teams did more information integration when they realized they needed to do the behaviors consistent with the II conditions (r = .48, p < .01) compared to those in the IS conditions (r = .41, p < .01), but the correlations between the conditions are not that different. Also, the correlations between the dummy-coded conditions and the actual variables showed that teams tended to do more information surfacing in the IS condition (r = .18, p < .10) compared to the II condition (r = .13, p = .217) and more information integration in the II condition (r = .22, p < .05) than in the IS condition (r = .09, p = .38), however these correlations are not particularly high. The information surfacing variable was measured via a scale developed for this study. An example item was: "My team encouraged all members to express their unique opinions and perspectives on the task" (α =.69). Information integration was measured with a scale partially created for this study and partially adapted from Mohammed and Ringseis (2001). A sample item was: "I integrated the viewpoints of other members of my team into my own perspective on the situation" (α =.77). The exploratory factor analysis for these two scales indicated two factors, one for information surfacing with item loadings of .84, .82, .58, and .42 and one for information integration with item loadings of .82, .77, .70, and .63. I thus proceeded to run my analyses with the actual information surfacing and integration variables to see whether these variables can help explain the non-findings for Hypotheses 5a and 5b.

Tables 24 and 25 show the regression results for these analyses for the team diversity measure using the average standard deviation of the cognitive styles. Results indicate that cognitive style diversity does not significantly interact with information surfacing to effect MMA (β = -.07, p > .10) and MMS (β = .15, p > .10). Information integration does not significantly moderate the relationship between cognitive style diversity and MMA (β = .02, p > .10), but it does significantly moderate the relationship between cognitive style diversity and MMS (β = .22, p < .05). This relationship is depicted in Figure 8. The interaction plot indicates a positive relationship between cognitive style diversity and MMS for teams that have high information integration and a negative relationship for teams that integrate information to a lesser extent.

Table 24. Regression Results for Cognitive Style Diversity x Team Information Surfacing on Team Mental Models[a]

	Dependent Variables											
Variables	**Team Mental Model Accuracy**						**Team Mental Model Similarity**					
	Model 1			Model 2			Model 1			Model 2		
	B	*SE*	*β*	*B*	*SE*	*β*	*B*	*SE*	*β*	*B*	*SE*	*β*
Control Variables												
Team size	3.12**	.64**	.45**	3.10**	.66**	.45**	-.19**	.06**	-.34**	-.19**	.06**	-.34**
Major diversity	1.79*	.91*	.18*	1.82*	.93*	.19*						
Average class year	.84†	.46†	.17†	.80†	.47†	.16†						
Verbal Cognitive style	.40	.57	.06	.38	.59	.06	-.03	.05	-.05	-.02	.05	-.04
Object Cognitive style	.92	.65	.13	.79	.69	.11	.04	.06	.06	.06	.06	.11
Spatial Cognitive style	-.01	.62	-.00	-.04	.65	-.01	-.11*	.05*	-.22*	-.12*	.05*	-.22*
Independent Variables												
Cognitive style diversity				.00	.22	.00				-.01	.02	-.04
Information Surfacing				-.06	.23	-.03				-.00	.02	-.03
Interaction Effect												
Cognitive style diversity x Information Surfacing				-.16	.22	-.07				.03	.02	.15
R^2			.31**			.31			.16**			.18
Adjusted R^2			.26**			.24			.12**			.11
ΔR^2			.31**			.00			.16**			.02
F			6.31**			4.14**			4.04**			2.65*

[a] N = 94.
[b] *B* = unstandardized regression coefficients, *β* = standardized regression coefficients, *SE* = Standard Error.
* p < .05, ** p < .01, † p < .10

Table 25. Regression Results for Cognitive Style Diversity x Team Information Integration on Team Mental Models[a]

Variables	Team Mental Model Accuracy						Team Mental Model Similarity					
	Model 1			Model 2			Model 1			Model 2		
	B	*SE*	*β*	*B*	*SE*	*β*	*B*	*SE*	*β*	*B*	*SE*	*β*
Control Variables												
Team size	3.12**	.64**	.45**	3.14**	.66**	.46**	-.19**	.06**	-.34**	-.17**	.06**	-.31**
Major diversity	1.79*	.91*	.18*	1.82*	.93*	.19*						
Average class year	.84†	.46†	.17†	.86†	.47†	.18†						
Verbal Cognitive style	.40	.57	.06	.43	.59	.07	-.03	.05	-.05	-.02	.05	-.03
Object Cognitive style	.92	.65	.13	.92	.67	.13	.04	.06	.06	.05	.06	.10
Spatial Cognitive style	-.01	.62	-.00	-.05	.64	-.01	-.11*	.05*	-.22*	-.10†	.05†	-.19†
Independent Variables												
Cognitive style diversity				.00	.22	.00				-.01	.02	-.05
Information Integration				-.11	.22	-.05				-.00	.02	-.01
Interaction Effect												
Cognitive style diversity x Information Integration				.05	.26	.02				.05*	.02*	.22*
R^2			.31**			.31			.16**			.20
Adjusted R^2			.26**			.24			.12**			.14
ΔR^2			.31**			.00			.16**			.05
F			6.31**			4.14**			4.04**			3.09**

[a] N = 94.

[b]*B* = unstandardized regression coefficients, *β* = standardized regression coefficients, *SE* = Standard Error.

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

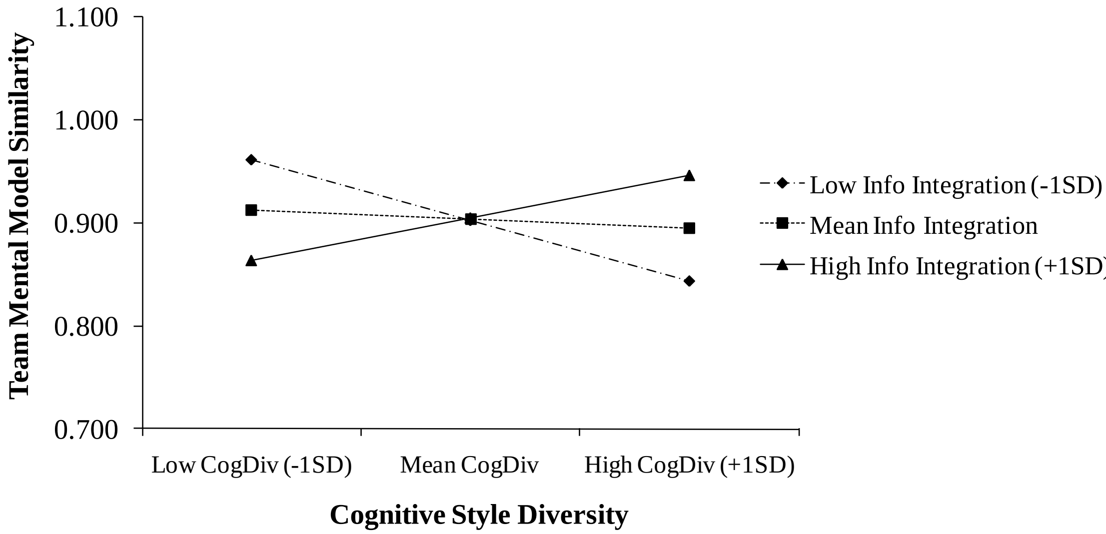

Figure 8. Interaction Effect of Cognitive Style Diversity and Information Integration on Mental Model Similarity

4.3.3 The Effects of TMM on Other Team Outcomes

Even though not hypothesized, it is possible that the mental model components influenced other team outcomes besides team performance. Since MMS is proposed to enhance the efficiency with which team members work together (e.g., Mathieu et al., 2000; Smith-Jentsch et al., 2001) it is probable that MMS has a positive effect on more affective team outcomes such as team viability, satisfaction with the team members, and satisfaction with the team solution. MMA is suggested to improve the effectiveness of the team and may thus also impact the teams' own perception of their performance, in addition to the rater's assessment of team performance. Tables 26-29 point out that MMA and MMS are not directly related to other team outcomes. MMA did not significantly affect the team outcomes (β = -.04, p > .10 for team viability, β = .04, p > .10 for satisfaction with team members, β = .04, p > .10 for satisfaction with team solution, and β

= .06, *p* > .10 for perceived solution quality), nor did the results yield any significant effects for MMS (β = -.03, *p* > .10 for team viability, β = .13, *p* > .10 for satisfaction with team members, β = -.13, *p* > .10 for satisfaction with team solution, and β = .10, *p* > .10 for perceived solution quality).

Table 26. Regression Results for the Effects of Team Mental Models on Team Viability[a]

Variables	Team Viability											
	Model 1			Model 2			Model 1			Model 2		
	B	*SE*	β	*B*	*SE*	β	*B*	*SE*	β	*B*	*SE*	β
Control Variables												
Team size	.10	.16	.06	.05	.18	.10	.43	.33	.14	.39	.36	.12
Major diversity	-.10	.22	-.05	-.13	.23	-.09						
Average class year	.05	.11	.05	.04	.12	.17						
Independent Variables												
Mental Model Accuracy				.02	.03	-.04						
Mental Model Similarity										-.10	.12	-.03
R^2			.01			.01			.01			.01
Adjusted R^2			-.02			-.03			-.01			-.02
ΔR^2			.01			.00			.01			.00
F			.30			.30			.56			.28

[a] N = 94.
[b] *B* = unstandardized regression coefficients, β = standardized regression coefficients, *SE* = Standard Error.
* *p* < .05, ** *p* < .01, † *p* < .10

Table 27. Regression Results for the Effects of Team Mental Models on Satisfaction with Team Members[a]

Variables	Satisfaction with Team Members											
	Model 1			Model 2			Model 1			Model 2		
	B	*SE*	*β*	*B*	*SE*	*β*	*B*	*SE*	*β*	*B*	*SE*	*β*
Control Variables												
Team size	.36	.23	.16	.32	.26	.14	.37	.23	.17	.46†	.24†	.21†
Major diversity	-.14	.33	-.05	-.17	.34	-.05						
Average class year	-.02	.17	-.01	-.03	.17	-.02						
Independent Variables												
Mental Model Accuracy				.01	.04	.04						
Mental Model Similarity										.52	.43	.13
R^2			.03			.03			.03			.04
Adjusted R^2			-.00			-.01			.02			.02
ΔR^2			.03			.00			.03			.01
F			.87			.67			2.65			2.06

[a] N = 94.

[b] *B* = unstandardized regression coefficients, *β* = standardized regression coefficients, *SE* = Standard Error.

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

Table 28. Regression Results for the Effects of Team Mental Models on Satisfaction with Team Solution

Variables	Satisfaction with Team Solution											
	Model 1			Model 2			Model 1			Model 2		
	B	*SE*	*β*	*B*	*SE*	*β*	*B*	*SE*	*β*	*B*	*SE*	*β*
Control Variables												
Team size	-.08	.13	-.06	-.10	.14	-.08	-.09	.12	-.07	-.03	.13	-.03
Major diversity	-.04	.18	-.02	-.05	.18	-.03						
Average class year	-.04	.09	-.05	-.05	.09	-.05						
Class year diversity	-.35†	.19†	-.19†	-.34†	.19†	-.19†	-.36†	.19†	-.19†	-.40*	.19*	-.22*
Experience with teams (number of teams)	.03*	.01*	.24*	.03*	.01*	.23*	.03*	.01*	.24*	.03*	.01*	.24*
Independent Variables												
Mental Model Accuracy				.01	.02	.04						
Mental Model Similarity										.28	.24	.13
R^2			.10†			.10			.10*			.11
Adjusted R^2			.05†			.04			.07*			.07
ΔR^2			.10†			.00			.10*			.01
F			2.00†			1.67			3.22*			2.78*

[a] N = 94.
[b] *B* = unstandardized regression coefficients, *β* = standardized regression coefficients, *SE* = Standard Error.
* $p < .05$, ** $p < .01$, † $p < .10$

Table 29. Regression Results for the Effects of Team Mental Models on Team Perceived Solution Quality

Variables	Team Perceived Solution Quality											
	Model 1			Model 2			Model 1			Model 2		
	B	*SE*	*β*	*B*	*SE*	*β*	*B*	*SE*	*β*	*B*	*SE*	*β*
Control Variables												
Team size	-.25	.19	-.14	-.30	.21	-.16	-.25	.19	-.14	-.19	.20	-.10
Major diversity	.19	.25	.07	.16	.26	-.06						
Average class year	-.30*	.13*	-.23*	-.31*	.13*	-.24*	-.30*	.13*	-.23*	-.28*	.13*	-.22*
Sex diversity	-.29	.29	-.10	-.26	.30	-.09	-.28	.29	-.10	-.32	.30	-.11
Class year diversity	.70**	.26*	.26**	.70**	.26**	.26**	.72**	.27**	.27**	.72**	.27**	.27**
Experience with teams (number of teams)	.03*	.02*	.21*	.03*	.02*	.21*	.03*	.02*	.22*	.03*	.02*	.21*
Independent Variables												
Mental Model Accuracy				.02	.03	.06						
Mental Model Similarity										.33	.33	.10
R^2			.23**			.24			.23**			.24
Adjusted R^2			.18**			.17			.19**			.19
ΔR^2			.23**			.00			.23**			.01
F			4.40**			3.77**			5.23**			4.52**

[a] N = 94.
[b] *B* = unstandardized regression coefficients, *β* = standardized regression coefficients, *SE* = Standard Error.
* $p < .05$, ** $p < .01$, † $p < .10$

Since MMA and MMS were found to interact to influence team performance, I also tested whether the interaction between these two mental model components influenced any other team outcomes. Results indicate that this was not the case (see Tables 30 and 31). MMA x MMS did not significantly influence any of the other team outcomes ($\beta = .02$, $p > .10$ for team viability, $\beta = -.08$, $p > .10$ for satisfaction with team members, $\beta = .08$, $p > .10$ for satisfaction with team solution, and $\beta = .05$, $p > .10$ for perceived solution quality).

Table 30. Regression Results for MMA x MMS and Team Viability and Satisfaction with Team Members[a]

Variables	Team Viability						Satisfaction with Team Members					
	Model 1			Model 2			Model 1			Model 2		
	B	*SE*	*β*	*B*	*SE*	*β*	*B*	*SE*	*β*	*B*	*SE*	*β*
Control Variables												
Team size	.10	.16	.07	.07	.19	.07	.37	.23	.17	.44	.23	.20
Major diversity	-.12	.22	-.06	-.15	.24	-.06	-.17	.32	-.06	-.24	.32	-.08
Average class year	.05	.11	.05	.04	.12	.05	-.03	.16	-.02	-.04	.17	-.02
Independent Variables												
Team Mental Model Accuracy				.03	.07	.05				.07	.10	.09
Team Mental Model Similarity				.01	.06	.01				.11	.09	.15
Interaction Effect												
Team Mental Model Accuracy x Team Mental Model Similarity				.01	.05	.02				-.05	.07	-.08
R^2			.01			.01			.03			.06
Adjusted R^2			-.02			-.06			.00			-.01
ΔR^2			.01			.00			.03			.03
F			.33			.19			.98			.87

Dependent Variables: Team Viability; Satisfaction with Team Members.

[a] N = 94.
[b]*B* = unstandardized regression coefficients, *β* = standardized regression coefficients, *SE* = standard error.
* $p < .05$, ** $p < .01$, † $p < .10$

Table 31. Regression Results for MMA x MMS and Satisfaction with Team Solution and Perceived Solution Quality[a]

Variables	Dependent Variables											
	Satisfaction with Team Solution						Perceived Solution Quality					
	Model 1			Model 2			Model 1			Model 2		
	B	*SE*	*β*	*B*	*SE*	*β*	*B*	*SE*	*β*	*B*	*SE*	*β*
Control Variables												
Team size	-.08	.13	-.06	-.09	.15	-.08	-.25	.19	-.14	-.27	.22	-.15
Major diversity	-.04	.18	-.02	-.10	.19	-.06	.19	.25	.07	.11	.26	.04
Average class year	-.04	.09	-.05	-.04	.09	-.05	-.30*	.13*	-.23*	-.31*	.13*	-.23*
Class year diversity	-.35†	.19†	-.19†	-.35†	.20†	-.19†						
Sex diversity							-.27	.29	-.09	-.28	.30	-.10
Race diversity							.73**	.27**	.27**	.73**	.27**	.27**
Experience with teams (number of teams)	.03*	.01	.24*	.02*	.01*	.23*	.03*	.21*	.21*	.03*	.02*	.20*
Independent Variables												
Team Mental Model Accuracy				.04	.05	.09				.05	.08	.08
Team Mental Model Similarity				.07	.05	.17				.08	.07	.13
Interaction Effect												
Team Mental Model Accuracy x Team Mental Model Similarity				.03	.04	.08				.02	.05	.05
R^2			.10†			.13			.24**			.25
Adjusted R^2			.05†			.04			.18**			.17
ΔR^2			.10†			.03			.24**			.01
F			1.94†			1.51			4.43**			3.08**

[a] N = 94.
[b] *B* = unstandardized regression coefficients, *β* = standardized regression coefficients, *SE* = standard error.
* $p < .05$, ** $p < .01$, † $p < .10$

4.3.4 Experimental Conditions as Moderators of the Mental Model-Performance Relationship

In this study it is possible that after the teams' discussion of the importance and relationships of the problem areas, the information surfacing and integration conditions still played a role in the process of generating the team solution and the members' affective reactions of their team work. To test this, I ran regression analyses testing whether the experimental conditions might moderate the relationship between MMA and MMS and team outcomes, which are team performance, team viability, and satisfaction with one's team members, satisfaction with team solution, and perceived solution quality. There were several additional variables (class year diversity, sex diversity, age diversity and the level of team experience measured as the number of teams that participants had worked on) that warranted inclusion in the regression equations because they were significantly correlated with the independent or dependent variables and will be controlled for in subsequent analyses.

Results indicate that the only significant result is the effect of the combination of MMA and II condition on team viability ($\beta = -.33$, $p < .05$), where there is a negative effect of MMA on team viability for teams in the II condition and a positive relationship between MMA and viability for those teams without information integration instructions (see Tables 32 and 33 and Figure 9). The analyses did not yield any other significant relationships for the MMA x II condition ($\beta = .19$, $p > .10$ for team performance, $\beta = -.19$, $p > .10$ for satisfaction with team members, $\beta = -.21$, $p > .10$ for satisfaction with team solution, and $\beta = .16$, $p > .10$ for perceived solution quality).

There were no significant interaction effects of MMA and IS condition ($\beta = -.10$, $p > .10$ for team performance, $\beta = -.06$, $p > .10$ for team viability, $\beta = -.03$, $p > .10$ for satisfaction with team members, $\beta = .03$, $p > .10$ for satisfaction with team solution, and $\beta = .02$, $p > .10$ for perceived solution quality). Also, no significant moderated relationships were found for the MMS x IS condition on team outcomes ($\beta = -.09$, $p > .10$ for team performance, $\beta = -.15$, $p > .10$ for team viability, $\beta = -.06$, $p > .10$ for satisfaction with team members, β = -.10, p >.10 for satisfaction with team solution, and β = -.04, p > .10 for perceived solution quality). Finally, the MMS x II condition also did not yield any significant results for team outcomes (β = .03, p > .10 for team performance, β = .11, p > .10 for team viability, β = .17, p > .10 for satisfaction with team members, β = -.10, p > .10 for satisfaction with team solution, and β = -.14, p > .10 for perceived solution quality).

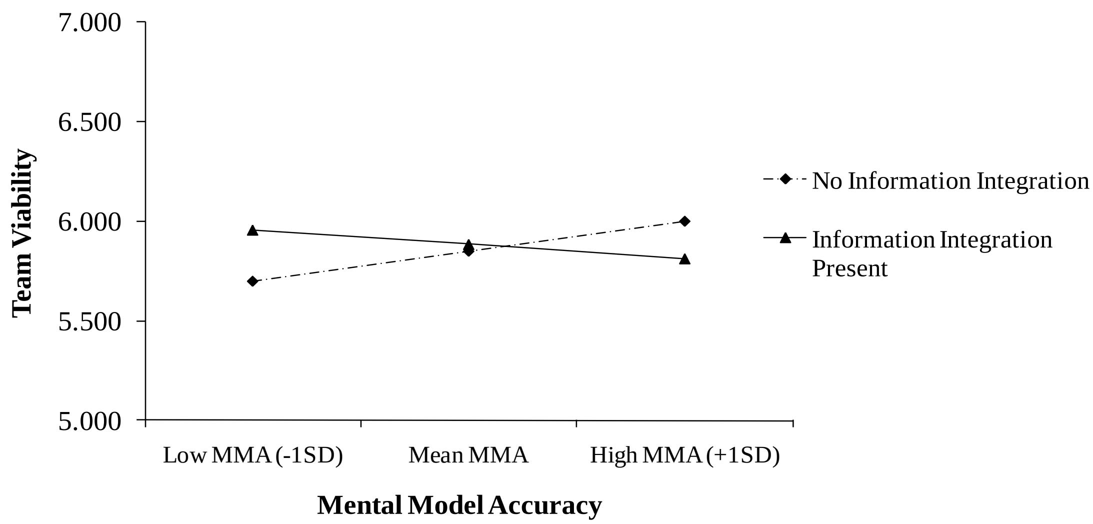

Figure 9. Interaction Effect of Mental Model Accuracy and Information Integration Condition on Team Viability

Table 32. Regression Results for Team Mental Models x Information Surfacing Condition on Team Outcomes[a]

Variables	Team Performance		Team Viability		Satisfaction with Team Members		Team Solution Satisfaction		Perceived Solution Quality	
	β		*β*		*β*		*β*		*β*	
Control Variables										
Team size	.09	.08	.03	.09	.14	$.21^{\dagger}$	-.08	-.03	-.16	-.10
Major diversity	-.05		-.06		-.05		-.02		.06	
Average class year	$.21^{\dagger}$		.04		-.03		-.07		-.24*	-.22*
Average SAT score	.17	$.19^{\dagger}$								
Class year diversity							$-.20^{\dagger}$	-.23*		
Sex diversity									-.09	-.11
Race diversity									.26*	.27**
Experience with teams (number of teams)							.24*	.25*	.21*	.22*
Independent Variables										
Mental Model Accuracy	.08		.11		.06		.00		.04	
Mental Model Similarity		-.15		.10		.18		.20		.12
IS Condition	.02	-.05	-.01	-.02	-.05	-.04	-.08	-.08	-.01	-.01
Interaction Effect										
MMA x IS Condition	-.10		-.06		-.03		.03		.02	
MMS x IS Condition		.09		-.15		-.06		-.10		-.04
R^2	.11	.07	.02	.02	.03	.05	.11	.12	.24	.24
Adjusted R^2	.03	.01	-.05	-.03	-.03	.01	.03	.06	.15	.17
ΔR^2	.01	.01	.01	.01	.00	.02	.01	.03	.00	.01
F	1.42*	$2.54^{\dagger}$	.22	.44	.49	1.11	1.31	.48	2.87**	3.32**

[a] N = 94.

[b] *β* = standardized regression coefficients with all variables in the equation

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

Table 33. Regression Results for Team Mental Models x Information Integration Condition on Team Outcomes[a]

Variables	Team Performance		Team Viability		Satisfaction with Team Members		Team Solution Satisfaction		Perceived Solution Quality	
	β		*β*		*β*		*β*		*β*	
Control Variables										
Team size	.08	.10	.06	.08	.16	.23*	-.06	-.03	-.15	-.11
Major diversity	-.02		-.08		-.06		-.04		.06	
Average class year	.20†		.06		-.01		-.04		-.22*	-.22*
Average SAT score	.19†	.19†								
Class year diversity							-.20†	-.23*		
Sex diversity									-.09	-.11
Race diversity									.28**	.26*
Experience with teams (number of teams)							.23*	.25*	.21*	.23*
Independent Variables										
Mental Model Accuracy	-.16		.30†		.17		.19		.17	
Mental Model Similarity		-.11		-.09		.02		.20		.20
II Condition	-.11	-.08	.04	.02	.01	-.02	.05	-.08	.01	-.01
Interaction Effect										
MMA x II Condition	.19		-.33*		-.19		-.21		-.16	
MMS x II Condition		.03		.11		.17		-.10		-.14
R^2	.13	.07	.06	.01	.05	.06	.13	.12	.25	.25
Adjusted R^2	.06	.01	-.00	-.03	-.02	.02	.04	.06	.17	.18
ΔR^2	.03	.01	.05	.01	.02	.03	.02	.02	.01	.02
F	1.78	1.24	.94	.27	.68	1.36	1.52	1.89†	3.04**	3.48**

[a] N = 94.
[b] *β* = standardized regression coefficients with all variables in the equation
* $p < .05$, ** $p < .01$, † $p < .10$

These relationships were also tested with the actual information surfacing and information integration variables. Tables 34 and 35 report the findings for these analyses. Results indicate that information surfacing is a significant moderator of the MMA-Team performance relationship ($\beta = -.20$, $p < .05$) and a marginally significant moderator of the MMS-Team performance relationship ($\beta = -.20$, $p < .10$). The interaction plot (Figure 10) shows a negative relationship between MMA and team performance when information surfacing is high and a positive relationship between MMA and team performance when information surfacing is low. The plot illustrates that information surfacing is more important when teams have a mental model that has low accuracy. The discrepancy in performance between teams with low or high information surfacing is much smaller when teams have high MMA.

Information surfacing did not significantly interact with MMA (β = .02, p > .10 for team viability, β = -.20, p > .10 for satisfaction with team members, β = .03, p > .10 for satisfaction with team solution, and β = .12, p > .10 for perceived solution quality) or MMS (β = .01, p > .10 for team viability, β = .12, p > .10 for satisfaction with team members, β = .00, p > .10 for satisfaction with team solution, and β = .10, p > .10 for perceived solution quality) to affect other team outcomes.

Table 34. Regression Results for Team Mental Models x Information Surfacing on Team Outcomes[a]

Variables	Team Performance		Team Viability		Satisfaction with Team Members		Team Solution Satisfaction		Perceived Solution Quality	
	β		*β*		*β*		*β*		*β*	
Control Variables										
Team size	.12	.13	.09	.12	.18	.24*	-.06	.01	-.13	-.07
Major diversity	-.02		-.08		-.09		-.05		.04	
Average class year	.21*		.05		-.01		-.05		-.23*	-.21*
Average SAT score	.15	.17†								
Class year diversity							-.15	-.19*		
Sex diversity									-.08	-.11
Race diversity									.24**	.24**
Experience with teams (number of teams)							.23*	.22*	.22*	.22*
Independent Variables										
Mental Model Accuracy	-.02		.06		.05		.06		.07	
Mental Model Similarity		-.04		-.01		.11		.13		.08
Information Surfacing	.16	.16	.49**	.49**	.39**	.39**	.39**	.39**	.40**	.40**
Interaction Effect										
MMA x Information Surfacing	-.20*		.02		.15		.03		.12	
MMS x Information Surfacing		-.20†		.01		.12		.00		.10
R^2	.16†	.13†	.25**	.24**	.20**	.20**	.25**	.26**	.40**	.40**
Adjusted R^2	.09†	.07†	.20**	.21**	.14**	.17**	.18**	.21**	.34**	.35**
ΔR^2	.07†	.07†	.24**	.23**	.17**	.17**	.15**	.16**	.17**	.17**
F	2.36†	2.46†	4.76**	6.92**	3.55**	5.54**	3.51**	4.99**	6.26**	7.09**

[a] N = 94.
[b] *β* = standardized regression coefficients with all variables in the equation
* $p < .05$, ** $p < .01$, † $p < .10$

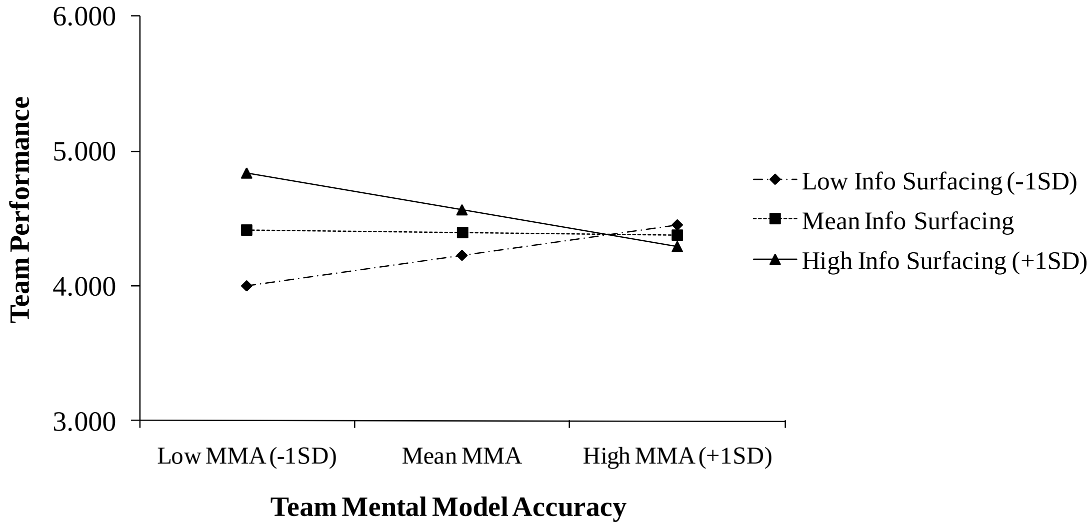

Figure 10. Interaction Effect of Mental Model Accuracy and Information Surfacing on Team Performance

The information integration variable was not a significant moderator of the relationships between MMA and team outcomes (β = -.09, p > .10 for team performance, β = .06, p > .10 for team viability, β = -.06, p > .10 for satisfaction with team members, β = -.02, p > .10 for satisfaction with team solution, and β = .04, p >.10 for perceived solution quality) or of the relationship between MMS and team outcomes (β = -.03, p > .10 for team performance, β = .07, p > .10 for team viability, β = -.09, p > .10 for satisfaction with team members, β = -.05, p > .10 for satisfaction with team solution, and β = .03, p > .10 for perceived solution quality).

Table 35. Regression Results for Team Mental Models x Information Integration on Team Outcomes[a]

Variables	Team Performance		Team Viability		Satisfaction with Team Members		Team Solution Satisfaction		Perceived Solution Quality	
	β		*β*		*β*		*β*		*β*	
Control Variables										
Team size	.08	.09	.02	.04	.12	.17†	-.17	-.06	-.17	-.12
Major diversity	-.04		-.08		-.06		-.04		.05	
Average class year	.22*		-.01		-.05		-.09		-.28**	-.25**
Average SAT score	.16	.18								
Class year diversity							-.15	-.18†		
Sex diversity									-.08	-.10
Race diversity									.20*	.20*
Experience with teams (number of teams)							.18†	.19†	.17†	.17†
Independent Variables										
Mental Model Accuracy	.01		.08		..04		.07		.08	.07
Mental Model Similarity		-.09		-.05		.13		.12		
Information Integration	.02	.06	.45**	.45**	.45**	.43**	.34**	.32**	.37**	.35**
Interaction Effect										
MMA x Information Integration	-.09		.06		-.06		-.02		.04	
MMS x Information Integration		-.03		.07		-.09		-.05		.03
R^2	.11	.07	.21**	.20**	.24**	.25**	.22**	.22**	.36**	.35**
Adjusted R^2	.03	.01	.15**	.16**	.19**	.22**	.14**	.16**	.29**	.29**
ΔR^2	.01	.01	.19**	.19**	.21**	.22**	.11**	.12**	.12**	.12**
F	1.41	1.22	3.70**	5.46**	4.59**	7.38**	2.87**	3.97**	5.13**	5.72**

[a] N = 94.
[b] *β* = standardized regression coefficients with all variables in the equation
* $p < .05$, ** $p < .01$, † $p < .10$

4.3.5 The Effects of Cognitive Diversity and Experimental Conditions on Other Team Processes

It could also be possible that cognitive style diversity together with the information processing mechanisms would influence other team processes besides team mental models. Tables 36-39 report on the regression analyses for the two sets of moderators: the experimental conditions and the information surfacing and integration variables. Since most of the team process variables are significantly correlated with each other, I did not include additional team process variables as controls. However, I did control for additional demographic variables if they were significantly correlated with the team process dependent variables. I failed to find support for the moderating effects of the experimental conditions on the relationships between cognitive style diversity and team processes. Also, no significant interaction effects on team process variables were found for the cognitive style diversity x information surfacing. However, I did find significant moderating effects when using the information integration variables. These analyses indicated a significant interaction between cognitive style diversity and information integration on cooperative behavior ($\beta = -.26$, $p < .01$) and social integration ($\beta = -.19$, $p < .05$). The graphs of these moderation effects (Figures 11 and 12) indicate that cooperative behavior and social integration are highest when there is low cognitive diversity present in the team while the team actively tries to integrate each others' viewpoints. For teams with high information integration behaviors these team processes diminishes as cognitive style diversity increases. However, interestingly, for teams that exhibit low information integration these team processes are enhanced when teams are more cognitively diverse.

Table 36. Regression Results for Cognitive Style Diversity x Information Surfacing Condition on Team Processes

Variables	Team Cooperative Behavior	Team Competitive Behavior	Team Cohesion	Team Social Integration	Team Psychological Safety	Team Task Conflict	Team Process Conflict	Team Relationship Conflict
	Dependent Variables							
	β	*β*	*β*	*β*	*β*	*β*	*β*	*β*
Control Variables								
Team size	-.01	-.01	-.13	-.11	-.03	-.01	-.12	-.17
Average SAT score						.28*		
Team experience (affective)				.17†				
Team experience (# of teams)			.21*	.29**				
Member familiarity (months)			-.06					
Member familiarity (capacity)			.50**		.27*			
Task familiarity								
Verbal Cognitive style	.14	.01	.08	.09	.17	-.21†	-.12	-.18†
Object Cognitive style	.22†	-.19†	.15	.15	.09	-.23*	-.37**	-.19†
Spatial Cognitive style	-.21†	.18	-.27**	-.30**	-.21†	.04	.17	.09
Independent Variables								
Cognitive style diversity	.08	.15	.14	.14	.11	.15	.08	.08
IS condition	.04	.03	-.06	-.08	.09	.17	.08	.00
Interaction Effect								
Cognitive style diversity x IS condition	-.04	-.11	-.11	-.13	-.03	-.05	-.15	-.16
R^2	.10	.07	.34	.21	.15	.16	.19	.11
Adjusted R^2	.02	-.01	.26	.12	.07	.08	.12	.04
ΔR^2	.00	.01	.01	.02	.01	.03	.02	.01
F	1.32	.85	4.30**	2.45*	1.81†	2.06*	2.85*	1.58

[a] N = 94.
[b] β = standardized regression coefficients with all variables in the equation
* $p < .05$, ** $p < .01$, † $p < .10$

Table 37. Regression Results for Cognitive Style Diversity x Information Integration Condition on Team Processes

Variables	Team Cooperative Behavior	Team Competitive Behavior	Team Cohesion	Team Social Integration	Team Psychological Safety	Team Task Conflict	Team Process Conflict	Team Relationship Conflict
	Dependent Variables							
	β	*β*	*β*	*β*	*β*	*β*	*β*	*β*
Control Variables								
Team size	-.00	-.01	-.11	-.11	-.05	-.01	-.12	-.18†
Average SAT score						.27*		
Team experience (affective)				.16				
Team experience (# of teams)			.19†	.27*				
Member familiarity (months)			-.07					
Member familiarity (capacity)			.55**		.30**			
Task familiarity								
Verbal Cognitive style	.14	-.01	.09	.09	.16	-.20†	-.10	-.17†
Object Cognitive style	.21*	-.18†	.17†	.17	.08	-.24*	-.36**	-.18†
Spatial Cognitive style	-.22*	.19†	.27**	-.28*	-.22*	.03	.17†	.11
Independent Variables								
Cognitive style diversity	.01	.02	.01	.06	.14	.00	-.16	-.04
II condition	.16	.08	.19	.05	.08	.08	.07	.03
Interaction Effect								
Cognitive style diversity x II condition	.05	.06	.11	-.00	-.09	.11	.16	.02
R^2	.12	.07	.37	.20	.15	.15	.19	.10
Adjusted R^2	.05	-.01	.30	.11	.07	.07	.13	.03
ΔR^2	.03	.01	.04	.01	.02	.02	.02	.00
F	1.71	.87	4.90**	2.30*	1.84†	1.85†	2.90**	1.43

[a] N = 94.
[b] *β* = standardized regression coefficients with all variables in the equation
* $p < .05$, ** $p < .01$, † $p < .10$

Table 38. Regression Results for Cognitive Style Diversity x Information Surfacing on Team Processes

	Dependent Variables							
Variables	**Team Cooperative Behavior**	**Team Competitive Behavior**	**Team Cohesion**	**Team Social Integration**	**Team Psychological Safety**	**Team Task Conflict**	**Team Process Conflict**	**Team Relationship Conflict**
	β	β	β	β	β	β	β	β
Control Variables								
Team size	.05	-.04	-.05	-.05	.03	-.03	-.16	-.21
Average SAT score						.28*		
Team experience (affective)				.09				
Team experience (# of teams)			.16†	.22*				
Member familiarity (months)			-.10					
Member familiarity (capacity)			.45**		.20*			
Task familiarity								
Verbal Cognitive style	.13	-.01	.07	.09	.16†	-.20†	-.11	-.18†
Object Cognitive style	.18*	-.20†	.13	.14	.08	-.24*	-.37**	-.23*
Spatial Cognitive style	-.07	.16	-.13	-.16	-.08	.03	.17	.07
Independent Variables								
Cognitive style diversity	-.03	.07	.03	.00	.03	.08	-.04	-.01
Information surfacing	.58**	-.14	.41**	.46**	.47	-.02	-.07	-.19†
Interaction Effect								
Cognitive style diversity x Information surfacing	-.06	-.12	-.06	-.05	.06	.04	-.09	-.18
R^2	.43*	.08	.49**	.39**	.33**	.14	.17	.15
Adjusted R^2	.38*	.00	.42**	.32**	.27**	.06	.11	.08
ΔR^2	.33*	.03	.16**	.21**	.20**	.01	.01	.05
F	9.14**	1.04	7.74**	5.88**	5.14**	1.68	2.55*	2.18*

[a] N = 94.
[b] β = standardized regression coefficients with all variables in the equation
* $p < .05$, ** $p < .01$, † $p < .10$

Table 39. Regression Results for Cognitive Style Diversity x Information Integration on Team Processes

Variables	Team Cooperative Behavior	Team Competitive Behavior	Team Cohesion	Team Social Integration	Team Psychological Safety	Team Task Conflict	Team Process Conflict	Team Relationship Conflict
	Dependent Variables							
	β	β	β	β	β	β	β	β
Control Variables								
Team size	-.08	-.03	-.13	-.15	-.05	-.02	-.14	-.17
Average SAT score						.26*		
Team experience (affective)				.10				
Team experience (# of teams)			.11	.17†				
Member familiarity (months)			-.15					
Member familiarity (capacity)			.53**		.23*			
Task familiarity								
Verbal Cognitive style	.08	-.00	.05	.06	.14	-.20†	-.10	-.16
Object Cognitive style	.22**	-.19†	.18*	.17†	.10	-.24*	-.36**	-.20†
Spatial Cognitive style	-.15†	.17	-.18†	-.21*	-.15	.05	.17	.09
Independent Variables								
Cognitive style diversity	-.03	.08	.02	.00	.02	.07	-.04	-.01
Information integration	.60**	-.14	.37**	.44**	.40**	.03	-.11	-.17
Interaction Effect								
Cognitive style diversity x Information integration	-.26**	-.08	-.11	-.19*	.02	.08	-.01	-.02
R^2	.46**	.08	.44**	.37**	.29**	.14	.18	.13
Adjusted R^2	.42**	.01	.37**	.30**	.22**	.06	.11	.06
ΔR^2	.37**	.03	.12**	.18**	.16**	.01	.02	.03
F	10.36**	1.10	6.48**	5.34**	4.25**	1.74	2.59*	1.84†

[a] N = 94.
[b] β = standardized regression coefficients with all variables in the equation
* $p < .05$, ** $p < .01$, † $p < .10$

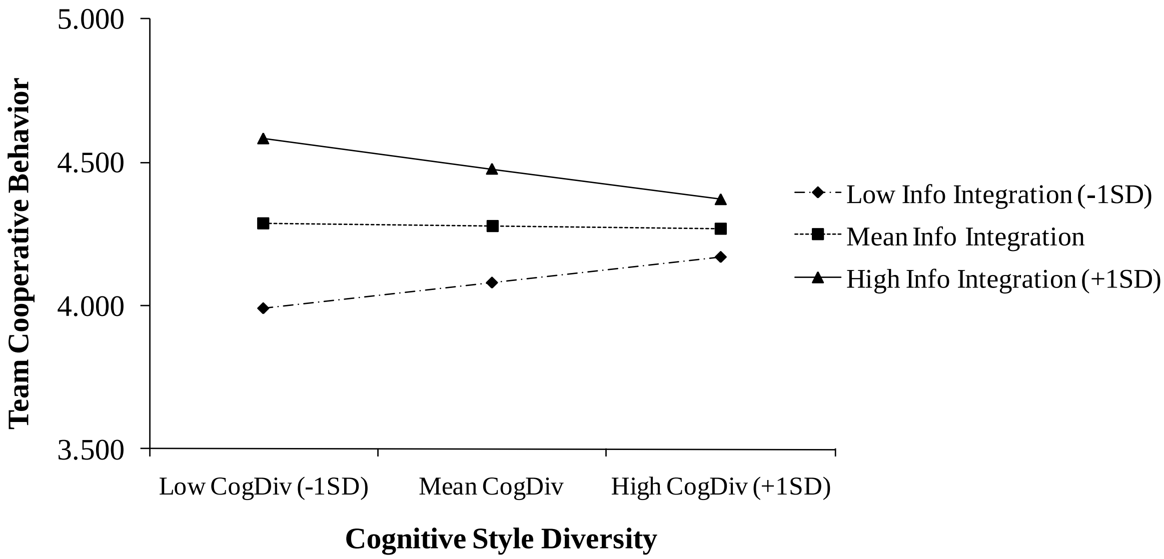

Figure 11. Interaction Effect of Cognitive Style Diversity and Information Integration on Team Cooperative Behavior

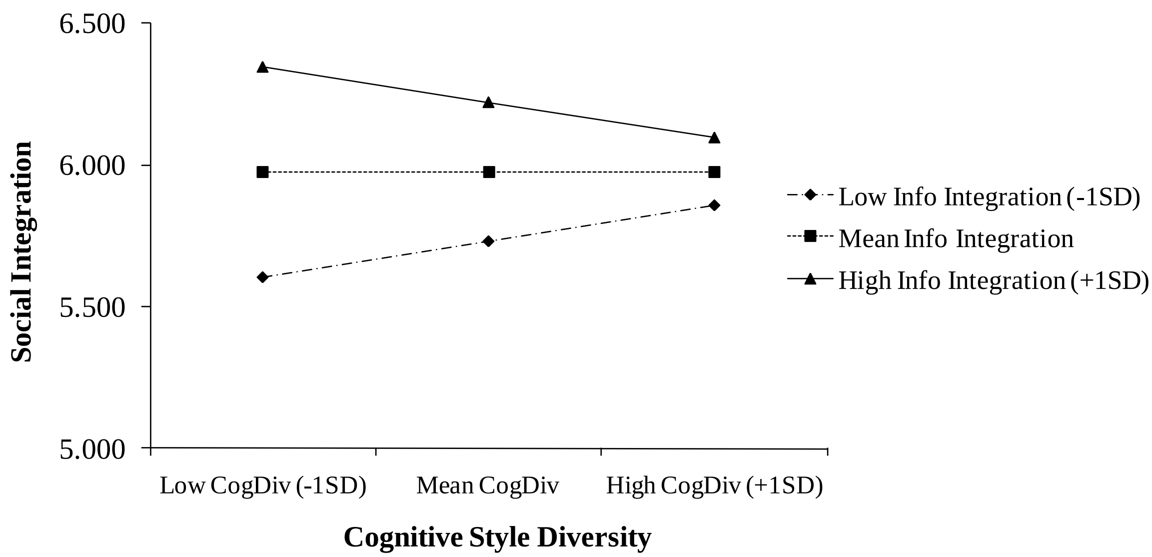

Figure 12. Interaction Effect of Cognitive Style Diversity and Information Integration on Team Social Integration

4.3.6 The Effects of Cognitive Diversity and Experimental Conditions on Team Performance

Since Hypothesis 1 received no support in this study, it may be the case that the cognitive style diversity-team performance relationship is moderated by the information processing mechanisms. Thus, the last analyses I wanted to test was regarding the moderating influence of information processing variables on the cognitive style diversity-performance link. Results in Tables 40 and 41 show no significant results for the experimental conditions ($\beta = .14$, $p > .10$ for the IS condition and $\beta = .02$, $p > .10$ for the II condition), but both information surfacing and information integration variables interact with cognitive style diversity to impact performance ($\beta = -.22$, $p < .05$ for information surfacing and $\beta = -.18$, $p < .10$ for information integration). The plots (Figures 13 and 14) show a similar relationship between cognitive diversity and the information processing variables on team performance as it did on the affective team processes described above. Again, teams perform best under conditions of low cognitive diversity and high information surfacing or integration, whereas teams perform worst under conditions of low cognitive diversity but also low information surfacing and integration. There is a positive relationship between cognitive diversity and team performance for teams that engage in low information surfacing and integration while information surfacing or integration to a high extent has a negative relationship with team performance as teams get more cognitively diverse.

Table 40. Regression Results for Cognitive Diversity x Experimental Conditions on Team Performance

Variables	Team Peformance											
	Model 1			Model 2			Model 1			Model 2		
	B	*SE*	*β*	*B*	*SE*	*β*	*B*	*SE*	*β*	*B*	*SE*	*β*
Control Variables												
Team size	.15	.11	.13	.13	.11	.12	.15	.11	.13	.14	.11	.13
Average SAT score	.17	.12	.15	.16	.12	.15	.17	.12	.15	.18	.12	.17
Verbal Cognitive style	.14	.12	.13	.15	.12	.13	.14	.12	.13	.14	.12	.13
Object Cognitive style	-.10	.12	-.09	-.11	.12	-.10	-.10	.12	-.09	-.11	.12	-.10
Spatial Cognitive style	.27*	.11*	.25*	.29*	.12	.26*	.27*	.11	.25*	.28*	.11	.25*
Independent Variables												
Cognitive style diversity				.01	.17	.01				.11	.15	.10
IS condition				-.06	.23	-.03						
II condition										-.23	.22	-.11
Interaction Effect												
Cognitive style diversity x IS condition				.22	.23	.14						
Cognitive style diversity x II condition										.04	.22	.02
R^2			.13*			.16			.13*			.16
Adjusted R^2			.09*			.08			.09*			.08
ΔR^2			.13*			.03			.13*			.03
F			2.70*			$1.95^{\dagger}$			2.70*			$1.98^{\dagger}$

[a] N = 94.
[b] *B* = unstandardized regression coefficients, *β* = standardized regression coefficients, *SE* = Standard Error.
* $p < .05$, ** $p < .01$, † $p < .10$

Table 41. Regression Results for Cognitive Diversity x Information Surfacing and Information Integration on Team Performance

Variables	Team Performance											
	Model 1			Model 2			Model 1			Model 2		
	B	*SE*	*β*	*B*	*SE*	*β*	*B*	*SE*	*β*	*B*	*SE*	*β*
Control Variables												
Team size	.15	.11	.14	.16	.11	.15	.15	.11	.14	.11	.11	.10
Average SAT score	.15	.12	.14	.19	.12	.17	.15	.12	.14	.17	.12	.16
Verbal Cognitive style	.15	.12	.14	.11	.11	.10	.15	.12	.14	.11	.12	.10
Object Cognitive style	-.08	.12	-.07	-.16	.12	-.14	-.08	.12	-.07	-.11	.12	-.10
Spatial Cognitive style	.28*	.11*	.25*	.33**	.11**	.30**	.28*	.11*	.25*	.27*	.11*	.25*
Independent Variables												
Cognitive style diversity				.09	.11	.09				.11	.11	.11
Information surfacing				.20†	.12†	-.18†						
Information integration										.11	.12	.10
Interaction Effect												
Cognitive style diversity x Information surfacing				-.23*	.11*	-.22*						
Cognitive style diversity x Information integration										-.23†	.13†	-.18†
R^2			.13*			.23*			.13*			.18
Adjusted R^2			.08*			.15*			.08*			.10
ΔR^2			.13*			.10*			.13*			.05
F			2.55*			3.07**			2.55*			2.22*

[a] N = 94.
[b]*B* = unstandardized regression coefficients, *β* = standardized regression coefficients, *SE* = Standard Error.
* $p < .05$, ** $p < .01$, † $p < .10$

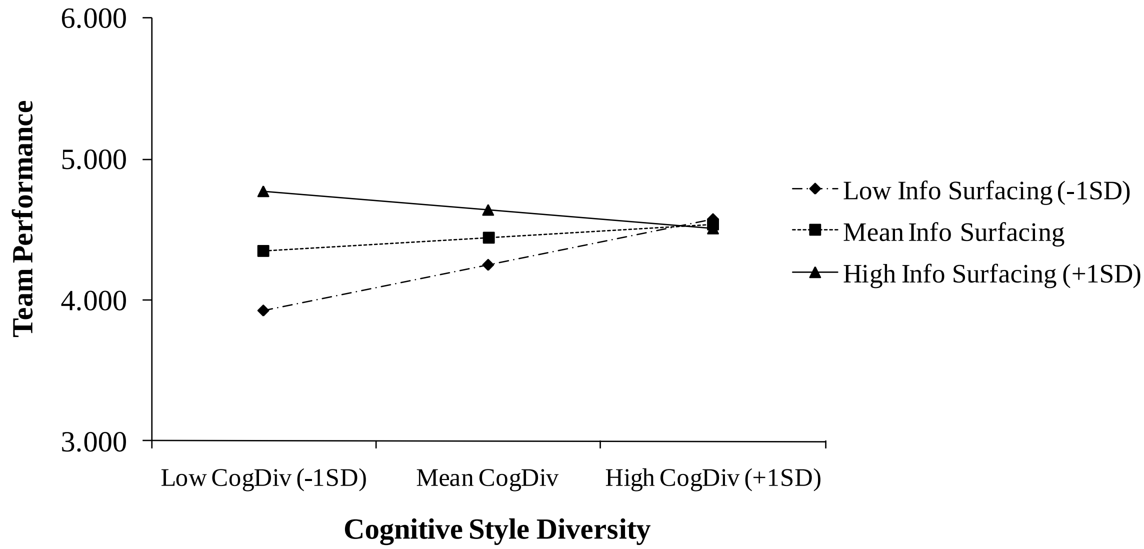

Figure 13. Interaction Effect of Cognitive Style Diversity x Information Surfacing on Team Performance

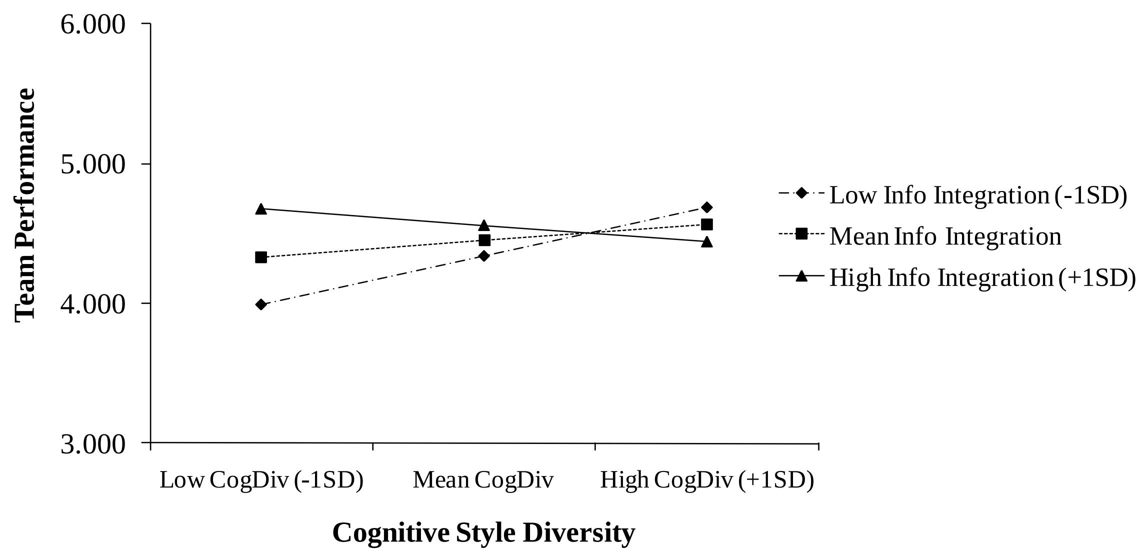

Figure 14. Interaction Effect of Cognitive Style Diversity x Information Integration on Team Performance

CHAPTER 5

DISCUSSION

5.1 Introduction

This research study set out to explore the mechanisms by which teams whose members are diverse in cognitive style impact team effectiveness. To this end, a research model based on information processing theory was developed and tested. Specifically, this model examined the effects of team cognitive style diversity on team task mental models and team performance and proposed information processing variables as moderators of the team diversity-mental model relationship. In this chapter, I will give an overview of the results and discuss the theoretical and practical contributions, limitations, and future research avenues.

5.2 General Discussion of Findings

Researchers still have not identified a clear and consistent pattern as to whether cognitive diversity is helpful or harmful for team performance. In this research study, I investigated the impact of cognitive style diversity on team performance. The correlation and regression results indicate a positive effect between team cognitive style diversity and team performance, but it was not statistically significant. When looking at the diversity of the individual cognitive styles, we see that diversity on verbal and object cognitive styles also have a positive, but not significant, effect on team performance. Surprisingly, the regression analysis identifies a negative effect of spatial cognitive style diversity on team performance. Overall, these findings lends some support for the conclusion that for teams that deal with decision-making and problem-solving tasks, diversity on cognitive style, at least for verbal and object styles, is beneficial for performance. These results are different from findings by Aggarwal and Woolley (2010) who found that both object and spatial cognitive style diversity, although the effect for spatial cognitive style was not significant, were negatively related to performance on a Lego building task. It is possible that the type of task made the difference between these findings.

I did not find support for the proposed relationships between team cognitive style diversity and team mental model accuracy and similarity as hypothesized. When testing these relationships for each of the cognitive style diversity separately, also none of the types of diversity was significantly related to MMA or MMS. These results both support and contradict findings by Aggarwal and Woolley (2010) who found that teams with low diversity on object cognitive style had significantly higher levels of strategic consensus than teams with high object cognitive style diversity. However, they did not find a significant effect of spatial cognitive style diversity on strategic consensus.

The study variable correlations show that MMA and MMS are significantly negatively correlated, which may indicate that teams whose mental models are accurate, are not similar and vice versa. MMA is positively correlated with the team performance measures whereas MMS is negatively correlated with these measures. This may mean that accuracy of the task mental model enhances performance but similarity of the mental model harms performance. It may be that for decision-making and problem solving teams the accuracy component is important in generating high performance and that MMS may detract from the creative component of decision-making and problem solving.

The regression results indicate that MMA and MMS do not have a significant direct effect on team performance but that MMA and MMS interacted to influence performance. The significant moderation effect corroborates previous studies (e.g., Mathieu et al., 2005). The interaction plot points out that teams who have an increasingly high level of MMA will enhance their performance when MMS is also high but will reduce their level of performance when MMS is low. This result is similar to results reported by Mathieu and colleagues (2005) who found that teams that shared highly accurate mental models outperformed those teams who had either high MMA or high MMS. However, teams who exhibit both low MMA and low MMS will also generate high performance. This result is somewhat contradictory to the literature which predicts that teams high in *both* mental model similarity and accuracy should outperform other teams.

No support was found for the proposed mediated effects of team mental models on the cognitive style diversity-team performance relationship since this study revealed no significant direct relationships between cognitive style diversity, mental model dimensions, and team performance, and as discussed above, thus did not warrant tests of mediation.

The last set of hypotheses proposed interaction effects of the experimental conditions with cognitive diversity on MMS and MMA. Even though, the hypothesized relationships were not supported, I found a non-hypothesized significant moderation effect of the information integration condition on the cognitive style diversity-team performance relationship. So instead of the II condition interacting with cognitive style diversity to affect MMS, it affected MMA. Specifically, in the information integration condition, teams with increasing levels of cognitive style diversity had increasing levels of MMA whereas in the no information integration condition, teams with increasing levels of cognitive style diversity had diminishing levels of MMA. Thus, for cognitively diverse teams to achieve high MMA they need to be prompted to integrate inputs from other team members into their thinking about the team task while for those teams low in cognitive style diversity information integration instructions only impeded MMA. It may be that in low cognitive style diversity teams, since they paid attention to similar information because of their similar cognitive styles, information integration instructions encouraged team members to form majority consensus on their ideas regarding the relevance of the problem areas and thereby foregoing the chance that one of the team members actually had an accurate minority opinion on key information items, thus collectively yielding a less accurate task mental model. Whereas members of cognitively diverse teams, because of their more salient differences in what information was processed and how, may have given more credibility to the opinions of other members when integrating their perspectives, generating a more accurate task mental model. When examining the moderated relationships for each cognitive style variable separately, I found that only the spatial cognitive style diversity interacted significantly with the information integration condition to yield greater MMA.

The moderated relationships in Hypothesis 5 were also tested using the information surfacing and integration scale variables. Instead of measuring the extent to which teams were told that they should surface or integrate information as assessed by the manipulation checks, these variables measured the extent to which the teams actually surfaced and integrated information. Results indicate that information surfacing has no significant results on the team mental model components but, as hypothesized in Hypothesis 5b, information integration was shown to significantly impact the relationship between cognitive style diversity and MMS where cognitively diverse teams achieve higher MMS when information integration is higher. This analysis also pointed to a negative relationship between cognitive style diversity and MMS for teams that integrate information to a lesser extent. This indicates that for teams to achieve high MMS, they need to either have low cognitive diversity or engage in information integration to a high extent.

Some other post-hoc analyses[6] were conducted examining the influence of mental models and experimental conditions on team outcomes. I found that similarity and accuracy of the task mental model alone or together were not significantly related to affective team outcomes such as team's willingness to work together in the future, satisfaction with team members, satisfaction with the proposed team solution, or the team's personal assessment of their performance. This implies that the teams' task view was neither an obstacle nor a benefit that influenced the teams' interaction processes enough to significantly shape the members' affective reactions.

I also tested whether the effects between mental models and team outcomes may have been moderated by the experimental conditions or the information surfacing and integration variables. Results indicate a significant interaction for team viability where either information integration instructions or having an accurate mental model resulted in

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[6] A note regarding the post-hoc analyses, all the results of these post-hoc tests should be interpreted with caution as no a-priori theory has guided these analyses.

a high willingness to work together in the future whereas none or both conditions resulted in low team viability. This result is not very interesting in that it does not give rise to a logical explanation or is useful as guidance to managers. It was also found that mental model accuracy interacted with information surfacing to significantly affect team performance. Results indicate that information surfacing is more important for team performance when teams have a mental model that has low accuracy. The discrepancy in performance between teams with low or high information surfacing is much smaller when teams have high MMA. Thus, high MMA seems to eliminate the need for further information surfacing. The graph illustrates that high information surfacing even detracts from team performance when the team already possesses a highly accurate task mental model.

Finally, a last set of post-hoc analyses were conducted examining the effects of cognitive style diversity and II and IS conditions on other team process variables and team performance. Overall these analyses show that low cognitive style diversity in combination with high information integration behaviors by the team members results in the highest levels of affective team processes such as social integration and cooperative behavior. The interaction plot illustrates that teams with high cognitive style diversity will have more similar levels of cooperative behaviors and social integration, regardless of the level which with they integrate information, than do teams with teams with low cognitive style diversity. This is interesting as I would have expected a larger impact of information integration for teams that have high cognitive style diversity, rather than low. Thus, it seems that as teams get more cognitively diverse, information integration hurts affective team processes for those teams that try to integrate information but helps those that do not integrate information to such a high level. It may be that teams who purposely trying to integrate its members' perspectives negatively affect team processes by means of putting emphasis on their differences. This is an interesting idea that future research could further investigate.

It was also found that information surfacing and integration variables significantly affected the cognitive style diversity-team performance relationship. These analyses indicate a similar story as for the diversity-team processes relationships described above. Team performance goes down slightly as cognitive style increases for teams who exhibit high information surfacing and integration behaviors, but goes up considerably for those teams that do not engage in a high level of information integration and surfacing. It seems that as long as teams engage in a fairly high level of information surfacing and integration, good performance can be realized. However, for those teams that have low cognitive style diversity and exhibit a low information surfacing or integration, poor performance will result. As for the positive slope for teams with low information processing behaviors, this is more complicated. It seems improbable that teams are able to take advantage of their cognitive diversity without surfacing, weighting, and consolidating their different views and information inputs. In this study, it could very well be that the process of extracting, discussing, and consolidating information from all members detracts from performance in this time-bound study. Teams that made sure every voice was heard, discussed objections, and finally integrated all the perspectives into all their recommendations may have taken too much time with this process in lieu of actually getting their ideas down on paper. Teams that did not engage much in these behaviors could actually reap some of the benefits of cognitive diversity but may have had more time for the documentation of their task performance.

To sum up this discussion section I will connect my findings to the three research questions that this study set out to answer:

1. How does cognitive diversity affect team mental model similarity and accuracy?

This study shows no evidence of a direct relationship between cognitive style diversity and MMA or MMS. However, the relationships between cognitive style diversity and both mental model components were moderated by information processing mechanisms, which I will discuss in the section below on research question number 3.

2. How do team mental model similarity and accuracy affect team performance?

I found that MMA is positively and MMS is negatively related to team performance although these relationships did not reach statistical significance. The combination of MMA and MMS proved to significantly impact team performance where teams with a similar task mental model that is also accurate generated higher performance than those teams that had high MMA or MMS alone. The mental model components alone or in combination were not found to significantly influence any other team outcomes such as team viability, team satisfaction with teammates, solution quality, or self-assessed performance.

3. What are the moderating effects of team information processing mechanisms on the relationships between cognitive diversity and team mental model similarity and accuracy?

Significant moderation effects for the information processing mechanisms were found for the relationships between cognitive style diversity and both mental model components, where cognitive style diversity interacted with information integration instructions to affect MMA and with actual information integration behavior to affect MMS. The relationships indicate that teams with high cognitive style diversity will benefit from actual information integration behaviors or from instructions that make salient the necessity for information integration behaviors for the development task mental models. On the other hand, teams more homogeneous on cognitive style are found to be harmed in their development of MMA or MMS when too much emphasis is put on the integration of information.

Team information integration behaviors also moderated the effects of cognitive style diversity on several team processes (i.e., team cooperative behaviors, team social integration) and team performance. On a high level, these relationships indicate that as teams get more cognitively diverse, high levels of information integration hurts affective team processes maybe by means of putting emphasis on their differences. For teams that tend to have low levels of information integration, cognitive diversity helps enhance team processes but not to the level of high-information integration teams. Thus, information integration is helpful for team processes regardless of level of cognitive diversity probably because team members like to participate in decision-making and have their voice be heard.

Team information surfacing behaviors were only a significant moderator of the cognitive style diversity-team performance relationship. Together with the interaction of information integration behaviors on this relationship, the findings seem to indicate that as long as teams engage in a fairly high level of information surfacing or integration, good performance can be realized, regardless of the level of team cognitive style diversity. However, for those teams that have low cognitive style diversity and exhibit a low information surfacing or integration, poor performance will result. Also, these relationships point to the fact that high cognitive diversity teams that have low levels of information integration or surfacing can also perform at a high level, possibly because of the tradeoff between information integration and actual task work for tasks with a time limit.

Lastly, as an overall conclusion, it seems that information integration, whether it is experimentally manipulated or assessed via scale measures, is more important for the effective and efficient functioning of cognitively diverse teams than is information surfacing and that actual information integration behavior in teams has a greater impact on team processes and emergent states than the mere suggestion of these behaviors via task instructions.

5.3 Limitations and Future Research

Some limitations of this study should be considered in interpreting the results. First of all, a student sample was chosen to ensure that the participants were highly similar in many regards (e.g., age, education level, background, team experience) as to put more emphasis on their cognitive differences. Even though the student sample was an appropriate choice for this study, it may limit generalizability to organizational teams and should thus be tested further in actual organizational settings. As organizational teams are often cross-functional and cognitive styles are related to different organizational functions (i.e., people with different vocations tend to use different cognitive styles (e.g., Blajenkova et al., 2006; Kozhevnikov, Kosslyn, & Shepard, 2005), organizational teams may have increased variation on cognitive style diversity.

The small sample size in combination with the number of control variables may have resulted in some of the non-findings. Alternatively, the effect sizes may have been smaller than expected thus yielding no significant results. However, this lends more credibility to the significant results that were found.

Also, the small team size may have limited the amount of cognitive style diversity in the teams and thus contributed to the lack of support for the hypotheses. As organizational teams often consist of a large number of team members, it would be worthwhile to investigate these relationships in larger teams. This could maybe indicate the formation of subgroups along the lines of cognitive diversity or task mental models.

Since I failed to find significant support for the ideas that cognitive diversity is related for team performance and that task mental model dimensions are a cognitive mediators linking cognitive diversity and team performance, future research should continue to investigate this relationship. Researchers have called for more research emphasis on identifying the psychological mechanisms that link team diversity and performance while stressing the importance of exploration of additional deep-level diversity variables (e.g., Mannix & Neale, 2005; van Knippenberg & Schippers, 2007). Therefore, promising next steps would be to look at other cognitive mediators and their interplay with team processes in affecting the cognitive diversity-team performance relationship; and examining these effects using different kinds of cognitive diversity variables.

Finally, the measure of cognitive style diversity was not ideal in that the individual cognitive styles seemed to relate differently to other variables in the study. Thus, future research should probably consider testing the effects of the three cognitive styles separately as not to mask any important relationships relating to the different types of cognitive styles. Alternatively, a different measure of cognitive style could be used in future studies.

5.4 Theoretical Contributions

One purpose of this research was to develop and test a research model that advances our understanding of the "black box" that links team diversity to team performance (Lawrence, 1997) while at the same time contributing to researchers' calls for more research into the cognitive workings of diversity. To this end, I have investigated an underrepresented type of diversity, cognitive style diversity, and found that cognitive style diversity in combination with the right team information processing mechanisms has an effect on whether teams' develop accurate and similar mental models and how they ultimately perform. It was also found that task-focused MMA and MMS did not significantly mediate the relationship between cognitive style diversity and team performance. Therefore, identifying the mediating mechanisms that link cognitive diversity to team performance remains an important avenue for future study.

This research also focused on exploring team information processing variables as moderators thereby answering the call for more process-oriented diversity research (e.g., Pelled et al., 1999; van Knippenberg, et al., 2004). In this study, I found that team processes matter, particularly information integration is a valuable information processing mechanism that helps cognitively diverse teams in their development of task-related mental models and helps them to generate greater team performance.

In addition to the diversity literature, this study contributes to the growing team mental model literature by investigating TMMs in teams that deal with decision-making and problem-solving, as most of the TMM literature to date has studied this cognitive construct in action teams. Here, it was found that task-related mental models are also important in a decision-making context. Particularly, even though there was no evidence of a direct influence of MMS or MMA on team performance, in combination they did predict levels of performance.

5.5 Practical Implications

It is important for managers to realize that cognitive style diversity in decision-making/problem-solving teams does not by itself help or harm team processes and outcomes. Instead, it is the combination with team information processing/cognition that determines how well these teams work together and perform.

This study indicates that to generate efficiency of team processes and effectiveness of team outcomes in decision-making/problem-solving teams, managers need to actively manage the level of informational input integration of the team members. Specifically, in decision-making/problem-solving teams, the level of information integration has implications for the development of mental models, the extent to which team members cooperate with each other, feel part of their team, and ultimately how well the team performs.

This study shows that in decision-making/problem-solving teams, a high level of information integration is necessary to enhance team processes like helping behavior, regardless of the level of team cognitive style diversity. Thus managers should try to facilitate information integration such as effective debate and -discussion mechanisms as much as possible. Also, to generate high performance, high levels of both information integration and surfacing will be important in both more cognitively homogeneous and more cognitively diverse teams. Information integration will also aid teams in the development of accurate shared mental models for high cognitively diverse teams. Since high levels of MMA and MMS together generate higher performance than teams with either high accurate or similar mental model, encouraging information integration would be sound advice.

However, this advice comes with one main stipulation: stimulating information integration would be ill-advised when trying to enhance mental model accuracy and similarity in low cognitive diversity decision-making/problem-solving teams. Too much focus on information integration can do more harm than good for these teams' mental models by possibly creating the illusion of greater cognitive diversity thus pushing the members' views further apart hurting the MMS, or in the case of MMA, diminishing the advantages that a small amount of cognitive diversity can bring. Surprisingly, this study also pointed to the fact that decision-making teams who have both low MMA and low MMS can still come up with a good solution set possibly partly because of the creative component that goes in to making good decisions and solving problems which should give teams with low mental model similarity an advantage.

If managers do not intervene in decision-making/problem solving teams that do not tend to use information integration mechanisms as part of their team interaction, affective team processes will be negatively affected as will, most likely, be performance.

5.6 Conclusion

The impact of team diversity on team effectiveness continues to be an important field of study. In this research study, I have explored the mechanisms by which teams whose members are diverse in cognitive style impact team effectiveness. To this end, a research model based on information processing theory was developed and tested. The results suggest that information processing/cognition at the team level plays an important role in the effective functioning of decision making teams. Specifically, the combination of team mental model similarity and accuracy predicts levels of team performance and that information integration is an important moderator linking cognitive style diversity to task mental models, team processes, and team performance.

APPENDIX A

PROPOSED RECOMMENDATIONS SHEET

We are going to evaluate the answers of all the teams that participate this semester and we will reward the 3 teams with the best recommendations. Therefore, if you are interested in being contacted in the event that your team has won one of the rewards, please enter your email address below.

Team member email addresses:

1. ________________________________ 2. ________________________________ 3. ______________________________

Instructions:
Please write down your team's recommendation(s) to Farm E-Z sliding profits on the grinder-blower. Make sure that you also report the problem that your solution is supposed to fix and the possible future consequences that you see from implementing your proposed solutions.

Proposed Recommendation(s)	**What problem area(s) does this address?**	**What are the possible future consequences of your proposed recommendations?**

APPENDIX B

MANIPULATION INSTRUCTION SHEETS

INSTRUCTIONS:

While working on the remainder of the task, you are asked to still assume the role of a consulting team that was hired by the General Manager of Farm E-Z to investigate the diminishing profit margins of their newest grinder-blower product. The purpose of this consulting assignment is to understand the main problem areas causing the decline in profits for the grinder-blower product and the relationships, if any, among the problem areas.

By now you have probably developed your own perspectives regarding the issues facing Farm E-Z. In the next step of this exercise, you will have 20 minutes to discuss the situation with your teammates. The objectives of this discussion are to:
(Note: one or two of the following three instructions depending on the experimental condition)

- Surface as many ideas and viewpoints as possible regarding the issues facing the company. (for the high information surfacing condition)
- Develop an integrated picture of Farm E-Z's situation as a team by incorporating the ideas and opinions of all team members. (for the high information integration condition)
- Have a chance to talk with your teammates about what you see as the situation facing the company. (for the control condition)

HIGH INFORMATION SURFACING INSTRUCTIONS

As you work on this task as a team, please make sure that:

- Each team member voices his or her perspective on the task.
- You encourage all team members to share their ideas and viewpoints on the task.
- You ask for elaboration of ideas and opinions expressed by others.
- Everyone in the team has the opportunity to share his or her ideas and perspectives.
- You work together to uncover a wide range of ideas and perspectives on the task.
- You encourage each other to express unique opinions and perspectives on the task.
- You surface as many ideas as possible before critiquing or discussing the ideas.

HIGH INFORMATION INTEGRATION INSTRUCTIONS

As you work on this task as a team, please make sure that you:

- Adjust your own perspectives on the issues by incorporating the views of other team members.
- Be open to re-think your own views and assumptions about the Farm E-Z situation based on the views of the other members of your team.
- Consider modifying your perspective about the main problems facing Farm E-Z, based on the team discussion.
- Work together as a team to develop an integrative picture of the issues facing Farm E-Z by integrating the ideas and opinions of all team members.
- Work together as a team to effectively connect each other's viewpoints.
- Incorporate the ideas and opinions of the other team members into your perspective on the task.

APPENDIX C

MENTAL MODEL SIMILARITY MEASURE

Below is a list of potential overarching problem areas that you have encountered in the Farm E-Z case. These problem areas are as follows:

1) Pricing refers to issues related to the price of the grinder-blower (this includes distributor margins, customer complaints about high prices, and cheaper competitor products etc.)
2) Training is the process by which the organization educates its employees (this includes training with regards to repair, marketing, selling etc.)
3) Production is the process by which Farm E-Z converts various inputs into the actual grinder-blower product (this includes manufacturing processes, production capacity etc.)
4) Management refers to the approach and methods used to motivate employees (this includes incentives, oversight of subordinates, metrics for performance and rewarding etc.)
5) Demand is the process by which Farm E-Z creates demand for its grinder-blower product (this includes advertising, distributors and sales representatives pushing the product etc.)
6) Parts and components are the inputs that go into the grinder-blower product (this includes steel, gear alloy, bearing quality, load control etc.)
7) External Issues are concerns related to stakeholders outside Farm E-Z (this includes the worker's union, suppliers etc.)

We are interested in how you see the RELATIONSHIPS among these potential overarching problem areas for Farm E-Z. In the table below, please indicate, by circling the appropriate number, how much you think that each pair of potential problem areas is related using a 7-point scale that ranges from 1 (not at all related) to 7 (highly related).

				Not at all Related			Somewhat Related			Highly Related
1.	**Pricing**	and	**Training**	1	2	3	4	5	6	7
2.	**Management**	and	**External Issues**	1	2	3	4	5	6	7
3.	**Production**	and	**Demand**	1	2	3	4	5	6	7
4.	**Pricing**	and	**Management**	1	2	3	4	5	6	7
5.	**External Issues**	and	**Pricing**	1	2	3	4	5	6	7
6.	**Production**	and	**Training**	1	2	3	4	5	6	7
7.	**Training**	and	**Demand**	1	2	3	4	5	6	7
8.	**Parts & Components**	and	**Pricing**	1	2	3	4	5	6	7
9.	**Demand**	and	**Management**	1	2	3	4	5	6	7
10.	**Training**	and	**Parts & Components**	1	2	3	4	5	6	7
11.	**External Issues**	and	**Training**	1	2	3	4	5	6	7
12.	**Demand**	and	**Parts & Components**	1	2	3	4	5	6	7
13.	**Production**	and	**Management**	1	2	3	4	5	6	7
14.	**Parts & Components**	and	**Production**	1	2	3	4	5	6	7
15.	**Production**	and	**External Issues**	1	2	3	4	5	6	7
16.	**Pricing**	and	**Production**	1	2	3	4	5	6	7
17.	**Training**	and	**Management**	1	2	3	4	5	6	7
18.	**Demand**	and	**External Issues**	1	2	3	4	5	6	7
19.	**Management**	and	**Parts & Components**	1	2	3	4	5	6	7
20.	**Pricing**	and	**Demand**	1	2	3	4	5	6	7
21.	**Parts & Components**	and	**External Issues**	1	2	3	4	5	6	7

APPENDIX D

TEAM PERFORMANCE MEASURES

1. **Please rate, on a scale from 1-7, the team solution on each of the following team effectiveness dimensions:**

Dimensions of Team Effectiveness	Very low			Moderate			Very high
Feasibility	1	2	3	4	5	6	7
Efficiency	1	2	3	4	5	6	7
Accuracy	1	2	3	4	5	6	7
Comprehensiveness	1	2	3	4	5	6	7
Novelty	1	2	3	4	5	6	7
Logic	1	2	3	4	5	6	7
Awareness	1	2	3	4	5	6	7

Definitions of the team effectiveness dimensions:

Feasibility	Solution proposes recommendations that are realistic and actionable *for Farm E-Z*. A high score means that the recommendations are feasible. A low score would mean that the recommendations are unrealistic for Farm E-Z to take action on. (See Column 1)
Efficiency	Number of recommendations/ number of problem areas that they solve. A high score would mean that a single recommendation solves a large number of problem areas. A low score would mean that a large number of recommendations solve a small number of problem areas. (See Columns 1 & 2)
Accuracy	Solution addresses relevant problem areas only. A high score would mean that the team identified a large number of the true problem areas. A low score would mean that the team identified few true problem areas and/or a lot of irrelevant problem areas. (See Column 2)
Comprehen-siveness	Solution addresses a large variety of problem areas. This dimension should not reflect accuracy. A high score would mean a broad range of problem areas independent of accuracy or fit with proposed recommendations. A low score would mean that a single or few problem areas are identified. (See Column 2)
Novelty	Solution proposes recommendations that are original and unique. (See Column 1)

Logic	Solution logically ties together the problems, recommendations, and consequences. A high score would mean that the recommendations logically follow from the problem areas and that the future consequences logically follow from the proposed recommendations. A low score would mean that recommendations do not make sense for the problem areas identified and that the future consequences described do not make sense from the recommendations listed. (See Columns 1,2,3)
Awareness	Solution takes into account other possible future implications or consequences of the proposed recommendations. These are unintended consequences and side effects that go beyond solving the specified problem area. A high score would mean that the future consequences described identified a large amount of possible implications (positive and negative) to the organization and its members. A low score would mean that the future consequences identified only point to solving the stated problem area(s). (See Columns 1 & 3)

2. Please rate on a scale from 1-7 your overall impression of the team's solution:

	Strongly disagree			Neither agree nor disagree			Strongly agree
1. Overall, I feel confident that following the recommendations in this team's solution will solve the problem stated in the case exercise.	1	2	3	4	5	6	7
2. Overall, I think that this team's solution is a good one for the problem described in the case exercise.	1	2	3	4	5	6	7
3. Overall, I think this team's solution may cause more problems than it will solve.	1	2	3	4	5	6	7
4. Overall, I think this team's solution satisfied the stated or implied goals in the case exercise.	1	2	3	4	5	6	7
5. Overall, I expect this team's solution to be effective.	1	2	3	4	5	6	7

*Note: The team solution consists of one of more recommendations.

APPENDIX E

RESEARCH CONSENT FORM

Project Title: Organizational Decision-Making Study
Investigators: Dr. Terry C. Blum & Marieke Schilpzand, Georgia Institute of Technology
Consent Title: ODM study – Consent Form 1/07/2010

You are being asked to be a volunteer in a research study.

Purpose:

- The purpose of this study is to explore the effect of cognitive diversity on performance and the development of team mental models.
- We expect to enroll up to 300 individuals for this study.

Procedures:

- If you decide to be in this study, you will be asked to complete an initial questionnaire that asks you about your personal characteristics. Your responses will remain anonymous. Your name will be used solely for the purpose of awarding you credit for your participation and will not be linked to your responses. This survey will take about 15 minutes to complete.
- The next part will involve reading a set of organizational emails and answering questions about what you consider to be this company's main problem areas.
- Next, you will be placed in a team and together with your team members you will be asked to discuss your ideas and perspectives about the main problem areas and to come up with recommendations for this company. This portion of the study will be video recorded to assess how your team works together and will take about 30 minutes. The tapes will be labeled with a team number only; no individual names will be associated with the videotapes at any time.
- At the end of the study you will be asked to respond to questions concerning your team and about the way team members worked together. The total study will take approximately 1.75-2 hours to complete.

Risks or Discomforts:

The risks involved are no greater than those involved in daily activities such as reading, writing/taking notes, or discussing an issue with friends.

Benefits:

You are not likely to directly benefit in any way from joining this research study, but we hope that management researchers and organizations will benefit from what we find in doing this study.

Compensation to You:

- You will receive study credit toward your MGT3102 (Human Resource Management) research requirement for participation in this research study. In addition, the members of the 3 most successful teams will receive a cash reward of $150, which means $50 per person.
- You are free to withdraw from this study at any time. However, if you withdraw from this study while it is in progress, you will not receive full course credit for completing this study. If this occurs, you should talk with your MGT3102 instructor and consult your syllabus for alternative ways to earn research credit for the course.
- If you choose not to participate in this research study, your course syllabus outlines an alternative assignment (a 5-7 page paper) that you may complete in order to fulfill the research requirement for your MGT3102 (Human Resource Management) course.

Confidentiality:
The following procedures will be followed to keep your personal information confidential in this study: The data collected about you will be kept private to the extent allowed by law. To protect your privacy, your records will be kept under a code number rather than by name. Your records will be kept in locked files and only study staff will be allowed to look at them. Similarly, the video tapes will be labeled with a code and be accessible only to the research team. All records and video tapes will be destroyed after data analysis is complete. Your name and any other fact that might point to you (e.g., email address) will not appear when results of this study are presented or published. We are only interested in group information. The reporting of the experimental results will only contain group mean results and will contain no personal information about individual participants including performance on the experiment. Your privacy will be protected to the extent allowed by law. To make sure that this research is being carried out in the proper way, the Georgia Institute of Technology IRB may review study records. The Office of Human Research Protections may also look over study records during required reviews.

Costs to You:
There are no costs to you, other than your time, for being in this study.

In Case of Injury/Harm:
If you are injured as a result of being in this research study, please contact Dr. Terry Blum at telephone (404) 894-4924 or e-mail terry.blum@ile.gatech.edu. Neither the Principal Investigator nor Georgia Institute of Technology has made provision for payment of costs associated with any injury resulting from participation in this study.

Participant Rights:

- Your participation in this study is voluntary. You don't have to be in this study if you don't want to be.
- You have the right to change your mind and leave the study at any time without giving any reason and without penalty.
- Any new information that may make you change your mind about being in this study will be given to you.
- You will be given a copy of this consent form to keep.
- You do not waive any of your legal rights by signing this consent form.

Questions about the Study:
If you have any questions about the research study, you may contact Dr. Luis Martins at telephone (404) 894-4366 or e-mail luis.martins@mgt.gatech.edu.

Questions about Your Rights as a Research Participant:
If you have any questions about your rights as a research participant, you may contact Ms. Melanie Clark, Georgia Institute of Technology Office of Research Compliance, at (404) 894-6942 or Ms. Kelly Winn, Georgia Institute of Technology Office of Research Compliance, at (404) 385-2175.

If you sign below, it means that you have read (or have had read to you) the information given in this consent form, and you would like to be a volunteer in this study.

____
Participant Name (printed)

____ __________
Participant Signature Date

____ __________
Signature of Person Obtaining Consent Date

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