THE INFLUENCE OF TEAM MENTAL MODELS

AND TEAM PLANNING ON TEAM PERFORMANCE

A Dissertation

by

PEDRO IGNACIO LEIVA NEUENSCHWANDER

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

August 2006

Major Subject: Psychology

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Approved by:

Chair of Committee,	Stephanie C. Payne
Committee Members,	Winfred Arthur, Jr.
	Laura Koehly
	Gilad Chen
Head of Department,	W. Steve Rholes

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ABSTRACT

The Influence of Team Mental Models

and Team Planning on Team Performance. (August 2006)

Pedro Ignacio Leiva Neuenschwander, B.A., Pontificia Universidad Católica de Chile;

M.S., Pontificia Universidad Católica de Chile

Chair of Advisory Committee: Dr. Stephanie C. Payne

Since Cannon-Bowers, Salas, and Converse (1993) introduced the concept of mental models (MMs) to team performance research, theory and research have supported the idea that common cognitions among team members facilitate team performance. One of the processes that contributes to MM similarity is team planning. In this study, the influence of two planning approaches on MM similarity and team performance are compared for teams that have engaged in different teamwork and taskwork experiences.

The purpose of the present study was threefold. First, I investigated the influence of team members' experience on their pre-planning teamwork and taskwork MM similarity. Second, I assessed the influence of pre-planning teamwork and taskwork MM similarity and two planning approaches on post-planning MM similarity. Third, I examined the influence of post-planning teamwork and taskwork MM similarity on team performance. I tested these relationships with 172 three-person ad hoc teams performing a problem-solving execution task in a lab setting. I employed a 2 (type of planning: case-based versus generative) x 3 (type of experience: teamwork, taskwork, combined teamwork and taskwork) fully crossed randomized between-subjects factorial design.

Although none of the hypotheses were supported, experience significantly interacted with pre-planning taskwork and pre-planning teamwork MM similarity to influence post-planning MM similarity. Also, team performance was significantly influenced by post-planning teamwork MM similarity for teams assigned to the case-based planning and teamwork experience conditions. Speculations as to why the hypotheses were not supported and suggestions for future research examining the influence of experience and planning on MM similarity and team performance are provided.

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INTRODUCTION

The increasingly turbulent, technology-oriented, hyper-competitive, and complex business environment has compelled organizations to integrate a wide range of processes (Funk, 1992). As a result, the complexity of the tasks completed in organizations has increased, frequently surpassing the capabilities of individuals and requiring organizations to adopt a collaborative multi-operator work approach (Cooke, Salas, Cannon-Bowers, & Stout, 2000). In response to this environment, organizations are adopting team-based structures or designs in order to pool together individual efforts and function in teams (Mathieu, Heffner, Goodwin, Salas, & Canon-Bowers, 2000; Smith-Jentsch, Mathieu, & Kraiger, 2005).

Given the increased adoption of team-based structures and designs in organizations, industrial/organizational (I/O) psychologists have developed a strong interest in team performance, and thus, also pursued research studies in this area. Salas and Fiore (2004) claimed that "teamwork can be viewed as the result of collective cognitive, behavioral, and attitudinal activity" (p. 4). Similarly, Zaccaro, Rittman, and Marks (2001) proposed that team effectiveness depends on the integration of team's cognitive, motivational, affective, and coordination processes. The focus of the present study is on team's cognitive processes and performance.

In the early 1990s, team researchers began to recognize common cognitions among team members as a precursor to team performance. According to Rentsch and

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This dissertation follows the style and format of *Journal of Applied Psychology*.

Woehr (2004), the study of team members' mental models (MMs), specifically their similarity and accuracy, facilitated the study of cognitive processes within the team as its own area of research. First, Cannon-Bowers, Salas, and Converse (1993) borrowed the concept of *mental models* from cognitive science to explain how implicit coordination mechanisms among team members work. Next, Klimoski and Mohammed (1994) reviewed the concepts that were used to describe this type of phenomena. Then, a series of conceptual and empirical articles followed to explain the antecedents of team members' MMs and demonstrated their effect on team performance (e.g., Cooke et al., 2000; Cooke, Salas, Kiekel, & Bell, 2004; Marks, Sabella, Burke, & Zaccaro, 2002; Mathieu, Heffer, Goodwin, Canon-Bowers, & Salas, 2005; Mathieu et al., 2000; Mohammed & Dumville, 2001; Rentsch & Klimoski, 2001; Rentsch & Woehr, 2004; Smith-Jentsch et al., 2005; Webber, Chen, Payne, Marsh, & Zaccaro, 2000). This research has also proposed that there are a number of different types of team mental models (TMMs) based on their content. In this study, I examine teamwork and taskwork MMs (Mathieu et al., 2000) which I describe in detail later.

TMMs are defined as the organized knowledge or representations the team members hold regarding the performance of a task and the team interactions involved in it (Cannon-Bowers, et al., 1993; Klimoski, & Mohammed, 1994; Mohammed, Klimoski, & Rentsch, 2000). The degree to which team members hold an accurate representation of a task in which there are a limited number of effective strategies has shown to improve performance (Edwards, Day, Arthur, & Bell, 2006). The degree to which team members share common representations or the extent to which the individuals' representations overlap is expected and has been shown to facilitate coordination processes (Cannon-Bowers et al., 1993; Mathieu et al., 2000; Smith-Jentsch et al., 2005). In this study, I examine team processes for a task in which there are multiple effective strategies, therefore I focus on the similarity rather than the accuracy of team members' MMs.

Marks, Mathieu, and Zaccaro (2001) proposed that teams perform in temporal cycles of goal-directed activity called "episodes," which are comprised of several sub-episodes. The latter can also be thought of as input-process-output (IPO) sub-cycles within a team performance episode. From this perspective, TMMs, which are typically classified as process variables, are considered team qualities that are transformed by several team processes. In this study, TMMs are considered to be both inputs and outputs depending on the performance sub-episode examined. As inputs, TMMs are transformed through transition-phase variables when the team analyzes the task and through action-phase variables when the team performs the task. The process of particular interest in this study is the strategy formulation and planning transition-phase.

The majority of planning research in I/O psychology can be found in the motivation literature, specifically goal setting, which has basically concluded that challenging, specific goals lead to better performance than no goals (Locke & Latham, 1984; Locke, Shaw, Saari, & Latham, 1981; Mento, Steel, & Karren, 1987; Wood, Mento, & Locke, 1987). According to goal-setting theory, challenging-specific goals influence people's performance through two mechanisms: (a) increasing their effort and (b) directing their attention to the task process and the development of more efficient task strategies (Locke et al., 1981; Mitchell & Silver, 1990). Because planning can be construed as a macro level task strategy, this research also suggests that challenging goals facilitate planning. In fact, evidence supporting this proposition has been found in studies conducted with individual tasks (e.g., Earley & Perry, 1987; Earley, Wojnaroski & Prest, 1987; Earley, Lee, & Hanson, 1990; Earley, Shalley, & Northcraft, 1992) and with group tasks (e.g., Smith, Locke, & Barry, 1990; Weingart, 1992; Weldon, Jehn, & Pradhan, 1991). Nonetheless, research concerning the *development* of task strategies and planning as a macro task strategy in a team context is quite limited.

Research on effective leadership behavior has shed some light on team planning, finding that some leadership characteristics such as planning skills and leadership behaviors such as structuring are related to quality of planning among teams (Marta, Leritz, & Mumford, 2004; Mumford, Schultz, & Osburn, 2002; Mumford, Zaccaro, Harding, Jacobs, & Fleishman, 2000). Research on TMMs has found that good quality planning has a positive effect on MM similarity (Stout, Cannon-Bowers, Salas, & Milanovich, 1999).

Theory and research on planning can also be found in the artificial intelligence (AI) literature. AI researchers have developed two broad competing approaches to planning that are based on two different sources for planning. The traditional planning approach, *generative planning*, proposes that the most efficient way to develop a plan is to generate it from scratch through a logical-rational analysis of the problem. Alternatively, *case-based planning*, proposes that plans are more efficiently generated by retrieving memory-stored relevant cases and adapting plans used on those cases to the new situation (Spalazzi, 2001). Although the AI theories have been useful to the design of automated intelligent agents, their effectiveness has not been investigated with humans. In the present study, the influence of these two planning approaches on team performance is examined. Additionally, because case-based planning is contingent on previous experience and I am studying teams, I examine the role of teamwork and taskwork experience on these two planning processes.

In the present study, I explore the effects of team experience and team planning on the similarity of the team members' taskwork and teamwork MMs and consequently team performance. The purpose of the present study was threefold. First, I investigate the influence of previous performance episodes on team members pre-planning MM similarity. Second, I assess the influence of pre-planning MM similarity and two planning approaches on post-planning MM similarity. Third, I examine the influence of the post-planning MM similarity on team performance. I tested these relationships with 172 three-person project-action teams (Sundstrom, De Meuse, & Futrell, 1990) performing a planning-performance task (McGrath, 1984) in a lab setting.

From a theoretical perspective, this study broadens our knowledge of team cognitive processes in three areas. First, this study explores the value of different types of experiences with the task and the team on teamwork and taskwork MMs, as well as the relative contribution of each TMM to team performance. Second, it reveals the influence of two planning methods (generative and case-based planning) on TMM similarity. Third, this study assesses the generalizability of the teamwork/taskwork MM framework on a new type of task; a planning-performance task. (The majority of TMM studies have used competitive tasks [McGrath, 1984])

This research also has important applied implications. The results of this study may enrich the tools human resource practitioners have available to improve team performance in organizations. For example, it has the potential to identify which team experiences are most likely to facilitate teamwork and taskwork MMs and which planning approach is most beneficial to each MM. These results could provide guidance on future team training content and curricula.

Figure 1 depicts an integrated diagram of the relationships hypothesized in this study. I propose three hypotheses. First, team experience relates to team member's pre-planning taskwork and teamwork MM similarity (H1). Second, team member's post-planning taskwork and teamwork MM similarity is determined by the interaction between the planning the team members' conduct, their pre-planning taskwork and their teamwork MM similarity (H2). Finally team member's post-planning taskwork and teamwork MM similarity relates to team performance (H3).

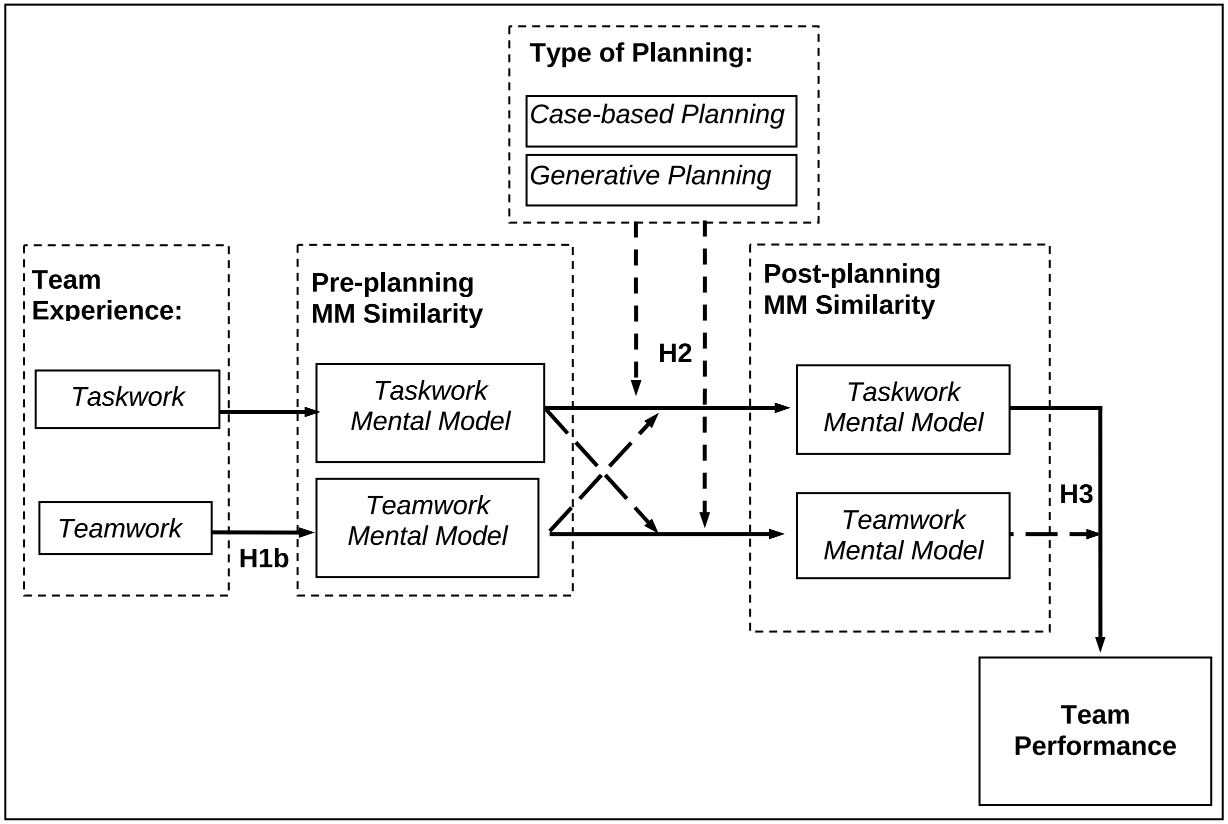

Figure 1. Conceptual framework for the hypothesized relationships

TEAMS AND TEAM RESEARCH

The transformation of organizational structures worldwide, which has changed the basic organization of work, has captured the attention of work group and team researchers (Kozlowski & Bell, 2003). In fact, Levine and Moreland (1990) noted that small group research in the 1980s shifted from group dynamics studied by social psychologists to a more practical concern of improving work group performance studied by applied organizational psychologists. Recently, the input-process-output (I-P-O) model of small group research (McGrath, 1964) has been revised to reflect a broader range of mediational variables that explain variability in team performance and viability, as well as the notion of cyclical feedback (Hackman, 1987; Ilgen, Hollenbeck, Johnson, & Jundt, 2005; Marks et al., 2001).

Of special interest to this study is Marks et al.'s (2001) temporally based framework and taxonomy of team processes. As mentioned earlier, from a temporal perspective, a team performance episode can be considered an I-P-O cycle composed of several sub-episodes, which represent I-P-O sub-cycles. Based on this framework, Marks et al. revisited the definition of process variables and distinguished between emergent states and process variables. Emergent states are dynamic team cognitive, affective, and behavioral *team qualities* that change along with team performance. Team cohesion, potency, perception of team conflict, and TMMs are all emergent states (Marks et al.). Process variables are team members' *behaviors* that transform inputs to outputs through a cognitive, verbal, and/or behavioral activity.

Marks et al. (2001) divided the team performance episode into two broad phases: transition and action phases. The transition phase involves analyzing the goals and the task to organize performance. The action phase involves performing the task in an effort to accomplish a goal. They further proposed that three types of processes occur during a transition phase: (a) mission analysis, (b) goal specification, and (c) strategy formulation and planning. The other four processes occur during action phases: (d) monitoring process toward goals, (e) system monitoring, (f) team monitoring and back up, and (g) coordination. Three additional processes can take place during either of these phases: (h) conflict management, (i) motivating and confidence building, and (j) affect management. This study focuses on the effect of the transition process, strategy formulation and planning, on team members' taskwork and teamwork MM similarity.

Definition of Team

I/O psychology researchers recognize that teams are a sub-category of groups, characterized by a certain level of interdependence; at least at the goal, task, or outcome level. All definitions of teams share certain ideas: (a) teams perform a task, (b) they have common goals, (c) they interact socially, and (d) its members share a level of interdependence based on role differentiation. In this study, the internal processes that lead teams to increase their level of performance are of focal interest, so a team definition that emphasizes these processes is most relevant for this study. For example, Salas, Dickinson, Converse, and Tannenbaum (1992) defined a team as "a distinguishable set of two or more people who interact, dynamically, interdependently, and adaptively toward a common and valued goal/objective/mission, who have been assigned specific roles or functions to perform, and who have a limited life-span of membership" (p. 4). I adopt this definition of a team in this study, because it emphasizes the nature of the processes team members engage in when they perform a task. It should be noted, however, that a limited life-span is not a requirement for a team, even though it is true of the ad hoc laboratory-based teams examined in this study.

Taskwork and Teamwork Dimensions of Team Performance

Based on studies of teams' evolution and maturation process, Morgan, Salas, and Glickman (1993) sustained that teams differentially develop two tracks of behaviors which have been shown to be useful to the understanding of team performance, team composition, team task analysis, and TMMs (e.g., Arthur, Edwards, Bell, Villado, & Bennett, 2005; Mathieu et al., 2000; Mohammed, Mathieu, & Bartlett, 2002). These two tracks of behaviors have been referred to as *taskwork* and *teamwork*. The taskwork track of behaviors "involves activities that are tied to the specific task(s) being performed. […] referred to as operational skills" (Morgan et al., 1993, p.283). This track is related to the technical aspects of the job that usually require some level of interaction with the other team members. A team that has developed the taskwork track is a team capable of performing the tasks assigned, because their members have developed the technical skills required for performance. Although the team members need to share some work experience together to develop this track of behavior as a team, the knowledge, skills, and abilities (KSAs) the team members developed prior to their team membership contribute extensively to their team's taskwork track of behavior.

The teamwork track of behaviors "is devoted to enhancing the quality of the interactions, interdependencies, relationships, affects, cooperation, and coordination of teams" (Morgan et al., 1993, p. 283). A team that develops this track of behaviors learns how to work interdependently because their team members have learned to communicate as efficiently as possible, already know what to expect from the others, and are willing to work with each other. Although team members' previous communication, negotiation, and coordination KSAs are likely to facilitate their teamwork, it is primarily from working together that the team develops the teamwork track of behavior.

Littlepage, Robinson, and Peddington (1997) examined teamwork and taskwork experience on an intellective experimental task by having group members perform a related or an unrelated task individually or as a team before they performed the criterion task together. The results revealed experience was significantly related to team performance, but the nature of the task moderated this relationship. When the task allowed for knowledge and strategy transfer from previous experience to the criterion task, only taskwork experience had an effect on team performance. When transfer was not possible (i.e., they completed an unrelated task), both taskwork and teamwork experience had an effect on team performance. They argued that in the tasks in which knowledge and strategy are transferable from previous experience to the criterion task, the effect is explained by the improvement of the team members' skills. For unrelated tasks, the improvement is explained by the capability of the team members to identify other members' expertise for team performance.

TEAM COGNITIVE PROCESSES: TEAM MENTAL MODELS

In order to better understand how teams adjust their behavior appropriately to future tasks and team requirements, Cannon-Bowers et al. (1993) borrowed the construct “mental model” from system control, cognitive psychology, and cognitive science and extended it to team research. They noted that knowledge structures shared by members of a team “enable them to form accurate explanations and expectations for the task, and, in turn, to coordinate their actions and adapt their behaviors to the demands of the task and other team members” (p. 228). TMMs have also been defined as an organized understanding or mental representation of knowledge shared by the team members (Klimoski, & Mohammed, 1994; Mohammed et al., 2000; Smith-Jentsch et al., 2005).

Cannon-Bowers et al. (1993) proposed that the extent to which team members share common representations of the task or MMs (usually referred to as shared MMs in the literature) is related to the team performance. When team members have similar representations of different aspects of the task and the team, they are able to coordinate more effectively than when each team member holds a different representation that does not overlap with the others. They further proposed that in order to be effective, team members need to share at least four different types of MMs: (a) the equipment model, which describes the equipment and operating procedures, (b) the task model, which describes the task, its likely contingencies and scenarios, and task strategies involved, (c) the team interaction model, which describes the roles, responsibilities, and interactions of team members, and (d) the team model, which describes the team members themselves. Building on Morgan et al.’s (1993) taskwork and teamwork distinction, Mathieu et al. (2000) combined these four types of models into two models: taskwork (the equipment and task models) and teamwork (the team interaction and team models) MMs. These models are likely to be related such that coordinating and integrating different pieces of information regarding the task might require the team members to share similar representations regarding the team, what to expect from each other, and how each team members’ skills supplement each other.

Because team members can share either accurate or inaccurate information regarding the task and the team, accuracy is another characteristic of TMMs that is likely to relate to performance. Edwards et al. (2006) proposed when a task has one correct way to be performed, MM accuracy will predict team performance better than MM similarity. Accordingly, they found that the extent to which the mental representations held by the team members were accurate over time had a stronger effect on performance than the extent to which team members had similar MMs. However, assessing MM accuracy is less relevant when there is more than one right way to perform the task, because multiple accurate representations of the task are likely to exist (e.g., Mathieu et al., 2005; Webber et al., 2000).

In this study, I explore the degree to which team members share common representations regarding taskwork and teamwork. MM similarity is a team level construct. Nevertheless, to obtain a measure of the extent to which the team members share common representations, the individual MMs must be measured first, and then a comparison index must be calculated. MMs researchers tend to agree about the best method to measure individual MMs, but they do not agree on the best index to assess the overlap between them.

When time to measure MMs is a constrained, the most appropriate method to elicit MMs is the rating of all possible pairwise combinations of a series of taskwork and/or teamwork performance components (Langan-Fox, Code, & Lanfield-Smith, 2000), and consequently this is the most frequently used method to measure individual MMs. Nevertheless, several statistics have been used to estimate the degree to which MMs are similar: interrater agreement (e.g., Webber et al., 2000), Pathfinder Closeness index (e.g., Marks, et al., 2002; Stout et al., 1999), and average correlation between team member’s responses (e.g., Smith-Jentsch et al., 2005).

Cooke et al. (2000) proposed that one of the sources from which TMMs emerge are past experiences that provide team members with knowledge they bring to the team. Similarly, Cannon-Bowers et al. (1993) identified experience and practice as critical components to the development of similar MMs. Cooke et al. noted further that past experiences might provide team members with two types of knowledge: task- or team-related. Thus, depending on the type of experience the team members have had, team members are likely to bring task- and/or team-related knowledge that will differentially contribute to taskwork and teamwork MMs.

In summary, past experiences provide team members with task- and team-relevant knowledge which contribute to taskwork and teamwork MMs. Therefore, to the extent that team members have common past experiences with a task, they will be more likely to have similar knowledge regarding the task, leading to more similar taskwork MMs.

(H1a) Team members with taskwork-related experience will have more similar taskwork MMs than team members who do not have previous taskwork-related experience.

Additionally, to the extent that team members have interacted in the context of task performance, they should have similar knowledge regarding the team, leading to more similar teamwork MMs.

(H1b) Team members with teamwork-related experience will have more similar teamwork MMs than team members who do not have previous teamwork-related experience.

TEAM COGNITIVE PROCESSES: TEAM PLANNING

Definition of Planning

There are multiple definitions of planning. Scholnick and Friedman (1987) noted that planning has been treated either as a general cognitive skill (e.g., Miller, Galanter, & Prigram, 1960) which makes definitions difficult to apply to specific situations, or as a context/task-specific activity (e.g., Hayes-Roth & Hayes-Roth, 1988; McGrath, 1984) which makes definitions difficult to generalize to other contexts and tasks.

In this study, planning is studied in a team problem-solving context making a more context specific definition necessary. From a problem-solving perspective, plans are usually defined with regard to their function. McDermott's (1978) theory of problem solving identified plans as a collection of subtasks, which permit one to perform a task that cannot be immediately carried out. In this context, planning involves identifying a collection of subtasks such that the problem task is solved by doing all of the subtasks. Similarly, Chaiklin (1984) identified plans as a set of instructions that guide problem solving. According to this view, planning is the process of identifying the necessary steps to solve a problem. These two definitions are more focused on the product of planning (i.e., the plans) than on the planning process which is the focus of this study.

Mumford, Schultz, and Van Doorn (2001) also proposed a definition of planning focused on the planning process in the context of task performance. Specifically, planning is "the active and conscious mental simulation of future action sequences intended to direct behavior and optimize the attainment of certain outcomes" (p. 214). Mumford et al. also emphasized that the construction of mental simulations is a demanding and intensive activity; therefore, people must be capable and willing to invest scarce resources in planning. I adopt this definition of planning in this study, because it bounds the concept of planning to a cognitive process and highlights the optimization of outcomes through the direction of behavior. Additionally, planning is proposed in the context of task performance, making it particularly applicable and pertinent to this study.

Team Planning

The definitions of planning described thus far have not taken into consideration the individual versus group context in which planning might be conducted. When planning is conducted at the individual level, there is only one person involved who may or may not make use of help from other persons as external resources. When planning occurs in a group context, more than one person is involved and additional cognitive, communication, and coordination processes arise.

Weldon et al. (1991) and Weingart (1992) proposed a distinction between individual and group planning. Planning for individual performance involves developing performance routines including the identification of: (a) task-relevant acts, (b) how to perform those acts, and (c) information cues necessary to perform the task. Planning for group performance focuses on coordinating group members, which includes delegation of subtasks, integration of individual outputs, and timing of actions. Whereas individual performance requires only individual planning, group performance requires both individual *and* group planning. At the group level, because more than one individual is involved in the execution of the task, planning involves the mental simulation of all the actions *each and every* group member may perform to accomplish a group goal, but also the division of roles and coordination of the actions derived from those roles. Therefore, when planning is conducted at the group level, the mental simulation of future action sequences intended to direct behavior and optimize outcomes must consider the actions each and every member of the team is going to perform and how they will be integrated.

The importance of team planning to team performance is likely to be directly related to the level of interdependence required by the task (Tesluk, Zaccaro, Marks, & Mathieu, 1997). Working on a task that demands a high level of interdependence sometimes requires dividing the task into subtasks that will be performed by each individual. This involves developing interdependent performance routines and integrating these subtask efforts (Weingart, 1992; Weldon et al., 1991). In other words, interdependence increases the need for team planning.

Considering these components, the definition of planning adopted in this study overlaps with Marks et al.'s (2001) definition of strategy formulation and planning: "the development of alternative courses of action for mission accomplishment" (p.365). This includes decision making regarding the way the team will accomplish its mission, discussion about task-related information as well as expectations about the team performance, goal prioritization, and role assignment. Accordingly, in this study team planning is defined as team members' discussion to simulate future sequences of actions with the intention to direct and coordinate their individual actions to optimize the attainment of team outcomes. Team planning is considered a process, because while simulating future actions team members transform team inputs (e.g., pre-planning MMs) into team outputs (e.g., post-planning MMs).

Timing of Planning

Another issue involved in the definition of planning is the timing of planning. Is planning a mental simulation that must be conducted *before* any of the steps of task performance are enacted? Although execution of the plan is clearly not a mental simulation and therefore would not be considered planning, monitoring the plan and making modifications to the plan during task execution are likely to be important, thus planning can take place after task performance has begun.

Weingart (1992) distinguished between two types of planning based on the timing of the planning. *Preplanning* involves the mental simulation of the whole chain of actions required to accomplish the goal before performing the task. *In-process planning* involves the mental simulation of a chain of actions and its implementation which follows successive subsequent mental simulations of other chains of actions and their implementation. According to this distinction, when pre-planning is conducted, plan modification is not expected during implementation. Nevertheless, a good plan is likely to recognize potential execution problems, include alternative courses of action, and specify markers for monitoring progress (Xiao, Milgram, & Doyle, 1997), as well as take into account the information obtained during execution which facilitates the exploitation of emerging opportunities (Platalano & Seifert, 1997). Therefore, modification to plans should be expected even when pre-planning occurs. In other words, the fact that the team engages in planning when performing the task does not discount the value of pre-planning.

Marks et al. (2001) classified strategy formulation and planning into three subdimensions. The first one is *deliberate planning* referring to the formulation of the principal course of action to accomplish the mission. The second, *contingency planning*, is the formulation of alternate courses of actions and adjustments due to anticipated changes in the environment. The third one, *reactive strategy adjustment*, is the alteration of plans already formulated due to unanticipated changes in the environment and/or unanticipated performance feedback. With regard to the timing of planning, deliberate and contingency planning are conducted before the team actually starts performing the task (preplanning), but reactive strategy adjustment is conducted only after the team starts performing the task (in-process planning). In this study, I focus primarily on the influence of planning prior to task execution (preplanning) on team performance. Such planning is most likely to be deliberate and/or contingency planning.

Two Approaches to Planning

In their effort to model human reasoning, AI researchers have described various approaches to planning. These approaches provide an interesting starting point to build hypotheses about how two different planning methods might increase group performance. It should be noted that these planning approaches have been proposed to develop AI technology for the design of automated intelligent agents. Because of this, it is unclear how these propositions and findings generalize to planning conducted by one person in a group context or several people in a group. This study will begin to address this gap in the literature.

Leake (1996) pointed out that reasoning is often modeled as a process that draws conclusions by chaining together generalized rules. Based on this approach to reasoning, the classical approach to planning has been defined as generating plans from scratch, and therefore it has been labeled *generative planning*. Leake also defined case-based reasoning, in which the primary source of knowledge is memory-stored cases. Solutions to new problems are obtained by adapting relevant solutions from prior experiences. This is the foundation for an alternative planning approach, *case-based planning*.

Generative Planning

Generative planning involves the generation of plans in order to satisfy a given goal (Spalazzi, 2001). Yang (1997) describes some of the complexities of generative planning. Once a goal is given, although the planner might be able to identify the actions required to satisfy that goal, the planner still faces an efficiency problem because of the availability of multiple plans. In fact, there are as many possible plans as the number of all combinations of the actions needed to satisfy a goal, and the cost associated with reviewing *each and every* possible plan is too high. Yang reviewed two methods that increase planning efficiency by exploiting the structures of the problem: divide-and-conquer and hierarchical planning with abstraction. Both methods of planning share the same basic principles: (a) identification of a set of sub-goals to be accomplished to reach a final goal and (b) the information needed to search and select plans, the description of the problem and the conditions under which it should be resolved, is contained within the information provided.

In summary, generative planning involves developing plans from scratch, by decomposing the main goal into sub-goals and looking for the most effective plan for each sub-goal. Consequently, the primary source for generative planning is the rational analysis of goals and all possible plans. Task-related information will be necessary to identify and analyze all possible actions involved in the attainment of the task, but the selection of the most effective sequence of actions to accomplish the task depends on the rational analysis of all possible plans.

Case-Based Planning

Case-based planning is based on the use of past experience; reuse of plans that have succeeded in the past and the recovery from plans that have failed (Spalazzi, 2001). In his effort to model human reasoning with AI, Hammond (1989, 1990) proposed that planning is a memory task in which plans are constructed by modifying a plan from memory that already satisfies or partially satisfies many, if not all, of the planner's goals. A new plan is based on the planner's knowledge of what has succeeded and failed in the past. Failures become expected failures that indicate the understanding of the world is faulty and should be altered. A case-based planner uses the memory of past failures to identify problems that need to be avoided and searches the memory of past successes for a plan that can be modified to fit the goals that need to be satisfied.

Leake (1996) stated that when people encounter the same type of problems they have experienced in the past, and there is consistency between the situations, a simple reuse of plans will be adequate to solve the problem. But as the new problem and its context are less similar to the past experience, case-based planning requires a more creative problem solving strategy than the simple reuse of old strategies. He further noted that when the stored experience and the new problem are different, a comparison of similarities and differences between the past experience and the new problem will help to resolve the problem.

According to Hammond (1990), the first step in case-based planning is to retrieve an appropriate plan to satisfy a problem’s set of sub-goals and modify it to the new situation. From memory-stored plans, the planner searches for the best matched plans to select a plan that satisfies as many goals in the new situation as possible. Once the plan is selected and retrieved from memory, an initial plan is obtained by modifying the retrieved plan to the new situation. When a plan has failed in the past, the experience is not discarded, but analyzed to avoid the same failure in the future by repairing the plan and storing it for retrieving purposes. It also gives the planner knowledge regarding the circumstances under which a plan is likely to fail.

In summary, case-based planning develops plans by retrieving memory stored-plans and modifying them to fit the new situation. Therefore, the main source for case-based planning is the rational analysis of previous experiences and the strategies used to accomplish a goal. Task-related information is necessary not only to identify the goals and possible actions involved in the attainment of the task, but to the selection of the most effective sequence of actions to accomplish the task, which is based on the analysis of previous experiences and their similarity with the new situation.

Planning Effectiveness in Individual Contexts

Case-based planning advocates believe that generative planning is more costly than case-based planning. Comparing the effectiveness of the two types of planning with intelligent non-human agents, Nebel and Koehler (1995) demonstrated that when modifying a plan conservatively, it takes more resources to reuse an old plan that must be modified than to plan from scratch. In this case, the computational costs associated with retrieving relevant cases from a plan library and analyzing successive modifications of the retrieved plan is higher than actually building a plan from scratch. This finding has not been explored in human beings.

Indeed, it can be argued that in order to engage in case-based planning an individual needs to have at least (a) one relevant case or previous experience from which to retrieve an initial plan and (b) the cognitive resources to analyze the initial plan within the new context and modify the strategies to fit the new situation. To engage in generative planning, an individual must invest a larger amount of cognitive resources to perform a pure rational-logical analysis of all the possible plans one could pursue. Therefore, when an individual has cognitive resources available but not relevant cases, case-based planning will lead to a lower quality planning process than generative planning.

From a broader reasoning framework, Leake (1996) argued that case-based reasoning might involve the simple straight re-use of a memory stored plan to a new but identical situation, to a more creative exercise in which memory stored-cases are used to identify similarities and differences of a new situation to solve problems. In the later case, the similarity of the relevant case from which reasoning is conducted is not as relevant as in the former case. What is relevant is the analysis of dissimilarities that provides resources to identify the need for alternative means to solve the problem.

Based on this rationale, case-based planning should be more effective than generative planning, because even the most dissimilar case should provide resources to look for alternative actions when planning. But this might not be the case because when memory stored cases are dissimilar to the new situation, the amount of cognitive resources required to retrieve an initial plan and modify it increases significantly, and, the advantage of case-based planning is reduced. Therefore, within an individual problem-solving context, case-based planning will be more effective when the problem is similar to a past experience. Generative planning will be more effective when the problem is dissimilar to past experiences, because the cognitive resources needed to retrieve a plan from past experience and modify it are larger than the ones needed to plan from scratch.

Planning Effectiveness in Team Contexts

As Weingart (1992) pointed out, planning for team performance requires not only individual planning, but also team planning. When two or more persons perform an interdependent task, planning involves the additional challenges of delegating subtasks, coordinating actions, and integrating individual outputs. Team planning requires the team members to communicate their individual ideas and integrate them to coordinate actions accordingly. When more than one individual is involved in the planning process, they are likely to have different past experiences. These experiences provide team members with different types of knowledge and skills that have the potential to enrich the group planning resources. But, as the heterogeneity of experiences and cognitive skills among team members increases, the likelihood of the team members conducting radically different individual rational thinking processes also increases. Additionally, the communication requirement increases potentially making the team planning process too costly and even detrimental to team performance.

In fact, research on the influence of top management team members' heterogeneity of previous experiences on strategic organizational performance has found a curvilinear relationship between team members' functional heterogeneity, the dimension most associated with different perceptions of the business, and performance (Greening & Johnson, 1997). This suggests that some level of functional heterogeneity among top management team members might be beneficial because of the varied skills and worldviews that diversity provides. However, high levels of heterogeneity are also associated with lower levels of performance due to potential interpersonal conflict and communication breakdowns that might detract from team behavioral integration (Carpenter & Frederickson, 2001). Nevertheless, the sources for generative and case-based planning are different. Therefore, the heterogeneity of team members' past experience and cognitive skills will influence each type of planning process differently.

Generative Planning and Planning Effectiveness in Team Contexts. As described earlier, the rational analysis of goals and sequences of actions is the primary source for generative plans. In a team context, when two or more persons are involved in generative planning each of them will conduct their own individual reasoning process.

Because each team member may analyze the problem from a different perspective, it is unlikely that all team members will identify the same set of sub-goals and sequences of actions to accomplish the goals. Because of this, the main challenge of conducting generative planning in a group context is communicating, coordinating, and integrating the individual plans into a team plan.

Teams with high levels of teamwork MM similarity have the same expectations regarding the interactions among team members and the way teamwork should be conducted. These teams are likely to be able to communicate with one another, integrate their ideas, and coordinate their actions better than teams who do not have shared teamwork MMs. Thus, teamwork MM is likely to facilitate generative planning, In contrast, taskwork MMs would not be as relevant because the specific representations of the task the team members shared are less likely to influence their capability to perform a logical analysis of the problem at hand. Individuals with the cognitive ability to conduct a logical analysis of the problem, its goal, and the situational constraints involved, should be able to identify similar actions needed to perform the task and analyze the quality of multiple possible plans (Yang, 1993).

In summary, whereas taskwork MM similarity should not influence team performance, teamwork MMs similarity should have a significant effect on the team's planning effectiveness when they engage in generative planning, because the more similar the teamwork MMs, the smoother the communication and coordination processes are likely to be.

Case-Based Planning and Planning Effectiveness in Team Contexts. One of the requirements to engage in case-based planning is the availability of a plan library that provides planners relevant cases to retrieve an initial plan. Yet, when case-based planning is conducted among two or more persons, each individual has their own plan library, which is unlikely to overlap with the others, unless they have past experiences that provide them with similar representations of the task. Thus, to facilitate case-based planning in a team context, the team members need to have similar taskwork MMs to retrieve a common initial plan. Additionally, like generative planning in team contexts, case-based planning in teams also involves communicating, coordinating, and integrating the different ideas the team members retrieve from their common experience. Thus, teamwork MMs are also expected to facilitate the case-based planning process, because they help team members to communicate and integrate their ideas.

In summary, because case-based planning relies on (a) the availability of relevant plans to retrieve an initial plan, and (b) team's communication, coordination, and integration capabilities, it is expected that the effectiveness of case-based planning in team contexts will be determined by the interaction between team members' pre-planning taskwork MM similarity and team members' pre-planning teamwork MM similarity. Teams with similar taskwork MMs will be able to retrieve a common initial plan and will be more effective conducting case-based planning, than teams with dissimilar taskwork MMs. At the same time, teams with similar pre-planning taskwork MMs will be more effective when they also have similar pre-planning teamwork MMs than when they have dissimilar teamwork MMs, because they will be able to communicate, integrate ideas, and coordinate better. For teams with dissimilar taskwork pre-planning MMs, pre-planning teamwork MM similarity will not have a significant effect, because the team will not be able to retrieve an initial plan to perform case-based planning.

TEAM COGNITIVE PROCESSES: PLANNING AND TEAM MENTAL MODELS

Marks et al. (2001) proposed that strategy formulation and planning is one of the transition processes that will influence TMMs. Within a strategy formulation and planning sub-episode, pre-planning TMMs might be considered input variables that are transformed during the planning process to become outputs as post-planning TMMs. When the members of a team deliberately analyze the task to identify the most effective actions and task strategies to accomplish the team's mission or goal, they share their own representations of the task and learn from their team members' interactions. Therefore, strategy formulation and planning are expected to increase team member MM similarity. Cooke et al. (2000) also proposed that group discussion is one of the sources by which MMs within a team context might change. Because planning is a type of structured group discussion, planning is expected to increase MM similarity among team members.

Stout et al. (1999) proposed teams that engage in better planning during a pre-performance period would develop more similar MMs. In their study, the quality of the team's planning was assessed on nine dimensions: (a) creating an open environment, (b) setting goals and awareness of consequences of errors, (c) exchanging preferences and expectations, (d) clarifying roles and information to be traded, (e) clarifying sequencing and timing, (f) unexpected events, (g) how high workload affects performance, (h) pre-prepared information, and (i) self-correcting. Teams were evaluated on each of these dimensions and then classified as either high or low quality planning teams. The analyses showed that high quality planning teams developed significantly more similar

MMs, used a more effective communication strategy, and committed significantly less errors than low quality planning teams.

Nevertheless, as described earlier, the effectiveness, and therefore the quality of the planning process will vary depending upon the planning method the team engages in, and the similarity of the team member's pre-planning taskwork and teamwork MMs. Thus it is hypothesized that the type of planning the team engages in will interact with the similarity of team members' pre-planning taskwork MMs, and the similarity of team members' pre-planning teamwork MMs to determine post-planning TMM similarity in the direction depicted in Figure 2. Accordingly, I hypothesize:

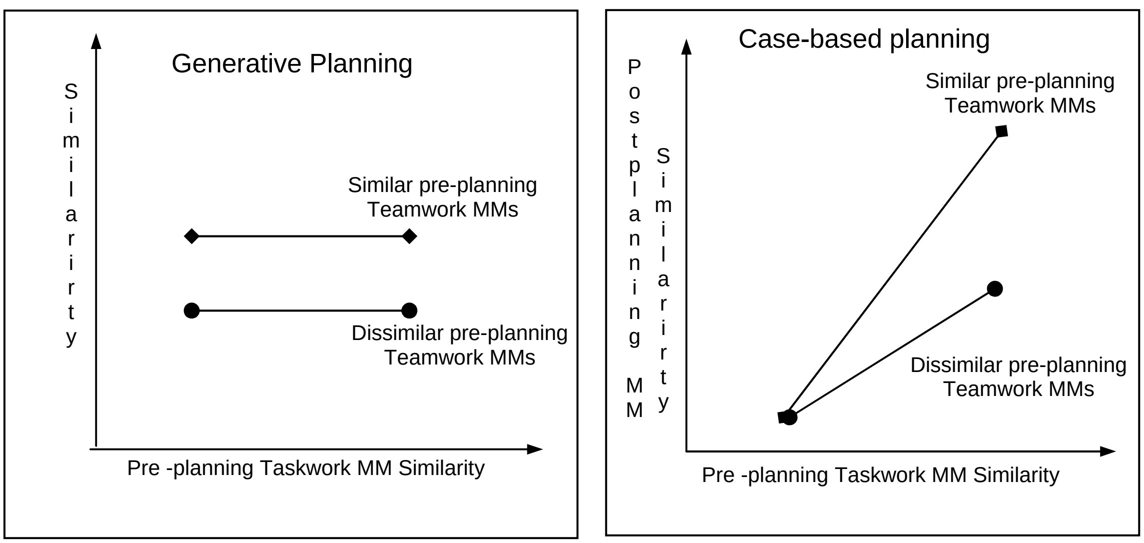

Figure 2. Expected influence of the interaction between type of planning, pre-planning taskwork MM similarity, and pre-planning teamwork MM similarity on post- planning MM similarity

H2a: There will be a three-way interaction among planning approach, pre-planning taskwork MM similarity, and pre-planning teamwork MM similarity on post-planning taskwork MM similarity such that in case-based planning, the relationship between pre-and post-planning taskwork MM similarity will be stronger for teams with similar pre-planning teamwork MMs than for teams with dissimilar pre-planning teamwork MMs, but in generative planning, only pre-planning teamwork MM similarity will positively influence post-planning taskwork MM similarity.

H2b: There will be a three-way interaction among planning approach, pre-planning taskwork MM similarity, and pre-planning teamwork MM similarity on post-planning teamwork MM similarity such that in case-based planning, the relationship between pre- and post-planning teamwork MM similarity will be stronger for teams with similar pre-planning taskwork MMs than for teams with dissimilar pre-planning taskwork MMs, and in generative planning, only pre-planning teamwork MM similarity will positively influence post-planning taskwork MM similarity.

TEAM MENTAL MODEL SIMILARITY AND TEAM PERFORMANCE

Recent research on TMMs has supported Cannon-Bowers et al.'s (1993) hypothesis that common cognitions among team members are associated with team effectiveness. Mathieu et al. (2000) provided indirect support for this hypothesis when they found that team coordination processes mediated the relationship between the level of convergence between TMMs (both taskwork and teamwork) and team performance on an F-16 fighter simulation task. In a replication of this study, Mathieu et al. (2005) found that team member taskwork MM similarity showed both direct and indirect effects on team performance through team coordination processes. Team member's teamwork MM similarity showed an indirect effect on team performance through team coordination processes when the accuracy of the TMMs was moderate to high. Marks et al. (2002) also found that taskwork MM similarity predicted team coordination processes, which in turn predicted three-person team effectiveness in an Apache helicopter flight simulator.

Using a different method to elicit MMs, Webber et al. (2000) found that team member agreement on MMs explained 14% of basketball teams' performance. Finally, in a sample of air traffic controllers, Smith-Jentsch et al. (2005) found that, after partialing out the effect of tower complexity, tower design, and average air traffic controller experience, the interaction between teamwork MM similarity and taskwork MM similarity predicted 5% of the variance in tower efficiency, and 10% of the variance in tower safety. Whereas teams with highly similar team MMs, demonstrated a positive relationship between task MM similarity and team performance, teams with dissimilar team MMs showed a negative relationship between task MM similarity and team performance. The authors speculated that the characteristics of the different locations in which the teams performed might explain these results. They also pointed out that the nature of the interaction suggests that the two types of TMMs are not compensatory (one does not make up for a lack of the other) and reported that the teams with the lowest level of performance were those with a low level of taskwork MM similarity and high levels of teamwork MM similarity.

The evidence obtained from the studies described above suggests that both taskwork and teamwork MMs are important contributors to team performance. Still, Smith-Jentsch et al. (2005) were the first to examine the interaction of these two types of MMs on team performance. Consequently, they suggested studying not only the linear effect of these two types of MMs on team performance but also the non-linear effects that are only evident when testing their interaction on team performance.

Following these suggestions and considering that the taskwork track of behavior is related to the level of technical expertise the team members hold to perform the task, and the teamwork track of behavior is related to the communication and coordination of team members' actions (Morgan et al., 1993), it seems reasonable to suggest that teamwork MM similarity moderates the relationship between taskwork MM similarity and team performance as shown in Figure 3. Thus I hypothesize that:

H3: There will be a significant interaction between teamwork and taskwork post-planning MM similarity on team performance, such that the relationship between taskwork MM similarity and team performance will be stronger for teams with *similar teamwork post-planning MMs than for teams with dissimilar teamwork post-planning MMs.*

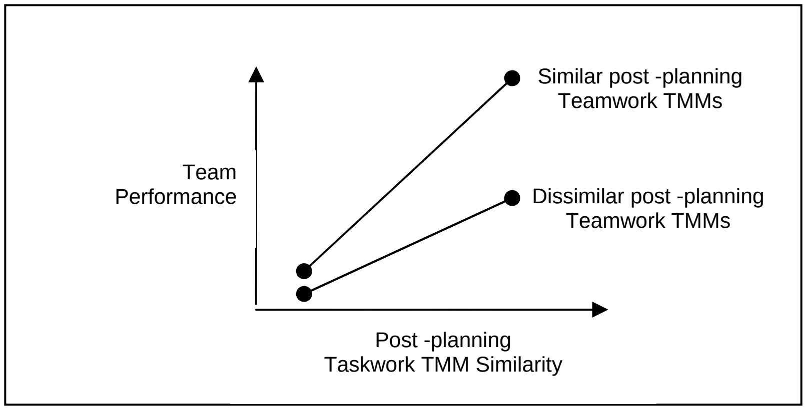

Figure 3. Hypothesized interaction between taskwork and teamwork post-planning MM similarity on team performance

METHOD

Participants

Five hundred and sixteen undergraduate students participated in the study in exchange for two hours of research credit toward a five hours class requirement. The sample consisted primarily 18 and 19-year old (45.9% and 34.3% respectively; *M* = 18.80, *SD* = 1.33) Caucasian (77.9%), male (57.4 %), freshmen (69%). The participants performed the task in 172 3-person teams (33 with all male, 75 with a female and two male, 47 with a male and two female, and 17 with only female participants).

Research Design

Experimental Task

The task used in this study was adapted from “The Manufacturing Game” (Zaccaro, Foti, & Kenny, 1991). The objective of the task is to obtain as much profit as possible by building four Lego® models (cars, trucks, robots, and boats) and selling them to the experimenter. The participants start with $10,000 to buy required materials from the experimenter to build the products. The prices to buy materials and to sell the products were pre-established and changed every five minutes. In order to ensure task interdependence, each participant was constrained to work with only one color of Lego© blocks (e.g., team member A was only allowed to build with red blocks) and no blocks of the same color could be placed next to each other within a given product.

In order to enhance the participants’ effort spent on the task all teams were assigned a challenging specific goal. Based on pilot testing, it was determined that only

10% of the teams obtained a profit higher than $20,000. Therefore, the goal to obtain at least $20,000 in profits was given to all of the teams. The detailed task instructions and materials provided to the participants are presented in Appendix A.

Experimental Conditions

A 2x3 (type of planning x type of previous experience) fully crossed randomized between-subjects factorial design was employed. The first factor was type of planning with two levels: (a) generative planning and (b) case-based planning. The second factor was type of experience with three levels: (a) taskwork, (b) teamwork, and (c) a combination of both taskwork and teamwork. Teams were randomly assigned to one of six conditions. Table 1 shows the final number of teams in each condition.

Table 1

Final Number of Teams in Each Experimental Condition

	Generative Planning	Case-based Planning	Total
Taskwork Experience	29	28	57
Teamwork Experience	29	27	56
Combined Taskwork - Teamwork Experience	29	30	59
Total	87	85	172

Experience Manipulation. Before performing the experimental task, all teams were randomly assigned to perform one of three 10-minute tasks, which provided taskwork and/or teamwork experience(s) to the teams. The teams assigned to the *taskwork experience condition* performed the experimental task individually with different market prices and without specific color assignments. The teams assigned to the *teamwork experience condition* performed a different team task, a *tower building task*. In this task, the team had 10 min to build as many wooden cube towers as possible. They were provided with a fixed number of wooden cubes of three different colors. Similar to the Lego building tasks, each participant was permitted to work with only one color of blocks and blocks of the same color were not allowed to be stacked on top of each other. The teams assigned to the *teamwork and taskwork experience condition* performed the group experimental task with different market prices than the criterion experimental task.

Planning Manipulation. Before performing the experimental task, all teams had 20 min to conduct one of two guided group-planning sessions. Both of these sessions were designed to include two steps of analyzing the task and a third step to detail a master plan.

The steps for the team members assigned to the *generative planning condition* were: (a) identify a set of sub-goals that will allow the team to obtain at least $20,000 in profits, (b) identify resources available, resources lacking, and constraints to reach each sub-goal, as well as the sequence of actions required to reach each of the sub-goals identified in the earlier step, and (c) merge the sequences of actions into one master plan in which there are no conflicting or duplicated actions (Appendix B). The steps for the team members assigned to the *case-base planning condition* were: (a) identify similarities and differences between the experimental task and the task they performed previously, (b) identify an initial plan based on the actions that would work on the present task, as well as actions that would not work on this new task, and (c) mentally simulate the initial plan to identify flaws, possible environmental changes, and alternative actions to these issues in order to detail a master plan (Appendix C).

Measures

Manipulation Checks

Experience. To assess whether the participants perceived the differences between the 10-min task (the first task) and the 20-min task (the second task) two instruments were designed. The first instrument assessed two dimensions: (a) taskwork instructions and (b) teamwork instructions. It was administered after the instructions for the second task were read. Team members rated how certain they were on a scale of one (extremely certain) to five (extremely uncertain) six statements were included in the first task instructions (Appendix D). Three of these statements came directly from the instructions for the taskwork experience condition, and the other three statements came directly from the instructions for the teamwork experience condition. Consequently, it was expected that the teams assigned to the teamwork or taskwork experience conditions would recognize three of the statements, and teams assigned to the combined teamwork - taskwork experience condition would recognize all six statements. The second instrument was completed at the end of the experiment. It contained six items that assessed two dimensions: (a) similarity of the tasks and (b) knowledge of teammates (Appendix D).

Planning. The guided team planning procedures for the case-based and generative planning conditions instructed team members to perform a task analysis procedure in two phases and to complete a team master plan form (Appendix E). To determine if the participants perceived differences in the planning manipulation, I initially intended to have two hypotheses- and condition-blind undergraduate research assistants rate the extent to which the planning was conducted based on previous experience or from scratch. Nevertheless, while implementing the coding procedure it was noted that the information obtained from the master plan forms was not enough to code the information needed to conduct a manipulation check. Consequently, six items were added to the final questionnaire to assess whether the participants perceived the planning instructions encouraged them to consider their previous experience, to review the strategies implemented in the 10-min task, and to use the information they had from the 10-min task to design their master plan. Because these items were added after data collection had commenced, only 51 teams (29.7%) responded to these items.

Independent Variables

Langan-Fox et al. (2000) recommended pairwise ratings as the MM elicitation method most appropriate when time is constrained. The team members were required to rate on a scale from 1 (not related at all) to 5 (highly related) how related were task-related concepts to each other in order to complete the experimental task successfully. Langan-Fox et al. also recommend Pathfinder as one of the methods to assess the similarity between individuals' MMs. "Pathfinder is a computerized networking technique that is used to derive associative networks based on perceived relatedness among a selected set of concepts" (p.255). In the first step, the Pathfinder algorithm creates a network (PF-network) from each individual's pairwise ratings, by finding the shortest paths between any two nodes in the network and eliminating paths that violate the triangle inequality. In the second step, Pathfinder Closeness (*C*) indexes are estimated by computing the ratio between links that each pair of team members' PF-networks share with the total number of links present. This index ranges from 0, when no links between the two networks are shared, to 1 when all links are shared. The three *C* indexes for each team are aggregated by averaging them together. These methods for eliciting and representing MMs have been used in previous team research (e.g., Edwards et al., 2006; Stout et al., 1999).

Team Members' Taskwork MM Similarity. Based on a task analysis, six non-overlapping concepts related to task performance were identified: (a) completing ordering form (b) reading market information sheets, (c) placing products in the designated area in order to sell to the experimenter, (d) requesting a time check, (e) exchanging Legos for a different color, and (f) snapping together Legos of your own color. Team members were asked to judge on a scale from 1 (not related at all) to 5 (highly related) the *relatedness* of these six actions that team members might demonstrate when performing the manufacturing task (15 pairwise comparisons-Appendix F).

Team Members' Teamwork MM Similarity. The same elicitation and representation method was used to assess teamwork MM similarity. Based on a task analysis and an examination of measures used in previous lab studies with the Lego manufacturing game (Hendricks, 2002; Philo, 2005), the following five non-overlapping concepts related to teamwork were identified: (a) communicating with each other, (b) encouraging each other, (c) coordinating actions, (d) leading the team, and (e) cooperating with each other. Team members were asked to judge on a scale from 1 (not related at all) to 5 (highly related) the *relatedness* of these six actions that team members might demonstrate when performing the manufacturing task (10 pairwise comparisons-Appendix F).

Dependent Variable

Team Performance. Team performance was simply the amount of profit each team earned when performing the manufacturing game (the second task).

Control Variables

Cognitive Ability. Cognitive ability has been found to be one of the strongest predictors of individual performance (Schmidt & Hunter, 1998) and team performance (Day, Arthur, Miyashiro, Edwards, Tubre, & Tubre, 2004; Devine & Philips, 2001). To control for the cognitive ability effects on team performance, the Wonderlic Personnel Selection test (Wonderlic, 1992) was administered to the participants before they started the experiment. This is 12-minute, 50-item timed test of problem-solving ability.

Team Members' Personality Characteristics. Team members' levels of conscientiousness and agreeableness have been found to predict team performance (Barrick, Stewart, Neubert, & Mount, 1998; Neuman, Wagner, & Christiansen, 1999). To control for the influence of team members' levels of conscientiousness and agreeableness on team performance, the Big Five Inventory (John, Donahue, & Ketle,

1991) was administered to the participants before they started the experiment. This is 44-item inventory that assesses the five dimensions comprised in the Big Five Factor model (Appendix G). In a sample of 711 undergraduates, Benet-Martinez and John (1998) reported acceptable reliability indexes for the five scales. The Cronbach's alpha indexes obtained in Benet-Martinez and John's study were .88 for extraversion, .84 for neuroticism, .82 for conscientiousness, .81 for openness to experience, and .79 for agreeableness. In this study, Cronbach's alpha was .75 for conscientiousness and .79 for agreeableness.

Familiarity with Teammates. To control for prior knowledge participants might have had about the other team members, the participants were asked to report on a five-point scale the extent to which they knew the other participants in that study session (see Appendix G).

Team Members' Previous Experience with Legos©. To control for team members' previous experience with Legos, the participants were asked to report on a five-point scale the extent to which they played with Legos when they were kids, they enjoyed playing with Legos, and they considered playing with Legos to be fun (see Appendix G). The Cronbach's alpha for these three items was .92.

Team Preference and Experience. One individual characteristic related to team performance is the individual team member's preference for working in teams versus on his/her own and previous experience with teams (Campion, Medsker, & Higgs, 1993; Campion, Papper, & Medsker, 1996; Johnson & Morgeson, 2003). To control for this variable, I assessed each team member's team preference and experience with 13-items adapted from Johnson and Morgeson's Team Experience Survey (see Appendix G). The participants reported on a five-point scale the extent to which they would rather work in a team instead of by themselves and the frequency with which they have worked with teams in which working as a team was more enjoyable and productive. The participants answered these 13 items before performing the experimental task. Cronbach's alpha for this scale was .90.

Procedure

The experiments were conducted by eight experimenters (two males and six females), seven upper level undergraduates, and one graduate student. Each of the experimenters was required to conduct at least two sessions of each of the six experimental conditions. Two of the experimenters conducted the minimum number of 12 teams (two per experimental condition). A series of ANOVAs confirmed that the experimenter did not have a significant influence on the study variables or the manipulation check items.

After completing the informed consent form, the participants completed a first questionnaire that included (a) demographic information, (b) the familiarity with the teammate scale items, (c) the team members' previous experience with Legos© items, (d) the team preference and experience items, and (e) the Big Five Inventory (John et al., 1991). After they all finished the Wonderlic Personnel Test was administered following the Wondelic's (1992) standardized procedure. Then, they performed one of the three

10-minute tasks (individual Lego building, team tower building, or team Lego building). Next the experimenter read aloud while the participants read silently the instructions to perform the experimental task. This was followed by the team members answering a team experience manipulation check questionnaire and the pre-planning TMM questionnaire. Then the teams had 20 min to conduct one of the two guided team planning procedures (case-based or generative). After the team wrote down their plan, the team members completed the post-planning TMM questionnaire. Then, the team performed the 20-min experimental task, after which the participants were debriefed, thanked, and dismissed.

Analyses

Before testing the hypotheses, the manipulation check items were analyzed to determine the effectiveness of the manipulations. The construct–related validity and internal consistency of the control variables' (conscientiousness, agreeableness, previous experience with Legos, familiarity with teammates, and team preference and experience) was determined. An item-analysis of the manipulation check items was conducted, followed by an assessment of the goodness-of-fit for the items of each of the five hypothesized dimensions: (a) taskwork instructions and (b) teamwork instructions, (c) similarity of the tasks and (d) knowledge of teammates, and (e) the planning manipulation. Finally, ANOVAs were conducted to assess the effect of the experimental manipulations on the manipulation check scales.

To perform the analyses, which were stated at the team level of analysis, control variable scores were aggregated and MM similarity scores among team members were computed. The control variables (e.g., cognitive ability) were measured at the individual level of analysis. Therefore, the team average and the team variance obtained on the control variables by the three members within each team were computed to test the hypotheses at the appropriate level of analysis. The independent variables (e.g., pre-planning taskwork MM similarity) were also measured at the individual level. Thus three *C* indexes, one for each pair of team members, were calculated and then averaged within each team. In order to ensure I had enough power to test for the three-way interactions hypothesized, I tested the significance of my findings with an alpha of .10

Different operationalizations of team composition variables, such as mean, minimum, and maximum team scores, have been theoretically suggested and empirically found to incrementally influence team performance (Bell, 2005). Therefore, each of the dependent variables in the hypotheses (post-planning taskwork MM similarity, post-planning teamwork MM similarity, and team performance) was regressed on all of the control variables. Only the significant control variables for a given dependent variable were included in each analysis. Because the mean and variance for familiarity with teammates were strongly correlated with one another ($r = .91$, $p < .10$), only the team mean of this variable was included in the analyses.

Because the hypotheses were going to be tested with regression analyses, all continuous predictors were centered before being introduced into the corresponding model. This was done with the purpose of reducing potential multi-collinearity among the predictors when interactions were tested and to facilitate the interpretation of the models' intercepts. The planning manipulation was dummy coded with generative planning condition as the referent group (0) and case-based planning as the comparison group (1). The experience manipulation conditions were also dummy coded with the referent group depending on the hypothesis.

Hypothesis 1 was tested with two-step hierarchical regressions in which the significant control variables were entered in the first step and the appropriate experience condition dummy-coded variables were entered in the second step. Although not hypothesized, to determine if the interaction between taskwork and teamwork experience conditions had an effect on pre-planning taskwork and teamwork MM similarity over and above the effect of each of them separately, additional analyses were conducted. Hypothesis 2 was tested with two four-step moderation regression analyses, in which the significant control variables were included in the first step, the main effects in the second step, the two-way interaction terms in the third step, and the three-way interaction term in the fourth step. Hypothesis 3 was tested with a three-step moderation regression analysis, with the significant control variables entered in the first step, the post-planning MM similarity main effects in the second step, and the two-way interaction in the third step. Significant interactions were graphed to facilitate interpretation. When continuous variables moderated the relationship, the regression lines were graphed to reflect one standard deviation above the mean and one standard deviation below the mean. All analyses followed the hierarchical pattern of entry in which lower order effects precede higher order effects.

RESULTS

Control Variables

Table 2 depicts the descriptive statistics for five control variables that were measured at the individual level of analysis. The internal consistency obtained for these scales was estimated with Cronbach's alpha. As reported in the diagonal of Table 2, the scales scores displayed acceptable levels of internal consistency, indicating that the participants tended to answer the items within each of these subscales consistently.

Table 2

Descriptive Statistics, Correlations, and Reliabilities for the Control Variables at the Individual Level of Analysis

	M	*SD*	1	2	3	4	5	6
1. Cognitive ability	25.17	4.73						
2. Experience with Legos	4.05	0.94	.11*	(.92)				
3. Conscientiousness	3.56	0.50	-.03	-.03	(.75)			
4. Agreeableness	3.79	0.52	-.14**	-.04	.20**	(.79)		
5. Team preference and experience	3.37	0.58	-.06	.06	.04	.31**	(.90)	
6. Familiarity with teammates	1.14	0.43	.02	-.07	-.07†	-.03	.03	

Notes. N = 516. † *p* < .10 **p* < .05, ***p* < .01.

A series confirmatory factor analyses (CFAs) demonstrated discriminant validity for the items of the four control variables that were administered in the same questionnaire: conscientiousness, agreeableness, experience with Legos, and team preference and experience. Familiarity with teammates was not included in this analysis because the nature of the items did not allow for inclusion in the model. The four-factor structure with free parameters for the latent factors had a significantly better fit [χ^2 = 1406.78, *df* = 521, *p* < .01, goodness-of-fit (GFI) = .86, comparative fit index (CFI) =

.94, normative fit index (NFI) = .91, non-normative fit index (NNFI) = .94, root mean square error of approximation (RMSEA) = .06] than a four factor structure with uncorrelated latent factors (χ^2 = 1475.49, *df* = 527, $p < .01$, GFI = .85, CFI = .94, NFI = .90, NNFI = .93, RMSEA = .06; ΔX^2 = 68.71, *df* = 6, $p < .01$). The four factor structure also had a significantly better fit than a one factor structure (χ^2 = 13053.79, *df* = 527, $p < .01$, GFI = .40, CFI = .60, NFI = .58, NNFI = .58, RMSEA = .22; $\Delta \chi^2$ = 11647.01, *df* = 6, $p < .01$) or any other alternative combination of two or three factors. These results demonstrated empirical support for the construct-related validity of the scales' scores.

The individuals in this study are nested within teams. As a result, individual responses may be influenced by team membership. Thus, the extent to which team membership created dependencies among individual responses within each team was examined by running an ANOVA with team membership as a random factor. As it might be expected, team membership did not have a significant relationship with the individual scores for cognitive ability, experience with Legos©, conscientiousness, agreeableness, and team preference and experience. Familiarity with teammates was significantly related to team membership, but the effect appeared to be relatively minimal (ICC1 = .09, ICC2 = .23).

The relationships between the control variables operationalized as team mean and variance with the three hypothesized dependent variables are reported in Table 3. Based on these correlations, none of the control variables were included in the model when testing a hypothesis with pre-planning taskwork MM similarity as

Table 3

Multiple Regression Analyses for Hypothesized Dependent Variables

	Pre-planning Taskwork MM Similarity			Pre-planning Teamwork MM Similarity			Post-planning Taskwork MM Similarity			Post-planning Teamwork MM Similarity			Team Performance		
Predictors	b	*SE*	β	b	*SE*	β	b	*SE*	β	b	*SE*	β	b	*SE*	β
(Constant)	0.44**	0.01		0.57**	0.01		0.44**	0.01		0.57**	0.01		7999.01**	461.12	
Cognitive ability (*M*)	0.00	0.00	.03	0.00	0.00	.01	0.00	0.00	-.01	0.01†	0.00	.14	83.75	184.91	.04
Cognitive ability (*Var*)	0.00	0.00	-.09	0.00†	0.00	-.15	0.00	0.00	-.11	0.00	0.00	-.01	5.59	18.87	.02
Experience with Legos (*M*)	-0.02	0.02	-.12	-0.01	0.02	-.05	0.04†	0.02	.19	0.03	0.03	.10	-304.97	1160.84	-.03
Experience with Legos (*Var*)	-0.02	0.01	-.15	-0.01	0.01	-.07	0.01	0.01	.07	-0.02	0.01	-.15	-586.72	546.34	-.11
Conscientiousness (*M*)	0.03	0.03	.08	0.02	0.03	.05	0.03	0.03	.09	0.01	0.04	.02	3931.15*	1697.74	.18
Conscientiousness (*Var*)	0.00	0.04	.01	0.11*	0.04	.21	-0.01	0.04	-.01	0.06	0.05	.09	3375.15	2183.26	.12
Agreeableness (*M*)	-0.02	0.04	-.07	0.03	0.04	.07	-0.07*	0.03	-.20	-0.01	0.04	-.01	-3774.10*	1881.07	-.18
Agreeableness (*Var*)	0.00	0.03	.01	0.03	0.03	.10	0.00	0.02	.01	-0.02	0.03	-.06	-4340.71**	1364.63	-.28
Team preference and experience (*M*)	0.01	0.03	.04	0.02	0.03	.05	0.00	0.03	-.01	-0.01	0.03	-.03	1101.20	1477.95	.06
Team preference and experience (*Var*)	0.00	0.02	.02	-0.02	0.02	-.09	-0.03	0.02	-.12	-0.02	0.02	-.08	475.88	955.77	.04
Familiarity with teammates (*M*)	0.00	0.03	.01	-0.02	0.03	-.06	-0.04*	0.03	-.13	-0.09	0.03	-.20	-328.43	1484.08	-.02
F		.46			1.33			1.52			1.82†			1.64†	

Notes. $N = 171$. † $p < .10$, *$p < .05$, **$p < .01$. TK MM S = Post-planning taskwork MM Similarity. TM MM S = Post-planning Teamwork MM Similarity dependent variable. When testing hypotheses with pre-planning teamwork MM similarity as the dependent variable, cognitive ability variance and conscientiousness variance were included. When testing hypotheses with post-planning taskwork MM similarity as the dependent variable, previous experience with Legos© mean and agreeableness mean were included. When testing hypotheses with post-planning teamwork MM similarity as the dependent variable, cognitive ability mean was included. Finally, when testing hypotheses with team performance as the dependent variable, conscientiousness mean and agreeableness mean, as well as agreeableness variance were included.

Manipulation Checks

As noted earlier, twelve items were administered to all participants to determine the strength of the experience manipulation and six items were administered to 153 participants to determine the strength of the planning manipulation. As Table 4 shows, the correlations among the manipulation check items revealed that most of the items had stronger correlations with the items designed to measure the same dimension than with items designed to assess other dimensions with a few exceptions (items 9, 12, 17, and 18). To test the effectiveness and independence of the experimental manipulations, first the items designed to measure each of the five dimensions described in the measure section [(a) taskwork instructions, (b) teamwork instructions, (c) similarity of the tasks, (d) knowledge of teammates, and (e) planning dependence on experience] were aggregated by averaging the scores within scale (see Table 5).

Table 4

Manipulation Check Item Descriptives and Correlations

		M	*SD*	1	2	3	4	5	6
1.	In this exercise, you will purchase Lego materials from me with an ordering form, build the products, and sell them back for profit.	4.69	0.84						
2.	The price to purchase supplies and sell products is predetermined and prices change every 5 minutes as indicated on these market information sheets	4.52	1.04	0.66**					
3.	It is your responsibility to keep track of your money, but you may ask me how much money you have left. If you over-spend at any point, you will be penalized 15% of your profits at the end of the task.	4.32	1.17	0.57**	0.48**				
4.	Note that the products are built with multiple colors and no blocks of the same color are touching each other.	4.45	1.22	0.16**	0.18**	0.29**			
5.	You are allowed to touch Legos of any color, but you can only snap your color Lego. If you snap on Legos of the wrong color, your team will be fined $100 for each occurrence.	4.06	1.41	0.31**	0.26**	0.38**	0.50**		
6.	If a product has Legos of the same color next to each other or does not match the shape of the model, I will tell you that the product is defective, but I won't tell you what is wrong with it. You will not earn any money for that product, and loose the Legos you used to build it.	4.22	1.30	0.38**	0.36**	0.39**	0.51**	0.58**	
7.	The 10-minute task was very similar to the 20-minute task.	2.68	1.21	-0.03	0.00	-0.03	0.02	0.10*	0.01
8.	The 10-minute task was exactly the same as the 20-minute task.	1.94	1.02	0.01	-0.02	0.03	0.11*	0.17**	0.11*
9.	Performing the 10-minute task facilitated my ability to do the 20-minute task.	2.91	1.03	0.06	0.03	0.06	0.14**	0.15**	0.11**
10.	The knowledge I gained about my teammates while performing the 10-minute task allowed me to better coordinate with my teammates in the 20-minute task.	3.36	1.12	0.05	0.04	0.06	0.22**	0.19**	0.18**
11.	The knowledge I gained about my team when performing the 10-minute task allowed me to identify ways to perform the 20-minute task better.	3.47	1.13	0.09*	0.05	0.12**	0.13**	0.12**	0.10*
12.	During the 10-minute task, I got to know my teammates pretty well.	3.75	0.99	0.07	0.06	0.08*	0.06	0.05	0.07
13.	The planning procedure we had to conduct really encouraged us to check for our previous experience.	3.35	1.05	0.13	0.08	0.02	-0.01	0.00	0.01
14.	We actually used the information we had from the 10-minute task to make up our master plan.	3.45	1.21	0.11	0.07	0.20*	0.11	0.20*	0.25**
15.	When making our master plan, we checked what we did during the 10-minute task to plan accordingly.	3.25	1.12	0.10	0.06	0.11	0.01	0.24**	0.16*
16.	If we had not gone through the 10-minute task, it would have been really difficult to conduct the planning procedure we were asked to.	3.63	1.16	0.06	0.06	0.00	0.03	0.17*	0.05
17.	When planning we were not required to check the strategies we implemented during the 10-minute task.	2.97	1.08	0.06	-0.02	-0.09	-0.11	0.01	-0.10
18.	We did not review what we did during the 10-minute task when we decided what to buy, build, and sell.	2.59	1.20	-0.18*	-0.02	-0.13	0.04	-0.04	-0.07

Notes. *N* for items 1 to 12 ranges from 494 to 514. *N* ranges from 167 to 172. *$p < .05$, **$p < .01$.

Table 4 (Continued)

	7	8	9	10	11	12	13	14	15	16	17
8. The 10-minute task was exactly the same as the 20-minute task.	0.52**										
9. Performing the 10-minute task facilitated my ability to do the 20-minute task.	0.11*	0.17**									
10. The knowledge I gained about my teammates while performing the 10-minute task allowed me to better coordinate with my teammates in the 20-minute task.	0.23**	0.23**	0.45**								
11. The knowledge I gained about my team when performing the 10-minute task allowed me to identify ways to perform the 20-minute task better.	0.15**	0.21**	0.29**	0.50**							
12. During the 10-minute task, I got to know my teammates pretty well. [a]	0.28**	0.17**	0.05	0.34**	0.40**						
13. The planning procedure we had to conduct really encouraged us to check for our previous experience.	0.22**	0.15	0.17*	0.15	0.36**	0.39**					
14. We actually used the information we had from the 10-minute task to make up our master plan.	0.14	0.16*	0.11	0.10	0.29**	0.42**	0.39**				
15. When making our master plan, we checked what we did during the 10-minute task to plan accordingly.	0.23**	0.14	0.23**	0.15*	0.36**	0.35**	0.51**	0.68**			
16. If we had not gone through the 10-minute task, it would have been really difficult to conduct the planning procedure we were asked to.	0.17*	0.15	0.08	0.09	0.41**	0.44**	0.32**	0.36**	0.36**		
17. When planning we were not required to check the strategies we implemented during the 10-minute task.	0.01	0.09	0.04	-0.13	-0.02	-0.15	-0.20*	-0.14	-0.25**	-0.10	
18. We did not review what we did during the 10-minute task when we decided what to buy, build, and sell.	0.00	-0.06	0.02	-0.07	-0.23**	-0.31**	-0.21**	-0.38**	-0.33**	-0.16*	0.20*

Notes. N for items 1 to 12 ranges from 494 to 514. *N* for items 13 to 18 ranges from 150 to 153. $*p < .05$, $**p < .01$.

Table 5

Descriptive Statistics, Correlations, and Reliabilities for the Manipulation Check Scales at the Team Level of Analysis

	M	*SD*	1	2	3	4	5
1. Taskwork instructions	4.24	1.09	(.77)				
2. Teamwork instructions	4.51	0.85	0.44**	(.78)			
3. Task similarity	2.79	0.80	0.13**	0.03	(.60)		
4. Knowledge of teammates	3.25	0.85	0.23**	0.09*	0.35**	(.68)	
5. Planning dependence on experience	3.21	0.54	0.15	0.09	0.38**	0.32**	(.73)

Notes. Scales 1 to 4 $N = 515$. Scale 5 $N = 153$. *$p < .05$, **$p < .01$.

Again, because individuals were nested within teams, it is important to examine the extent to which team membership influenced individual responses. To do this, I conducted random coefficient model analyses to test whether the variance explained by type of experience, type of planning, and their interaction was significant on each of the five manipulation check scale scores after taking into account the nested nature of the data. The estimated model included type of experience, type of planning, and the interaction between the two conditions as fixed factors, but the intercept was allowed to vary to account for team membership. When the variance explained by any of the fixed factor components of the models was significant, Bonferroni's post-hoc multiple comparisons were conducted to determine which experience conditions were significantly different from one another, and a t-test was conducted to identify the difference between the two types of planning conditions.

Experience Manipulation Check Scales

The random coefficient model analyses indicated that team membership significantly related to responses to the first two manipulation check scales completed after performing the first task, but the effect appeared to be relatively minimal for taskwork instructions (*Wald Z* = 2.15 $p < .10$; *ICC1* = .11; *ICC2* = .27) and teamwork instructions (*Wald Z* = 2.15 $p < .10$; *ICC1* = 0.09; *ICC2* = .22). Team membership was also significantly related to responses to the other two experience manipulation check scales responded to after performing the second task for task similarity (*Wald Z* = 2.15 $p < .10$; *ICC1* = 0.15; *ICC2* = .24) and teammate knowledge helpfulness (*Wald Z* = 2.15 $p < .10$; *ICC1* = 0.17; *ICC2* = .26) , but this time the effect was stronger.

As expected, the taskwork instruction scale scores ($F_{(2,81)} = 26.015$, $p < .10$) and the teamwork instruction scale scores ($F_{(2,77)} = 9.27$, $p < .10$) differed significantly for the three experience conditions. Neither the planning manipulation nor the interaction between the experience and planning manipulations had significant effects on the scales.

Consistent with expectations, the post-hoc comparisons reported in Table 6 revealed that the teamwork experience condition (Condition C) scored significantly lower on the taskwork instructions than the combined taskwork-teamwork experience condition (Condition A; $\Delta M = -0.43$, $p < .10$) and taskwork experience condition (Condition B; $\Delta M = -0.24$, $p < .10$) .Condition A and Condition B also were significantly different from one another ($\Delta M = 0.19$, $p < .10$). Post-hoc comparisons showed that Condition A obtained significantly higher scores on the teamwork instructions than Condition C ($\Delta M = 0.87$, $p < .10$) and Condition B ($\Delta M = 0.32$, $p < .10$). Additionally, Condition A reported significantly higher scores on teamwork instructions than Condition B ($\Delta M = 0.55$, $p < .10$).

Table 6

Experience and Planning Manipulation Check Scale Descriptives by Experimental Condition

	Combined Taskwork - Teamwork Experience (A)		Taskwork Experience (B)		Teamwork Experience (C)		Generative Planning (D)		Case-based Planning Experience (E)	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
1. Taskwork instructions	4.71[a]	0.46	4.52[b]	0.72	4.29[c]	1.19	4.44[d]	0.96	4.58[d]	0.72
2. Teamwork instructions	4.63**[a]**	0.61	3.76[b]	1.43	4.31[c]	0.88	4.19[d]	1.13	4.29[d]	1.04
3. Task similarity	3.06[a]	0.80	2.52[b]	0.72	2.79[a]	0.80	2.47[c]	1.02	2.15[d]	0.90
4. Teammate knowledge helpfulness	3.56[a]	0.72	2.77[c]	0.86	3.40[b]	0.76	3.43[d]	0.97	3.4 [d]	0.98
5. Planning manipulation strength	3.47[a]	0.48	3.30[a]	0.64	3.04[a]	0.8262	3.23[b]	0.87	3.65[c]	0.80

Notes. Means with different superscripts are significantly different from one another.

The results for the task similarity scale demonstrated some support for the effectiveness of the experience manipulation. The analysis revealed a significant main effect for the experience manipulation ($F_{(2,91)}$ = 16.67, $p < .10$), but also for the planning manipulation ($F_{(1,91)}$ =5.05, $p < .10$). The interaction between experience and planning manipulation was not significant. Post-hoc comparisons revealed that Condition A scored significantly higher on task similarity than Condition B ($\Delta M = 0.54$, $p < .10$) and than Condition C ($\Delta M = 0.27$, $p < .10$). But contrary to expectation, Condition B reported significantly less task similarity than Condition C ($\Delta M = -0.27$, $p < .10$). With regard to the planning manipulation factor, the generative-planning condition scored significantly higher than the case-based planning condition on task similarity (ΔM = 0.18, $p < .10$).

Finally, the analysis performed on the knowledge of teammate helpfulness scale provided support for the effectiveness of the experience manipulation. As expected, this analysis revealed a main effect for team experience ($F_{(2,95)}$ =36.64, , $p < .10$), but not for planning or the interaction between experience and planning. Post-hoc comparisons revealed that Condition B scored significantly lower than Condition B ($\Delta M = -0.79$, $p <$ .10) and Condition C ($\Delta M = -0.63$, $p < .10$). The difference between Conditions A and C was not significant ($\Delta M = 0.16$, $p < .10$).

The results of these analyses indicate that the participants were generally aware of similarities in the task instructions for the two tasks, but the effectiveness of the experience manipulation is less clear. Three of the scales designed to assess the recognition of the experience manipulation showed the expected differences between the three conditions. But the difference in the scores on the task similarity scale revealed that, although Condition A was expected to score higher than Conditions B and C, and Conditions B and C were not expected to be different, Conditions A and C were not significantly different from one another. This last result indicates that participants evaluated the similarity of the two tasks more so on the interactions they were required to perform than the similarity of the actual task they had to complete.

Planning Manipulation Check Scale

The last scale was designed to assess the participants' perceptions regarding the extent to which the planning procedure required them to use team members' past experiences. The random coefficient model analyses indicated that team membership significantly related to how the participants responded to this manipulation check scale completed after performing the first task and the effect appeared to be strong (*Wald Z* = 1.80 $p < .10$; *ICC1* = .15; *ICC2* = .40). After accounting for the team membership variance, there was also a significant main effect for the planning manipulation ($F_{(1,26)} = 5.08$, $p < .10$) but not the experience manipulation or the interaction between experience and planning manipulations. As expected, participants in the generative planning condition (Condition D) perceived that they were less dependent on experience to conduct planning than the participants in the case-based planning condition (Condition E) ($\Delta M = -0.42$, $p < .10$). These results show that the planning manipulation was effective in that the participants assigned to the case-based planning condition perceived that they were instructed to rely on their past experience when planning to a greater extent than those assigned to the generative planning condition.

Hypothesis Testing

Table 7 reports descriptive statistics and correlations among the variables of interest at the team level of analysis.

Hypothesis 1

Hypothesis 1a and 1b proposed that taskwork experience would be related to pre-planning taskwork MM similarity and teamwork experience would be related to pre-planning teamwork MM similarity. Furthermore, these effects were hypothesized to be independent of each other. Two hierarchical regression analyses were conducted to test the effect of the experience manipulation on pre-planning taskwork and pre-planning teamwork MM similarity.

In the first regression analysis model, the effect of taskwork experience on pre-planning taskwork MM similarity was tested. For this analysis, the experimental manipulation conditions were dummy coded with teamwork experience as the referent group (0) and the other two conditions, in which participants were exposed to a taskwork experience, were combined to form the comparison group (1). In the second regression analysis model, the effect of teamwork experience on pre-planning teamwork MM similarity was tested. For this analysis, the experimental manipulation conditions were dummy coded with taskwork experience as the referent group (0) and the other two conditions, in which participants were exposed to a teamwork experience, were combined to form the comparison group (1).

Table 7

Descriptive Statistics and Correlations for the Variables at the Team Level of Analysis

	M	*SD*	1	2	3	4	5	6	7	8	9	10	11
1 Cognitive Ability (*M*)	25.17	2.71											
2 Cognitive Ability (*Var*)	22.47	25.13	.01										
3 Experience with Legos (*M*)	3.79	0.29	-.15*	.02									
4 Experience with Legos (*Var*)	0.27	0.39	.07	-.08	-.39**								
5 Conscientiousness (*M*)	3.56	0.29	-.08	.05	.24**	.09							
6 Conscientiousness (*Var*)	0.25	0.22	.19*	-.08	-.12	.08	-.11						
7 Agreeableness (*M*)	4.05	0.53	.13	-.11	-.06	.02	.01	-.07					
8 Agreeableness (*Var*)	0.92	1.12	.09	.03	.03	.05	.04	.20**	-.61**				
9 Team Preference and Experience (*M*)	3.37	0.33	-.04	-.01	.23**	-.19*	.02	-.01	.14	-.14			
10 Team Preference and Experience (*Var*)	0.35	0.52	.07	-.15	-.09	.28**	.04	-.04	.13	-.07	.00		
11 Familiarity with teammates (*M*)	1.14	0.32	.21**	-.02	-.11	-.01	-.08	.07	-.08	.11	-.05	-.08	
12 Pre-planning Taskwork MM Similarity	0.44	0.11	.00	-.09	-.05	.04	.05	.00	.00	-.08	.03	.04	.01
13 Pre-planning Teamwork MM Similarity	0.57	0.12	.01	-.16*	.04	.06	.04	.20**	.00	.00	.05	-.05	-.05
14 Post-planning Taskwork MM Similarity	0.44	0.11	.01	-.11	-.16*	.07	.05	.01	.16*	-.06	-.03	-.05	-.11
15 Post-planning Teamwork MM Similarity	0.57	0.14	.10	-.01	.00	-.06	.00	.06	.21**	-.20	.02	-.04	-.18*
16 Team performance (Profits)	7966.22	6168.09	.04	.03	-.03	-.19*	.10	.08	.05	-.09	.08	-.02	-.01

Notes. N ranges from 163 to 172. $*p < .05$, $**p < .01$.

Table 7 (Continued)

	12	13	14	15
12 Pre-planning Taskwork MM Similarity				
13 Pre-planning Teamwork MM Similarity	0.08			
14 Post-planning Taskwork MM Similarity	0.16*	0.12		
15 Post-planning Teamwork MM Similarity	0.19*	0.18*	0.25**	
16 Team performance (Profits)	0.01	0.02	0.01	0.03

Notes. N ranges from 163 to 172. *$p < .05$, **$p < .01$.

After estimating these two hierarchical regression analysis models, it was noted that the residuals were normally distributed for pre-planning teamwork MM similarity (*Shapiro-Wilk* (167) = .99, $p > .10$), but not for pre-planning taskwork MM similarity (*Shapiro-Wilk* (170) = .96, $p < .01$). Thus, the regression analysis model for pre-planning taskwork MM similarity was estimated without the outliers scores, after which the residuals were normally distributed (*Shapiro-Wilk* (169) = .99, $p > .10$).

Table 8 depicts the regression coefficients for the final models obtained in the hierarchical regression analyses with pre-planning taskwork MM similarity and teamwork MM similarity. Contrary to expectation, none of the regression coefficients were significant.

Table 8

Influence of Type of Experience on Taskwork and Teamwork MM Similarity

	Taskwork MM similarity				Teamwork MM similarity			
Predictors	b	SE	β	ΔR^2	b	SE	β	ΔR^2
Step 1				----				.06
(Constant)	0.44**	0.01			0.56**	0.02		
Cognitive ability (*Var*)					0.00†	0.00	-.15	
Conscientiousness (*Var*)					0.10*	0.04	.19	
Step 2				.00				.01
Taskwork previous experience	0.00	0.02	.01					
Teamwork previous experience					0.02	0.02	.08	

Notes. *N* = 169 for Taskwork MM similarity. *N* = 167 for Teamwork MM similarity. † $p < .10$, *$p < .05$, **$p < .01$.

Additional analyses were conducted to make alternative comparisons between the experimental groups. To test whether the taskwork and teamwork experience interacted to influence pre-planning MM similarity, the results for the combined taskwork-teamwork experience condition were compared with the results for each of the other two conditions, taskwork and teamwork experience conditions, to contrast the joint effect of both experiences relative to the independent effect of each experience. Finally, the taskwork condition was compared to the teamwork condition for both hypotheses. However, none of these analyses yielded significant differences between the experimental conditions. In summary, the assignment of teams to a taskwork, teamwork, or combined taskwork-teamwork experience conditions did not have a significant effect on pre-planning MM similarity.

Hypothesis 2

Hypothesis 2 stated that post-planning MM similarity would be a function of the the interaction between pre-planning taskwork MM similarity, pre-planning teamwork MM similarity, and planning condition. Specifically, in the generative planning condition, only pre-planning teamwork MM similarity would have a significant effect on post-planning taskwork and teamwork MM similarity. In the case-based planning condition, the interaction between pre-planning taskwork and teamwork MM similarity would have a significant effect on post-planning taskwork and teamwork MM similarity.

Hypothesis 2 was tested with two moderated regression analyses. The first analysis tested the effect of the three variables of interest on post-planning taskwork MM similarity. The second analyses tested the effect of the predictors on post-planning teamwork MM similarity.

After conducting the analysis with post-planning taskwork MM similarity, it was noted that the residuals were not normally distributed (*Shapiro-Wilk (162)* = .97, $p < .01$). Consequently, the scores of the teams that deviated more than three standard deviations away from the sample mean were deleted. The distribution of the residuals without those outliers still deviated significantly from the normal distribution (*Shapiro-Wilk (159)* = .98, $p < .01$), but improved compared to the distribution of the residuals with the outliers. Thus, the analysis was conducted without the outliers.

Contrary to expectation, neither the inclusion of the three-way interaction term nor the two-way interaction terms significantly increased the proportion of variance explained in the dependent variable over and above the main effects (see Table 9). However, the regression coefficient for the interaction between pre-planning taskwork and pre-planning teamwork MM similarity was significant. Therefore a new analysis was conducted to test the effect of the interaction between pre-planning taskwork and pre-planning teamwork MM similarity in post-planning taskwork MM similarity over and above the control variables and type of planning.

Table 10 shows that after controlling for type of planning, the interaction between pre-planning taskwork and pre-planning teamwork MM similarity on post-planning taskwork MM similarity was significant. As depicted in Figure 4, the nature of the interaction is such that the relationship between pre-planning and post-planning taskwork MM similarity was positive when teams had similar pre-planning teamwork

Table 9

Moderated Regression Analyses for Post-Planning Taskwork MM Similarity

	Step 1			Step 2			Step 3			Step 4		
Predictors	b	SE	β	b	SE	β	b	SE	β	b	SE	β
(Constant)	0.44**	0.01		0.44**	0.01		0.44**	0.01		0.44	0.01	
Experience with Legos (*M*)	0.02	0.01	.10	0.02	0.02	.10	0.02	0.02	.09	0.02	0.02	.09
Agreeableness (*M*)	-0.06*	0.03	-.17	-0.05*	0.03	-.15	-0.06*	0.03	-.16	-0.06	0.03	-.16
Team mates knowledge (*M*)	-0.04	0.02	-.11	-0.03	0.02	-.11	-0.03	0.02	-.10	-0.03	0.02	-.10
Type of planning				-0.01	0.02	-.04	-0.02	0.02	-.08	-0.02	0.02	-.09
Pre-planning Taskwork MM similarity				0.09	0.08	.09	0.06	0.08	.06	0.06	0.08	.06
Pre-planning Teamwork MM similarity				0.05	0.07	.06	0.09	0.07	.10	0.10	0.07	.11
TP x TK MM S							-0.22	0.17	-.11	-0.23	0.17	-.12
TP x TM MM S							0.04	0.15	.02	0.05	0.15	.03
TK MM S x TM MM S							1.31†	0.70	.15	1.35†	0.71	.16
TP x TK MM x TM MM S										1.17	1.41	.07
$\Delta R^2 / R^2$		.05 /.05			.02 /.07			.03 /.10			.00 /.10	
ΔF		2.78*			0.79			1.81			0.69	

Notes. $N = 159$. †$p < .10$, *$p < .05$, **$p < .01$. TP = Type of Planning. TK MM S = Pre-planning Taskwork MM Similarity. TM MM S = Pre-planning Teamwork MM Similarity

Table 10

Interaction between Pre-planning Taskwork and Pre-planning Teamwork MM Similarity on Post-planning Taskwork MM Similarity

	Step 1			Step 2			Step 3		
Predictors	b	SE	β	b	SE	β	b	SE	β
(Constant)	0.44**	0.01		0.44**	0.01		0.44	0.01	
Experience with Legos (*M*)	0.02	0.01	.10	0.02	0.02	.10	0.02	0.01	0.10
Agreeableness (*M*)	-0.06*	0.03	-.17	-0.05*	0.03	-.15	-0.05	0.03	-0.16
Team mates knowledge (*M*)	-0.04	0.02	-.11	-0.03	0.02	-.11	-0.03	0.02	-0.10
Type of planning				-0.01	0.02	-.04	-0.02	0.02	-0.08
Pre-planning Taskwork MM similarity				0.09	0.08	.09	0.08	0.08	0.08
Pre-planning Teamwork MM similarity				0.05	0.07	.06	0.06	0.07	0.07
TK MM S x TM MM S							1.33†	0.69	0.16
$\Delta R^2 / R^2$		.05	/.05		.02	/.07		.03	/.10
ΔF		2.78**			0.79			3.71†	

Notes. N = 159. †$p < .10$, *$p < .05$, **$p < .01$. TP = Type of Planning. TK MM S = Pre-planning Taskwork MM Similarity. TM MM S = Pre-planning Teamwork MM Similarity

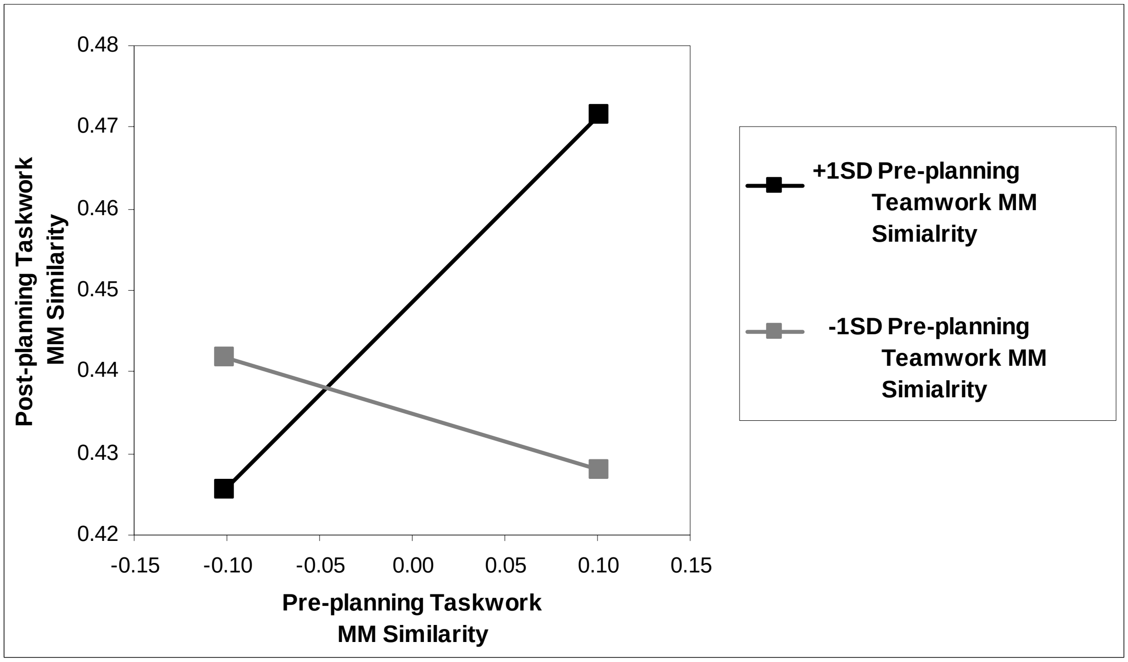

Figure 4. Interaction between pre-planning taskwork MM similarity, and pre-planning teamwork MM similarity on post-planning taskwork MM similarity

MMs, but the relationship was negative when the team had dissimilar pre-planning MMs.

When predicting post-planning teamwork MM similarity, the distribution of the residuals showed no significant deviation from the normal distribution (*Shapiro-Wilk = (161)* = .99, $p > .10$). Contrary to expectation, the introduction of the three-way and the two-way interaction terms did not significantly increase the proportion of variance explained in the dependent variable (see Table 11). Only the pre-planning taskwork and teamwork MM similarity main effects significantly predicted post-planning teamwork MM similarity. These relationships were positive. Thus, independent of the type of planning condition and the level of pre-planning teamwork MM similarity, teams with higher scores in pre-planning taskwork MM similarity obtained higher levels of post-

Table 11

Moderated Regression Analyses for Post-planning Teamwork MM Similarity

	Step 1			Step 2			Step 3			Step 4		
Predictors	b	SE	β	b	SE	β	b	SE	β	b	SE	β
(Constant)	0.57**	0.01		0.57**	0.01		0.57**	0.01		0.57**	0.01	
Cognitive ability (*M*)	0.01	0.00	.10	0.01	0.00	.10	0.00	0.00	.09	0.00	0.00	0.09
Type of planning				0.01	0.02	.04	0.01	0.02	.03	0.01	0.02	0.04
Pre-planning Taskwork MM similarity				0.23**	0.10	.18	0.27**	0.11	.21	0.28**	0.11	0.22
Pre-planning Teamwork MM similarity				0.20**	0.09	.16	0.18†	0.10	.15	0.16	0.10	0.13
TP x TK MM S							0.04	0.23	.02	0.05	0.23	0.02
TP x TM MM S							-0.19	0.21	-.08	-0.21	0.21	-0.09
TK MM S x TM MM S							0.76	0.93	.07	0.58	0.94	0.05
TP x TK MM x TM MM S										-1.94	1.89	-0.08
$\Delta R^2 / R^2$		.01	/.01		.07	/.08		.01	/.09		.00	/.09
ΔF		1.73			3.70**			0.63			1.05	

Notes. N = 168. † $p < .10$, *$p < .05$, **$p < .01$. TP = Type of Planning. TK MM S = Pre-planning Taskwork MM Similarity. TM MM S = Pre-planning Teamwork MM Similarity planning teamwork MM similarity than teams with low scores in pre-planning taskwork MM similarity. At the same time, independent of the type of planning condition and the level of pre-planning taskwork MM similarity, teams with higher scores in pre-planning teamwork MM similarity obtained higher levels of post-planning teamwork MM similarity than teams with low scores in pre-planning teamwork MM similarity.

In summary, Hypotheses 2a and 2b were not supported. However, pre-planning MM similarity did significantly influence post-planning MM similarity. The results for post-planning taskwork MM similarity showed that whereas the relationship between pre-planning and post-planning taskwork MM similarity was positive for teams with high levels of pre-planning teamwork MM similarity, this relationship was negative for teams with low levels of pre-planning teamwork MM similarity. The results for post-planning teamwork MM similarity showed that pre-planning taskwork and pre-planning teamwork MM similarity predicted post-planning teamwork MM similarity independent of each other and the planning approach conducted.

Due to the lack of significant effects and in an effort to rule out the potential influence of experience on the development of post-planning taskwork and post-planning teamwork MM similarity, additional analyses were conducted to determine if the results differed when the variance of the experience condition was included in the model (see Appendix H for details). Modeling the effect of the experience condition along with the interaction of experience with pre-planning taskwork MM similarity, pre-planning teamwork MM similarity, and planning condition on post-planning taskwork and teamwork MM similarity revealed the relationship between pre-planning and post-planning MM similarity varied depending on the teams' experience condition assignment. These results provide some interesting avenues for future research.

First, when the orthogonal comparison between the combined taskwork-teamwork experience and the other two conditions was included in the model, the interaction between experience condition, pre-planning taskwork and teamwork MM similarity did significantly influence post-planning taskwork MM similarity. For teams in the combined taskwork-teamwork experience condition, the relationship between pre-planning and post-planning taskwork MM similarity was positive at high levels of pre-planning teamwork MM similarity, but negative at low levels of pre-planning teamwork MM similarity. For teams in the taskwork and teamwork experience conditions, the relationship between pre-planning taskwork and post-planning taskwork MM similarity was positive, but did not vary significantly at different levels of pre-planning teamwork MM similarity, even though the scores in post-planning taskwork MM similarity are higher for teams with high levels rather than low levels of pre-planning teamwork MM similarity.

Second, when the orthogonal comparison between the combined taskwork-teamwork experience and the other two conditions was included in the model, the interaction between experience condition, planning condition, and pre-planning teamwork MM similarity did significantly influence post-planning teamwork MM similarity. For teams in the combined taskwork-teamwork experience condition, whereas the relationship between pre-planning and post-planning teamwork MM similarity scores was positive for teams in the generative planning condition, it was negative for teams in the case-based planning condition. For teams in the taskwork and teamwork experience conditions, the relationship was positive in both types of planning, but stronger for teams in the case-based planning condition than for teams in the generative planning condition.

Third, when the orthogonal comparison between taskwork and teamwork experience conditions was included in the model, the interaction between the experience condition and pre-planning taskwork MM similarity significantly influenced post-planning teamwork MM similarity. Whereas the relationship between pre-planning taskwork and post-planning teamwork MM similarity was negative for teams in the combined taskwork-teamwork experience condition, it was positive for teams in the taskwork and teamwork experience conditions.

Finally, in both of the orthogonal comparisons, (a) between the combined taskwork-teamwork experience condition and the other two conditions and (b) between the taskwork and teamwork experience conditions, after controlling for the effect of experience conditions, the effect of the interaction between pre-planning taskwork and pre-planning teamwork MM similarity on post-planning teamwork MM similarity was statistically significant. As shown above, pre-planning teamwork MM similarity did not moderate the relationship between pre-planning taskwork and post-planning teamwork MM similarity when the experience condition was not included in the model. The interaction in both of the comparisons showed that the relationship between pre-planning taskwork and post-planning teamwork MM similarity was positive, but stronger for teams high rather than low in pre-planning teamwork MM similarity.

Hypothesis 3

Hypothesis 3 predicted a significant interaction between teamwork and taskwork post-planning MM similarity on team performance, such that the relationship between taskwork MM similarity and team performance would be stronger for teams with similar teamwork post-planning MMs than for teams with dissimilar teamwork post-planning MMs. Table 12 shows the results of the moderated regression analysis conducted to test this hypothesis. Contrary to expectation, post-planning taskwork MM similarity did not significantly interact with post-planning teamwork MM similarity. Thus, Hypothesis 3 was not supported.

Because the additional analyses for Hypothesis 2 revealed that the experience manipulation moderated the relationship between the variables of interest, additional analyses were conducted to determine if the results differed when the experience conditions' main effects and their interaction with post-planning taskwork and teamwork MM similarity were included in the model. However, the inclusion of experience in the model did change the results.

Table 12

Interaction between Post-Planning Taskwork and Post-Planning Teamwork MM Similarity on Team Performance

	Step 1			Step 2			Step 3		
Predictors	b	SE	β	b	SE	β	b	SE	β
(Constant)	7994.39**	459.43		7994.57**	462.39		7958.80**	472.30	
Conscientiousness (*M*)	3586.40*	1732.76	.17	3607.43*	1750.66	.17	3626.69*	1756.16	.17
Agreeableness (*M*)	-3929.82*	1883.24	-.18	-3972.48*	1923.42	-.19	-3993.55*	1929.46	-.19
Agreeableness (*Var*)	-4323.50**	1344.26	-.28	-4321.34**	1357.68	-.28	-4259.06**	1370.39	-.27
Pre-planning Taskwork MM similarity	183.85	4346.40	.00	226.13	4473.25	.00	334.90	4493.91	.01
Pre-planning Teamwork MM similarity	2026.30	4172.08	.04	2060.43	4278.77	.04	1965.45	4297.21	.04
Post-planning Taskwork MM similarity				-647.24	4712.24	-.01	-1499.28	5187.34	-.03
Post-planning Teamwork MM similarity				184.25	3626.91	.00	74.69	3647.32	.00
TK MM S x TM MM S							9595.62	24102.76	.03
$\Delta R^2 / R^2$		.04/.04			.00 /.04			.00/.04	
ΔF		0.74			0.32			0.00	

Notes. $N = 171$. † $p < .10$, *$p < .05$, **$p < .01$. TK MM S = Post-planning taskwork MM Similarity. TM MM S = Post-planning Teamwork MM Similarity

DISCUSSION

Based on the idea that team effectiveness depends on the integration of team's cognitive, motivational, affective, and coordination processes, the focus of the present study was on team's cognitive processes and performance. Adopting Marks et al.'s (2001) temporally based framework of team processes, I suggested that taskwork and teamwork MM similarity would be related to planning and the interaction between them would have a significant effect in team performance. Specifically, I proposed that the team's pre-planning taskwork and teamwork MM similarity would depend on the type of experience they had in previous team performance episodes; whether it was taskwork or teamwork related. Second, teams' pre-planning taskwork and teamwork MM similarity would interact with the type of planning approach adopted to influence team's post-planning taskwork and teamwork MM similarity. Finally, post-planning taskwork and teamwork MM similarity would influence team performance. Therefore the purpose of the present study was threefold. First, I investigated the influence of prior taskwork- and teamwork-related performance episodes on the similarity of team members' pre-planning MMs. Second, I assessed the influence of the similarity of pre-planning MMs and two planning approaches on the similarity of post-planning MMs. Third, I examined the influence of taskwork and teamwork MM similarity on team performance. The study hypotheses were tested in a lab setting with 172 three-person project-action teams.

Hypothesis 1 proposed that previous performance episode (experience) provides team members with task- and team-relevant knowledge, which contributes to team members' taskwork and teamwork MM similarity. Therefore, it was predicted that team members who have a common task-related experience will have more similar taskwork MMs. In addition, team members who share team-related past experience would be likely to have more similar teamwork MMs. Contrary to expectation, the experience manipulation did not have a significant effect on pre-planning taskwork MM similarity, nor on pre-planning teamwork MM similarity. Thus, in this study, previous experience did not have a significant effect on pre-planning MM similarity.

These results did not converge with Littlepage et al. (1997) who found that for tasks in which task strategies were transferable to a new task, task-related experience increased team performance, but when task strategies were not transferable to a new task, knowledge of teammates' expertise was also relevant to increase team performance. One plausible explanation for the lack of convergence between Littlepage et al.'s study and this study is the nature of the tasks. Whereas Littlepage et al. studied intellective tasks, this study explored the effect of taskwork and teamwork experience on a problem-solving execution task. This task required additional team processes because the participants are also required to implement the solution to the problem, which requires them prove its effectiveness and adjust it when does not work.

Nonetheless, there are three alternative explanations for the lack of a significant relationship between experience and pre-planning MM similarity: (a) the task instructions interfered with the influence of the experience manipulation on MM development, (b) MMs were not fully developed, and (c) the MM measures lacked construct validity and/or were not sensitive to the phenomenon of interest. Regarding the first alternative explanation, following the experimental manipulation, participants were read the task instructions for the second 20-min task. All participants heard the same instructions. Thus, participants may have focused on these instructions more so than their previous task experience when completing the pre-planning MM measures. This alternative explanation is consistent with Cooke et al.'s (2000) theoretical proposition regarding the role of new information and the use of team MMs for team performance. They stated that the extent to which teams use their MMs or new information depends on team members' perceptions regarding the extent to which each of them is more related to the successful performance of the task.

A second explanation for the lack of support for Hypothesis 1 is that the teams did not have enough time together for their MMs to converge. The teams interacted for approximately 10 minutes in a contrived laboratory setting. It is possible that their MMs were still developing when measured. Very little research has examined the development of MMs and team MM similarity. Thus, we simply do not know how long it takes for them to develop and how much team interaction is necessary for them to converge. Actually, as the additional analysis including the experience manipulation in the model showed, the experience condition moderated the interaction between the planning manipulation, pre-planning taskwork and pre-planning teamwork MM similarity on post-planning taskwork and post-planning teamwork MM similarity. This result might be interpreted as a time lagged effect, such that past experience did not have an effect on pre-planning MM similarity because the measurement of MMs was too proximal to the experience. Instead, experience had an effect on post-planning MM similarity because enough time had passed allowing for the effect to emerge.

The third alternative explanation for the lack of support for Hypothesis 1 is the lack of construct-related validity of the MM measures. As Langan-Fox et al. (2000) recommended, this study adopted pairwise ratings as the mental model elicitation method to measure the participants MM and Pathfinder *C* as the index of MM similarity among the members of each team. Although these methods have been shown to predict team performance directly and indirectly through team processes (e.g. Mathieu et al. 2000, Mathieu et al. 2005, Stout et al., 1999), problems with this elicitation method have been reported and might have been experienced in this study.

For example, making pairwaise ratings can be a monotonous and repetitive task, and because of that might induce a response set (Langan Fox et al., 2000). To avoid this problem, in this study, the least number of concepts were chosen to reduce the number of pairwise ratings the participant had to do to elicit their taskwork and teamwork MM. Additionally, instead of a computer based format, a paper and pencil measurement format was administered to decrease the likelihood of response sets. Nevertheless, some outlier scores that distorted the distribution of the residuals were found, which can be explained as a lack of discrimination among the answers within the same team. Thus, the possibility that participants engaged in a response set must not be completely discarded.

Another critical issue in the design of a MM elicitation method based on pairwise ratings is the selection of the concepts to be rated. For a pairwise rating MM elicitation method to be valid, all the critical actions for the successful performance of the task must be included. This requirement raises another issue, which is the potential of priming the participants to perform in certain ways or to pay attention to key information because the measurement of MMs is conducted prior to task performance. As Mathieu et al. (2000) reported, one of the explanations for the lack of empirical evidence supporting a direct effect of MM similarity on team performance is that the act of completing the MM measure might give team members clues about the relevant actions required for successful performance, decreasing the relationship between the variables. To avoid this problem in this study, the concepts included in the taskwork MM measure were limited to the instructions given to the participants, and the concepts included in the teamwork MM measure were relatively generic, frequently required for any team task.

Hypothesis 2 stated that the level of post-planning teamwork and taskwork MM similarity would be determined by the interaction between pre-planning taskwork, pre-planning teamwork MM similarity, and planning condition. Specifically, I suggested that in the generative planning condition, whereas pre-planning taskwork MM similarity would not be significantly related to post-planning taskwork, or post-planning teamwork MM similarity, pre-planning teamwork MM similarity would positively be related to post-planning taskwork and post-planning teamwork MM similarity. For case-based planning, I hypothesized that both pre-planning taskwork and pre-planning teamwork MM similarity would be positively related to post-planning taskwork and teamwork MM similarity.

The results of the moderation regression analysis conducted with post-planning taskwork MM similarity scores did not support the hypothesis. Although post-planning taskwork MM similarity was significantly influenced by the interaction between pre-planning taskwork and pre-planning teamwork MM similarity, planning condition did not have an effect in the dependent variable. Similar results were found for the post-planning teamwork MM similarity scores. Independent of the planning condition, only pre-planning taskwork and pre-planning teamwork MM similarity significantly influenced post-planinng teamwork MM similarity. These variables did not interact to influence post-planning teamwork MM similarity.

Because the manipulation check scales revealed that the planning manipulation had a significant effect on the experience manipulation, additional Hypothesis 2 analyses were conducted with experience condition as a moderator of the suggested relationships. Experience manipulation did significantly moderate the proposed relationships. When the combined taskwork-teamwork experience condition results were contrasted with the other two experience conditions, post-planning taskwork MM similarity was significantly influenced by the three-way interaction between experience condition, pre-planning taskwork and pre-planning teamwork MM similarity. Similarly, post-planning teamwork MM similarity was significantly influenced by (a) the three-way interaction between experience condition, planning condition, and pre-planning teamwork MM similarity, and (b) the two way interaction between experience condition and pre-planning taskwork MM similarity.

Additionally, after controlling for the effect of the experience condition, post-planning teamwork MM similarity was significantly influenced by the interaction between pre-planning taskwork and pre-planning teamwork MM similarity. This result was not found when conducting the analyses without experience condition in the model.

Although the manipulation checks revealed that the participants in the case-based planning condition reported they were encouraged to plan according to their previous experience to a greater extent than the participants in the generative planning condition, the results showed that planning did not have a significant effect on the dependent variables. One reason why the planning manipulation did not have the expected effect on the pre-planning taskwork and teamwork MM similarity interaction is the difficulty human beings might have with planning from scratch when they have had relevant task experience. Although AI researchers have identified generative and case-based planning as two distinct planning approaches for intelligent agents to resolve problems, these two approaches might not be as distinct for human beings. As Mumford et al. (2001) suggested, planning can be understood as a complex active and conscious mental simulation process conducted with the aim of identifying a future sequence of actions intended to improve outcomes, where the rational analysis of goals and actions plays a central role, but also where past experience plays a critical role too. As the planning manipulation check scores showed, the combined taskwork-teamwork experience condition scored significantly higher on the use of previous experience when planning than the taskwork experience condition, which scored higher than the teamwork experience condition. This result reveals that independent of the planning condition, the participants used their past experience in a greater extent when they conducted a similar task than when they conducted a dissimilar task. Regarding the lack of support for the pre-planning taskwork and pre-planning teamwork MM similarity interaction on post-planning MM similarity (Hypothesis 2), perhaps experience is more likely to moderate the relationship between pre-planning teamwork and pre-planning MM similarity on post-planning taskwork and teamwork MM similarity than planning itself.

Hypothesis 3 stated that team performance would be determined by the interaction between post-planning taskwork and post-planning teamwork MM similarity. The results did not support the hypothesis. When the experimental experience conditions were included in the model as moderators of the hypothesized interaction, no support for the hypothesis was found either.

An explanation for the lack of support for Hypothesis 3 is the role of MM similarity on team performance. The relationship between MM similarity and team performance might be mediated by process variables (e.g., Mathieu et al., 2000; Stout et al., 1999). This is a very plausible explanation especially in this study because, according to Marks et al.’s (2001) temporally-based framework of team processes, team performance also depends on team processes implemented when performing the task: (a) team monitoring their progress towards the goal, (b) team monitoring the their environment, (c) coordination, and (d) team monitoring of each other. Therefore, teams with a high level of MM similarity may not reach a high level of performance if they do not effectively implement team processes when performing the task. In contrast, a team with low level of MM similarity might obtain a high level of performance if they successfully implement these processes.

Another explanation for the lack of support for Hypothesis 3, is invalid MM similarity measures. The validity of taskwork MM similarity is suspect and may not have detected a true relationship with team performance.

Limitations of the Study

The first limitation of this study is inherent to any study conducted in a lab setting, a lack of external validity. In order to increase internal validity, lab studies control for extraneous variables, which sometimes increases the artificiality of the situation, making it hard to replicate outside the lab. In this study, a lab setting was chosen over a field study, because the purposes of the study were to identify the effect of experience on pre-planning MM similarity and the effect of two different planning approaches on post-planning MM similarity. Thus, it was necessary to manipulate experience and planning to ensure variability on these constructs and rule out other possible explanations for the results. In spite of this, because cognitive ability, conscientiousness, agreeableness, previous experience with Legos, attitudes toward working in groups, and familiarity with teammates had been suggested to influence team performance, these variables were also measured to statistically control for their effect on the variables of interest.

Another limitation of the lab setting, which threatens the internal validity of the study, is the limited time frame for the team members to get to know and interact with one another and for the manipulations to have an effect. The experience manipulation did not have an effect on pre-planning MM similarity, but it did moderate the interaction between pre-planning taskwork MM similarity, pre-planning teamwork MM similarity, and planning approaches on post-planning MM similarity. Thus, it appears the time lag between the experience manipulation and the measurement of pre-planning MM similarity was too short to measure the effect of experience. Perhaps if pre-planning MM similarity was measured in a natural setting where MMs are built on repeated common experiences, the relationship between common experience and pre-planning MM similarity might have been significant.

Another potential limitation of this study was the construct validity of the MM similarity measures. There are two disadvantages of using pairwaise ratings as a MM elicitation method: (a) the potential for response sets and (b) the extent to which the concepts chosen for pairwaise ratings represent all critical actions to successfully perform the task. To avoid response sets, a paper-and-pencil format was chosen to collect the pairwise ratings. Also the order of the pairwaise ratings was changed when post-planning MM were measured. Still, about three MM similarity scores per index of MM similarity were three standard deviations above or below the sample mean suggesting that approximately the participants of three teams engaged in a response set. Nevertheless, after deleting the extreme scores, the distribution of the MM similarity scores did not significantly deviate from the normal distribution, suggesting that response set was not a significant problem in this study.

The inclusion in the MM measures of all relevant actions to successfully perform the task poses another potential problem, a priming effect on task performance (Mathieu et al., 2000). To avoid priming, the instrument was designed to include all relevant actions that were already mentioned as part of the task instructions. This means some of the actions relevant for the successful task performance (e.g., monitoring the progress of the plan, reformulate goals based on time passed, monitoring the profit made) were not included in the MM measure. Nevertheless, post-planning teamwork MM similarity was significantly related to team performance for at least one condition (case-based planning and teamwork experience) providing some criterion-related validity for the MM similarity measures, suggesting the actions included were sufficient.

A final limitation of this study is other team processes were not assessed: (a) team monitoring their progress toward the goal, (b) team monitoring of their environment, (c) coordination, and (d) team monitoring of each other. If these processes variables would have been measured, a better inference regarding the indirect effect of post-planning MM similarity on team performance might have been detected. Also the relative influence of planning compared to other team processes could have been assessed.

Directions for Future Research

Based on the results obtained regarding the two planning approaches, future research should consider studying the effect of generative planning and case-based planning as complementary planning strategies. Instead of manipulating planning to study these two approaches separately, participants could be encouraged to plan and the type of planning they engage in could be measured (coded). Past experiences available to conduct case-based planning could also be assessed. An approach like this would prevent confounds between the planning and experience variables. This would also permit an examination of the prevalence of each type of planning, the extent to which they are conducted together, and their relative influence on performance.

Additional research is needed to determine the most optimal time to assess MM similarity. Previously reported indirect effects of MM similarity on team performance (Mathieu et al., 2000; Stout et al., 1999) suggest that the influence of MM similarity measured before task performance on task performance is likely mediated by team processes that emerge during the performance of the task. Another way to find a direct relationship between MM similarity and team performance is to measure MM similarity after the performance of the task. According to Marks et al. (2001), MM similarity is an emergent state variable that is determined not only by the transition processes, but also by the action processes the team implements during the performance of the task. Therefore, measuring post-performance MM similarity might be a more proximal measurement of the phenomenon, and more directly related to team performance than post-planning MM similarity.

The failure to find a significant effect for the experience manipulation on pre-planning MM similarity suggests that future research should employ longer time lags between the predictor and MM similarity. Research of this nature may be more appropriate in the field than in the lab. This would ensure MMs are based on multiple performance episodes rather than just a few, allow the MMs to become more stable and make the MMs less susceptible to the influence of new information and more related to their previous experiences. Ideally this would yield stronger relationships between MM similarity and performance.

CONCLUSIONS

The purpose of the present study was threefold. The first aim was to identify the effect of previous experience on pre-planning MM similarity. The second purpose was to assess the moderating effect of two planning approaches on the relationship between pre-planning taskwork and pre-planning teamwork MM similarity and post-planning MM simialrity. Third, I sought to test the interaction between post-planning taskwork and teamwork MM similarity on team performance. The evidence suggested that the experience manipulation designed in this study did not have an effect on pre-planning MM similarity. Because experience had a moderating effect on the relationship between pre-planning MM similarity and post-planning MM similarity, it might be concluded that the lack of a direct relationship needs to be explored in other settings with a longer time lag between experience and the measurement of MM similarity. With a longer time lag, in which the team members have more opportunities to practice task performance, experience should show a stronger effect on pre-planning MM similarity.

Planning approach did not moderate the interaction between pre-planning taskwork and pre-planning teamwork MM similarity on post-planning taskwork or teamwork MM similarity. The effect of experience manipulation on the planning manipulation checks and on the tested relationships suggests that the participants were not able to plan regardless of the experience they had on a prior task. Therefore, future research should explore the generative and case-based planning approaches as complementary planning strategies that mediate the effect of previous experience and pre-planning MM similarity on post-planning MM similarity.

Finally, the lack of support for the relationship between post-planning MM similarity and team performance confirms the need to measure team processes not only within the transition phase of team performance, but also within the action phase of the team performance episode. Nonetheless, the lack of findings regarding the relationship between post-planning MM similarity and team performance suggests that better MM measures should be designed.

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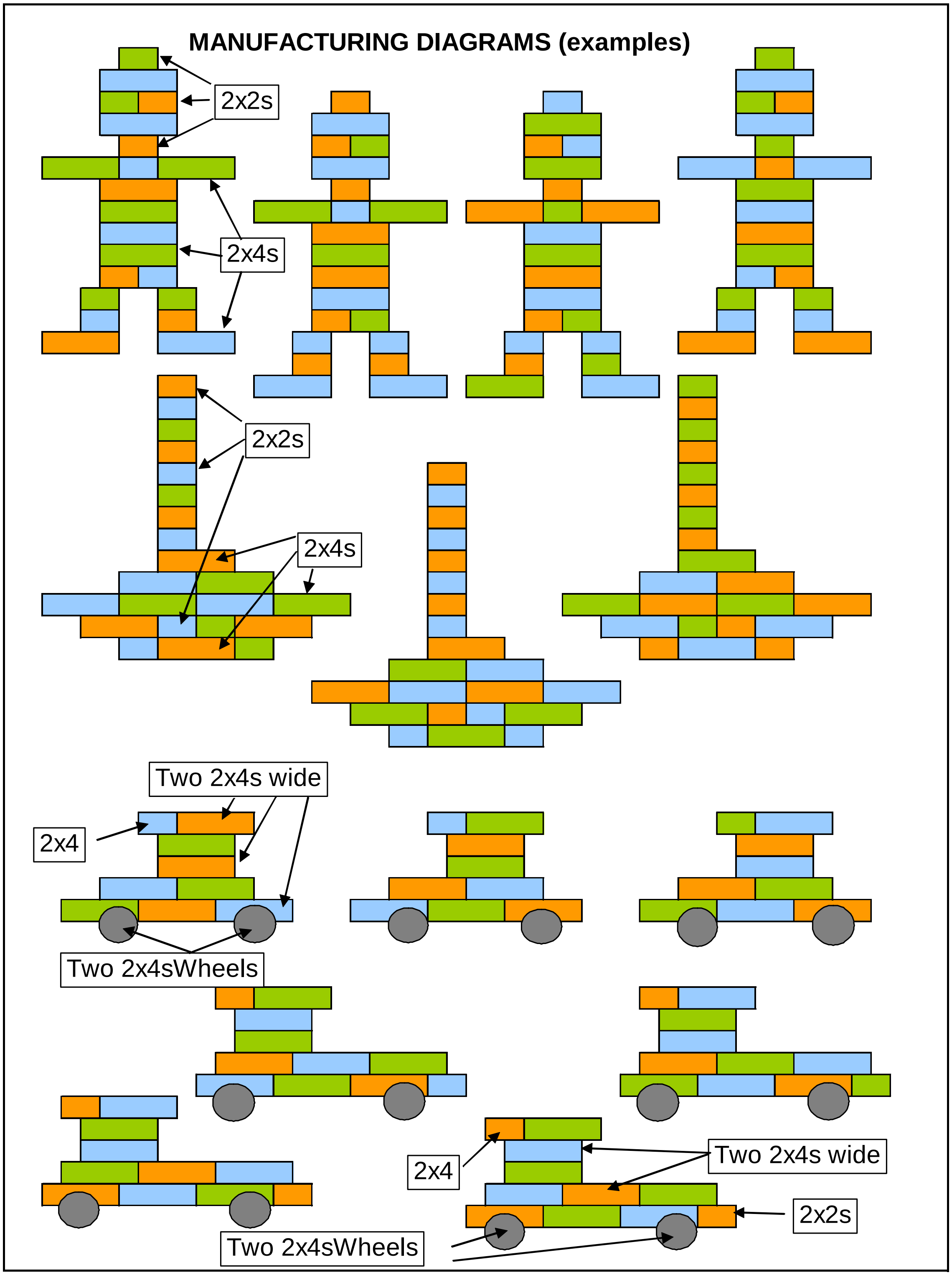
APPENDIX A

Experimental Materials

MANUFACTURING TASK INSTRUCTIONS

- Now I need you to pretend that your team is a business organization that manufactures cars, trucks, robots, and boats.
- Here are the models, the diagrams, and the configuration of each product.
- Note that the products are built with multiple colors and no blocks of the same color are touching each other.
- In this exercise, you will purchase Lego materials from me with an ordering form, build the products, and sell them back for profit.
- **Your goal is to make at least $20,000 in profits during 20-minute performance period.** It does not matter which type of products you make. **The more profit you make, the better.**
- You have $10,000 to purchase your initial materials. You cannot "borrow" more money, but you can use the money that you earn to buy more raw materials.
- It is your responsibility to keep track of your money, but you may ask me how much money you have left. If you over-spend at any point, you will be penalized 15% of your profits at the end of the task.
- The price to purchase supplies and sell products is predetermined and prices change every 5 minutes as indicated on these market information sheets.
- You are allowed to **touch** Legos of any color, but you **can only snap your color Lego.**. If you snap on Legos of the wrong color, your team will be fined $100 for each occurrence.
- **On the ordering form you won't specify the colors. I will fill the order from these cups, which are a mix of colors. If you run out of a color, you can exchange Legos of the same shape for the color you need.**
- Before performing the task, you will spend 20 minutes planning. While your team must come up with a plan, you are not required to follow it.
- To sell your products, you must place them in the designated area. After a product is placed in the selling area, no changes are allowed.
- If a product has Legos of the same color next to each other or does not match the shape of the model, I will tell you that the product is defective, but I won't tell you what is wrong with it. You will not earn any money for that product, and you will loose the Legos you used to build it.
- At any time during the task, you may request a time check. I will read you the time on the stopwatch..
- After the building time expires, you may not sell any more products. I will not purchase unfinished products or excess materials.
- **Remember, your goal is to make at least $20,000 in profits during 20-minute performance period. Also remember each team members of the highest performing team will will ahve the chance to receive $25.**


MANUFACTURING DIAGRAMS (examples)
2x2s
2x4s
2x2s
2x4s
Two 2x4s wide
2x4
Two 2x4sWheels
2x4
Two 2x4s wide
2x2s
Two 2x4sWheels

MARKET INFORMATION TIME #1

1st five minutes (0:00 - 5:00)

Supplies Prices

Component	Cost	Product	Cost
2 x 2	100	Car	2000
2 x 4	100	Truck	2400
Wheels	150	Boat	2200
		Robot	2100

Selling Prices

Product	Market Price
Car	3460
Truck	3620
Boat	2800
Robot	2410

MARKET INFORMATION TIME #2

2nd five minutes (5:00 - 10:00)

Supplies Prices

Component	Cost	Product	Cost
2 x 2	80	Car	1140
2 x 4	60	Truck	1420
Wheels	60	Boat	1340
		Robot	1480

Selling Prices

Product	Market Price
Car	1590
Truck	2310
Boat	2660
Robot	2390

MARKET INFORMATION TIME #3

3rd five minutes (10:00 - 15:00)

Supplies Prices

Component	Cost	Product	Cost
2 x 2	50	Car	1050
2 x 4	40	Truck	1230
Wheels	100	Boat	1300
		Robot	940

Selling Prices

Product	Market Price
Car	2020
Truck	2740
Boat	1590
Robot	1530

MARKET INFORMATION #4

4th five minutes (15:00 - 20:00)

Supplies Prices

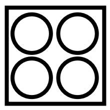
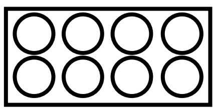
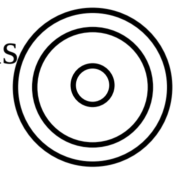
Component	Cost	Product	Cost
2 x 2	50	Car	950
2 x 4	50	Truck	1150
Wheels	50	Boat	880
		Robot	1050

Selling Prices

Product	Market Price
Car	1630
Truck	1630
Boat	1700
Robot	2230

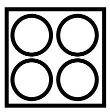
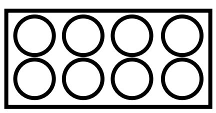
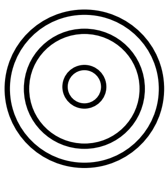
MANUFACTURING TASK ORDERING FORM

Quantity

Order	#1	#2	#3	#4	#5	#6	#7	#8	#9	#10
2 X 2 										
2 X 4 										
Wheels 										

LEGO© CONFIGURATION FOR EACH PRODUCT

Lego Components

		Car	Truck	Boat	Robot
2 x 2		0	2	12	11
2 x 4		17	19	10	10
Wheels		2	2	0	0

*Note: All wheels (regardless of size and color) are considered equivalent.

APPENDIX B

Generative Planning Procedure

- I would like to let you know that I just started the video camera and I need to record the team code on it.
- Now it is time for you to make a master plan to make at least $20,000 in profits. You need to discuss what supplies to buy and what products to build during the 20 minutes you have to perform the Lego manufacturing task.
- To make sure you design the best plan you need to analyze the task before you discuss what to buy, build, and sell.
- Therefore, I will lead you through a **task analysis procedure** that has been scientifically tested and proven to increase the performance of the teams by 75%.
- Here are two forms you will need to fill out.
- The first one is a Group Analysis Form that will help you to analyze the task and identify relevant actions to perform as efficiently as possible.
- The second one is a Master Plan form in which, after analyzing the task, you will write down the sequence of actions you will implement during the 20 minutes.
- Here is an example of a master plan for two people to paint a living room in 3 hrs.
- **Note that a master plan is a sequence of actions** in which the resources required and role of each worker is identified. Some actions are performed by one worker and overlap in the same time period. Others are performed by both of them, so they are recorded sequentially.
- Here you will find some previous actions they had to perform while analyzing the task, and here is the analysis they did to come up with this Master Plan.
- Let's concentrate on your plan now. First, I need you to set aside or disregard all team experiences you have had before, as well as all the experiences you have had with Legos. I need you to approach this task without any bias.
- Now I want you to look at the materials that I distributed to you earlier and take a minute to review the instructions again. In case you need to do some calculations, here is a calculator.
- The first step in performing a complex task is to **divide the complex task** into a series of simpler or shorter sub-tasks. The second step is to identify (a) constraints, (b) the resources available, and (c) the resources lacking. These will help you identify sub-tasks that should be included in your plan.

- For example, on the master plan example I handed to you, the workers initially divided the task in two main sub-tasks: (1) painting the ceiling first and (2) painting the walls second.
- However, as you can see on the previous actions sheet, the poor shape of the walls made the workers realize that some preliminary work on the walls was required. Therefore, they decided to include on their Group Analysis Form the sub-task “Preparing the walls” along with the sub-tasks “Painting the ceiling” and “Painting the wall”.
- In summary, from the initial 2 sub-tasks identified to paint a room, the characteristics of this specific room forced them to consider 1 more sub-task.
- Later, the workers learned that one constraint was to “not stain the carpet”. Therefore they decided to add another sub-task to the Group Analysis form: “Protecting the floor”.
- Also there was a time constraint and, as you can see on the previous actions sheet, they did some computations to choose the appropriate supplies and pace their work.
- In summary, the constraints imposed led the workers to identify additional sub-tasks (i.e., protecting the floor) needed to perform the task, and to conduct preliminary actions to fulfill the time constraint (estimating time needed to paint the room).
- Now I need you to identify at least **three simpler or shorter sub-tasks** that will result in you earning at least $20,000 in profits. Some examples of sub-tasks are: (a) making $ 3,000 in profit in time block 1, (b) building 6 boats in the fourth timeblock, and (c) selling 9 robots in timeblock 3.
- Take a minute to discuss your ideas and agree on at least three sub-tasks that will lead you to obtain $20,000 in profits. Write down your ideas on the “Identifying Tasks” section of the “Group Analysis” form. Make sure you are specific on the sub-tasks. Instead of writing “building a model,” write down which model, when, and who will be involved.
- Now that you have identified sub-tasks, on the “Sub-tasks and Actions” of the form, label each sub-task section with the name of a sub-task you agreed upon. Identify the resources available, resources lacking, and constraints to performing each sub-task and write them down. Make sure you are specific. Instead of writing “Legos,” write down which type of Lego, its price, and the specific time block in which the Lego piece is required.
- Then identify the actions required to accomplish the subtask and order them sequentially. Perform any previous action you would need to make sure you do not waste time when performing the task. Be as detailed as possible.
- Now it is time for you to actually decide what to buy, build, and sell. Your Group Analysis form has a series of sub-plans you need to merge into a single master plan.

Order these sub-plans sequentially and write them down into your master plan. As a result you should have a list of actions you will take to make at least $20,000.

- When you merge the different plans into a master plan, you need to check for conflicting and redundant actions. While redundant actions might be implemented in such a way to save efforts, conflicting actions need to be resolved to avoid contradictory effects on your plan.
- Think carefully about the different actions to make sure you have all of the resources required, whether you will be able to perform each action, and if you will end up where you need to be in order to begin the next action.
- Using the “Master Plan” form, write down the actions you will take minute by minute, identifying the resources required and any additional information you might need.

____
Team Code

GROUP ANALYSIS

IDENTIFYING SUB-TASKS

List the set of actions you all agree to work on to obtain as much profit as possible in 20 minutes:

____ ______________________________________

____ ______________________________________

____ ______________________________________

____ ______________________________________

SUB-TASKS AND ACTIONS

Identify **resources** available, resources lacking and **constraints** related to each specific sub-task. Then, identify the most detailed and specific **sequence of actions** that will lead your team to accomplish the sub-task.

SUB-TASK 1 _______________________________________

Resources available	Resources lacking	Constraints
__________	__________	__________
__________	__________	__________
__________	__________	__________

Sequence of sub-actions to accomplish the action.

____ ______________________________________

____ ______________________________________

____ ______________________________________

____ ______________________________________

____ ______________________________________

SUB-TASK 2___________________________________

Resources available	Resources lacking	Constraints

Sequence of sub-actions to accomplish the action.

SUB-TASK 3___________________________________

Resources available	Resources lacking	Constraints

Sequence of sub-actions to accomplish the action.

SUB-TASK 4____

Resources available	Resources lacking	Constraints

Sequence of sub-actions to accomplish the action.

SUB-TASK 5______________________________________

Resources available	Resources lacking	Constraints

Sequence of sub-actions to accomplish the action.

APPENDIX C

Case-Based Planning Procedure

- I would like to let you know that I just started the video camera and I need to record the team code on it.
- Now it is time for you to make a master plan to make at least $20,000 in profits. You need to discuss what supplies to buy and what products to build during the 20 minutes you have to perform the Lego manufacturing task.
- To make sure you design the best plan you need to analyze the task before you discuss what to buy, build, and sell.
- Therefore, I will lead you through a particular **task analysis procedure** that has been scientifically tested and proven to increase the performance of the teams by 75%.
- Here are two forms you will need to fill out.
- The first one is a Group Analysis Form that will help you to analyze the task and identify relevant actions to perform as efficiently as possible.
- The second one is a Master Plan form in which, after analyzing the task, you will write down the sequence of actions you will implement during the 20 minutes.
- Here is an example of a master plan for two people to paint a living room in 3 hrs.
- **Note that a master plan is a sequence of actions** in which the resources required and role of each worker is identified. Some actions are performed by one worker and overlap in the same time period. Others are performed by both of them, so they are recorded sequentially.
- Here you will find some previous actions they had to perform while analyzing the task, and here is the analysis they did to come up with this Master Plan.
- Let's concentrate on your plan now. Research has shown that people tend to forget one of the most important resources when planning: **THEIR OWN EXPERIENCE**. The task analysis procedure I will guide you through makes sure you use this resource intensively.
- Now I want you to look at the materials that I distributed to you earlier and take a minute to review the instructions again. In case you need to do some calculations, here is a calculator.
- The first step in generating an effective plan of action is to think about your **past experiences** to find effective actions or strategies to perform the new task. **Identify the similarities and differences** between the task you are facing and actions you have performed in the past. Try to identify actions that are likely to be effective for the new task.

- To come up with the Master Plan Example, the workers remembered that during the summer they helped Uncle Joe to paint his living room. Uncle Joe had bought all the supplies needed, the flooring was going to be changed afterwards, the walls were in good shape, and there were no time constraints. So only two actions were necessary: painting the ceiling and painting the walls.
- Now, to paint the family room, the room needs to be painted in only 3 hours, the carpet needs to be kept spotless, and the poor shape of the walls will require some preliminary work on them.
- Now I need you to take a minute to think about the task you just performed and the new task you are about to perform. Please identify **similarities and differences** between the two tasks. Examples of **similarities** you might consider are: (1) the models have the same shape and (2) each person has an assigned color to work with. Examples of **differences** you might consider are: (1) the goal is to make $20,000 instead of the most profit and (2) the task lasts 20 minutes instead of 10.
- Take a minute to discuss your ideas and agree on the similarities and differences between the two tasks, and write them down on the "Analyzing the Task" section of the Group Analysis form. Make sure you are specific about the similarities. Instead of writing "the models are different," write down the specific model that is different, and the specific differences between them.
- The second step in this planning procedure is to identify **different actions** you did and you could have implemented, and plan accordingly.
- On the Master Plan Example, the rooms to be painted were similar. So, because painting first the ceiling and second the walls with Uncle Joe avoided creating mistakes on the walls, the workers planned painting in the same order. Because preparing the walls gives a better finish, they included this action in the plan. But, because using the roller brush all the way to the corners messed up the corners, the plan considers doing the corners with a thin brush.
- Finally, because in the new case the floor must not be stained, "Protecting the floor" has been included on the master plan. Also, because now a 3 hour limit has been imposed, the workers estimated the time required to paint the room to choose the appropriate supplies.
- Please, take a minute to work on the "Actions for Initial Plan" section of the Group Analysis form.
- Based on the similarities between the tasks, write down on the Group Analysis form the actions that you efficiently implemented. On a different column write down the actions you failed to implement but that might have helped to improve your performance, so that you can include them in the master plan. Also on the other column, identify the actions that did not work in the last task, so that you can exclude them from the master plan.

- In the last column of the Group Analysis form, based on the differences between tasks, identify actions that did not work and might work now because the situation is different, so that you can consider them for your master plan.
- Make sure you are specific. Instead of writing "building a model," write down who will or should be involved, how, and when.
- The information you have on the last form you filled out constitutes the basis for your master plan.
- So, the last step for this planning procedure is to come up with a master plan.
- Take a look at the actions you implemented that contributed to your efficiency before and might be useful in the new situation. Also think about the actions you did not implement that might be useful in this new situation. Ultimately you want to identify a sequence of actions that will lead you to obtain $20,000 in profits.
- Once you have identified the sequence of actions you will perform, review the requirements of the task, and the desired end state for each action. Will they help you to reach the goal?
- Using the "Master Plan" form, write down the actions you will take minute by minute, identifying the resources required and any additional information you might need.

GROUP ANALYSIS

ANALYZING THE TASK

Similarities between the task you have performed and the task you are going to perform with your team.

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____

Differences between the task you have performed and the task you are going to perform with your team.

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ACTIONS FOR INITIAL PLAN

Actions that **worked effectively** in the previous task and **should work** in this new task because of similarities.

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Actions that **did not work effectively** in the previous task and **would not work** in this new task because of similarities.

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Actions that **were not implemented** in the previous task and **should be implemented** in this new task because of similarities.

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Actions that **were not implement** in the previous task and **should be implemented** in this new task because of differences.

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APPENDIX D

Manipulation Check

Instructions: Bellow are statements extracted from the task instructions for the 20-minute task. Some of these statements are the same as the ones given for the 10-minute task. Please rate how certain you are that you heard these statements for the 10-minute task you performed earlier.

Please use the following scale to record your answers on the scantron:

(A)	(B)	(C)	(D)	(E)
Extremely Uncertain				**Extremely Certain**

1. Note that the products are built with multiple colors and no blocks of the same color are touching each other.
2. In this exercise, you will purchase Lego materials from me with an ordering form, build the products, and sell them back for profit.
3. The price to purchase supplies and sell products is predetermined and prices change every 5 minutes as indicated on these market information sheets
4. It is your responsibility to keep track of your money, but you may ask me how much money you have left. If you over-spend at any point, you will be penalized 15% of your profits at the end of the task.
5. You are allowed to touch Legos of any color, but you can only snap your color Lego.. If you snap on Legos of the wrong color, your team will be fined $100 for each occurrence.
6. If a product has Legos of the same color next to each other or does not match the shape of the model, I will tell you that the product is defective, but I won’t tell you what is wrong with it. You will not earn any money for that product, and you will loose the Legos you used to build it.

Manipulation Check Inventory

Instructions: Answer the next questions based on the two tasks you just performed in this experiment. Please, indicate how much you agree with the following statements.

Please use the following scale to record your answers on the scantron:

(A)	(B)	(C)	(D)	(E)
Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree

1. During the 10-minute task, I got to know my teammates pretty well.
2. The 10-minute task was very similar to the 20-minute task.
3. The knowledge I gained about my teammates while performing the 10-minute task allowed me to better coordinate with my teammates in the 20-minute task.
4. Performing the 10-minute task facilitated my ability to do the 20-minute task.
5. The 10-minutes task was exactly the same as the 20-minute task.
6. The knowledge I gained about my team when performing the 10-minute task allowed me to identify ways to perform the 20-minute task better.

APPENDIX E

Master Plan

TIME		**TASK/ACTIONS**	**RESOURCES REQUIRED**	
Cum				

APPENDIX F

Taskwork MMs Inventory

Instructions: Below you will find 15 pairs of actions that that you and your teammates might demonstrate when performing the manufacturing task. Your task is to make judgments about the "relatedness" of each of these pairs.

Please use the following scale to record your answers on the scantron:

(A) (B) (C) (D) (E)
Not at all related
Highly related

1. ---------Reading market information sheets ---- Completing ordering form
2. -------------------------Requesting time check ---- Snapping Legos of your own color
3. --------Exchanging Legos of different color ---- Placing products in the designated area
4. ----------Snapping Legos of your own color ---- Reading market information sheets
5. ---Placing products in the designated area ---- Reading market information sheets
6. ----------Snapping Legos of your own color ---- Completing ordering form
7. ---Placing products in the designated area ---- Completing ordering form
8. --------Exchanging Legos of different color ---- Completing ordering form
9. --------Exchanging Legos of different color ---- Snapping Legos of your own color
10. ---Placing products in the designated area ---- Requesting time check
11. --------Exchanging Legos of different color ---- Reading market information sheets
12. ---------Reading market information sheets ---- Requesting time check
13. ----------Snapping Legos of your own color ---- Placing products in the designated area
14. ----------------------Completing ordering form ---- Requesting time check
15. -------------------------Requesting time check ---- Exchanging Legos of different color

Teamwork MMs Inventory

Instructions: Below you will find 15 pairs of actions that that you and your teammates might demonstrate when performing the manufacturing task. Your task is to make judgments about the "relatedness" of each of these pairs.

Please use the following scale to record your answers on the scantron:

(A) (B) (C) (D) (E)

Not at all related

Highly related

1. ----------------------------Coordinating actions ---- Cooperating with each other

2. ------------------Cooperating with each other ---- Leading the team

3. --------------------------------Leading the team ---- Communicating with each other

4. ----------------------------Coordinating actions ---- Encouraging each other

5. ----------------Cooperating with each other ---- Encouraging each other

6. --------------------------------Leading the team ---- Coordinating actions

7. ------------------Cooperating with each other ---- Communicating with each other

8. -------------Communicating with each other ---- Coordinating actions

9. --------------------------------Leading the team ---- Encouraging each other

10. ------------------------Encouraging each other ---- Communicating with each other

APPENDIX G

Big Five Inventory (John, 1991)

Instructions: Please use the following rating scale to indicate the extent to which you agree or disagree with each of the following statements. Describe yourself as you see yourself at the present time, not what you wish to be in the future. Describe yourself as you are typically, as compared with other persons you know of the same sex and of roughly the same age.

Please use the following scale to record your answers on the scantron:

(A)	(B)	(C)	(D)	(E)
Strongly Disagree	**Disagree**	**Neither Agree nor Disagree**	**Agree**	**Strongly Agree**

I think about myself as *someone who…*	
1. is talkative.	**23.** tends to be lazy.
2. tends to find fault in others.	**24.** is emotionally stable, not easily upset.
3. does a thorough job.	**25.** is inventive.
4. is depressed, blue.	**26.** has an assertive personality.
5. is original, comes up with new ideas.	**27.** can be cold and aloof.
6. is reserved.	**28.** perseveres until the task is finished.
7. is helpful and unselfish with others.	**29.** can be moody.
8. can be somewhat careless.	**30.** value artistic, aesthetic experiences.
9. is relaxed, handles stress well.	**31.** is sometimes shy, inhibited.
10. is curious about many different things.	**32.** is considerate and kind to almost everyone.
11. is full of energy.	**33.** does things efficiently.
12. starts quarrels with others.	**34.** remains calm in tense situations.
13. is a reliable worker.	**35.** prefers work that is routine.
14. can be tense.	**36.** is outgoing, sociable.
15. is ingenious, deep thinker.	**37.** is sometimes rude to others.
16. generates a lot of enthusiasm.	**38.** makes plans and follows through with them.
17. has a forgiving nature.	**39.** gets nervous easily.
18. tends to be organized.	**40.** likes to reflect, play with new ideas.
19. worries a lot.	**41.** has few artistic interests
20. has an active imagination.	**42.** likes to cooperate with others
21. tends to be quiet.	**43.** is easily distracted.
22. is generally trusting.	**44.** is sophisticated in art, music, or literature.

Teammate Knowledge Items

Instructions: Please indicate the extent to which you know the other participants in this study session.

1. Red. **2. Blue.**

Please use the following scale to record your answers on the scantron:

(A) We just met today.
(B) We have had class together before, but I have not interacted with him/her before.
(C) We have interacted in class(es).
(D) We have interacted outside of class(es).
(E) We have interacted quite a bit in and/or outside of class(es).

Previous Experience with Legos Items

Instructions: Please indicate the extent to which you agree or disagree with each of the next statements.

(A)	(B)	(C)	(D)	(E)
Strongly Disagree	**Disagree**	**Neither Agree nor Disagree**	**Agree**	**Strongly Agree**

1. I played with Legos when I was a kid.
2. I enjoyed playing with Legos.
3. Playing with Legos is fun.

Team Preference and Experience Items

Instructions: Regarding your past experience working in groups, please indicate how often have you experienced the situation described in the following statements.

Please use the following scale to record your answers on the scantron:

(A)	(B)	(C)	(D)	(E)
Never	**Rarely**	**Somewhat often**	**Very Often**	**Almost Always**

1. How often do you work in teams that are productive?
2. How often do you work in teams instead of working by yourself?
3. How often do you work in a team in which the productivity is higher than it would be if the team members worked by themselves?
4. How often have you been forced to work in a team when you would have preferred to work by yourself?
5. How often do you work by yourself instead of working on a team?

Instructions: Please indicate how much you agree with the following statements regarding your past experience working in groups. Use the following scale to record your answers on the scantron:

(A)	(B)	(C)	(D)	(E)
Strongly Disagree	**Disagree**	**Neither Agree nor Disagree**	**Agree**	**Strongly Agree**

6. I think it is enjoyable to work with others.
7. Teams are productive.
8. Working in a team is more enjoyable than working by myself.
9. I prefer to work by myself than in a group.
10. If given the choice I prefer to work as a part of a team rather than work by myself.
11. I like to work in teams that require a great deal of interaction between team members to accomplish a task.
12. I generally prefer to work as part of a team.
13. Teams perform far better than the individual team members on their own.

APPENDIX H

Hypothesis 2 Additional Analyses with Experience Manipulation

To determine if the relationships examined when testing Hypothesis 2 were influenced by the experience condition, the analyses were conducted again introducing into the model the experience condition main effect, as well as the interaction between experience and the three variables of interest. To test the effect of the three experience conditions, two orthogonal comparisons were conducted. The first one compared the results of the combined taskwork-teamwork experience condition with the taskwork and teamwork experience conditions, thus a dummy-coded variable was computed accordingly (2,-1,-1). The second comparison contrasted the results of the taskwork experience condition with the teamwork experience condition, thus a second dummy-coded variable was computed accordingly (0, 1,-1). Because orthogonal comparisons are uncorrelated, it allows exploring the effect of each of these comparisons separately. Consequently, two series of analyses were performed. The first including the effect of the first orthogonal comparison in the model and the second including the effect of the second orthogonal comparison.

Because the effect of the experience manipulation might have influenced the variables of interest and/or their interaction effects on the dependent variables, several analyses were conducted. First, the effect of the four-way interaction between the dummy-coded variable, planning condition, pre-planning taskwork and pre-planning teamwork MM similarity on the post-planning taskwork and post-planning teamwork MM similarity. When the increase in the variance explained by the higher order interaction was not significant, separate analyses were conducted to test the effect of each of the lower level interaction terms in the model. For instance, when the experience condition, planning condition, pre-planning taskwork and pre-planning teamwork MM similarity four-way interaction was not significant, three other analyses were conducted testing the effect of each of the three-way lower level interactions: (a) experience condition, planning condition, and pre-planning taskwork MM similarity, (b) experience condition, planning condition, and pre-planning teamwork MM similarity, and (c) experience condition, pre-planning taskwork MM similarity, and pre-planning teamwork MM similarity. When any of these three-way interaction terms were not significant, separate analyses were conducted to test the effect of each of the lower level interaction terms in the model. For instance, (a) experience condition and planning condition, (b) experience condition and pre-planning taskwork MM similarity, and (c) experience condition and pre-planning teamwork MM similarity.

The analyses of the residuals obtained in the analysis after deleting the scores more than three standard deviations from the sample mean showed that the assumption of normality of the residuals for the post-planning taskwork MM similarity analysis was met (*Shapiro-Wilk* (159) = .98, $p > .01$). Regarding the distribution of the residuals for the post-planning teamwork MM similarity analysis, even though the deviation from normality was less serious than with the whole sample, it was still significant at a level of .001 (*Shapiro-Wilk* (157) = .97, $p > .01$).

Combined Taskwork-Teamwork vs Other conditions Orthogonal Comparison Results

The regression analyses conducted on post-planning taskwork MM similarity scores when including the comparison of the combined taskwork-teamwork experience with the taskwork and teamwork experience conditions showed that the experience condition, planning condition, pre-planning taskwork and pre-planning teamwork four-way interaction term did not explain a significant amount of variance in the dependent variable. However, the three-way interaction between the experience condition, pre-planning taskwork and pre-planning teamwork MM similarity significantly increased the variance explained in post-planning taskwork MM similarity (see Table 13). This interaction is graphed in Figure 5. The graph shows that in the combined taskwork-teamwork experience condition, the relationship between pre-planning and post-planning taskwork MM similarity was positive for teams with high level of pre-planning teamwork MM similarity, and the relationship between these two variables was negative for teams with low levels of pre-planning teamwork MM similarity. But in the taskwork and teamwork experience conditions, there was a positive relationship between pre-planning and post-planning taskwork MM similarity as well as between pre-planning teamwork and post-planning taskwork MM similarity, but the slope of these relationships did not vary along different levels of the other variable.

Because the other three way interaction terms were not significant, another analysis was conducted testing whether the lower level two-way interaction terms between planning condition and the other variables had significant effects on the prediction of post-planning taskwork MM similarity. The results of these analyses revealed that

Table 13

Influence of Type of Experience, Pre-planning Taskwork, and Pre-planning Teamwork MM Similarity on Post-planning Taskwork MM Similarity

	Step 1			Step 2			Step 3			Step 4		
Predictors	b	SE	b	b	SE	β	b	SE	β	b	SE	β
(Constant)	0.44**	0.01		0.44**	0.01		0.44**	0.01		0.43**	0.01	
Experience with Legos (*M*)	0.02	0.01	.10	0.02	0.02	.10	0.02	0.02	.10	0.02	0.02	.08
Agreeableness (*M*)	-0.06*	0.03	-.17	-0.05†	0.03	-.15	-0.06*	0.03	-.17	-0.06*	0.03	-.17
Team mates knowledge (*M*)	-0.04	0.02	-.11	-0.03	0.02	-.11	-0.02	0.02	-.07	-0.02	0.02	-.07
Experience condition				0.00	0.01	.02	0.00	0.01	-.01	0.00	0.01	-.04
Planning condition				-0.01	0.02	-.04	-0.01	0.02	-.06	-0.01	0.02	-.05
Pre-planning Taskwork MM similarity				0.09	0.08	.09	0.08	0.09	.08	0.07	0.08	.07
Pre-planning Teamwork MM similarity				0.05	0.07	.06	0.08	0.07	.09	0.08	0.07	.09
EC x PL							0.01	0.01	.10	0.01	0.01	.05
EC x TK MM S							0.08	0.06	.12	0.08	0.06	.11
EC x TM MM S							0.02	0.05	.03	0.02	0.05	.03
PC x TK MM S							-0.21	0.17	-.11	-0.21	0.17	-.11
PC x TM MM S							0.03	0.15	.02	0.07	0.15	.04
TK MM S x TM MM S							1.36†	0.71	.16	1.24†	0.70	.15
EC x TK MM S x TM MM S										1.11*	0.48	.19
$\Delta R^2 / R^2$		.05 /.05			.01 /.07			.05 /.12			.03 /.15	
ΔF		2.78*			0.60			1.48			5.43*	

Notes. N = 159. † *p* < .10, **p* < .05, ***p* < .01. EC = Experience Condition. PC = Planning Condition. TK MM S = Pre-planning Taskwork MM Similarity. TM MM S = Pre-planning Teamwork MM Similarity

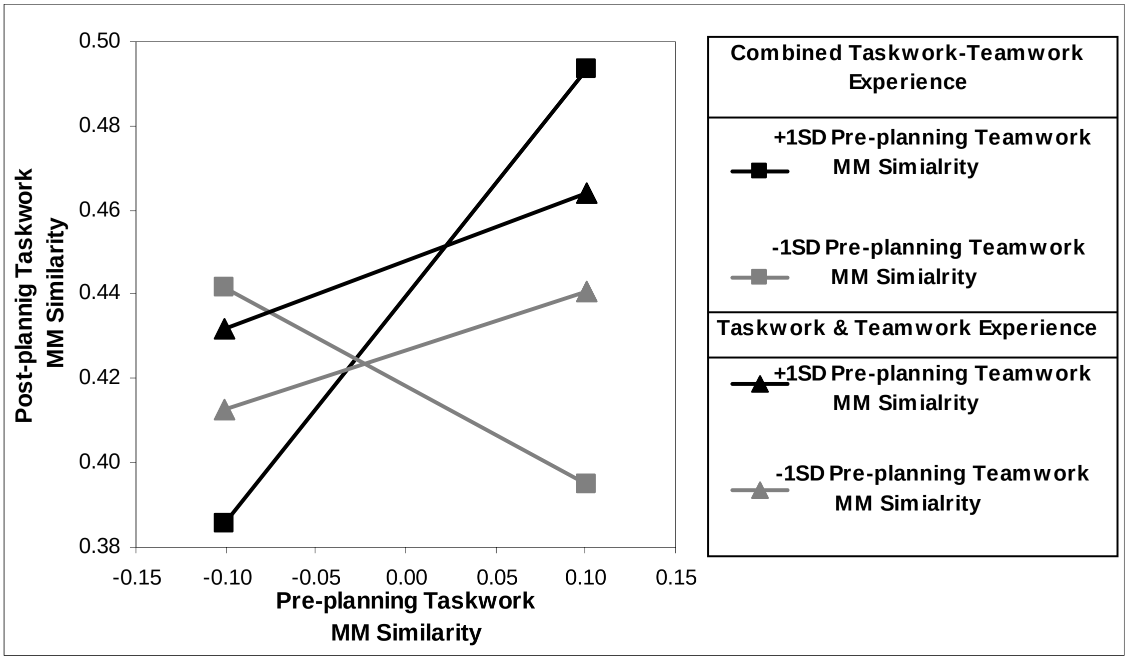

Figure 5. Influence of type of experience, pre-planning taskwork MM similarity, and pre-planning teamwork MM similarity on post-planning taskwork MM similarity

planning condition did not have a significant main effect on post-planning taskwork MM similarity, nor did it significantly interact with anything to predict post-planning MM similarity.

The regression analyses conducted on post-planning teamwork MM similarity scores comparing the combined taskwork-teamwork experience with the taskwork and teamwork experience conditions showed that the experience condition, planning condition, pre-planning taskwork and pre-planning teamwork four-way interaction term did not explain a significant amount in the dependent variable. However, the three-way interaction between experience condition, planning condition, and pre-planning teamwork proved to significantly increase the variance explained in post-planning teamwork MM similarity (see Table 14).

As Figure 6 depicts teams in the combined taskwork-teamwork experience condition had a positive relationship between pre-planning and post-planning teamwork MM similarity when they did generative planning, but this relationship was negative when they did case-based planning. For teams in the taskwork and teamwork experience conditions, the relationship between pre-planning and post-planning teamwork MM similarity was positive, but stronger for teams assigned to the case-based planning condition than for teams assigned to the generative planning condition.

Regarding the lower order effects not considered by the significant three-way interaction, the two way interaction between experience conditions and pre-planning taskwork MM similarity significantly increased the variance explained in post-planning teamwork MM similarity (see Table 15). Also, after controlling for the experience condition, the two-way interaction between pre-planning taskwork and pre-planning teamwork MM similarity, which was not significant when testing Hypothesis 2, significantly increased the variance explained in post-planning teamwork MM similarity (see Table 16).

Figure 7 graphs the interaction between experience condition and pre-planning taskwork MM similarity. The interaction indicates whereas the relationship between pre-planning taskwork and post-planning teamwork MM similarity was negative for teams in the combined taskwork-teamwork condition, this relationship was positive for teams in the taskwork and/or teamwork experience condition.

Figure 8 graphs the effect of the interaction between pre-planning taskwork and pre-planning teamwork MM similarity after controlling for the effect of experience

Table 14

Influence of Type of Experience, Type of Planning, and Pre-planning Teamwork MM Similarity on Post-planning Teamwork MM Similarity

	Step 1			Step 2			Step 3			Step 4		
Predictors	b	SE	b	b	SE	β	b	SE	β	b	SE	β
(Constant)	0.57**	0.01		0.57**	0.01		0.57**	0.01		0.57**	0.01	
Cognitive ability (*M*)	0.01	0.00	.10	0.01	0.00	.11	0.01	0.00	.11	0.01†	0.00	.12
Experience condition				0.01	0.01	.12	0.01	0.01	.11	0.01	0.01	.09
Planning condition				0.01	0.02	.04	0.00	0.02	-.01	0.00	0.02	.01
Pre-planning Taskwork MM similarity				0.23*	0.10	.18	0.17†	0.10	.14	0.16†	0.10	.12
Pre-planning Teamwork MM similarity				0.19*	0.09	.16	0.20*	0.09	.17	0.23*	0.09	.18
EC x PL							-0.01	0.01	-.04	-0.01	0.01	-.03
EC x TK MM S							-0.26**	0.07	-.27	-0.22**	0.07	-.23
EC x TM MM S							-0.08	0.06	-.10	-0.08	0.06	-.10
PC x TK MM S							-0.03	0.08	-.03	-0.02	0.08	-.02
PC x TM MM S							0.02	0.07	.02	0.03	0.07	.03
TK MM S x TM MM S							0.37**	0.14	.21	0.29*	0.14	.16
EC X PC x TM MM S										-0.34**	0.13	-.20
$\Delta R^2 / R^2$		.01 /.01			.08 /.09			.12 /.21			.04 /.25	
ΔF		1.73			3.41*			3.81**			7.26**	

Notes. N = 163. † $p < .10$, *$p < .05$, **$p < .01$. EC = Experience Condition. PC = Planning Condition. TK MM S = Pre-planning Taskwork MM Similarity. TM MM S = Pre-planning Teamwork MM Similarity

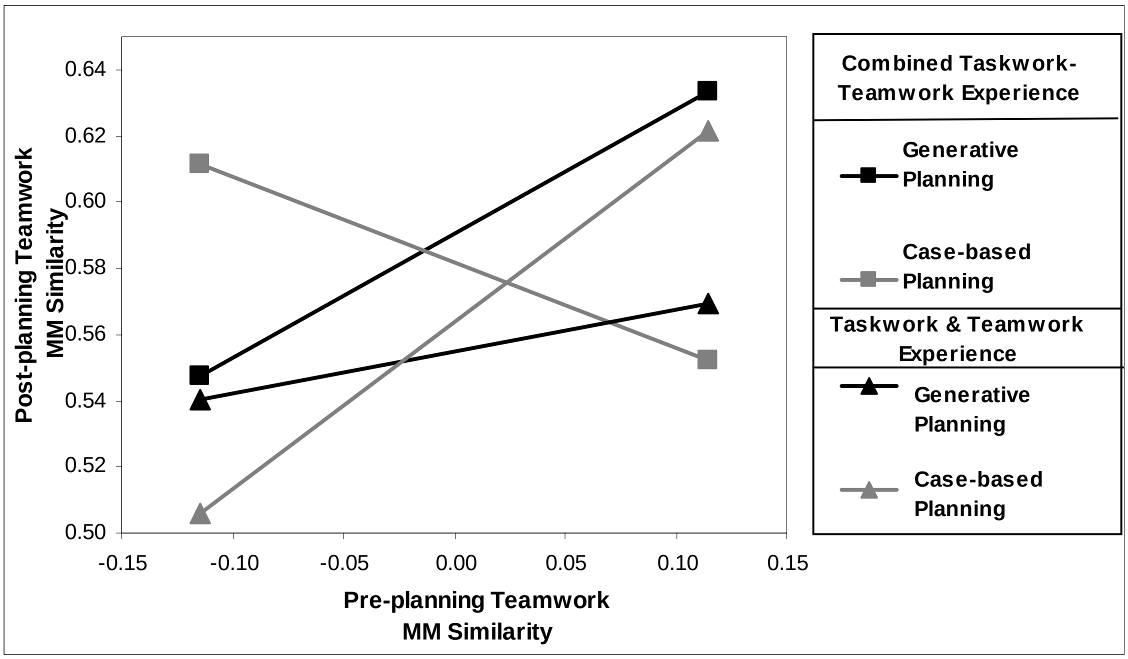

Figure 6. Influence of type of experience, type of planning, and pre-planning teamwork MM similarity on post-planning teamwork MM similarity

Table 15

Influence of Type of Experience and Pre-planning Taskwork MM Similarity on Post-planning Teamwork MM Similarity

	Step 1			Step 2			Step 3		
Predictors	b	SE	b	b	SE	β	B	SE	β
(Constant)	0.57**	0.01		0.57**	0.01		0.57	0.01	
Cognitive ability (*M*)	0.01	0.00	.10	0.01	0.00	.11	0.00	0.00	.09
Experience condition				0.01	0.01	.12	0.01	0.01	.12
Planning condition				0.01	0.02	.04	0.00	0.02	.01
Pre-planning Taskwork MM similarity				0.23*	0.10	.18	0.15	0.10	.12
Pre-planning Teamwork MM similarity				0.19*	0.09	.16	0.24*	0.09	.19
EC x TK MM S							-0.27**	0.07	-.28
$\Delta R^2 / R^2$		.01 /.01			.08 /.09			.07 /.16	
ΔF		1.73			3.41*			13.69**	

Notes. $N = 173$. † $p < .10$, *$p < .05$, **$p < .01$. EC = Experience Condition. TK MM S = Pre-planning Taskwork MM Similarity.

Table 16

Influence of Pre-planning Taskwork MM Similarity and Pre-planning Teamwork MM Similarity on Post-planning Teamwork MM Similarity for Teams in the Combined Taskwork-Teamwork Experience Condition Compared to Teams in the Taskwork and Teamwork Experience Conditions

	Step 1			Step 2			Step 3		
Predictors	b	SE	b	b	SE	β	b	SE	β
(Constant)	0.57**	0.01		0.57**	0.01		0.57**	0.01	
Cognitive ability (*M*)	0.01	0.00	.10	0.01	0.00	.11	0.01	0.00	.12
Experience condition				0.01	0.01	.12	0.01	0.01	.10
Planning condition				0.01	0.02	.04	0.01	0.02	.03
Pre-planning Taskwork MM similarity				0.23*	0.10	.18	0.24*	0.10	.19
Pre-planning Teamwork MM similarity				0.19*	0.09	.16	0.14	0.09	.12
TK MM S x TM MM S							0.34*	0.14	.19
$\Delta R^2 / R^2$		.01 /.01			.08 /.09			.05 /.12	
ΔF		1.73			3.41*			6.23*	

Notes. $N = 163$. † $p < .10$, *$p < .05$, **$p < .01$. TK MM S = Pre-planning Taskwork MM Similarity. TM MM S = Pre-planning Teamwork MM Similarity

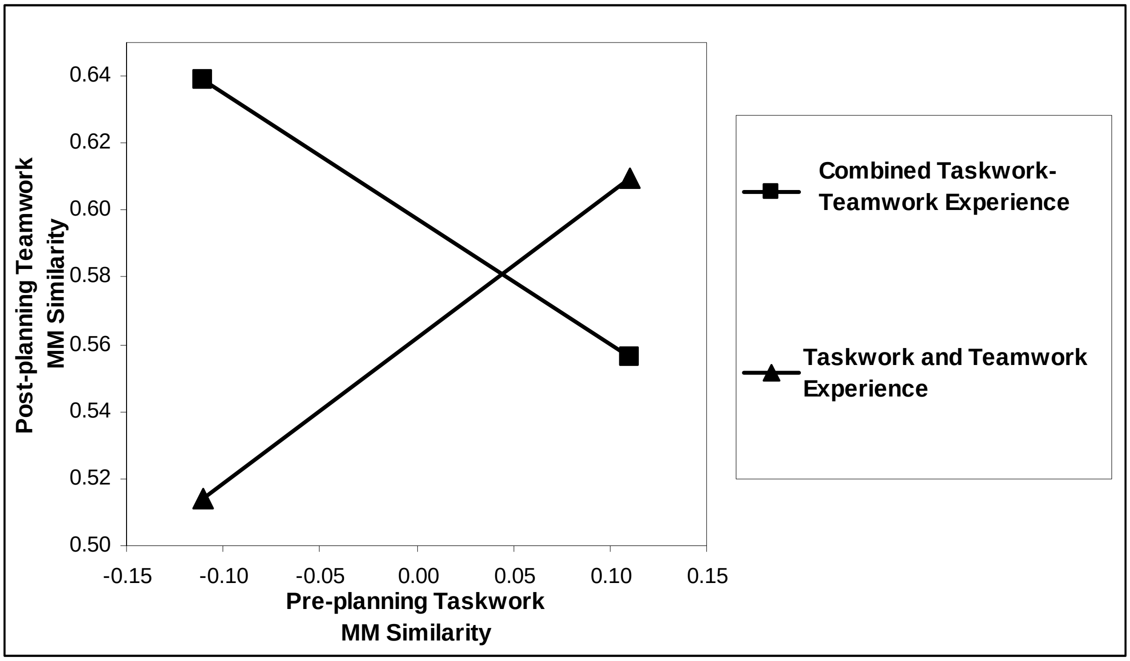

Figure 7. Influence type of experience and pre-planning taskwork MM similarity on post-planning teamwork MM similarity

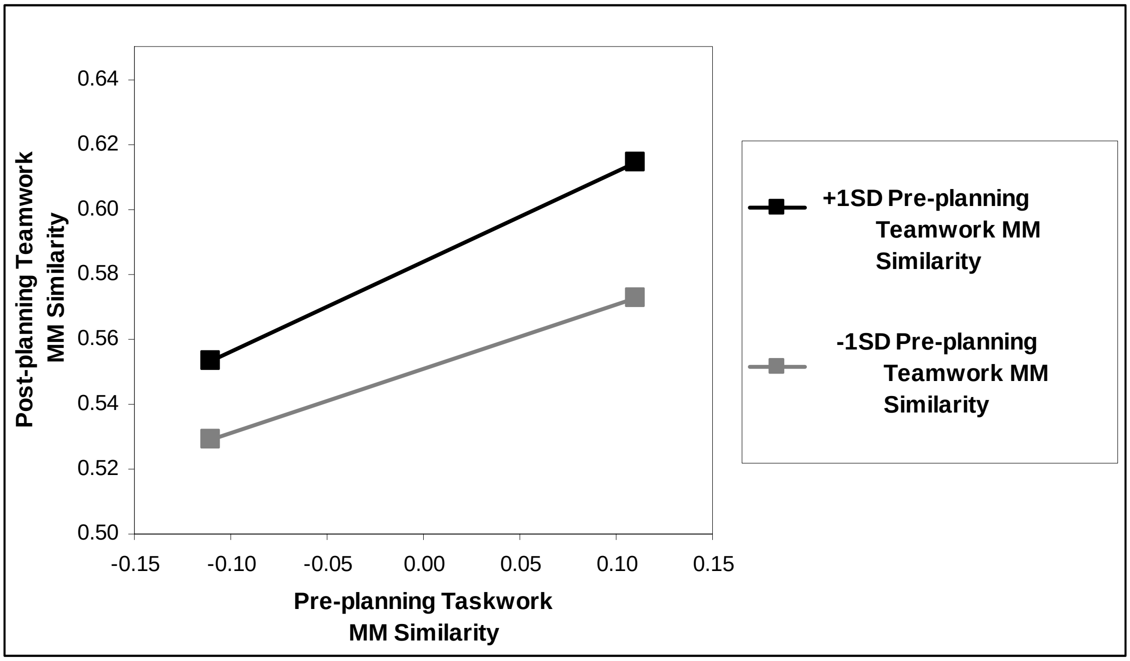

Figure 8. Influence of pre-planning taskwork and pre-planning teamwork MM similarity on post-planning teamwork MM similarity for teams in the combined taskwork-teamwork experience condition compared to teams in the taskwork and teamwork experience conditions

conditions. According to the graph, the relationship between pre-planning taskwork and post-planning teamwork MM similarity is positive, but it is stronger as teams have higher scores on pre-planning teamwork MM similarity.

Taskwork vs Teamwork Conditions Orthogonal Comparison Results

The regression analyses conducted on post-planning taskwork MM similarity scores when including the comparison of the taskwork experience with the teamwork experience conditions showed that the experience condition, planning condition, pre-planning taskwork and pre-planning teamwork four-way interaction term did not explain a significant amount in the dependent variable. Among the three analyses conducted to test the effect of each of the three-way interaction terms on post-planning taskwork MM similarity, none of them significantly increased the proportion of variance explained in post-planning taskwork MM similarity. The analyses conducted to assess the effect of each of the two-way interaction terms over and above the main effects revealed that experience condition did not interact with the planning condition, pre-planning taskwork, or pre-planning teamwork MM similarity to influence post-planning taskwork MM similarity.

The regression analyses conducted on post-planning teamwork MM similarity when including the comparison between the taskwork and teamwork experience conditions showed that the experience condition, planning condition, pre-planning taskwork and pre-planning teamwork four-way interaction term did not explain a significant amount in the dependent variable. The analyses conducted to test the effect of the lower level three-way and two-way interaction terms separately did not significantly increase the variance explained in post- planning MM similarity over and beyond the main effect of pre-planning teamwork MM similarity. Nevertheless, after controlling for experience condition, the two-way interaction between pre-planning taskwork and pre-planning teamwork MM similarity, which was not significant when testing Hypothesis 2, significantly increased the variance explained in post-planning teamwork MM similarity (see Table 17).

Figure 9 graphs the effect of the interaction between pre-planning taskwork and pre-planning teamwork MM similarity on post-planning teamwork MM similarity. Similar to the results obtained with the orthogonal comparison that compared the

Table 17

Influence of Pre-planning Taskwork MM Similarity and Pre-planning Teamwork MM Similarity on Post-planning Teamwork MM Similarity for Teams in the Taskwork Experience Condition Compared to Teams in the Teamwork Experience Condition

	Step 1			Step 2			Step 3		
Predictors	b	SE	b	b	SE	β	b	SE	β
(Constant)	0.57**	0.01		0.57**	0.01		0.57**	0.01	
Cognitive ability (*M*)	0.01	0.00	.10	0.01	0.00	.11	0.01	0.00	.12
Experience condition				0.01	0.01	.12	0.00	0.01	.01
Planning condition				0.01	0.02	.04	0.01	0.02	.03
Pre-planning Taskwork MM similarity				0.23*	0.10	.18	0.24*	0.10	.19
Pre-planning Teamwork MM similarity				0.19*	0.09	.16	0.15	0.09	.12
TK MM S x TM MM S							0.36*	0.14	.20
$\Delta R^2 / R^2$		.01 /.01			.07 /.08			.04 /.11	
ΔF		1.76			2.79*			6.68*	

Notes. N = 163. † $p < .10$, *$p < .05$, **$p < .01$. TK MM S = Pre-planning Taskwork MM Similarity. TM MM S = Pre-planning Teamwork MM Similarity

combined taskwork-teamwork experience condition to the taskwork and teamwork experience conditions, after controlling for the effect of experience condition, the relationship between pre-planning taskwork and post-planning teamwork MM similarity was positive, but this relationship was stronger for teams with high levels of pre-planning teamwork MM similarity than for team with lower levels of this variable.

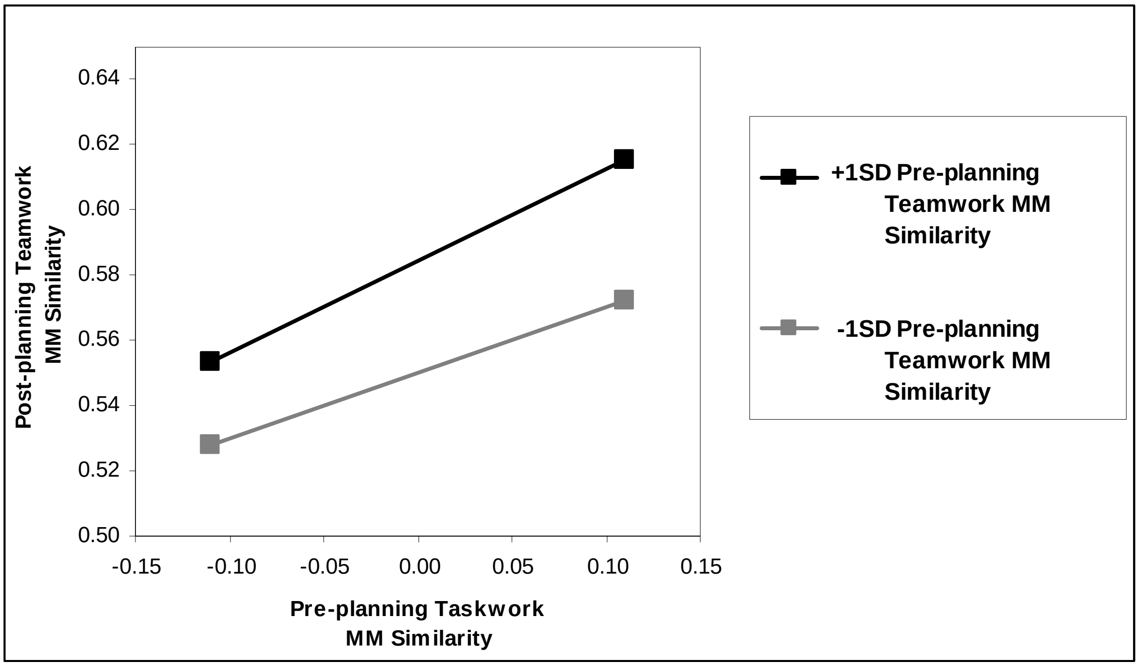

Figure 9. Influence of pre-planning taskwork and pre-planning teamwork MM similarity in post-planning teamwork MM similarity for teams in the taskwork experience condition compared to teams in the teamwork experience condition

VITA

Pedro Ignacio Leiva Neuenschwander

Permanent Address: P. Universidad Católica de Valparaíso
Escuela de Psicología
Facultad de Filosofía y Educación
Avenida Brazil 2950
Valparaíso – V Región
Chile

Education

Ph.D. *Texas A&M University* August, 2006
Psychology Major: Industrial and Organizational emphasis.

M.S. *Pontificia Universidad Católica de Chile* July, 1997
Psychology Major.

B.A. *Pontificia Universidad Católica de Chile* December, 1994
Psychology Major.

Selected Publications

Leiva, P. (1999) Educación para la Democracia: Recuento de Experiencias Internacionales (Citizenship education: Review of international experiences). *Estudios Pedagógicos Nº 25*: 91-112.

Avendaño, C. y Leiva, P. (1998) Cuestionario de Riesgos para la Salud Psicológica en Enfermeras (Female nurses psychological health risk questionnaire) *PSYKHE, Vol 7,* Nº 2, 53-61.

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Scholarships and Awards

J. William Fulbright Foreign Scholarship, August 2002
National Scholarship Program of Chile, August 2002