DISTAL AND PROXIMAL TEAM PROCESSES AS MEDIATORS OF THE TRAINING OUTCOMES — TRAINING TRANSFER RELATIONSHIPS

A Thesis
Presented to
The Academic Faculty

by

Brian Anthony Thomas

In Partial Fulfillment
of the Requirements for the Degree
Master of Science in Psychology

Georgia Institute of Technology

September 2003

DISTAL AND PROXIMAL TEAM PROCESSES AS MEDIATORS OF THE TRAINING OUTCOMES — TRAINING TRANSFER RELATIONSHIPS

Approved by:

Dr. Gilad Chen, Advisor

Dr. Todd Maurer

Dr. Charles Parsons

Date Approved [illegible]

ACKNOWLEDGEMENT

I would like to acknowledge my advisor, Gilad Chen, for the continual guidance, motivation, patience, and the resources provided that made this study possible. Special gratitude is also extended to Todd Maurer and Chuck Parsons for providing insightful comments and asking intriguing questions. I would also like to acknowledge Grant Gruetzmacher, Tim Hur, Megan Lutz, Erin Page, and Craig Wallace, for assisting in the countless hours required to conduct such a study. Last, but certainly not least, I would like to thank Megan Berryman and my family for their unconditional support and encouragement. With all my gratitude and thanks, I gratefully acknowledge those above.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

SUMMARY

This study examined a comprehensive model relating multidimensional training outcomes (i.e., cognitive, behavioral, attitudinal/motivational) to training transfer in a team context. Team training transfer was hypothesized to be influenced by proximal team processes (i.e., action processes) which are influenced by more distal team processes (i.e., transition processes) that are influenced by inputs (i.e., multidimensional training outcomes). The hypothesized model was assessed using data collected from 78 dyads operating within the context of a low-fidelity computer-based flight simulator. Partial support for the unique and positive prediction of multidimensional training outcomes on transition processes was found. Results also suggest that transition processes partially mediate the collective efficacy — action processes relationship and that action processes positively influence team transfer performance. Contributions to theory and practice are discussed, as well as limitations and directions for future research.

INTRODUCTION

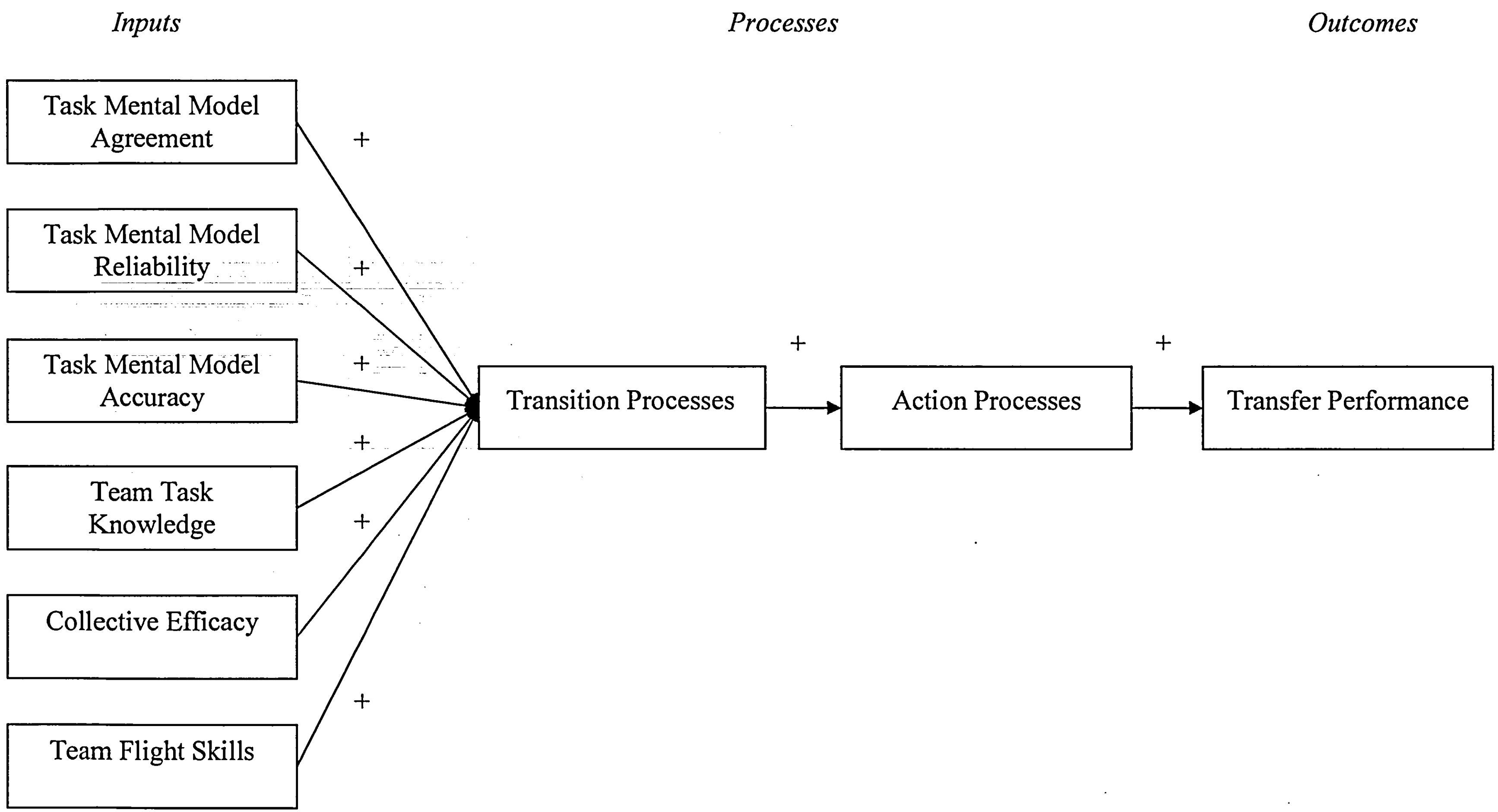
Almost two decades ago, researchers deduced that organizations may be better off with teams as the basic building blocks (Leavitt, 1975). Since then, research has repeatedly found evidence for the value of teams (Cohen & Bailey, 1997; Sundstrom, 1999) and organizations now more than ever rely on their use (Kozlowski & Bell, 2003). This reliance is due in part to changes in contextual factors (e.g., growing technological sophistication), that require tasks to be completed by interdependent teams where members hold specialized roles (Kozlowski, 1998; Mathieu, Heffner, Goodwin, Salas, & Cannon-Bowers, 2000). Teams are working in dynamic and fluid environments that require the generalization and maintenance of their training (Kozlowski, Gully, McHugh, Salas, & Canon-Bowers, 1996; Salas, Bowers, & Edens, 2001).

To adapt to dynamic and fluid environments, team training should facilitate the multidimensional training outcomes (MTOs) reflecting the cognitive, behavioral, and attitudinal/motivational aspects of learning (Kraiger, Ford, & Salas, 1993; Salas et al., 2001). Researchers have demonstrated the theoretical effectiveness of relating MTOs (e.g., knowledge structures, skills, and self-efficacy) and training transfer at the individual level (Ford, Smith, Weissbein, Gully, & Salas, 1998; Ford & Weissbein, 1997; Salas & Canon-Bowers, 2001; Kozlowski, Gully, Brown, Salas, Smith, & Nason, 2001). At the team level, when researchers have linked MTOs (e.g., task mental models, team skills, and collective efficacy) and training transfer, team processes (e.g., coordination) were identified as important mediators (e.g., Marks, 1999; Marks, Zaccaro, & Mathieu, 2000; Mathieu et al., 2000). But despite an extensive literature on team training and team processes, relatively little is known about how temporal factors influence the regulatory processes mediating MTOs and training transfer.

Furthermore, team research has rarely examined more than one aspect of MTOs at a time. Mathieu et al. (2000) and Marks et al. (2000) focused only on shared mental models, whereas Marks (1999) focused only on collective efficacy. Thus, research has failed to address the *unique contribution* of these training outcomes on team processes and transfer performance.

Building on the extant literature, the current research addresses two questions. First, do the relationships among MTOs and training transfer generalize to the team context? Second, are the relationships between MTOs and training transfer mediated through distal (i.e., between-episode) and proximal (i.e., during-episode) team processes? In addressing these questions the current research will examine a comprehensive framework (Figure 1) where training transfer is influenced by proximal team processes (i.e., action processes) which are influenced by more distal team processes (i.e., transition processes) that are influenced by inputs (i.e., MTOs). To date no empirical research has decomposed team processes into distal and proximal processes.

Figure 1. Conceptual model depicting the inputs – outcome relationships mediated through distal and proximal team processes.



CONCEPTUAL FRAMEWORK OF TEAM EFFECTIVENESS

Teams can be defined as "a distinguishable set of two or more people who interact, dynamically, interdependently, and adaptively toward a common and valued goal/objective/mission, who have each been assigned specific roles or functions to perform, and have a limited life-span of membership" (Salas, Dickinson, Converse, & Tannenbaum, 1992, p. 4). While team typologies recognize many diverse types of teams (for team typologies, see Cohen & Bailey, 1997; Sundstrom, 1999) operating in organizations, one type of team particularly relevant to organizations are action teams. Action teams are characterized by Marks et al. (2002) as teams where "expertise, information, and tasks are distributed across specialized individuals, where team effectiveness depends on rapid, complex, and coordinated task behavior, and the ability to dynamically adapt to shifting demands of the situation" (p. 3).

The temporal rhythm of action teams are partially dictated by the various teamwork processes engaged in while working on completing a task in a given episode (Marks et al., 2001). Episodes are distinguishable periods of time over which performance accrues and feedback is given (Mathieu & Button, 1992). Training transfer is particularly challenging for action teams, because of the reliance on specialized skill sets, dependence on teamwork processes, and the tendency to perform in novel and challenging environments (Marks et al., 2002; Sundstrom, 1999). In particular, the novelty and complexity of the environments in which action teams often perform make it difficult to train these teams to effectively anticipate and react to every possible environmental contingency. This means that organizations need to train action teams how to be highly adaptable.

Although the life span of action teams may vary in duration (hours or days), there are many opportunities for interactions to affect performance (Hackman, 1987; Sundstrom, 1999). Thus, it is important to curb the opportunities for "process loss" and possibly turn these into "process gains" (Steiner, 1972). The high interdependence required of action team members places a premium on team processes (e.g., coordination) that facilitate quick and improvised responses (Kozlowski et al., 1996; Marks, Zaccaro, & Mathieu, 2000; Sundstrom, 1999). Role specialization and high interdependence requires the synchronization of collective skill making action teams ideal for examining the complex processes that can unfold over time during transfer of training periods.

Recurring Phase Model

Theoretical models of team effectiveness have predominately adopted the Input-Process-Outcome (I-P-O) framework (e.g., Gist, Locke, & Taylor, 1987; Guzzo & Dickson, 1996; Marks et al., 2001) developed by McGrath (1964) and later refined by Hackman and Morris (1975) and Hackman (1987). This framework considers inputs to be conditions and resources (e.g., member, team, organizational characteristics) that exist prior to the episode (Mathieu et al., 2000). Inputs lead to processes, which are the regulatory mechanisms organized around taskwork that teams engage in to convert inputs to outcomes (Marks et al., 2001). Taskwork pertains to the team's interactions with the requisite equipment and systems (Bowers, Braun, & Morgan, 1997). In other words, taskwork pertains to *what* the team does during a performance episode, whereas teamwork (or team processes) refers to *how* the team regulates its task-related behavior during a performance episode. Outcomes, in a general sense, are the valued by-products of team activity, such as team performance (Mathieu et al., 2000).

I-P-O models have proven useful in predicting team effectiveness (e.g., Campion, Medsker, & Higgs, 1993; Guzzo & Dickson, 1996; Marks, Sabella, Burke, & Zaccaro, 2002; Marks et al., 2000; Mathieu et al., 2000). However, some researchers have criticized the often static perspective many have taken when examining team effectiveness. As McGrath (1993) put it, “the field may have put considerable stock in well-documented ‘findings’ that are statistically significant and robust at a static level, but that are more or less temporally ephemeral” (p. 410). Moreover, Zaheer, Albert, and Zaheer (1999) have called for more research on how temporal events influence organizational processes.

Recently, Marks and her colleagues (2001) have proposed a more dynamic model of team processes, the recurring phase model. The recurring phase model is a derivation of the I-P-O framework that consists of several I-P-O-type cycles running sequentially and simultaneously (Marks et al., 2001). From a recurring phase model perspective, I-P-O models consist of episodes and sub-episodes and team processes “are likely to vary in importance across episodes” (Marks et al., 2001, p. 360). Moreover, these authors argue that certain team processes are more likely to occur prior to an episode, while other processes are more likely to occur during an episode. Below I lay out the conceptual foundation for a model (Figure 1) accounting for the temporal factors that influence the team regulatory processes (i.e., distal and proximal) mediating the linkages between inputs (i.e., MTO) and outcomes (i.e., training transfer).

Model Overview

The research model presented in Figure 1 is highly influenced by the works of Ford et al. (1998) and Kozlowski et al. (2001). Baldwin and Ford (1988) and Kraiger et al. (1993) developed and supported a model of individual level MTOs relating to training transfer. While these individual level models are theoretically powerful, researchers have little understanding of whether these individual level findings generalize to a team context. Moreover, the mechanisms by which MTOs relate to training transfer are not explained. In addressing this gap, the current model integrates individual and team level research to support a comprehensive model where team regulatory processes serve as the mediating mechanisms (i.e., distal and proximal) between the MTOs and training transfer relationship.

In the current model, MTOs (i.e., task mental models, team task knowledge, team skills, and collective efficacy) are expected to influence distal team processes (i.e., transition processes), which in turn lead to team processes that are more proximal (i.e., action processes) to desired training outcomes (i.e., training transfer). Transition processes are centered on "evaluation and/or planning" to execute an objective. Action processes typically occur after transition processes and involve coordinated team behaviors that contribute directly to goal attainment (Marks et al., 2001). In other words, team regulatory processes centered on evaluation and/or planning are expected to effectively channel team inputs to later team processes that more directly contribute to effective team training transfer. The constructs in Figure 1 are defined below beginning with the most distal in relation to training transfer.

Inputs

Training outcomes are considered important inputs that lead into team processes (i.e., both distal and proximal) and outcomes (i.e., transfer; Marks et al., 2001). Extending the more behaviorist-oriented work of Kirkpatrick (1976, 1987), Baldwin and Ford (1988) identified training outcomes as "the amount of original learning that occurs during the training program and the retention of that material after the program is completed" (p. 64). Kraiger and colleagues (1993) taxonomic work reorganized training outcomes to include the cognitive, behavioral, and attitudinal/motivational outcomes of training (i.e., MTOs). Below these MTOs are demarcated in the contexts of action teams.

Cognitive Outcomes. In addition to the amount and type of knowledge stored, Kraiger and his colleagues (1993) stressed that mental models are equally, or of greater importance. Mental models describe how people organize their knowledge to describe, explain, and predict future system states (Rouse & Morris, 1986). At the team level, researchers have used the notion of shared mental models to explain how teams can adapt to shifting task conditions (Cannon-Bowers, Salas, & Converse, 1990; Hinsz, Tindale, & Vollrath, 1997; Kraiger & Wenzel, 1997; Klimoski & Mohammed, 1994; Stout, Cannon-Bowers, & Salas, 1996). Shared mental models are the "organized understanding or mental representation of knowledge that is shared by team members" (Mohammed, Klimoski, and Rentsch, 2000, p. 123). Effective teams possess shared mental models allowing them to identify when and how to use the appropriate behaviors for promoting effective team performance (Cannon-Bowers, Salas, & Converse, 1993).

As with mental models, its individual level counterpart (see Rouse & Morris, 1986), the premise of shared mental model theory is that shared mental models assist the team in describing, explaining, and predicting future outcomes (Klimoski & Mohammed, 1994). Shared mental models allow teams to create an organized set of expectations to make accurate and timely predictions in terms of task and team demands (Cannon-Bowers et al., 1990). These predictions facilitate coordination, adaptability, and the anticipation of other team member behaviors that are often necessary in dynamic environments (Cannon-Bowers et al., 1990).

While multiple shared mental models (e.g., task, equipment, and team interaction) may operate within a team at a given time, researchers have identified two major content domains– task and team mental models (Klimoski & Mohammed, 1994; Mathieu et al., 2000). Task mental models describe, explain, and predict the procedures, task strategies, and contingencies necessary for effective task accomplishment in a given environment (Mathieu et al., 2000). Team mental models contain shared knowledge about team interactions as well as team-specific knowledge of teammates (Mathieu et al., 2000).

While acknowledging the importance of team mental models, research suggests a premium should be placed on first establishing task mental models before developing team mental models (Mathieu, 2002). Other researchers have also emphasized the importance on task mental models because in dynamic environments that require adaptability and improvised responses, team performance becomes increasingly dependent on task mental models (Cannon-Bowers et al., 1990; Mathieu et al., 2000). Research indicates that task mental models influence team performance through team processes (e.g., Mathieu et al., 2000). Specifically, there is evidence that team processes mediate the task mental model – team performance relationship (Mathieu et al., 2000).

Although existing research has not specifically tested for the influence of shared mental models on transition processes per se, theoretically task mental models represent a cognitive outcome of training likely to influence transition processes. Task mental models increase the capability individuals have at describing, explaining, and predicting information relevant to both the task and the team. In return, this shared knowledge is likely to facilitate the team regulatory processes centered on planning and evaluation (i.e., transition processes) that occur during the transition phase.

However, Webber et al. (2000) argued and found that different operationalizations of shared mental models (e.g., agreement, reliability, and accuracy) may capture different phenomena. Consequently, task mental models may exhibit differential prediction patterns, depending on how task mental models are operationalized. Consistent with Webber et al. (2000) findings, Mathieu (2002) also found the prediction pattern depended on the operationalization of the relevant shared mental model. Specifically, Mathieu (2002) found that an agreement index based on the variance of responses across members within a team exhibited a negative relationship with the criteria (i.e., efficiency and safety), while a reliability-based index exhibited a positive relationship with the criteria. While this research suggests a differential pattern of relationships may be found, the empirical work is too scant to offer any precise hypotheses regarding exactly the pattern of relationships that will be found.

Behavioral Outcomes. At the individual level, theories of skill acquisition generally identify, though varying in terminology, three definable phases of skill acquisition: declarative knowledge, knowledge compilation, and procedural knowledge (Anderson, 1982; R. Kanfer & Ackerman, 1989; Kraiger et al., 1993). Declarative knowledge is “knowledge about facts and things” (Anderson, 1985, p. 199). In this initial phase, trainees performance tends to be slow and error prone (R. Kanfer & Ackerman,

1989) because of the substantial attentional resources that are necessary to keep facts available for interpretative procedures (Anderson, 1982).

During the compilation phase, trainee performance tends to be faster and less error prone because sequential steps of routines are collapsed into a single routine (composition) producing the effect of the entire sequence and the need for the trainee to retrieve domain-specific declarative knowledge is no longer required (proceduralization; Anderson, 1982). The last phase, the autonomous phase, is "one of gradual continued improvement in the performance of the skill" (Anderson, 1982, p. 369). A definable characteristic may be that there is a shift from controlled to automatic processing. Controlled and automatic processes may be best thought of as operating along a continuum, where automatic processes are considered to: (a) occur outside awareness, (b) require no, or few, attentional resources, (c) occur without intention and (d) are uncontrollable once triggered (Shiffrin & Schneider, 1977). Once behaviors are automatized demands for cognitive resources may not result in performance decrements (Ackerman, 1987).

At the team level, team members are required to perform their roles vis-à-vis other team members. Workflow interdependence among team members helps dictate how individual skills compile to create team skills (Kozlowski, Gully, Nason, & Smith, 1999). In this sense, team skills can be considered to be the ability of the team as a whole to execute interdependent actions. In particular, the skills of action teams are more than an aggregate of individual level skills to a higher level of analysis. Since team skills are the complex interdependent linkages of individual skills (which are dictated by task requirements) this makes team skills better reflected as a global unit property (Kozlowski et al., 1999). Global unit properties are "observable, descriptive characteristics of a unit" that originate and manifest themselves at the unit level (Kozlowski & Klein, 2000, p. 33).

Teams who possess the requisite skills are more effective in transition processes, such as strategy formulation (Marks et al., 2002; Marks et al., 2000; Mathieu et al., 2000). More specifically, strategy formulation in highly skilled teams takes into account members' expertise and how task-related activities should be executed (Marks et al., 2001). Teams that do not possess the requisite skills are likely to engage in poor strategy formulation, or no strategy formulation at all, making it difficult to adjust to complex and novel tasks (Marks et al., 2001). Previous performance of highly skilled teams may provide the necessary experiences that facilitate other transition processes, such as effective planning (Bandura, 1997; Wood & Bandura, 1989). In short, highly skilled teams are likely to be more capable of engaging in effective transition processes (e.g., strategy formulation and planning) because they are more capable of integrating their complex interdependent linkages in a concerted manner.

Attitudinal/Motivational Outcomes. Acknowledging the importance of attitudinal/motivational outcomes of training, Kraiger and his colleagues (1993) suggest researchers should include self-efficacy in post-training measures. Not surprisingly, organizational researchers have paid more and more attention to the concept of self-efficacy (Chen & Bliese, 2002). Self-efficacy is the "belief in one's capabilities to organize and execute the courses of action required to produce given attainments" (Bandura, 1997, p. 3).

A team level analogue of self-efficacy is collective efficacy (Bandura, 1997; Chen & Bliese, 2002; Lindsley, Brass, & Thomas, 1995). Collective efficacy is "a sense of collective competence shared among individuals when allocating, coordinating, and integrating their resources in a successful concentrated response to specific situational demands" (Zaccaro, Blair, Peterson, and Zazanis, 1995, p. 309). Bandura (1997) asserts collective efficacy drives regulatory components (e.g., motivational and persistence in the face of failure) that facilitate performance. That is, more efficacious teams are more likely to mobilize their resources towards task success. In the current context, efficacious teams are likely to initiate and persist in the execution of their knowledge and skills during transfer periods (Ford et al., 1998; Kozlowski et al., 2001). Consistent with this notion, other researchers have used collective efficacy as a means to understand how teams regulate their behavior (Marks, 1999). In fact, collective efficacy has been found to positively predict group motivation (Prussia & Kinicki, 1996). Moreover, meta-analytic work has demonstrated the importance of collective efficacy as a predictor of team effectiveness in a variety of samples, tasks, and settings (Gully, Incalcaterra, Joshi, & Beaubien, 2002).

Interestingly, evidence suggests collective efficacy is positively related to lower-order action processes (e.g., coordination) in routine environments and negatively related to lower-order action processes in novel environments (Marks, 1999). However, the findings in novel environments emerged when examining collective efficacy and team processes following training. This potentially confounds whether the findings are due to the complexity and novelty of the task environment or due to what happens to collective efficacy during later transfer periods, after participants realize the task keeps getting more and more complex.

While it is unclear whether collective efficacy is negatively related to lower-order action processes in novel environments, other research suggests collective efficacy is positively associated with lower-order transition processes, such as: planning, goal specification, and strategy formulation (Mesch, Farh, & Podsakoff, 1994; Weldon & Weingart, 1993; Zaccaro, Blair, Peterson, & Gilbert, 1992; Zaccaro et al., 1995). A recurring theme in the literature is that efficacy beliefs positively impact subsequent regulatory processes that catalyze increasing levels of performance (e.g., Kozlowski et al., 2001). For example, collective efficacy is believed to enhance the expectancy of meeting a team goal which further mobilizes and directs attention towards successful task accomplishment (Weldon & Weingart, 1993). Some team regulatory processes believed to be positively associated with collective efficacy are planning, setting and adhering to difficult team goals, and effective strategy formulation (Mesch et al., 1994; Weldon & Weingart, 1993; Zaccaro et al., 1995).

Processes

In a general sense, processes are the regulatory mechanisms that teams engage in to "convert inputs to outcomes through cognitive, verbal, and behavioral activities directed toward organizing taskwork to achieve collective goals" (Marks et al., 2001, p. 357). This notion is analogous to its individual level counterpart of self-regulation. Self-regulation refers to the "intrapersonal processes by which an individual exercises control over the direction, persistence, and intensity of thinking, affect, and behavior for the purpose of goal attainment" (R. Kanfer & F. H. Kanfer, 1991, p. 291). In short, team and self regulation can be conceptualized as a collection of processes. Broadly, team regulation is composed of transition and action processes, whereas self-regulation comprises: self-monitoring, self-evaluations, and self-reactions.

In taking an episodic approach, there are two distinct phases during which team processes unfold: transition and action phases (Marks et al., 2001). Transition phases are characterized by times where team processes are focused on "evaluation and/or planning" to execute an objective (i.e., transition processes, Marks et al., 2001, p. 360). Whereas, action phases are periods of time when team processes are focused on engaging in acts that contribute directly to goal accomplishment (i.e., taskwork)" and can be considered more proximal in their relationship with training transfer (Marks et al., 2001, p. 360). Not only do transition and action processes differ on the basis of time, but they also differ in regard to the several lower-order dimensions that compose these higher-order domains (discussed below; Marks et al., 2001; Smith, 2000). Given lower-order processes compile to form the broader domains of transition and action processes are highly related and occur more frequently during their respective phases (i.e., transition and action phases) it is warranted for both transition and action processes to be examined as a collection of processes, which are specified below.

Transition Phases. Transition processes involve mission analysis, goal specification, and strategy formulation and planning, which are critical during the transition phase for successful team performance. *Mission analysis* pertains to the teams' "interpretation and evaluation of the team's mission, including identification of its main tasks as well as the operative environmental conditions and team resources available for mission execution" (Marks et al., 2001, p. 365). The verbal communication that occurs during mission analysis is necessary to create a unified objective for the team. Two key features involved in mission analysis are backward and forward evaluations (Marks et al., 2001).

Backward evaluations involve the reflection of past performance to evaluate the causes of success or failure. Teams that assess the causal linkages between past performances are more capable in preparing for future events (Blickensderfer, Cannon-Bowers, & Salas, 1997). Forward evaluations involve the team's interpretations of its goals for the future in respect to the context of current events. Teams that abbreviate or omit the forward evaluation phase run the risk of not effectively allocating their efforts until it is too late (Gersick, 1988).

The second lower-order dimension of transition processes involves *goal specification*. Goal specification requires the identification and prioritization of the team's goals and sub-goals (Marks et al., 2001). Effective goals (e.g., precise, challenging, attainable) can lead to successful team performance, while ineffective goals (e.g., ambiguous, conflicting, unattainable) can be detrimental to a team's performance (Marks et al., 2001). Teams that omit the goal specification stage completely are likely to have no shared understanding of the team's purpose, resulting in an ineffective strategy (Marks et al., 2001).

The last lower-order dimension, *strategy formulation and planning*, refers to "the development of alternative courses of action for mission accomplishment" (Marks et al., 2001, p. 365). There are two sub-dimensions of strategy formulation and planning relevant during transition phases, deliberate planning and contingency planning. Deliberate planning involves formulating and transmitting a principal course of action for team goal attainment (Marks et al., 2001), whereas contingency planning involves creating backup plans to assist in managing the potential unfolding of events in dynamic environments. Pre-episode strategy formulation and planning can enhance team performance (Stout, Cannon-Bowers, Salas, & Milanovich, 1999). For example, Orasanu (1990) found that teams engaging in more planning activities demonstrated greater performance than teams who engaged in less planning activities.

Transition processes provide the backdrop for facilitating the development of strategies to achieve future performance goals and feed into processes that directly contribute to taskwork. In short, effective planning and strategy formulation in the transition (i.e., pre-episode) phase are likely to facilitate effective team processes that lead to better coordination and accomplishment in the action (i.e., during-episode) phase.

Action Phases. While transitions processes are most salient *prior to or after* episodes, an entirely different set of processes are likely to occur *during* the episode (i.e., action processes). During action phases teams engage in acts that contribute directly to taskwork, which is temporally more proximal in relationship with training transfer (Marks et al., 2001, p. 360). Teamwork processes during action phases are dominated by action processes, which are composed of several lower-order processes centered on activities that lead directly to goal accomplishment, such as: (a) monitoring progress toward goals, (b) systems monitoring, (c) team monitoring and backup behaviors, and (d) coordination activities.

Monitoring progress toward goals is defined as "tracking task and progress toward mission accomplishment, interpreting systems information in terms of what needs to be accomplished for goal attainment, and transmitting progress to team members" (Marks et al., 2001, p. 366). When teams monitor progress towards goals they are engaging in regulatory processes that are advantageous for successful performance. Many times these assessments of discrepancies between the current state and goal attainment happen in real-time (Austin & Vancouver, 1996). Monitoring progress towards goals also requires that team members transmit information regarding the current state and goal attainment discrepancy to other team members. If relevant information is provided among team members, there is likely to be increased effectiveness (Gaddy & Watchel, 1992).

Systems monitoring refers to "tracking team resources and environmental conditions as they relate to mission accomplishment; it involves (1) internal systems monitoring, tracking team resources such as personnel, equipment, and other information that is generated or contained within the team and (2) environmental monitoring, tracking the environmental conditions relevant to the team" (Marks et al., 2001, p. 367). To be effective teams need to monitor the critical internal (e.g., available resources) and external (e.g., conditions requiring resources) information as it relates to goal attainment. Systems monitoring is especially important in dynamic environments where critical internal and external information are likely to change rapidly.

Team monitoring and backup occurs when a team member provides another teammate with either verbal assistance, behavioral assistance, or actually completes a teammate's task (Marks et al., 2002). Team monitoring and backup involves the provision and solicitation of task-related support when necessary. Increases in team monitoring are expected to motivate team members to engage in backup behaviors when appropriate (McIntyre & Salas, 1995). Without team monitoring and backup, the team is likely to fail with the failure of any one if its member's (Marks et al., 2001).

Coordination activities are the "process of orchestrating the sequence and timing of interdependent actions" (Marks et al., 2001, pp. 367-368). Coordination activities involve how and when synchronization of team members can simultaneously influence the actions of other team members (Smith-Jentsch, Johnston, & Payne, 1998). Effective coordination results in distributing task-related information directly and proficiently (Smith-Jentsch et al., 1998). Moreover, effective coordination allows for exceedingly smooth transitions when adjusting to complex and dynamic environments (Entin & Serfaty, 1999; Salas et al., 1992; Serfaty, Entin, & Johnston, 1998).

The compilation of these four lower-order processes forms the broader domain of action processes, which are believed to be more proximal in their relationship with training transfer than the more distal transition processes. Action processes occur more frequently during action phases (i.e., during-episode) and are those processes organized around taskwork that contribute directly to goal attainment. Through the regulatory mechanisms of both distal (i.e., transition processes) and proximal processes (i.e., action processes), inputs (e.g., MTOs) are believed to be linked to desirable outcomes, such as training transfer.

Transfer

Baldwin and Ford (1988) defined transfer "as the degree to which trainees effectively apply knowledge, skills, and attitudes gained in a training context" (p. 63). Although, researchers vary in their conceptualization of the underlying dimensions of transfer (see Barnett & Ceci, 2002, for review and conceptualization), the Baldwin and Ford definition serves as the modus operandi for organizational researchers studying transfer to the job (Ford & Weissbein, 1997). According to this definition, transfer is composed of two components, namely generalization and maintenance of trained skills (Baldwin & Ford, 1988; Ford & Weissbein, 1997). In referring to generalization, Baldwin & Ford (1988) stated that it was the "extent to which trained skills and behaviors are exhibited in the transfer setting" (p. 95). Maintenance refers to the period of time for which the trained skills and behaviors exist (Baldwin & Ford, 1988).

The degree of transfer is also a salient concern for transfer researchers (Ford and Weissbein, 1997). Barnett and Ceci (2002) provide a framework that suggest the content (i.e., what is transferred) and the context (i.e., when and where it is transferred from and to) are indicative of the degree of transfer. The content of transfer is expected to reflect the skills learned, the performance change, and the memory demands. The context of transfer pertains to the physical context, temporal context, functional context, social context, and modality.

Although there is variability in the degree of transfer (i.e., near or far), existing empirical work (as discussed above) at the individual level has found MTOs to relate to training transfer. Specifically, Ford et al. (1993) and Kozlowski et al. (2001) studied how individual differences, learning strategies, and training outcomes influenced transfer of learning. Relevant key findings from this research are threefold. First, the importance of MTOs (i.e., declarative knowledge, knowledge structure coherence, skills, and self-efficacy) as unique predictors of training transfer was demonstrated. Second, affective and motivational training outcomes (e.g., self-efficacy) appear to be important indicators of training transfer because they may facilitate resiliency in the face of greater task complexity. Last, regulatory strategies, such as metacognition, appeared to allow individuals to help identify problem situations and adapt to the new environment. In short, not only are MTOs important, but engaging in effective regulatory processes are important for effective team training transfer.

Further emphasizing the importance of effective regulation, team level research (e.g., Marks, 1999; Marks et al., 2000; Mathieu et al., 2000) also suggests that effective team regulation is an important mediator of the relationship between MTO and training transfer. Unfortunately, past research has not tested a theoretical model examining the dynamic nature of team regulation as a function of the temporal rhythm of the team. Thus the current model addresses this concern and expands on exisiting literature by testing a model that links MTOs and training transfer through both distal (i.e., transition) and proximal (i.e., action processes) team process.

RESEARCH MODEL AND HYPOTHESES

Model Overview

Figure 1 depicts a model in which MTOs serve as the inputs that feed into transition processes. Transition processes then lead to action processes which lead to transfer performance. It is important to note that transition processes and action processes are captured during two different phases, transition and action respectively. Importantly, the current study begins to address researchers demands for more dynamic models of team processes (Marks et al., 2001; McGrath, 1993; Zaheer et al., 1999). In testing this model, the following hypotheses are generated:

Hypothesis 1: MTOs (i.e., task mental models, team task knowledge, team skills, and collective efficacy) uniquely and positively influence transition processes.

Hypothesis 2: Transition processes mediate the positive influences of MTOs on action processes.

Hypothesis 3: Action processes positively influence team transfer performance.

Hypothesis 4: Action processes mediate the positive influences of transition processes on team transfer performance.

METHOD

Participants

Forming 80 two-member teams, a sample of 160 Georgia Institute of Technology undergraduate students were recruited through an undergraduate subject pool. Participants received 5 extra course credits in exchange for participation. As an incentive, each member of the best performing team received a $50 gift certificate, each member of the second best performing team received a $25 gift certificate, and each member of the third best performing team received a $15 gift certificate.

Two teams had incomplete data due to computer difficulties ($n = 1$) or failure to follow the study protocol ($n = 1$). Data from these teams were assumed to be missing at random and excluded from all analyses. The gender distribution of the sample approximated the gender distribution of the university, 26.9% female and 73.1% male. Likewise, the mean participant age approximated that of typical university students ($M = 20$, SD = 1.57).

Task Apparatus

The present research involved a low-fidelity computer simulation of a Longbow Apache helicopter. Past research has recognized that low fidelity networked simulators provide a platform suitable for empirically examining team-level phenomena (e.g., Weaver, Bowers, Salas, & Cannon-Bowers, 1995; Brannick, Roach, & Salas, 1993; Stout et al., 1999). Some advantages of using a computer simulation as a platform is that it allows one to script scenarios that set the parameters or boundary conditions for the phenomena of interests (Marks, 2000). Another advantage is low-fidelity computer simulators tend to be more engaging and the researcher has the flexibility to create complex and highly interactive task environments with similar principles to those encountered by many of today's work teams (Marks, 2000). The primary disadvantage is the increased cost and complexity of setting up such a simulation (Marks, 2000). Given that the current research seeks to model team processes unfolding over time in complex and novel transfer environments, the benefits appear to far outweigh the cost.

The software employed was a computer-generated low-fidelity Longbow Apache helicopter simulator, namely LongBow2 (1997). LongBow2 was designed for use with one two-person team consisting of a pilot and gunner. Each member in the team maintains a specialized role (i.e., there is no overlap between the roles) in which they work highly interpedently with one another (Tesluk, Mathieu, Zaccaro, & Marks, 1997). The pilot was primarily responsible for nine roles: (a) maintaining optimal flight altitude, (b) following the waypoint path, (c) crossing over waypoints, (d) maintaining optimal airspeed, (e) using the chain gun (f) monitoring time to next waypoint, (g) monitoring distance to next waypoint, (h) extinguishing engine fires when necessary, and (i) lining up the I-Beam with cross-hairs. The gunner was primarily responsible for eight roles: (a) identifying and differentiating targets, (b) selecting weapons appropriately, (c) monitoring weapons status, (d) prioritizing targets appropriately, (e) monitoring helicopter's systems, (f) informing pilot of aircraft systems' status, (g) using rockets, and (h) using missiles. For more specific task responsibilities identified via the BTA/CTA refer to Appendix A.

In general, the team is tasked with flying to successive waypoints and eliminating primary and secondary enemy targets as outlined in the mission briefing. In conjunction with special mission scripting software, Missioneer Plus (1998), this simulation is extremely versatile. For example, one can control the: (a) mission objectives, (b) location of waypoints, (c) terrain, (d) weather, (e) number of weapons, (f) flight paths and objectives of other friendly vehicles, and (e) number, type, skill-level, and formation of enemies.

Participants were randomly assigned to either the pilot or gunner terminal. Terminals consist of a: (a) personal computer, (b) monitor, (c) microphone-equipped headphones, and (d) joystick. The personal computers are networked and audio and video recordings are available of the sound and images displayed on the teams' monitors (see Appendix B and Appendix C for sample image).

Procedure

This study is a part of a larger study conducted in one 5 hour session. Upon arriving to the study, participants were provided with information about the purpose of the study and were asked to complete an informed consent form. Upon consent, participants completed the following tasks in order: (1) premeasure assessment, (2) task training, (3) assessment of training evaluation, (4) transition phase, and (5) transfer mission. Phases three through five were repeated two additional times for the purpose of the larger study. However, in the context of the current research, data were collected once from all five phases.

Premeasure assessment. After consent, participants spent approximately 45 minutes completing a battery of several individual difference measures (e.g., general mental ability and experiences) that an extensive cognitive and behavioral task analysis (CTA/BTA; Orvis, Zaccaro, Cho, Smith, & Mathieu, 2000) suggests are likely to predict performance in this type of setting. These individual difference variables were used to examine if they correlated with any of the substantive study variables.

Task training. After completing the measures, the participants joined as a team to begin approximately 1.5 hours of task training. Task training began with a 15-minute introduction video designed to facilitate the learning process. This video was developed using Microsoft PowerPoint (XP) software and was displayed to the participants on a 32" color television monitor.

After the introductory video, participants received approximately 1 hour of scripted task training using various training missions standardized across teams. Following the guidance of Cannon-Bowers, Tannenbaum, Salas, and Volpe (1995), task training was largely hands-on training emphasizing the competencies necessary for successful task performance. This hands-on training was supplemented with instructional cards. In short, training was carried out emphasizing training role members on their responsibilities while becoming familiar with their team member's responsibilities (see Appendix A). For example, the pilot was trained on maintaining optimal flight altitude while the gunner was familiarized on being aware of the optimal flight altitude.

Experimenters, who were also subject matter experts (SMEs), followed a checklist and used coaching to ensure that all team members reached a minimal level of competency. As in past research (e.g., Orvis et al., 2000), to achieve status of a SME, one had to fly the simulation for at least 30 hours and successfully complete a 15-minute complex and challenging mission three consecutive times. This mission was the same as the team members' transfer mission discussed below. The various minimum levels of competency assessed by the checklist are based on an extensive CTA/BTA as well as extensive pilot testing. The checklist was standardized such that no participant continued to the next phase of training without first reaching some minimal level of competency of the previous phase.

After ensuring a minimal level of role-specific competencies, participants began team training. Following a similar procedure to the role-specific training, team training involved experimenters using standardized checklists based on an extensive CTA/BTA as well as extensive pilot testing. No team was able to proceed to the next phase of training without first reaching a minimal level of task competencies. The team training concluded after the team flew an 8-minute team practice mission.

Training evaluation assessment. Following training, participants spent approximately 30 minutes completing a task mental model grid, collective efficacy measure, and a role-specific knowledge test. Team skills were assessed using the team's performance on the final practice mission. Together the last training performance mission and the training evaluation measures capture cognitive, behavioral, and attitudinal/motivational aspects of learning (Kraiger et al., 1993).

Transition phase. In total, the transition phase could last for up to 10-minutes. First intelligence reports and a map of the upcoming mission were provided to each participant. To ensure team members communicated with one another about the upcoming mission each intelligence report had unique and equally relevant information. That is, each team member's intelligence report had non-overlapping information with their partner's intelligence report. The map allowed the participants to view the flight path and terrain of the upcoming mission, but no information was provided about the location of enemy and friendly targets. The intelligence report outlined the time constraints, primary and secondary objectives, armament type and amount, and approximate location of friendly, primary, and secondary objectives. Team members were encouraged to write and discuss the map and intelligence report with each other.

Then teams were asked to plan for an upcoming mission for 10-minutes. During this time SMEs in real-time rated the team on how successfully they effectively demonstrated the three types of transition processes (i.e., mission analysis, goal specification, and strategy formulation and planning). After participants completed the transition phase, participants completed a self-report measure of the extent to which the team engaged in the transition processes.

Transfer mission. In the fifth phase the team flew a 10-minute transfer mission during which action processes were captured (again, using SMEs real-time ratings). Consistent with past research (e.g., Kozlowski et al., 2001; Marks, 1999), the transfer mission required teams to be highly adaptive to adjust to the novel and more complex transfer mission. In particular, the transfer mission was longer in flight duration, the environment was more difficult to navigate in (e.g., mountainous), and the enemies were more skilled and in greater numbers.

Measures

Team composition. Four variables were used to assess team composition: familiarity with flight partner, general gaming experience, flight simulation experience, and team general mental ability. Familiarity with flight partner was assessed using one question that asked participants: "How well do you know the other participant in this study?". Response options to this question ranged from 1 (*We have never met prior to today*) to 4 (*We are good friends*). Two types of experiences were assessed: general gaming and flight simulation experience. General gaming experience captured more general types of vido/arcade gaming experience and flight simulation experience captured experience with flight simulators. Team general mental ability was assessed by aggregating individual scores of the Wonderlic Personnel Test to the team level.

Knowledge test. The respective role-member's knowledge was assessed using a 10-item knowledge test developed by the SMEs. Three types of knowledge were assessed: declarative, procedural, and strategic knowledge. Declarative knowledge questions required the participant to possess information about the required attributes of their role. For example, "Using the image below, what can you conclude about your weapons status?". Procedural knowledge questions required the participant to possess information about how the participant was to perform a given action. For example, "To determine whether a target is friendly, secondary, or a primary objective, you should refer to your:". Last, strategic knowledge questions required the participant to possess information about, for example, which action should be performed "When approaching a group of enemy targets and you see the following: two stationary primary tanks, one moving primary tank, and a primary enemy tent, the best strategy would be to:". See Appendixes D and E for complete measures.

Shared mental models. Team task mental models were assessed using individual team members' reflecting various critical task-related attributes. SMEs consulting a comprehensive CTA/BTA (cf., Marks et al., 2002; Orvis et al., 2000; Tesluk et al., 1997) identified six critical task-related attributes. These are: (a) following waypoints, (b) identifying and differentiating enemy targets, (c) positioning the helicopter for targeting, (d) adjusting airspeed, (e) firing weapons, and (f) selecting targets. Importantly, these six critical task-related attributes are distinguishable yet related. For example, positioning the helicopter for targeting and adjusting the airspeed are more closely related than positioning the helicopter for targeting and following waypoints.

Each team member was presented with one matrix reflecting the task mental model (see Appendix F). The six identified critical task-related attributes are located along the top and side of the matrix. Definitions of the critical task-related attributes are listed directly next to the respective attribute. Team members' are asked to rate the degree of relatedness amongst the critical task-related attributes using a 9-point scale ranging from 1 (not related) to 9 (very related). These ratings are completed at the end of the 8-minute practice mission.

The task mental model matrix was used to assess three different operationlaizations of task mental models: agreement, reliability, and accuracy. Task mental model agreement was based on the extent to which team members provided the same rating for a given cell. Task mental model reliability was based on the extent to which team members provided consistent responses across cells. Task mental model accuracy was based on the extent to which team members' provided ratings similar to a group of SMEs ratings.

Team skills. The operationalization of team skills is consistent with past research (e.g., Ford et al., 1998; Kozlowski et al., 2001) — the team's performance on the final team practice mission. Practice missions were scripted and standardized across teams. Teams had three objectives for each mission: (a) survive (30 points); (b) eliminate eight pre-designated assigned targets while avoiding neutral and friendly targets (worth 20 points each); and (3) eliminate seven pre-designated bonus targets per mission (worth 10 points each). At the end of the mission Longbow2 (1997) displays a scoreboard with a mission summary, from which, SMEs recorded team point totals.

Team performance was equal to the total number of points the team accumulated during the mission based on the: helicopter status, number of assigned primary targets eliminated, and number of assigned secondary target eliminated. If the helicopter status was undamaged (i.e., no damage to the systems of the helicopter) the team was awarded 30 points. If the helicopter status was damaged (i.e., damage to one or more systems of the helicopter) the team was awarded 20 points. If the helicopter was destroyed, no points were awarded to the team. Each assigned primary target eliminated was worth 20 points and each assigned secondary target eliminated was worth 10 points.

Collective efficacy. Collective efficacy was assessed using individual team member's response to a 6-item measure (the same six critical task-attributes identified for the task mental model measure) capturing the team's confidence in their ability to execute critical team tasks (see Appendix G). Specifically, team members were asked to rate "how confident YOUR TEAM is in its ability to successfully and consistently accomplish each of the following team tasks", with response options ranging from 1 (not at all confident) to 5 (extremely confident). The team members' collective efficacy scale score was aggregated (i.e., averaged) to the team level of analysis.

Team processes. A self-report measure of transition and action processes (see Appendix H) was developed. Based on the taxonomy of team processes developed by Marks and her colleagues (2001), a panel of SMEs verified that the items of the self-report measure of transition and action processes were representative of the content domain. The following transition processes, were measured during the transition phase (i.e., pre-transfer mission): mission analysis, goal specification, and strategy formulation and planning. The following action processes were measured during the action phase (i.e., during-transfer mission): monitoring progress toward goals, systems monitoring, team monitoring and backup behavior, and coordination activities. Each of the three transition processes and four action processes were assumed to be of equal relevance, thus were equally weighted. SMEs were provided with a clear definition of the content domain of each of the transition and action processes and asked to match the item to the respective team process content domain. The team members' self-report transition and action processes scale scores were aggregated (i.e., averaged) to the team level of analysis.

In addition to self-report measures of team processes SMEs also provided ratings of team processes. SMEs assessment of team processes were based on the recommendations made by Dickson and McIntyre (1997) and Brannick and Prince (1997). Specifically, after extensive training on the definitions and descriptions of each of the three transition processes and four action processes dimensions, a SME provided real-time ratings of team process data using behaviorally anchored ratings scales (BARS). The BARS scale used in the current study is based on a measure of the relevant team processes used in similar studies that have used computer simulations for team research (e.g., Smith, 2000). Using the BARS, a SME rated the team on a 5-point scale ranging from 1 (hardly any skill) to 5 (complete skill) for each of the seven lower-order team process dimension (for example, see Appendix I). Multiple observers (i.e., three SMEs) met periodically to help maintain adequate levels of reliability and agreement.

Transfer. The transfer mission was longer in duration (i.e., 15 minutes) and required teams to be highly adaptive to adjust to the novel (i.e., different terrain) and more complex (i.e., greater number of enemy targets) environment. Transfer was assessed, similar to team skills, by using the following weighted objective data: survive (30 points), eliminate 12 pre-designated primary targets (worth 20 points), and eliminate 10 pre-designated secondary targets (worth 10 points each). Again, SMEs recorded team point totals by referring to the scoreboard provided at the end of the mission.

Team transfer performance was equal to the total number of points the team accumulated during the transfer mission based on the: helicopter status and the number of primary and secondary targets eliminated. If the helicopter status was undamaged (i.e., no damage to the systems of the helicopter) the team was awarded 30 points. If the helicopter status was damaged (i.e., damage to one or more systems of the helicopter) the team was awarded 20 points. If the helicopter was destroyed, no points were awarded to the team. Each assigned primary target eliminated was worth 20 points and each assigned secondary target eliminated was worth 10 points. The transfer mission was fifty percent longer in flight duration, the environment was more difficult to navigate in (e.g., mountainous), and the enemies were more skilled and in greater numbers (i.e., 20 percent more enemies).

Multitrait-Multimethod Matrix

Campbell and Fiske (1959) suggested the use of four criteria when evaluating construct validity using the mulitrait-multimethod matrix. First, homotrait-heteromethod correlations should be statistically significant to demonstrate convergent validity. Second, convergent validities should be greater than the correlations between heterotraitsheteromethods. Third, convergent validities should be greater than heterotraits-monomethod. Fourth, the pattern of hetereotraits-monomethod should be similar for each method. Table 1 reveals that of the four criteria Campbell and Fiske (1959) suggested, only the third criteria was not met.

Table 1. *Multi-Method Multi-Trait Matrix*

	Method 1		Method 2	
	Trait A	B	A	B
1. SME BARS Ratings of Team Processes				
A. Transition Processes	—			
B. Action Processes	.508***	—		
2. Self-Report Ratings of Team Processes				
A. Transition Processes	<u>.394</u>***	.443***	(.783)***	
B. Action Processes	.208	<u>.525</u>***	.594***	(.871)***

*** $p \leq .001$.

Note. Analyses were conducted at the team-level: $N = 78$. Reliability coefficients are in parentheses and convergent validity coefficients are underlined.

Aggregation Analysis

Collective efficacy, SME rating of transition and action processes, and self-report ratings of transition and action processes represent shared team-level constructs, thus it is important to demonstrate sufficient agreement and reliability with these variables (Bliese, 2000). Agreement (i.e., consensus) refers to the "degree to which ratings from individuals are interchangeable; that is, agreement reflects the degree to which raters provide essentially the same ratings" (Bliese, 2000, p. 351). Within-group agreement can be evaluated using the $r_{wg(j)}$ statistic assuming a rectangular response distribution (Bliese, 2000).

In addition to establishing within-group agreement, reliability (i.e., consistency) also needs to be assessed. Reliability refers to the "relative consistency of responses among raters" (Bliese, 2000, p. 354). Reliability is typically assessed by the intraclass correlation coefficients: ICC(1) and ICC(2). Where, ICC(1) represents the proportion of variance due to group membership. Large ICC(1) values indicate a single rating from an individual is likely to provide a relatively reliable rating of the group mean. However, when ICC(1) values are small, multiple ratings of the group mean are necessary to provide reliable estimates of the group mean. The ICC(2) provides an estimate of the reliability of group means (Bliese, 2000). A significant F-value from a one-way random effects ANOVA suggests average responses differ significantly by teams (Bliese, 2000). As depicted in Table 2 sufficient agreement and reliability values are obtained for collective efficacy, self-report ratings of transition and action processes, and SME BARS ratings of action processes. That is, only ICC(1) and ICC(2) values calculated using SME BARS ratings of transition processes were non-significant, but this appears to be a result of inadequate power.

Table 2. Within-Group Reliability and Agreement ($r_{wg(j)}$) Indices (N = 78)

						$r_{wg(j)}$	
Variable	*ICC(1)*	*ICC(2)*	*F*	*Minimum*	*Maximum*	*Median*	*Mean*
1. Collective efficacy	.39	.56	2.29***	.00	.99	.95	.88
2. SME ratings of transition processes	.34	.60	2.53	.71	.98	.94	.89
3. SME ratings of action processes	.82	.93	14.54***	.98	.99	.98	.98
4. Self-report transition processes	.30	.46	1.85**	.00	.99	.90	.80
5. Self-report action processes	.39	.56	2.29***	.20	1.00	.95	.91

** $p < .01$. ***$p < .001$.

Principle Component Analysis

On measures that contained multiple items, principle components analysis was conducted to determine the dimensionality of the team composition and key study variables. Decision rules for component extraction were based on theory, the Kaiser criterion, and the scree plot.

Team task experience. Based on the aforementioned decision rules, initial results suggest the extraction of two components. Using a varimax rotation a two-component solution was produced (Table 3), although the fourth question (i.e., "Flying computer jet combat simulators") cross-loaded on general gaming experience. In short, two components were identified, one representing general gaming experience and another representing more specific flight simulation experience. The general gaming experience component accounted for 23% of the total item variance ($\alpha = .51$). The flight simulation experience component accounted for 36% of the total item variance ($\alpha = .54$). Identical conclusion were obtained when employing an oblimin rotation.

Table 3. Principle Components Analysis of Experience Questionnaire (N = 156)

Item description	Varimax-rotated principal component	
	General gaming experience	Flight simulation experience
Measure of general gaming experience		
1. Playing any type of computer game	**.697**	.000
2. Playing Nintendo, Sega, or Playstation type games	**.793**	.000
3. Playing video/arcade games	**.646**	.219
Measure of flight simulation experience		
4. Flying computer jet combat simulators	**.439**	**.581**
5. Flying computer helicopter simulators	.000	**.852**
6. Flying (specifically) the Longbow Apache helicopter simulator	.000	**.806**

Note. Loadings greater than or equal to .40 in absolute magnitude are given in boldface.

Collective efficacy. Using the decision rules, initial results suggest the extraction of two components. Employing a varimax rotation a two-component solution was produced with only the second question pertaining to "Maintaining Optimal Airspeed" cross-loading on the second component (Table 4). Albeit principal components analysis suggests a two-component solution, collective efficacy was assessed using the total scale score (i.e., all items representing one component) to ensure the content validity of the scale. Content validity of the collective efficacy scale was ensured by SMEs matching each individual item to the performance domain.

Table 4. Principle Components Analysis of Collective Efficacy Scale (N = 156)

	Varimax-rotated principal component	
Item description	1	2
Maintaining optimal flight altitude	**.856**	.000
Maintaining optimal airspeed	**.751**	.247
Remaining undamaged	**.465**	**.641**
Positioning the helicopter for targeting	-.178	**.858**
Firing weapons	.304	**.519**
Navigating along the waypoint path	.352	.350

Note. Loadings greater than or equal to .40 in absolute magnitude are given in boldface.

Team flight skills. Following the two decision rules, initial results suggest the extraction of one-component representing team flight skills (Table 5). The team flight skills component accounted for 73% of the total item variance (α = .61). Identical conclusion were obtained when employing an oblimin rotation.

Table 5. Principle Components Analysis of Team Flight Skills (N = 78)

	Principal component
Item description	1
Time alive	**.899**
Helicopter status	**.866**
Primary target	**.879**
Secondary target	**.772**

Note. Loadings greater than or equal to .40 in absolute magnitude are given in boldface.

Self-report ratings of team processes. Initial results suggested the extraction of anywhere from two to four components. However, further inspection of the loadings revealed high cross-loadings for three items (i.e., two transition processes and one action processes item). After dropping these items from the analysis and using the guidance of theory, the Kaiser criterion, and the scree plot as decision rules, a varimax rotation produced a two-component solution (see Table 6). Analogous to the SME BARS ratings of team processes, the self-report ratings of team processes produced a two component solution — one component representing transition processes (i.e., pre-mission processes) and one component representing action processes (i.e., during-mission processes). The transition processes component accounted for 10% of the total item variance ($\alpha = .78$). The action processes component accounted for 41% of the total item variance ($\alpha = .87$). Identical conclusions were obtained when an oblimin rotation was employed.

Table 6. Principle Components Analysis of Self-Report Team Processes (N = 156)

Item description	Varimax-rotated principal component: Transition processes	Action processes
Measure of transition processes		
Mission analysis		
1. We tried to better understand the main objectives of the upcoming mission	**.558**	.375
Goal specification		
4. We identified specific mission goals for our team to accomplish	**.803**	.156
5. We prioritized the importance of different goals for our team	**.824**	.171
Strategy formulation and planning		
6. We formulated strategies for accomplishing our goals	**.780**	.157
7. We developed alternative courses of action for accomplishing our goals	**.522**	.135
Measure of action processes		
Monitoring progress towards goals		
1. We focused on how well out team progressed toward accomplishing our goals	.303	**.624**
2. We paid close attention to what we needed to do at each stage of the mission	.357	**.663**
Systems monitoring		
3. We monitored the physical condition of our helicopter	.000	**.521**
4. We focused our attention on how many weapons we had left	.000	**.617**
5. We monitored the approaching of primary and secondary targets	.186	**.691**
Monitoring and backup behavior		
7. We provided verbal feedback to each other	.119	**.643**
8. We coached each other to help us accomplish our individual tasks	.313	**.668**
Coordination activities		
9. We timed and synchronized our actions	.398	**.665**
10. We focused on coordinating well with each other	.355	**.719**
11. We communicated our personal actions to each other when it was necessary	.124	**.657**

Note. Loadings greater than or equal to .40 in absolute magnitude are given in boldface.

Subject matter expert ratings of team processes. Using the Kaiser criterion, the scree plot, and theory, initial results suggest the extraction of two-components. Using a varimax rotation a two-component solution was produced (Table 7), although "Monitoring Progress Towards Goals" cross-loaded on transition processes. In short, two components were identified, one representing transition processes (i.e., pre-mission processes) and another representing action processes (i.e., during-mission processes). The transition processes component accounted for 20% of the total item variance ($\alpha = .89$). The action processes component accounted for 59% of the total item variance ($\alpha = .89$). Identical results and conclusion were obtained when an oblimin rotation was employed.

Table 7. Principle Components Analysis of SME Ratings of Team Processes (N = 78)

	Varimax-rotated principal component	
Item description	Transition processes	Action processes
Goal specification	**.883**	.239
Mission analysis	**.882**	.184
Strategy formulation and planning	**.856**	.245
Systems monitoring	.211	**.875**
Monitoring and backup behavior	.156	**.873**
Coordination activities	.200	**.872**
Monitoring progress towards goals	**.416**	**.701**

Note. Loadings greater than or equal to .40 in absolute magnitude are given in boldface.

Transfer performance. Following the Kaiser criterion and the scree plot, initial results suggest the extraction of one component representing team transfer performance (Table 8). The transfer performance component accounted for 72% of the total item variance ($\alpha = .61$).

Table 8. Principle Component Analysis of Transfer Performance (N = 78)

Item description	Principal component 1
Time alive	**.890**
Helicopter status	**.888**
Primary target	**.738**
Secondary target	**.865**

Note. Loadings greater than or equal to .40 in absolute magnitude are given in boldface.

ANALYSIS STRATEGY

Team composition was assessed by averaging each individual difference variable (i.e., general mental ability, familiarity, general experience, and flight simulation experience) among the team. A series of regression analyses were run to examine beta-weights and increments in R^2. This information was used to test the path model presented in Figure 1. The first set of analyses tested the influence of MTOs on transition processes (Hypothesis 1). The second set of analyses tested if transition processes mediate the positive influences of MTOs on action processes (Hypothesis 2). The third set of analyses examined the influence of action processes on team transfer performance (Hypothesis 3). The final set of analyses tested if action processes mediate the positive influences of transition processes on team transfer performance (Hypothesis 4).

Simultaneous regression was used in the first regression analysis to examine the relative importance of task mental model agreement, task mental model reliability, task mental model accuracy, team task knowledge, collective efficacy, and team skills to the prediction of transition processes (Hypothesis 1). These variables were entered simultaneously into a single step of the regression analysis.

The second set of analyses tested if transition processes mediate the positive influences of MTOs on action processes (Hypothesis 2). Baron and Kenny's (1986) method for mediation testing was used to examine if transition processes mediate the relationship between MTOs and action processes. Step 1, involved regressing the criterion, action processes (which was captured in one score), on all the predictors (MTOs) simultaneously. Step 2, involved regressing the mediator, transition processes (which was captured in one score), on all the predictors (MTOs) simultaneously. In step 3, action processes (again captured in one score) were regressed on the transition processes will controlling for the MTOs. This step was necessary to show the mediator (i.e., transition processes) predicts the criterion (action processes) over and above the predictors (i.e., MTOs). The effects of the predictor (MTOs) on the criterion (action processes) should diminish after controlling for the mediator (transition processes) if full mediation exists.

For the third analysis, the influence of action processes on team transfer performance was examined (Hypothesis 3). For this regression analysis, team transfer performance was regressed on action processes. The final set of analyses tested if action processes mediate the positive influences of transition processes on team transfer performance (Hypothesis 4). Again, Baron and Kenny's (1986) method for mediation testing was used to examine if action processes mediate the relationship between transition processes and team transfer performance. Step 1, involved regressing the criterion, team transfer performance, on the predictor, transition processes. Step 2, involved regressing the mediator, action processes, on the predictor, transition processes. In step 3, team transfer performance was regressed on action processes while controlling for transition processes. This will show if action processes predicts team transfer performance over and above transition processes and the effects of transition processes on team transfer performance should diminish after controlling for action processes to establish full mediation.

RESULTS

Means, standard deviations, and inter-correlations among study variables are reported in Table 9. Of the team composition variables, only general gaming experience, flight simulation experience, and average team general mental ability correlated with any of the key study variables. Variable(s) that correlate with the relevant key study variables were controlled for in future analyses.

Table 9. Means, Standard Deviations, and Correlations among Variables

Variable	*M*	*SD*	1	2	3	4	5
1. Mental model agreement	13.00	3.80	—				
2. Mental model reliability	0.27	0.29	.52**	—			
3. Mental model accuracy	2.22	0.39	.62**	.42**	—		
4. Team task knowledge	7.31	0.98	0.05	-0.04	-0.11	—	
5. Collective efficacy	3.53	0.52	0.02	0.00	-0.06	.26*	—
6. Team flight skills	110.79	84.91	-0.02	0.10	-0.02	0.19	.61**
7. Subject matter expert ratings of transition processes	9.80	2.69	-0.05	-0.02	-0.02	.23*	.34**
8. Subject matter expert ratings of action processes	12.49	3.27	-0.04	-0.05	-0.08	.42**	.49**
9. Self-report transition processes	3.56	0.60	-0.04	0.08	0.05	0.18	.44**
10. Self-report action processes	3.56	0.57	-0.10	0.09	-0.01	0.15	.42**
11. Transfer performance	0.00	84.05	-0.07	0.06	-0.08	0.27	.36**
12. General gaming experience	1.66	1.07	-0.18	.23*	-0.15	.29**	.28*
13. Flight simulation experience	0.10	0.20	-0.21	0.17	0.08	-0.03	-0.06
14. Average familiarity with teammate	1.83	1.29	-0.03	0.10	-0.06	0.13	0.12
15. Average team general mental ability	28.13	2.94	0.01	0.05	-0.09	.40**	0.12

Analyses were conducted at the team-level: $N = 78$.

* $p \leq .05$. ** $p \leq .01$.

[a] Response to the question "How well do you know the other participant in this study?" Participants responded on a scale ranging from 0 (*we have never met prior to today*) to 4 (*we are good friends*). [b] Average team member score on the Wonderlic Personnel Inventory.

Continuation of Table 9

Variable	6	7	8	9	10	11	12	13	14	15
7. Subject matter expert ratings of transition processes	—									
8. Subject matter expert ratings of action processes	0.20	—								
9. Self-report transition processes	0.20	.51**	—							
10. Self-report action processes	0.28*	.39**	.44**	—						
11. Transfer performance	-0.02	0.20	.53**	.59**	—					
12. General gaming experience	0.18	0.12	.56**	0.11	.37**	—				
13. Flight simulation experience	0.09	0.12	.32**	.26*	.29**	.26**	—			
14. Average familiarity with teammate	-0.12	0.09	0.10	0.10	0.16	0.02	.35**	—		
15. Average team general mental ability	0.10	-0.01	0.06	0.19	0.09	-0.15	0.08	0.10	—	
	0.19	0.18	.24*	0.12	0.03	0.16	0.02	-0.20	0.13	—

Analyses were conducted at the team-level: $N = 78$.

* $p \leq .05$. ** $p \leq .01$.

[a] Response to the question "How well do you know the other participant in this study?" Participants responded on a scale ranging from 0 (*we have never met prior to today*) to 4 (*we are good friends*). [b] Average team member score on the Wonderlic Personnel Inventory.

Hypotheses

Hypothesis 1. Simultaneous regression was used in the first regression analysis to examine the relative importance of task mental models (agreement, reliability, and accuracy), team task knowledge, team skills, and collective efficacy to the prediction of both self-report and SME BARS ratings of transition process ratings (Hypothesis 1). Task mental model agreement was indexed by computing the squared Euclidean distance per team. Squared Euclidean distances provide a dissimilarity measure reflecting the difference between two items. Task mental model reliability was indexed by computing a correlation between each team member's responses on the task mental model matrix. Task mental model accuracy was indexed by calculating the absolute difference between each participant's task mental model value and the respective SMEs' value. This process was repeated for all 15 attribute comparisons (i.e., each task mental model value). Then these 15 absolute difference values were averaged to generate the respective team member's (i.e., pilot or gunner) overall accuracy index. Last, the pilot and gunner's overall accuracy index was aggregated to the team level by taking the mean of the respective pilot and gunner overall accuracy index.

Testing Hypothesis 1 using self-report transition processes, 24% of the self-report transition process variance was predicted using the six training outcomes, $F(8,69) = 2.779, p \leq .01$. Of the six MTOs, collective efficacy provided a unique and positive contribution to the prediction of SME ratings of transition processes ($\beta = .394, t = 2.788, p \leq .01$). When using SME BARS ratings of transition processes, the MTOs did not significantly predict the SME BARS ratings of transition processes, $F(8,69) = 1.635, p = .131$. However, collective efficacy ($\beta = .331, t = 2.221, p \leq .05$) provided a unique and positive contribution to the prediction of SME ratings of transition processes. Thus, Hypothesis 1 was partially supported. Collective efficacy provides a unique and positive contribution to self-report and SME BARS ratings of transition processes (Table 10 and Table 11). However, the cognitive and behavioral outcomes of training did not positively and uniquely predict transition processes.

Table 10. Regressions for Hypothesis 1 Using Self-Report Ratings of Transition Processes (N = 78)

Analysis/Variable	*b-weight*	*SE*	β	*t*
DV = Transition Processes, R^2 = .244, $F(8,69) = 2.779, p \leq .01$				
1. Mental model agreement	.000	.023	.113	.439
2. Mental model reliability	.154	.264	.075	.560
3. Mental model accuracy	.309	.208	.204	.143
4. Team task knowledge	.000	.075	.042	.738
5. Collective efficacy	.449	.161	.394	2.788**
6. Team skills	.000	.001	.001	.007

** $p \leq .01$.

Table 11. Regressions for Hypothesis 1 Using Subject Matter Expert Ratings of Transition Processes

Analysis/Variable	*b-weight*	*SE*	*β*	*t*
DV = Transition Processes, $R^2 = .159$, $F(8,69) = 1.635$, $p = .131$				
1. Mental model agreement	.101	.109	.143	.934
2. Mental model reliability	-.496	1.253	-.054	-.396
3. Mental model accuracy	.602	.990	.088	.609
4. Team task knowledge	.356	.359	.130	.993
5. Collective efficacy	1.669	.765	.331	2.221*
6. Team skills	.000	.005	.039	.269

* $p \leq .05$.

Hypothesis 2. The second set of analyses tested if transition processes mediate the positive influences of MTOs on action processes (Hypothesis 2). Following Baron and Kenny's (1986) recommendations for mediation analysis, I regressed: (a) action processes on the MTOs, (b) transition processes on the MTOs, and (c) action processes on MTOs while controlling for transition processes. If these first three steps are supported partial mediation exists (Kenny, Kashy, & Bolger, 1997). Full mediation exists, if in addition to these first three steps, the effects of the predictors on the criterion diminish to zero when controlling for the mediator.

Results from the first step indicated that MTOs accounted for 35% of the self-report action processes variance, $F(9,68) = 4.666$, $p \leq .001$ (see Table 12). Results from the second step indicated that MTOs accounted for 24% of the self-report transition processes variance, $F(8,69) = 2.779$, $p \leq .01$. Results from the third step indicated that MTOs and self-report transition processes accounted for 53% of the self-report action processes variance, $F(9,68) = 8.503$, $p \leq .001$. However, MTOs (i.e., collective efficacy and team flight skills) still related to self-report action processes when controlling for self-report transition processes. This indicates the possibility of partial mediation. Testing if the indirect effects of collective efficacy on self-report action processes was significant, a Sobel test was conducted (Sobel, 1982). The Sobel test revealed a significant indirect effect ($t = 3.360, p \leq .001$) of collective efficacy on self-report action processes. A Sobel test was also conducted to test if the indirect effects of team flight skills on self-report action processes was significant. The Sobel test revealed a non-significant indirect effect of team flight skills on self-report action processes. Partially supporting Hypothesis 2, transition processes partially mediate the collective efficacy — action processes relationship and transition processes fully mediate the team flight skills — action processes relationship when using self-report measures of team processes.

Table 12. Regressions for Hypothesis 2 Using Self-Report Ratings of Team Processes

Analysis/Variable	*b-weight*	*SE*	*B*	*t*
DV = Action Processes, $R^2 = .351$, $F(9,68) = 4.666$, $p \leq .001$				
1. Mental model agreement	.000	.020	.164	
2. Mental model reliability	.220	.235	.111	1.220
3. Mental model accuracy	.281	.186	.193	1.512
4. Team task knowledge	.000	.067	.064	.551
5. Collective efficacy	.736	.144	.670	5.126***
6. Team skills	.000	.001	-.465	-3.666***
DV = Transition Processes, $R^2 = .244$, $F(8,69) = 2.779$, $p \leq .01$				
1. Mental model agreement	.000	.023	.113	.758
2. Mental model reliability	.154	.264	.075	.632
3. Mental model accuracy	.309	.208	.204	1.461
4. Team task knowledge	.000	.075	.042	.612
5. Collective efficacy	.449	.161	.394	2.788**
6. Team skills	.000	.001	.001	.007
DV = Action Processes, $R^2 = .529$, $F(9,68) = 8.503$, $p \leq .001$				
1. Mental model agreement	.000	.018	.109	.942
2. Mental model reliability	.148	.202	.075	.733
3. Mental model accuracy	.136	.162	.094	.843
4. Team task knowledge	.000	.058	.043	.437
5. Collective efficacy	.526	.130	.479	4.049***
6. Team skills	.000	.001	-.465	-4.278***
7. Transition Processes	.467	.092	.486	5.078***

** $p \leq .01$. *** $p \leq .001$.

As depicted in Table 13, when using SME BARS ratings of team processes the results differ in some respects to the results obtained using self-report ratings of team processes. Specifically, the first step indicated that MTOs accounted for 39% of the SME BARS ratings of action processes, $F(8, 69) = 5.456$, $p \leq .001$. In contrast to the self-report ratings of team processes, results from the second step did not reveal a significant relationship between MTOs and SME BARS ratings of transition processes, $F(8, 69) = 1.635$, $p = .131$. However, collective efficacy ($\beta = .331$, $t = 2.221$, $p \leq .05$) uniquely and positively predicted SME BARS ratings of transition processes. Results from the third step indicated that MTOs accounted for 48% of the SME BARS ratings of action processes variance when controlling for SME BARS ratings of transition processes, $F(8, 69) = 6.919$, $p \leq .001$. Results from the fourth step indicated that team task knowledge ($\beta = .198$, $t = 1.888$, $p = .06$) approached conventional significance levels and collective efficacy ($\beta = .373$, $t = 3.045$, $p \leq .01$) remained significant when controlling for SME BARS ratings of transition processes. A Sobel test conducted on team task knowledge revealed a non-significant indirect effects ($t = 1.822$, $p = .07$) while collective efficacy revealed a significant indirect effects ($t = 2.545$, $p \leq .01$) on SME BARS ratings of action processes. Thus, when using SME BARS ratings of team processes, Hypothesis 2 was not supported as SME BARS ratings of transition processes did not mediate the MTOs – action processes relationships since the MTOs did not directly relate to the transition processes in step two of the mediation test.

Table 13. Regressions for Hypothesis 2 Using Subject Matter Expert Ratings of Team Processes

Analysis/Variable	*b-weight*	*SE*	*B*	*t*
DV = Action Processes, $R^2 = .387$, $F(8,69) = 5.456$, $p \leq .001$				
1. Mental model agreement	.000	.113	.109	-.834
2. Mental model reliability	-1.234	1.301	-.109	-.948
3. Mental model accuracy	.172	1.028	.021	.167
4. Team task knowledge	.801	.373	.241	2.150 *
5. Collective efficacy	3.008	.795	.481	3.785 ***
6. Team skills	.000	.005	-.170	-1.379
DV = Transition Processes, $R^2 = .159$, $F(8,69) = 1.635$, $p = .131$				
1. Mental model agreement	.101	.109	.143	.934
2. Mental model reliability	-.496	1.253	-.054	-.396
3. Mental model accuracy	.602	.990	.088	.609
4. Team task knowledge	.356	.359	.130	.993
5. Collective efficacy	1.699	.765	.331	2.221*
6. Team skills	.000	.005	-.039	-.269
DV = Action Processes, $R^2 = .478$, $F(9,68) = 6.919$, $p \leq .001$				
1. Mental model agreement	.000	.105	.062	.508
2. Mental model reliability	-1.036	1.211	-.092	-.855
3. Mental model accuracy	.000	.959	-.008	-.072
4. Team task knowledge	.659	.349	.198	1.888 [a]
5. Collective efficacy	2.330	.765	.373	3.045 **
6. Team skills	.000	.004	-.157	-1.371
7. Transition Processes	.399	.116	.328	3.434 **

[a] p = .06. * $p \leq .05$. ** $p \leq .01$. *** $p \leq .001$.

Hypothesis 3. Simple regression was used to examine if action processes positively predicted team transfer performance. Using self-report ratings of action processes, action processes predicted 16% of the self-report transfer performance variance, $F(2, 75) = 7.148$, $p \leq .001$. Similar results were found when using SME BARS ratings of action processes. Specifically, action processes predicted 18% of the transfer performance variance, $F(3, 74) = 5.535$, $p \leq .01$. Thus, using both self-report and SME

BARS ratings of action processes, Hypothesis 3 was fully supported as action processes positively influence team transfer performance (Table 14 and Table 15).

Table 14. Regression for Hypothesis 3 Using Self-Report Ratings of Team Processes

Analysis/Variable	*b-weight*	*SE*	*β*	*t*
DV = Transfer Performance, $R^2 = .160$, $F(2,75) = 7.148$, $p \leq .001$				
1. Action Processes	46.712	16.166	.319	2.889***

*** $p \leq .001$.

Table 15. Regression for Hypothesis 3 Using SME Ratings of Team Processes

Analysis/Variable	*b-weight*	*SE*	*β*	*t*
DV = Transfer Performance, $R^2 = .183$, $F(3,74) = 5.535$, $p \leq .01$				
1. Action Processes	46.254	16.052	.316	2.881**

** $p \leq .01$.

Hypothesis 4. The final set of analyses tested if action processes mediate the positive influences of transition processes on team transfer performance (Hypothesis 4). Using self-report ratings of team processes, results from the first step indicated that transition processes marginally related to team transfer performance, $F(2,75) = 2.763$, $p = .07$, accounting for 6.9% of the team transfer performance variance. Results from the second step indicated that self-report transition processes ($\beta = .541$, $t = 5.855$, $p \leq .001$) accounted for 37% of the self-report action processes variance, $F(3,74) = 14.686$, $p \leq .001$. Results from the third step indicated that self-report action processes accounted for 21% of the team transfer performance variance when controlling for transition processes, $F(4,73) = 4.955$, $p \leq .001$. While the three steps in the mediation analysis are partially supported, further inspection of the regression coefficients indicates the possibility of suppression. For example, the transition processes coefficient becomes significant and the sign reverses from positive to negative. In short, Hypothesis 4 was not supported as action processes did not mediate the positive influences of transition processes on team transfer performance (Table 16).

Table 16. Regressions for Hypothesis 4 Using Self-Report Ratings of Team Processes

Analysis/Variable	*b-weight*	*SE*	β	*t*
DV = Transfer Performance, $R^2 = .069$, $F(2,75) = 2.763$, $p = .07$				
1. Transition Processes	6.541	16.270	.046	.402
DV = Action Processes, $R^2 = .373$, $F(3,74) = 14.686$, $p \leq .001$				
1. Transition Processes	.541	.092	.563	5.855***
DV = Transfer Performance, $R^2 = .214$, $F(4,73) = 4.955$, $p \leq .001$				
1. Transition Processes	-30.942	18.458	-.220	-1.676[a]
2. Action Processes	64.351	19.185	.440	3.354***

[a] $p = .10$. *** $p \leq .001$.

Using the SME BARS ratings of team processes Hypothesis 4 was tested. Results from the first step indicated that transition processes did not relate to team transfer performance, $F(1,76) = 1.039$, $p = .311$. Results from the second step indicated that SME ratings of transition processes accounted for 35% of the SME ratings of action processes variance ($\beta = .546$, $t = 4.688$, $p \leq .001$), $F(3,74) = 13.414$, $p \leq .001$. Results from the third step indicated that action processes accounted for 35% of the team transfer performance variance when controlling for transition processes, $F(4,73) = 9.927$, $p \leq .001$. Results from the fourth step indicated that transition processes becomes significant and the sign reverses from positive to negative, again suggesting suppression. Accordingly, Hypothesis 4 was not supported as action processes did not mediate the positive influences of transition processes on team transfer performance (Table 17). The reader should interpret these results with caution as further inspection of the prediction equation revealed the presence of suppression.

Table 17. Regressions for Hypothesis 4 Using Subject Matter Expert Ratings of Team Processes

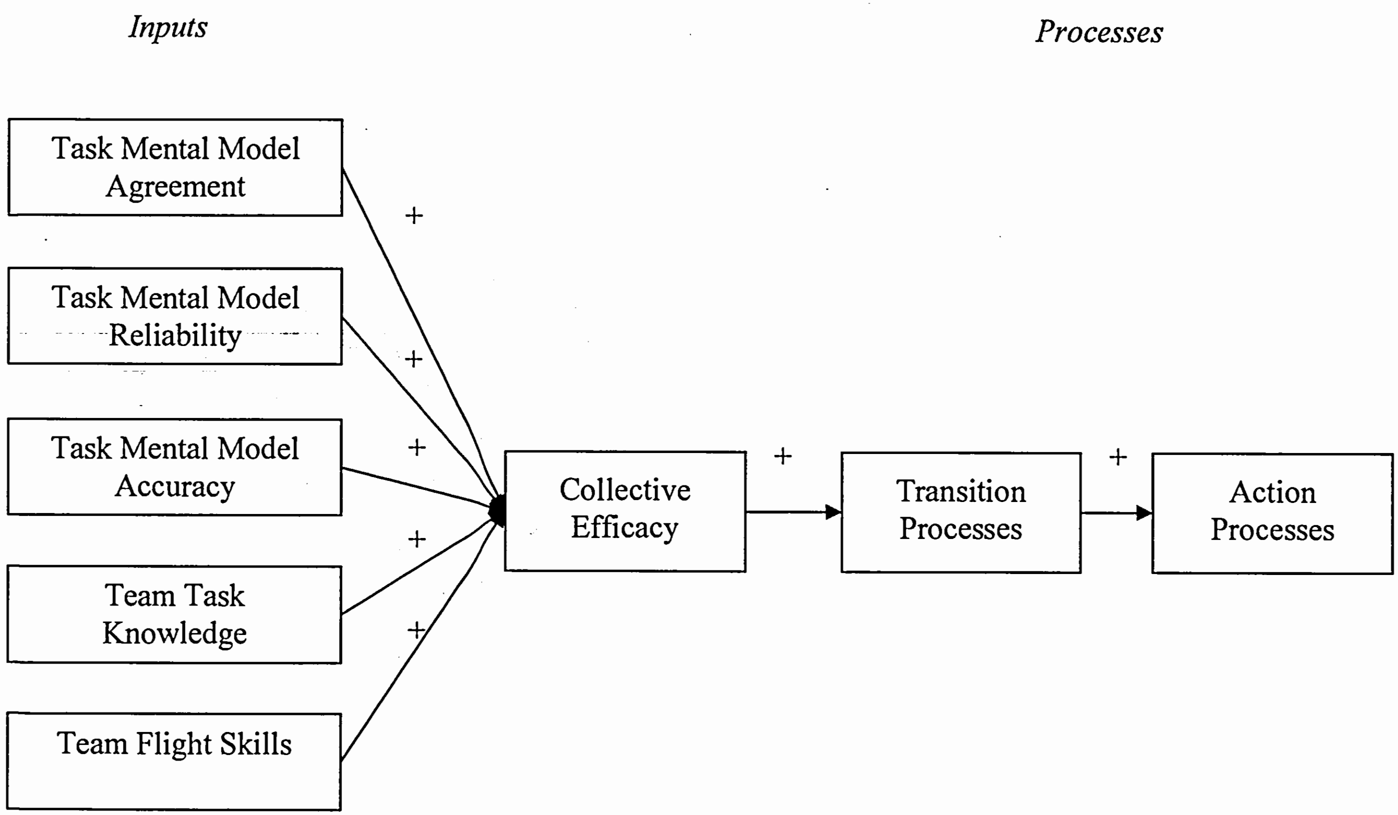
Analysis/Variable	*b-weight*	*SE*	*β*	*t*
DV = Transfer Performance, $R^2 = .013$, $F(1,76) = 1.039$, $p = .311$				
1. Transition Processes	3.630	3.561	.116	1.019
DV = Action Processes, $R^2 = .352$, $F(3,74) = 13.414$, $p \leq .001$				
1. Transition Processes	.546	.116	.449	4.688***
DV = Transfer Performance, $R^2 = .352$, $F(4,73) = 9.927$, $p \leq .001$				
1. Transition Processes	-6.957	3.431	-.223	-2.028*
2. Action Processes	16.188	3.006	.630	5.384***

* $p \leq .05$. *** $p < .001$.

SUPPLEMENTAL ANALYSIS

As mentioned in the introduction, efficacious teams are likely to initiate and persist in the execution of their knowledge and skills during transfer periods (Ford et al., 1998; Kozlowski et al., 2001). Conceptually, collective efficacy may be a result of the enhancement of knowledge and skills during training. That is, when the requisite knowledge and skills are developed in training, shared perceptions of efficacy (i.e., collective efficacy) may assist in catalyzing effective team regulatory processes, such as transition and action processes. As Weldon and Weingart (1993) discuss, collective efficacy facilitates effective team regulation by enhancing the belief that the team can meet its current goal. This expectation of goal accomplishment may facilitate transition processes (e.g., goal specification) and assist in mobilizing and directing attention (i.e., engagement in the relevant action processes) towards successful task accomplishment (Weldon & Weingart, 1993). Accordingly, an alternative model was tested to examine if collective efficacy mediates the knowledge and skills — transition processes relationships and if transition processes mediates the collective efficacy — action processes relationship. This alternative model is depicted in Figure 2. Note a mediation analysis was not performed to examine if action processes mediates the transition processes — transfer performance relationship as this would have been redundant with testing Hypothesis 4.

Figure 2. . Alternative model depicting collective efficacy as a mediator of the knowledge and skills — transition processes relationships and transition processes as a mediator of the collective efficacy — action processes relationship.



Two series of regression analyses were used to test the alternative model. First, Baron and Kenny's (1986) method for mediation testing was used to test if collective efficacy mediated the relationship between knowledge and skills (i.e., task mental models, team task knowledge, and team flight skills) and transition processes using both self-report and SME BARS ratings of transition processes. Second, Baron and Kenny's (1986) method for mediation testing was used to examine if transition processes mediated the collective efficacy — action processes relationship using both self-report and SME BARS ratings of transition and action processes.

Self-report measures of transition processes were used to test if collective efficacy mediated the knowledge and skills — transition processes relationship. Results from the first step indicated that the knowledge and skills indices approach conventional standards of significance, $F(7,70) = 1.884, p = .09$, and accounted for 16% of the self-report transition processes variance (Table 18). Only team skills uniquely and positively predicted transition processes, ($\beta = .235, t = 2.073, p \leq .05$). Results from the second step of the mediation analysis indicated that the five knowledge and skill indices accounted for 45% of the collective efficacy variance, $F(7,70) = 8.190, p \leq .001$. Again, only team skills uniquely and positively predicted collective efficacy, ($\beta = .595, t = 6.490, p \leq .001$). Results from the third step indicated that collective efficacy ($\beta = .394, t = 2.788, p \leq .01$) accounted for 24% of the self-report transition processes variance, $F(8,69) = 2.779, p \leq .01$. Moreover, the team skills — transition processes relationship was no longer significant. Albeit the first step did not reach conventional standards of significance, this suggests the approximation of a fully mediated model.

Table 18. Regressions Testing for Mediation of the Knowledge and Skill — Transition Processes Relationships Using Self-Report Ratings

Analysis/Variable	*b-weight*	*SE*	*B*	*t*
DV = Transition Processes, $R^2 = .159$, $F(7,70) = 1.884$, $p = .085$				
1. Mental model agreement	.000	.024	.088	-.578
2. Mental model reliability	.000	.274	.031	.234
3. Mental model accuracy	.255	.217	.168	1.171
4. Team task knowledge	.000	.079	.071	.547
5. Team skills	.000	.001	.235	2.073*
DV = Collective Efficacy, $R^2 = .450$, $F(7,70) = 8.190$, $p \leq .001$				
1. Mental model agreement	.000	.017	.065	.526
2. Mental model reliability	-.201	.194	-.111	-1.034
3. Mental model accuracy	-.121	.154	-.091	-.787
4. Team task knowledge	.000	.056	.074	.708
5. Team skills	.000	.001	.595	6.490***
DV = Transition Processes, $R^2 = .244$, $F(8,69) = 2.779$, $p \leq .01$				
1. Mental model agreement	.000	.023	.113	-.779
2. Mental model reliability	.154	.264	.075	.585
3. Mental model accuracy	.309	.208	.204	1.482
4. Team task knowledge	.000	.075	.042	.335
5. Team skills	.000	.001	.001	.007
6. Collective Efficacy	.449	.161	.394	2.788**

[a]$p = .09$. * $p \leq .05$. ** $p \leq .01$. *** $p \leq .001$.

SME BARS ratings of transition processes were also used to test if collective efficacy mediated the knowledge and skills — transition processes relationship. Results from the first step indicated that the knowledge and skills indices did not predict SME BARS ratings of transition processes, $F(7,70) = 1.102$, $p = .372$ (Table 19). Results from the second step of the mediation analysis are analogous to the results above. Specifically, the five knowledge and skill indices accounted for 45% of the collective efficacy variance, $F(7,70) = 8.190$, $p \leq .001$. Only team skills uniquely and positively predicted collective efficacy, ($\beta = .595$, $t = 6.490$, $p \leq .001$). Results from the third step indicated that the predictors (i.e., knowledge and skills) and the mediator (i.e., collective efficacy) did not predict SME BARS ratings of transition processes, $F(8,69) = 1.635$, $p = .131$.

Thus, while results from self-report ratings of transition processes suggests collective efficacy fully mediates the knowledge and skills — transition processes relationships, results using SME BARS ratings of transition processes do not support mediation.

Table 19. Regressions Testing for Mediation of the Knowledge and Skill — Transition Processes Relationships Using SME BARS Ratings

Analysis/Variable	*b-weight*	*SE*	*B*	*t*
DV = Transition Processes, $R^2 = .099$, $F(7,70) = 1.102$, $p = .372$				
1. Mental model agreement	.000	.111	.122	.775
2. Mental model reliability	-.837	1.278	-.090	-.655
3. Mental model accuracy	.397	1.013	.058	.392
4. Team task knowledge	.423	.367	.155	1.153
5. Team skills	.000	.004	.158	1.345
DV = Collective Efficacy, $R^2 = .450$, $F(7,70) = 8.190$, $p \leq .001$				
1. Mental model agreement	.000	.017	.065	.526
2. Mental model reliability	-.201	.194	-.111	-1.034
3. Mental model accuracy	-.121	.154	.091	-.787
4. Team task knowledge	.000	.056	.074	.708
5. Team skills	.000	.001	.595	6.490***
DV = Transition Processes, $R^2 = .159$, $F(8,69) = 1.635$, $p = .131$				
1. Mental model agreement	.101	.109	.143	.934
2. Mental model reliability	-.496	1.253	-.054	-.396
3. Mental model accuracy	.602	.990	.088	.609
4. Team task knowledge	.356	.359	.130	.993
5. Team skills	.000	.005	-.039	-.269
6. Collective Efficacy	1.699	.765	.331	2.221*

* $p \leq .05$. *** $p \leq .001$.

Both self-report and SME BARS ratings of team processes were used to test the second series of regression analyses regarding transition processes as a potential mediator of the collective efficacy — action processes relationship. When using self-report ratings of team processes, results from the first step indicated that collective efficacy ($\beta = .366$, $t = 3.417$, $p \leq .001$) accounted for 21% of the action processes variance, $F(2,75) = 9.729$, p

$\leq .001$ (Table 20). Results from the second step of the mediation analysis indicated that collective efficacy ($\beta = .394$, $t = 3.694$, $p \leq .001$) accounted for 21% of the transition processes variance, $F(2,75) = 10.129$, $p \leq .001$. Results from the third step indicated that collective efficacy ($\beta = .173$, $t = 1.692$, $p \geq .05$) and transition processes ($\beta = .489$, $t = 4.802$, $p \leq .001$) accounted for 40% of the self-report action processes variance, $F(3,74) = 16.080$, $p \leq .001$. Moreover, the collective efficacy — action processes relationship was no longer significant which suggests a fully mediated model.

Table 20. Regressions Testing for Mediation of the Collective Efficacy — Action Processes Relationship Using Self-Report Ratings of Team Processes

Analysis/Variable	*b-weight*	*SE*	*B*	*t*
DV = Action Processes, $R^2 = .206$, $F(2,75) = 9.792$, $p \leq .001$				
1. Collective Efficacy	.402	.118	.366	3.417***
DV = Transition Processes, $R^2 = .213$, $F(2,75) = 10.129$, $p \leq .001$				
1. Collective Efficacy	.450	.122	.394	3.694***
DV = Action Processes, $R^2 = .395$, $F(3,74) = 16.080$, $p \leq .001$				
1. Collective Efficacy	.190	.113	.173	1.692
2. Transition Processes	.471	.098	.489	4.802***

*** $p \leq .001$.

When using SME BARS ratings of team processes, results from the first step indicated that collective efficacy ($\beta = .411$, $t = 4.064$, $p \leq .001$) accounted for 31% of the action processes variance, $F(3,74) = 11.247$, $p \leq .001$ (Table 21). Results from the second step of the mediation analysis indicated that collective efficacy ($\beta = .319$, $t = 2.818$, $p \leq .01$) accounted for 12% of the transition processes variance, $F(2,75) = 5.049$, $p \leq .01$. Results from the third step indicated that collective efficacy ($\beta = .296$, $t = 3.022$, $p \leq .01$) and transition processes ($\beta = .359$, $t = 3.753$, $p \leq .001$) accounted for 42% of the SME BARS ratings of action processes, $F(4,73) = 13.448$, $p \leq .001$. In contrast to the results using self-report ratings of team processes, the SME BARS ratings of team processes supported transition processes as a partial mediator of the collective efficacy — action processes relationship as a Sobel test indicated that the indirect effect of collective efficacy on action processes was significant (t = 2.732, $p \leq .01$).

Table 21. Regressions Testing for Mediation of the Collective Efficacy — Action Processes Relationship Using SME BARS Ratings of Team Processes

Analysis/Variable	*b-weight*	*SE*	*B*	*t*
DV = Action Processes, R^2 = .313, $F(3,74)$ = 11.247, $p \leq .001$				
1. Collective Efficacy	2.507	.632	.411	4.064***
DV = Transition Processes, R^2 = .119, $F(2,75)$ = 5.049, $p \leq .01$				
1. Collective Efficacy	1.641	.582	.319	2.818**
DV = Action Processes, R^2 = .424, $F(4,73)$ = 13.448, $p \leq .001$				
1. Collective Efficacy	1.854	.613	.296	3.022**
2. Transition Processes	.437	.116	.359	3.753***

** $p \leq .01$. *** $p \leq .001$.

DISCUSSION

This study examined if distal (i.e., transition) and proximal (i.e., action) team processes mediate the relationship between the cognitive, affective/motivational, and behavioral outcomes of training and training transfer. Findings suggested that of the six MTOs, only the affective/motivational training outcome (i.e., collective efficacy) uniquely and positively influenced distal (i.e., transition) team processes. While theoretical and empirical work have suggested cognitive and behavioral training outcomes positively predict team performance, team researchers would proffer from a greater understanding of the mechanisms through which MTOs relate to team performance. The current research represents a first attempt in predicting transition processes operationalized as a cluster of between-episode team processes.

Though only collective efficacy predicted transition processes, future research would benefit from finding other cognitive, affective/motivational, and behavioral training outcomes that predict transition processes. Having a fully specified model in which multidimensional training outcomes relate to transition processes would provide both theoretical and practical contributions. Using theory to identify the distal predictors of transition processes would facilitate the generation of practical interventions. For example, research findings that other types of shared mental models (e.g., team mental models) which influence transition processes which further influence the regulatory behavioral interactions (i.e., action processes) that govern team behavior within-episode, would suggest to practitioners that training would benefit from developing team mental models.

The current research also tested if between-episode processes (i.e., transition processes) mediated the relationship between multidimensional training outcomes and within-episode processes (i.e., action processes). When using self-report measures of transition and action processes, it was found that transition processes partially mediated the collective efficacy — action processes relationship. However, when using SME BARS ratings of team processes, no mediation was found. From the current research it cannot be determined which operationalization more closely approximates the "true" states of affairs, but future research is likely to benefit from further investigation into the differential prediction patterns that results from the differing operationalizations of team processes. This avenue of research may be informative, because if self-report measures of team processes are found to be adequate measures, than practitioners would likely benefit from the reduced time and cost that it takes to have a SME provide ratings. In short, future research should examine if the differential prediction patterns are a results of statistical artifacts (e.g., common method variance) or are tapping a qualitatively different phenomenon.

While prediction patterns depended on the form of measurement (i.e., self-report or SME BARS ratings) when examining if transition processes mediated the relationship between MTOs and action processes, analogous prediction patterns where found between the two measurement forms when examining if action processes positively influenced transition processes. While most research has tested individual components of transition processes (e.g., coordination behavior), this finding supports the predictive validity of assessing within-episode processes as a cluster of team processes that transpire to predict action processes.

Interestingly, even though sound theoretical reasoning suggests action processes should mediate the transition processes — transfer performance relationship, the current research did not support this conclusion. Thus, support is not lent for the importance of examining a more longitudinal set of team processes. However, there are numerous reasons why this relationship may not have been found (e.g., nature of the task, team type, size of team, etc.). Future research exposing the conditions in which a more dynamic set of team processes influences important team outcomes (e.g., team performance) will provide a richer theoretical understanding of the nature of teams. Forearmed with this knowledge, practitioners will be more apt to understand the conditions in which between-episode team interactions are likely to have substantive influences on the behavioral interaction of team members' within-episodes. These within-episode interaction patterns will be more proximal in there relationship with important team outcomes. This stated, the current research highlights what other researchers have been calling for — more research on how temporal events influence organizational processes (McGrath, 1993; Zaheer et al., 1999).

Supplemental analyses also revealed differential prediction patterns depending on whether self-report or SME ratings of team processes were used. Specifically, when examining an alternative model in which collective efficacy was hypothesized to mediate the knowledge and skills — transition processes relationships, self-report measures of team processes indicated that collective efficacy fully mediated the skills — transition processes relationship. However, when SME ratings of team processes were used, the results suggested that collective efficacy did not mediate the knowledge and skills — transition processes relationship. The findings from the SME ratings would lead practitioners to a different conclusion than when using the self-report measures of team processes.

A final supplemental analysis was conducted in which it was examined if transition processes mediated the collective efficacy — action processes relationship. Again, different patterns of predictions where found depending on whether self-report or SME ratings of team processes were used. Specifically, when using self-report ratings of team processes, transition processes fully mediated the collective efficacy — action processes relationship. However, when SME ratings of team processes were used, transition processes partially mediated the collective efficacy — action processes relationship. None-the-less, these results suggests that transition processes may perform an important role in linking attitudinal/motivational outcomes of training to transfer performance.

While the current study produces some interesting conclusions, there are some noteworthy limitations. The use of objective flight scores provided a reliable means to collect data, but there was the disadvantage of the level of specificity of the measure. That is, taking a summary score of the teams flight score during the practice and transfer mission made it difficult to assess precisely the level of training the team achieved (c.f., Alliger & Janek, 1989). Team researchers (e.g., Marks et al., 2000) have suggested that a sufficient level of task proficiency is obtained by a team when their score on the practice mission is approximately 70% of the score of those teams composed of SMEs. However, in the current study, the average team score on the practice mission was approximately 43% of the performance of teams composed of SMEs. While the current study pilot tested the missions, future research should perform more extensive pilot testing on a larger sample of teams to ensure a floor or ceiling effect is not created if the missions are too easy or too difficult.

The difficulty in assessing the level of training attainment also made it difficult to understand if a shared mental model had adequate time to develop. As Mathieu (2002) discussed, shared mental models may take longer to develop than what transpires over a one-and-a-half hour training session. Examining shared mental models that develop over longer periods of time (e.g., months, years) would likely be a useful contribution to shared mental model theory.

Another limitation of the current study is the laboratory setting in which it was conducted. While this may limit the generalizability of the findings, the laboratory was deemed the appropriate place to test the model before testing in a field sample. Examining different types of teams in different contexts performing different tasks would also contribute greatly to our understanding of how MTOs relate to transfer performance at the team level. However, it is not the specific research study that is expected to generalize to the field, but the research study facilitates the development of theory and the theory is what is applied to the field (Driskell & Salas, 1992). This was the aim of the current study, to test and assist in further theory development . To repeat Kurt Lewin's (1964) well-known aphorism, "there is nothing so practical as a good theory" (p. 169).

APPENDIX A

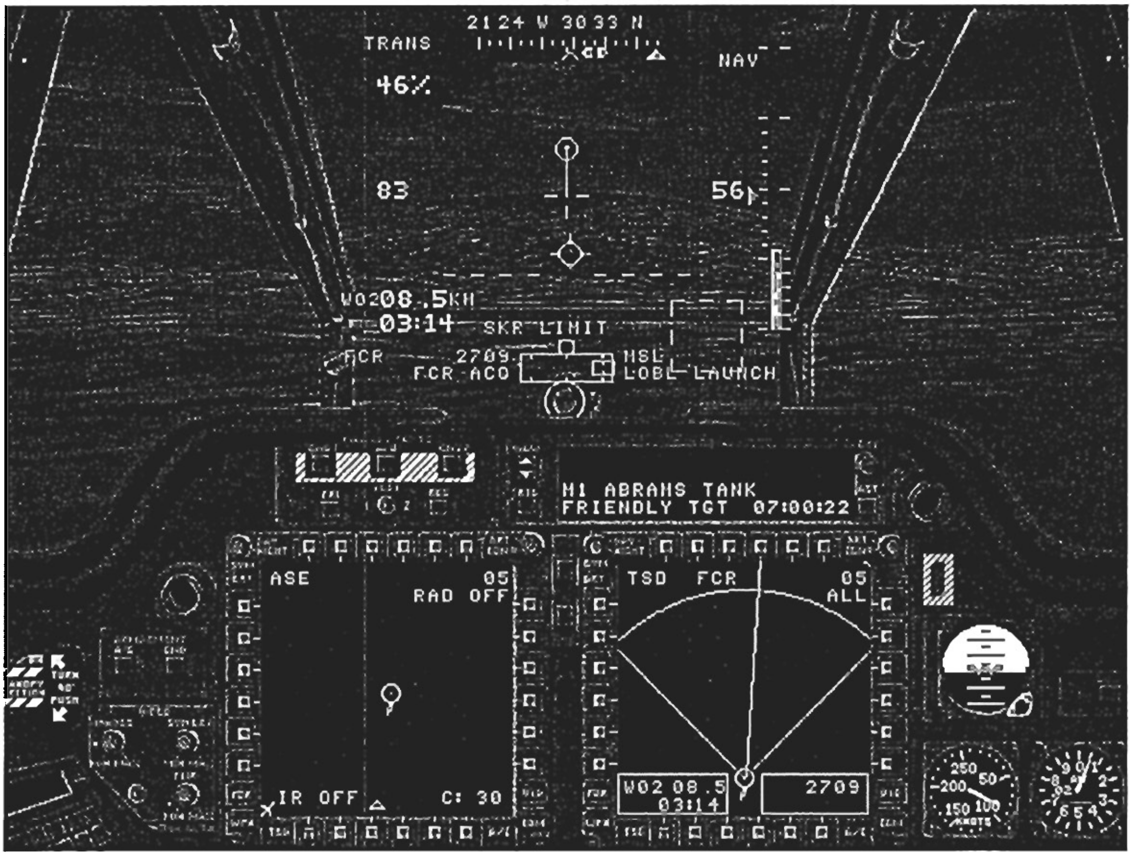
Task Functions Critical to Performance by Positions

Function	Pilot	Gunner
Maintaining Optimal Flight Altitude	X	A
Following the Waypoint Path	X	A
Crossing Over Waypoint	X	A
Maintaining Optimal Airspeed	X	A
Using Chain Gun	X	A
Monitoring Time to Next Waypoint	X	A
Monitoring Distance to Next Waypoint	X	A
Extinguishing Engine Fire When Necessary	X	A
Lining Up I-Beam With Cross-Hairs	X	A
Identifying and Differentiating Targets	N/A	X
Selecting Weapons Appropriately	N/A	X
Monitoring Weapons Status	N/A	X
Prioritizing Targets Appropriately	N/A	X
Monitoring Helicopter's Systems	A	X
Informing Pilot of Aircraft Systems' Status	N/A	X
Using Rockets	A	X
Using Missiles	A	X

A: pilot or gunner should be aware
X: pilot or gunner is responsible for carrying out this function

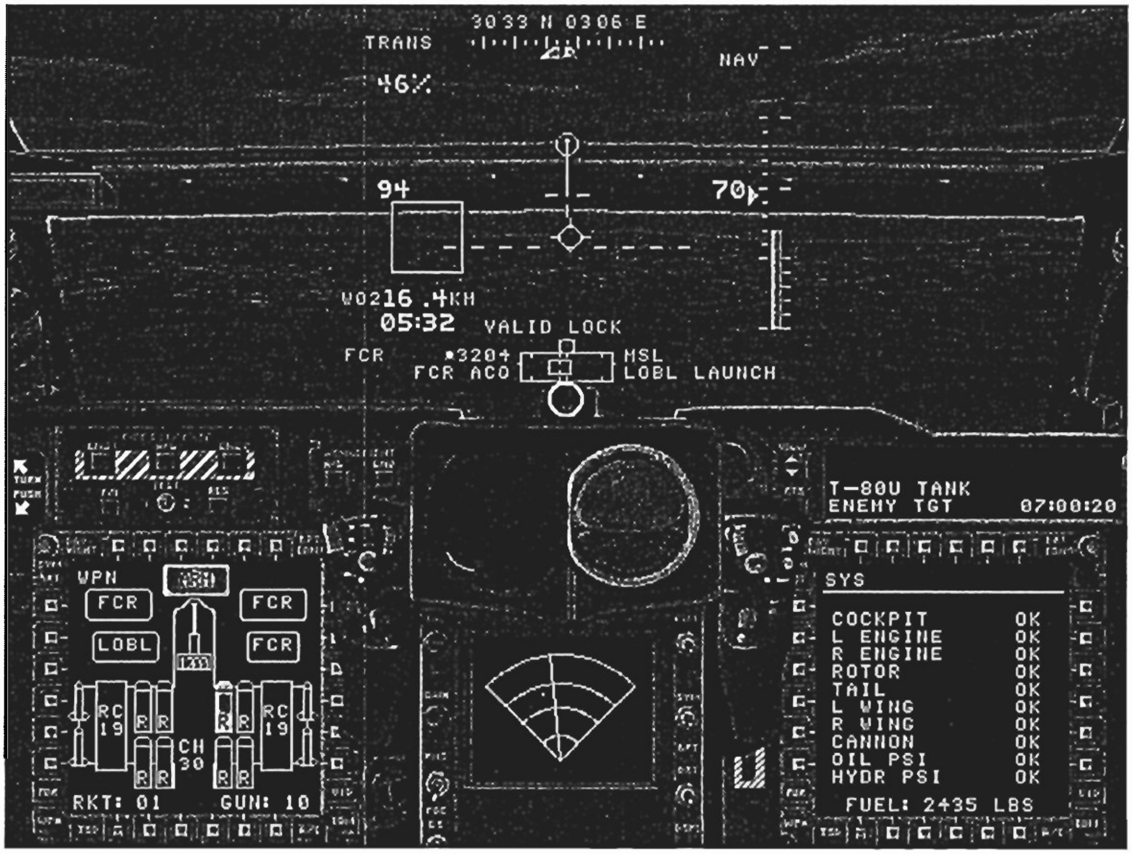
APPENDIX B

Sample Image of Display on Pilot's Monitor.



APPENDIX C

Sample Image of Display on Gunner's Monitor.

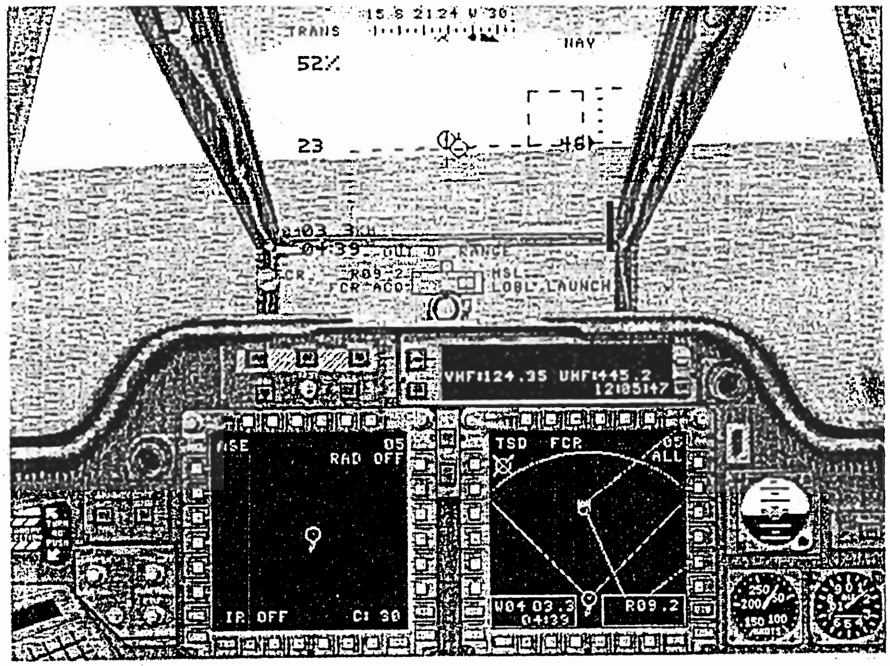


APPENDIX D

PILOT KNOWLEDGE TEST

Below are questions regarding the Pilot's role, please circle the most correct answer.

1. Using the image below, you should:
    a. Decrease the altitude and fire the chain gun.
    b. Increase the altitude and fire the rockets.
    c. Increase the altitude and turn the helicopter.
    d. Increase the altitude and bank the helicopter.

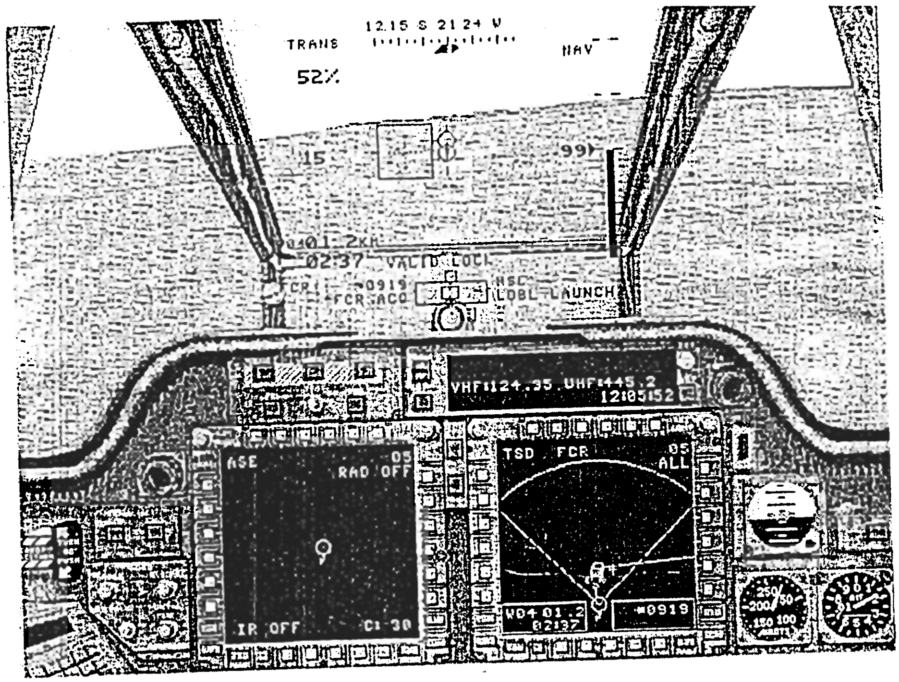


2. When navigating to the next waypoint, your helicopter symbol should be in the _____ position in relation to the waypoint path leading to the next waypoint.
    a. 12 o'clock
    b. 9 o'clock
    c. 6 o'clock
    d. 3 o'clock

3. In general, when navigating from waypoint to waypoint you should first make certain that you:
    a. Decrease the altitude.
    b. Stabilize the altitude.
    c. Increase the airspeed.
    d. Decrease the airspeed.

4. When eliminating moving targets the best strategy to employ is:
    a. Hover and use the rockets
    b. Hover and use the chain gun
    c. Use the missiles
    d. Use the chain gun while flying by

5. Using the image below you may wan to seek advice from the Gunner to:



    a. Increase the airspeed.
    b. Activate the hover hold.
    c. Remain along the waypoint path.
    d. Decrease the altitude.

6. How should the pilot cycle though chain-gun burst rates?
    a. By pressing the 03 button
    b. By pressing the 02 button
    c. Request the gunner to change the rate
    d. The pilot cannot change the burst rate

7. When approaching a group of enemy targets, which type of target should be eliminated first to avoid damage to your helicopter?
    a. Stationary Tanks
    b. SAM
    c. AAA
    d. Moving tanks

8. If the helicopter has been severely damaged, your best strategy is to:
   a. Land the helicopter and wait until the end of the mission
   b. Kill as many enemies as possible
   c. Fly back to base following the waypoints
   d. Fly straight to base ignoring the waypoints

9. If the Gunner announces that there are numerous light enemy targets that need to quickly be eliminated you should consider:
   a. Increasing your salvo size
   b. Increasing your burst rate
   c. Rapidly firing the missiles
   d. Rapidly firing the rockets

10. The pilot should constantly monitor the altitude to make sure:
   a. The helicopter is not easily eliminated by enemy targets
   b. The helicopter is not easily detected by enemy radar
   c. The Gunner can readily fire the rockets
   d. The Pilot can readily fire the chain gun.

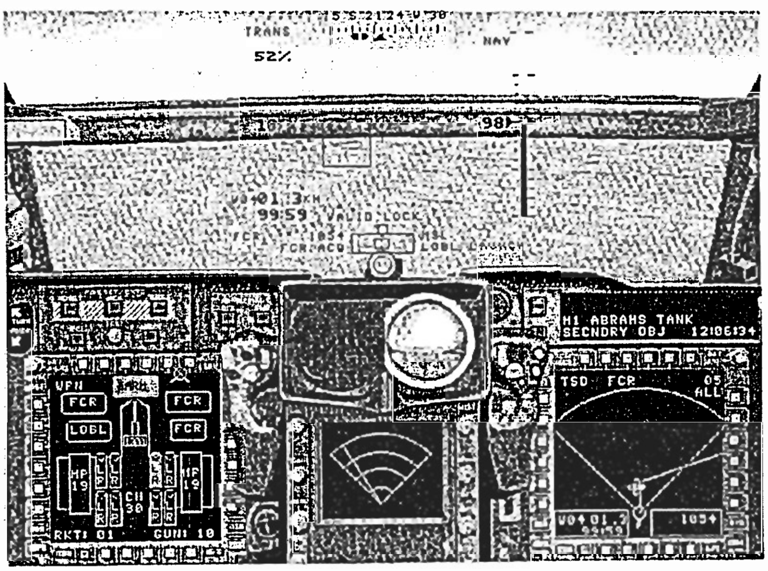
GUNNER KNOWLEDGE TEST

Below are questions regarding the Pilot's role, please circle the <u>most</u> correct answer.

1. When approaching a group of enemy targets and you see the following: two stationary primary enemy tanks, one moving primary tank, and a primary enemy tent, the best strategy would be to:
   - a. First eliminate the moving primary enemy tank with a missile, then eliminate the two stationary primary tanks with the missiles, and then use the chain gun to eliminate the primary enemy tent.
   - b. First eliminate the moving primary enemy tank with a missile, then eliminate the primary enemy tent with the chain gun, and then eliminate the two stationary primary enemy tanks with the missiles.
   - c. First eliminate the moving primary enemy tank with a missile, then eliminate the two stationary primary tanks with the rockets, and then use the chain gun to eliminate the primary enemy tent.
   - d. First eliminate the moving primary enemy tank with a missile, then eliminate the two stationary primary enemy tanks with the rockets, and then eliminate the primary enemy tent with the rockets.

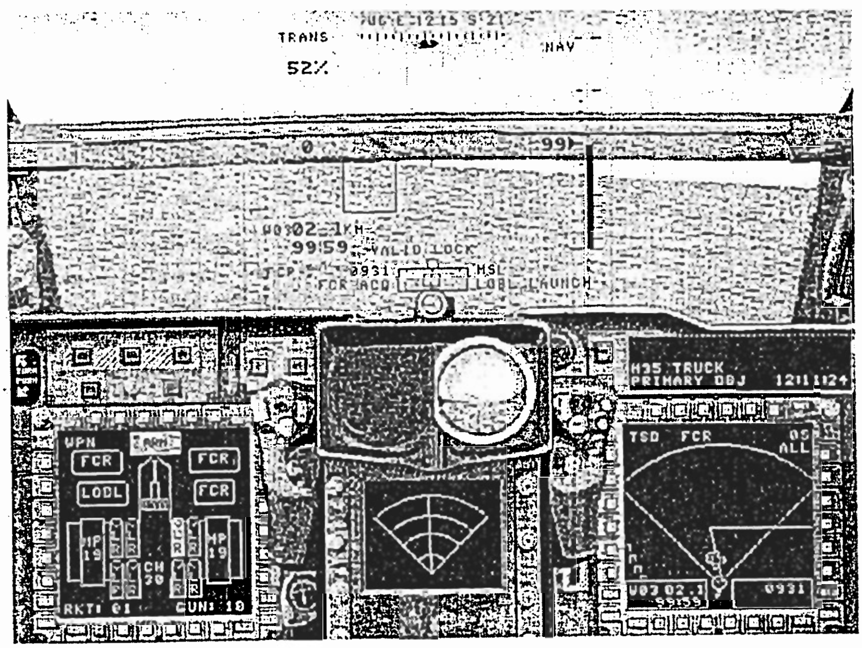
2. When you are approaching 1000 meters of an enemy guard tower you should:
   - a. Request for the pilot to fire the chain gun.
   - b. Request for the pilot to pull to a hover, so you can fire the rockets.
   - c. Request for the pilot to pull to a hover, so you can fire the missiles.
   - d. Fire the missiles as soon as you have a valid lock.

3. Using the image below, what can you conclude?



a. You are ready to fire the missiles.
b. You are NOT ready but will fire the missiles when ready.
c. You are ready to fire the rockets.
d. You are NOT ready but will fire the rockets when ready.

4. Imagine that you are monitoring the Pilot's performance. Based on the image below and the response options, what would you conclude about the Pilot's performance?

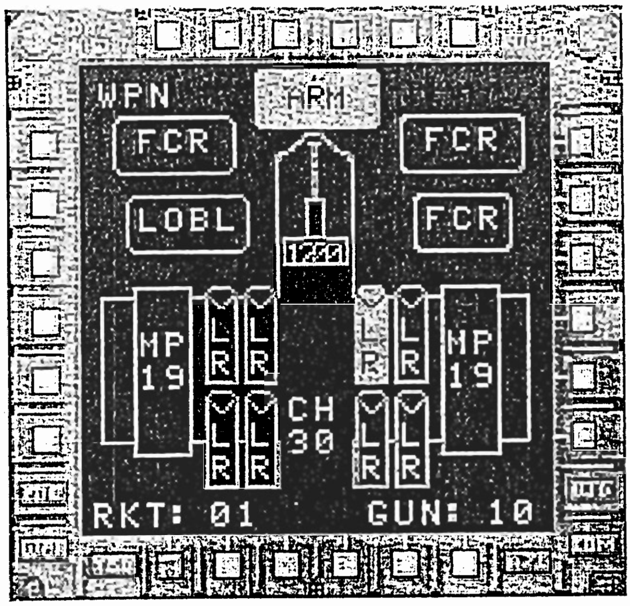


a. The Pilot should not and has not activated the hover hold.
b. The Pilot should not, but has, activated the hover hold.
c. The Pilot should, but has not, activated the hover hold.
d. The Pilot should and has activated the hover hold.

5. When engaging enemy targets which type of target should be eliminated first to avoid damage to your helicopter?
a. Stationary Tanks
b. SAM
c. AAA
d. Moving tanks

6. When eliminating primary objectives the best strategy to employ is:
a. Hover and use the rockets
b. Hover and use the chain gun
c. Use the missiles
d. Use the chain gun while flying by

7. Using the image below, what can you conclude about your weapons status?



a. you have 8 rockets, 1200 rounds of chain gun ammunition, and 19 missiles
b. you have 4 missiles, 19 rockets, and 1200 rounds of chain gun ammunition
c. you have 8 missiles, 1200 rounds of chain gun ammunition, and 38 rockets
d. you have 38 missiles, 8 rockets, and 10 chain gun rounds.

8. To determine whether a target is friendly, secondary, or a primary objective, you should refer to your:

a. Upfront Display
b. Tactical Situation Display
c. IHADSS
d. Weapons Page

9. Which weapon, indicated on the IHADSS, requires a "VALID LOCK" on targets?

a. Rockets
b. Chain gun
c. Machine gun
d. Missiles

10. Monitoring the altitude is the responsibility of:

a. The Pilot

b. The Gunner

c. There is no need to ever change the altitude

d. The Pilot and Gunner

APPENDIX F

TEAM TASK MENTAL MODEL GRID

INSTRUCTIONS:

Below are several descriptions of the "team task" aspects of flying the simulator. Using the scale below, please rate how related each aspect is to all of the others to complete the mission. For example, in the uppermost square, you would rate how **Maintaining Optimal Airspeed** is related to **Reaming Undamaged**. Rate all **Non-Shaded** boxes.

1	2	3	4	5	6	7	8	9
▼	▼	▼	▼	▼	▼	▼	▼	▼
Not Related								Very Related

Aspects:

1. **Maintaining Optimal Flight Altitude**
2. **Maintaining Optimal Airspeed**
3. **Positioning the Helicopter for Targeting**
4. **Firing Weapons**
5. **Navigating along the Waypoint Path**
6. **Remaining Undamaged**

	Maintaining Optimal Airspeed	**Positioning the Helicopter for Targeting**	**Firing Weapons**	**Navigating along the Waypoint Path**	**Remaining Undamaged**
Maintaining Optimal Flight Altitude					
Maintaining Optimal Airspeed					
Positioning the Helicopter for Targeting					
Firing Weapons					
Navigating Along the Waypoint Path					

APPENDIX G

COLLECTIVE EFFICACY

Using the scale below, rate how confident YOUR TEAM is in its ability to successfully and consistently accomplish each of the following gunner tasks:

1	2	3	4	5
▼	▼	▼	▼	▼
Not At All Confident	**A Little Confident**	**Somewhat Confident**	**Pretty Confident**	**Extremely Confident**

1. _____ Maintaining Optimal Flight Altitude
2. _____ Maintaining Optimal Airspeed
3. _____ Positioning the Helicopter for Targeting
4. _____ Firing Weapons
5. _____ Navigating along the Waypoint Path
6. _____ Remaining Undamaged

APPENDIX H

SELF-REPORT TRANSITION PROCESSES

The following questions ask you about your <u>team's</u> activities and experiences during the last planning session. Using the scale below, please rate the extent to which <u>your team</u> collectively engaged in each of the following behaviors <u>during this last planning session.</u>

1 ▼	2 ▼	3 ▼	4 ▼	5 ▼
No Extent	**Slight Extent**	**Moderate Extent**	**Large Extent**	**Great Extent**

1. _____ We tried to better understand the main objectives of the upcoming mission
2. _____ We thought about the environmental conditions (e.g., terrain) of the next mission
3. _____ We paid close attention to the weapons available to use in the next mission
4. _____ We identified specific mission goals for our team to accomplish
5. _____ We prioritized the importance of different goals for our team
6. _____ We formulated strategies for accomplishing our goals
7. _____ We developed alternative courses of action for accomplishing our goals

SELF-REPORT ACTION PROCESSES

The following questions ask you about your <u>personal</u> activities and experiences during the last planning session. Using the scale below, please rate the extent to which <u>you personally</u> engaged in each of the following behaviors <u>during this last flight mission.</u>

1 ▼	2 ▼	3 ▼	4 ▼	5 ▼
No Extent	**Slight Extent**	**Moderate Extent**	**Large Extent**	**Great Extent**

1. _____ We focused on how well out team progressed toward accomplishing our goals
2. _____ We paid close attention to what I needed to do at each stage of the mission
3. _____ We monitored the physical condition of our helicopter
4. _____ We focused my attention on how many weapons we had left
5. _____ We monitored the approaching of primary and secondary targets
6. _____ We paid close attention to the terrain we were flying in
7. _____ We provided verbal feedback to my flight partner
8. _____ We coached my flight partner to help him/her accomplish his/her tasks
9. _____ We timed my own actions to correspond with my flight partner's actions
10. ____ We focused on coordinating well with my flight partner
11. ____ We communicated my actions to my flight partner when it was necessary

APPENDIX I

BARS Team Process Rating Scale (Example)
MISSION ANALYSIS

Definition: Interpretation and evaluation of the team's mission, including identification of the mission's main tasks as well as the operative environmental conditions and team resources available for mission execution.

Examples:
- Gathering appropriate and relevant information
- Understanding the overall MTS mission and the team's contributions to the mission
- Identifying the main tasks and environmental contingencies of the mission
- Prioritizes the mission objectives and required tasks
- Allocating team resources to accomplish each task
- Communicating the mission plan to all team members

Complete skill	5	Team members fully understood their individual/flight team's roles and task responsibilities; they also fully understood the individual or flight team's contribution to the overall mission.
Very much skill	4	
Adequate skill	3	Team members understood their individual/flight team's roles and task responsibilities; but did not understand the individual or flight team's contribution to the overall mission.
Some skill	2	
Hardly any skill	1	Team members did not understand their individual/flight team's roles and task responsibilities; nor did they understand the individual or flight team's contribution to the overall mission. They had no idea what their mission objectives were.

REFERENCES

Alliger, G. M., & Janak, E. A. (1989). Kirkpatrick's levels of training criteria: Thirty years later. *Personnel Psychology, 42,* 331–342.

Austin, J. T., & Vancouver, J. B. (1996). Goal constructs in psychology: Structure, process, and content. *Psychological Bulletin, 120,* 338-375.

Baldwin, T., & Ford, J. K. (1988). Transfer of training: A review and direction for future research. *Personnel Psychology, 41,* 63-105.

Bandura, A. (1997). *Self-efficacy: The exercise of control.* New York: Freeman.

Barnett, S. M. & Ceci, S. J. (2002). When and where do we apply what we learn? A Taxonomy for far transfer. *Psychological Bulletin, 128,* 612-637.

Baron, R. M., & Kenny, D. A. (1986). The moderator-mediator variable distinction in social psychological research: Conceptual, strategic and statistical considerations. *Journal of Personality and Social Psychology, 51,* 1173-1182.

Bliese, P. D. (2000). Within-group agreement, non-independence, and reliability: Implications for data aggregation and analyses. In K. J. Klein and S. W. J. Kozlowski (Eds.), *Multilevel theory, research, and methods in organizations: Foundations, extensions, and new directions,* pp. 349-381. San Francisco, CA: Jossey-Bass.

Blickensderfer, E., Cannon-Bowers, J. A. & Salas, E. (1997). Theoretical bases for team self-corrections: Fostering shared mental models. In M. M. Beyerlein & D. A. Johnson (Eds.), *Advances in interdisciplinary studies of work teams* (Vol. 4, pp. 249-279). Greenwich, CT: JAI Press.

Borgatti, S., Everett, M. G., & Freeman, L. C. (2002). *UCINET IV networks analysis software*. Columbia, SC: Analytic Technologies.

Bowers, C. A., Braun, C. C., & Morgan, B. B., Jr. (1997). Team workload: Its meaning and measurement. In M. T. Brannick, E. Salas, & C. Prince (Eds.), *Team performance and measurement: Theory, methods, and applications (pp. 85-108).* Mahwah, NJ: Lawrence Erlbaum Associates.

Brannick, M. T. & Prince, C. (1997). An overview of team performance measurement. In M. T. Brannick, E. Salas, & C. Prince (Eds.), *Team performance assessment and measurement*, pp. 3-18. Mahwah, NJ: Lawrence Erlbaum Associates.

Brannick, M. T., Roach, R. M., & Salas, E. (1993). Understanding team performance: A multimethod study. *Human Performance, 6,* 287-308.

Cannon-Bowers, J.A., Salas, E. & Converse, S.A. (1990). Cognitive psychology and team training: Shared mental models in complex systems. *Human Factors Bulletin, 33,* 1-4.

Cannon-Bowers, J.A., Salas, E. & Converse, S.A. (1993). Shared mental models in expert team decision-making. In N. J. Castellan (Ed.), *Individual and group decision making* (pp. 221-246). Hillsdale, NJ: LEA.

Cannon-Bowers, J. A., Tannenbaum, S. I., Salas, E., & Volpe, C. E. (1995). Defining competencies and establishing team training requirements. In R. A. Guzzo & E. Salas (Eds.), *Team effectiveness and decision making in organizations* (pp. 333-380). San Francisco, CA: Jossey-Bass.

Campbell, D. T., & Fiske, D. W. (1959). Convergent and discriminate validation by the multitrait-multimethod method matrix. *Psychological Bulletin, 56,* 81-105.

Campion, M. A., Medsker, G. J., & Higgs, A. C. (1993). Relations between work group characteristics and effectiveness: Implications for designing effective work groups. *Personnel Psychology, 46,* 823-850.

Chan, D. 1998. Functional relations among constructs in the same content domain at different levels of analysis: A typology of composition models. *Journal of Applied Psychology, 83,* 234-246.

Chen, G., & Bliese, P. D. (2002). The role of different levels of leadership in predicting self and collective efficacy: Evidence for discontinuity. *Journal of Applied Psychology, 87,* 549-556.

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

Driskell, J. E. & Salas, E. (1992). Can you study real teams in contrived settings? The value of small group research to understanding teams. In R. W. Swezey & E. Salas (Eds.), *Teams: Their training and performance,* 101-124. Toronto, Canada: Ablex Publishing.

Entin, E. E., & Serfaty, D. (1999). Adaptive team coordination. *Human Factors, 41,* 312-325.

Ford, J. K., Smith, E., Weissbein, D., Gully, S., & Salas, E. (1998). The influence of goal orientation, metacognitive activity, and practice strategies on learning outcomes and transfer. *Journal of Applied Psychology, 83,* 218-233.

Ford, J. K., & Weissbein, D. A. (1997). Transfer of training: An updated review and analysis. *Performance Improvement Quarterly, 10,* 22-41.

Gaddy, C. D., & Watchel, J. A. (1992). Team skills in nuclear power plant operations. In R. W. Swezey & E. Salas (Eds.), *Teams: Their training and performance,* 379-396. Norwood, NJ: Ablex.

Gersick, C. J. G. (1988). Time and transition in work teams: Toward a new model of group development. *Academy of Management Journal, 42,* 138-152.

Gist, M. E., Locke, E. A., & Taylor, M. S. (1987). Organizational behavior: Group structure, process, and effectiveness. *Journal of Management, 13*, 237-257.

Gully, S. M., Incalcaterra, K. A., Joshi, A., & Beaubien, J. M. (in press). A meta-analysis of team-efficacy, potency, and performance: Interdependence and level of analysis as moderators of observed relationship. *Journal of Applied Psychology.*

Guzzo, R. A., & Dickson, M. W. (1996). Teams in organizations: Recent research on performance and effectiveness. *Annual Review of Psychology, 47,* 307-338.

Hackman, J. R. (1987). The design of work teams. In J. W. Lorsch (Ed.), *Handbook if organizational behavior (*pp. 315-342). Englewood Cliffs, NJ: Prentice-Hall.

Hackman, J. R., & Morris, C. G. (1975). Group tasks, group interaction process, and group performance effectiveness: A review and proposed integration. In *Advances in experimental social psychology.* (Ed.), Berkowitz. New York: Academic Press.

Hinsz, V. B., Tindale, R. S., & Vollrath, D. A. (1997). The emerging conceptualization of groups as information processors. *Psychological Bulletin, 121,* 43-64.

Kanfer, R., & Kanfer, F. H. (1991). Goals and self-regulation: Applications of theory to work settings. In M. L. Maehr & P. R. Pintrich (Eds.), Advances in Motivation and Achievement (Vol. 7, pp. 287-326). Greenwich, CT: JAI Press.

Kenny, D. A., Kashy, D. A., & Bolger, N. (1998). Data analysis in social psychology. In D. Gilbert, S. Fiske, & G. Lindzey (Eds.), *The handbook of social psychology* (Vol. 1, 4th ed., pp. 233-265). Boston, MA: McGraw-Hill.

Kirkpatrick, D. L. (1976). Evaluation of training. In R. L. Craig (Ed.), *Training and development handbook: A guide to human resource development* (2nd ed., pp. 1-27). New York: McGraw-Hill.

Kirkpatrick, D. L. (1987). Evaluation of training. In R. L. Craig (Ed.), *Training and development handbook: A guide to human resource development* (3rd ed., pp. 301-319). New York: McGraw-Hill.

Klimoski, R. J., & Mohammed, S. (1994). Team mental model: Construct or metaphor? *Journal of Management, 20,* 403-437.

Kozlowski, S. W. J. (1998). Training and developing adaptive teams: Theory, principles, and research. In J. A. Cannon-Bowers, & E. Salas (Eds.), *Making decisions under stress: Implications for individual and team training* (pp. 115-153). Washington, DC: American Psychological Association.

Kozlowski, S. W. J., Bell, B. S. (2003). Work groups and teams in organizations. In W. C. Borman, D. R. Ilgen, & R. J. Klimoski (Eds.), *Comprehensive Handbook of Psychology (Vol. 12): Industrial and Organizational Psychology*. New York: Wiley.

Kozlowski, S. W. J., Gully, S. M., Brown, K. G., Salas, E., Smith, E. M., & Nason, E. R. (2001). Effects of training goals and goal orientation traits on multidimensional training outcomes and performance adaptability. *Organizational Behavior and Human Decision Processes, 85,* 1-31.

Kozlowski, S. W. J., Gully, S. M., McHugh, P. P., Salas, E., & Cannon-Bowers, J. A. (1996). A dynamic theory of leadership and team effectiveness: Developmental and task contingent leader roles. *Research in Personnel and Human Resources Management, 14,* 253-305.

Kozlowski, S. W. J., Gully, S. M., Nason, E. R., & Smith, E. M. (1999). Developing adaptive teams: A theory of compilation and performance across levels and time. In D. R. Ilgen & E. D. Pulakos (Eds.), *The changing nature of work performance: Implications for staffing, personnel actions, and development*, pp. 240-292. San Francisco, CA: Jossey-Bass.

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

Kraiger, K., Ford, J. K., & Salas, E. (1993). Application of cognitive, skill-based, and affective theories of learning outcomes to new methods of training evaluations [Monograph]. *Journal of Applied Psychology, 78,* 311-328.

Kraiger, K., & Wenzel, L. H. (1997). Conceptual development and empirical evaluation of measures of shared mental models as indicators of team effectiveness. In M. T. Brannick, E. Salas, & C. Prince (Eds.), *Team performance assessment and* *measurement: Theory, methods, and application (pp. 63-84).* Mahwah, NI: Erlbaum.

Leavitt, H.J. (1975). Suppose we took groups seriously. In Cass & Zimmer (Eds.), *Man and work in society.* New York: Van Nostrand Reinhold.

Lewin, K. (1964). "Problems of Research in Social Psychology." In D. Cartwright (ed.), *Field theory in social science.* New York: Harper.

Lindsley, D. H., Brass, D. J., & Thomas, J. B. (1995). Efficacy-performance spirals: A multi-level perspective. *Academy of Management Review, 20,* 645-678.

Longbow2 (computer software). (1997). Janes Combat Simulations.

Marks, M. A. (1999). A test of the impact of collective efficacy in routine and novel performance environments. *Human Performance, 12,* 295-310.

Marks, M. A. (2000). A critical analysis of computer simulations for conducting team research. *Small Group Research, 31,* 653-675.

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

Marks, M. A., Sabella, M. J., Burke, C. S., & Zaccaro, S. J. (2002). The impact of cross-training on team effectiveness. *Journal of Applied Psychology, 87,* 3-13.

Marks, M. A., Zaccaro, S. J., & Mathieu, J. E. (2000). Performance implications of leader briefings and team-interaction training for team adaptation to novel environments. *Journal of Applied Psychology, 85,* 971-986.

Mathieu, J. E. (2002). *Alternative measures and operationalizations of shared mental models and their relationships to air traffic controllers' effectiveness* (Contract No. DAAH04-96-C-0086). Columbus, OH: Battelle Columbus Division.

Mathieu, J. E., & Button, S. B. (1992). An examination of the relative impact of normative -information and self-efficacy on personal goals and performance over time. *Journal of Applied Social Psychology, 22,* 1758-1775.

Mathieu, J. E., Heffner, T. S., Goodwin, G. F., Salas, E., & Cannon-Bowers, J. A. (2000). The influence of shared mental models on team process and performance. *Journal of Applied Psychology, 85,* 971-986.

McGrath, J. E. (1964). *Social psychology: A brief introduction.* New York: Holt, Rinehart, & Winston.

McGrath, J. E. (1993). Introduction: The JEMCO workshop– description of a longitudinal study. *Small Group Research, 24,* 285-306.

McIntyre, R. M., & Salas, E. (1995). Measuring and managing for team performance: Emerging principles from complex environments. In R. Guzzo & E. Salas (Eds.) *Team effectiveness and decision making in organizations.* (pp. 9-45). San Francisco, CA: Jossey-Bass.

Mesch, D. J., Farh, J, Podsakoff, P. M. (1994). Effects of feedback sign on group goal setting, strategies, and performance. *Group and Organization Management, 19,* 309-333.

Mohammed, S., Klimoski, R., & Rentsch, J. R. (2000). The measurement of team mental models: We have no shared schema. *Organizational Research Methods, 3,* 123-165.

Orasanu, J. (1999). *Shared mental models and crew decision making* (Tech Rep. No 46). Princeton, NJ: Princeton University, Cognitive Sciences Laboratory.

Orvis, K. L., Zaccaro, S. J., Cho, S. M., Smith, J. W., & Mathieu, J. E. (2000). *Cognitive and behavioral task analysis: An individual and team level analysis for a complex task.* AFOSR Technical Report.

Pedhazur, E.J. (1997). *Multiple regression in behavioral research: Explanation and prediction* (3rd ed.). New York: Harcourt Brace College Publishers.

Prussia, g. E., & Kinicki, A. J. (1996). A motivational investigation of group effectiveness using social-cognitive theory. *Journal of Applied Psychology, 81,* 187-198.

Rouse, W. B., & Morris, N. M. (1986). On looking into the black box: Prospects and limits in the search for mental models. *Psychological Bulletin, 100,* 349-363.

Rousseau, D. M. (1985). Issues of level in organizational research: Multi-level and cross-level perspectives. *Research in Organizational Behavior, 7,* 1-37.

Salas, E., Bowers, C.A., & Edens, E. (Eds.). (2001). *Improving teamwork in organizations: Applications of resource management training*. Hillsdale, NJ: LEA, Inc.

Salas, E., & Cannon-Bowers, J. A. (2001). The science of training: A decade of progress. *Annual Review of Psychology, 52,* 471-499.

Salas, E., Dickinson, T. L., Converse, S. A., & Tannenbaum, S. I. (1992). Toward an understanding of team performance and training. In R. W. Swezey & E. Salas (Eds.), *Teams: Their training and performance* (pp. 3-29). Norwood, NJ: Albex.

Serfaty, D., Entin, E. E., & Johnston, J. H. (1998). Team coordination training. In J. A. Cannon-Bowers, & E. Salas (Eds.), *Making decisions under stress: Implications for individual and team training.* (pp. 221-245). Washington, D.C.: American Psychological Association.

Smith, J. W. (2000). The influence of leader mood on team process and performance. Unpublished manuscript, The Pennsylvania State University.

Smith-Jentsch, K. A., Johnston, J. H. & Payne, S. C. (1998). Measuring team-related expertise in complex environments. In J. A. Cannon-Bowers, & E. Salas (Eds.), *Making decisions under stress: Implications for individual and team training.* (pp. 299-311). Washington, D.C.: American Psychological Association.

Sobel, M. E. (1982). Asymptotic confidence intervals for indirect effects in structural equation models. In S. Leinhardt (Ed.), *Sociological Methodology 1982* (pp. 290-312). Washington DC: American Sociological Association.

Steiner, I. D. (1972). Group process and productivity. New York: Academic Press.

Stout, R. J., Cannon-Bowers, J. A., & Salas, E. (1996). The role of shared mental models in developing team situational awareness: Implications for training. *Training Research Journal, 2,* 86-116.

Stout, R. J., Cannon-Bowers, J. A., & Salas, E., & Milanovich, D. M. (1999). Panning, shared mental models, and coordinated performance: An empirical link is established. *Human Factors, 41,* 61-71.

Sundstrom, E. (1999). The challenges of supporting work team effectiveness. In E. Sundstrom & Associates (Eds.), *Supporting work team effectiveness: Best management practices for fostering high performance* (pp. 3-23). San Francisco, CA: Jossey-Bass.

Tesluk, P., Mathieu, J. E., Zaccaro, S. J. (1997). In: *Brannick, Michael T. (Ed);Salas, Eduardo (Eds.), Team performance assessment and measurement: Theory, methods, and applications* (pp. 197-224). Mahwah, NJ: Lawrence Erlbaum Associates.

Weaver, J. L., Bowers, C. A., Salas, E., & Cannon-Bowers, J. A. (1995). Networked simulations: New paradigms for tem performance research. *Behavior Research Methods, Instruments, & Computers, 27,* 12-24.

Webber, S. S., Chen, G., Payne, S. C., Marsh, S. M., & Zaccaro, S. J. (2000). Enhancing team mental model measurement with performance appraisal practices. Organizational Research Methods, 3, 307-322.

Weldon, E. & Weingart, L. R., (1993). Group goals and group performance. *British Journal of Social Psychology, 32*, 307-334.

Wood, R. E. (1986). Task complexity: Definition of the construct. *Organizational Behavior and Human Decision Processes, 37,* 60-82.

Zaccaro, S. J., Blair, V., Peterson, C., & Gilbert, J. A. (1992). *Collective control: Causes and consequences of group members' beliefs about group competence.* Manuscript submitted for publication.

Zaccaro, S. J., Blair, V., Peterson, C., & Zazanis, M. (1995). Collective efficacy. In J. E. Maddux (Ed.), *Self-efficacy, adaptation, and adjustment: Theory research, and application* (pp. 305-328).

Zaheer, S., Albert, S., & Zaheer, A. (1999). Time scales and organizational theory. *Academy of Management Review, 24*, 725-741.