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Leadership in Multiteam Systems

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This study examined 2 leader functions likely to be instrumental in synchronizing large systems of teams (i.e., multiteam systems [MTSs]). Leader strategizing and coordinating were manipulated through training, and effects on functional leadership, interteam coordination, and MTS performance were examined. Three hundred eighty-four undergraduate students participated in a laboratory simulation modeling a 3-team MTS performing an F-22 battle simulation task ($N = 64$ MTSs). Results indicate that both leader training manipulations improved functional leadership and interteam coordination and that functional leader behavior was positively related to MTS-level performance. Functional leadership mediated the effects of both types of training on interteam coordination, and interteam coordination fully mediated the effect of MTS leadership on MTS performance.

Keywords: teams, multiteam, leadership, coordination

Multiteam systems (MTSs) are a new and emerging organizational form that present unique challenges for leadership. *MTSs* are formally defined as “two or more teams that interface directly and interdependently in response to environmental contingencies toward the accomplishment of collective goals” (Mathieu, Marks, & Zaccaro, 2001, p. 290). MTSs are tightly coupled constellations of teams offering specialized skills, capabilities, and functions aimed at attaining goals too large to be performed by a single team. MTSs are found in many settings where complex tasks require multiple teams and often diverse expertise. An emergency response MTS requires the coordinated effort of teams of firefighters, EMTs, and surgical units. Successfully bringing a new product to market necessitates marketing, manufacturing, and design teams working in tandem. And oftentimes governmental decision making is the result of long-term collaboration between architects, city planners, municipalities, and various governmental agencies. However, the complexity of MTSs presents clear challenges for leaders as they attempt to coordinate multiple team efforts. How do leaders effectively guide the efforts of multiple teams simultaneously working toward both proximal team goals and distal MTS goals? In this study, we extend propositions regarding the team–leader interface to advance and test a model of multiteam leadership in which leaders facilitate cross-team interaction in the context of a highly interdependent MTS performing an F-22 flight simulation task. This research answers Gist, Locke, and Taylor’s (1987) call to “extend beyond the study of groups in isolation to the study of groups as part of a system of organizational activity” (p. 253).

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Leading Teams and MTSs

Functional leadership theory is especially useful in elaborating the role of the team leader. The core assertion is that the leader’s job is “to do, or get done, whatever is not being adequately handled for group needs” (McGrath, 1962, p. 5). This view of leadership is implied by both the systems view of organizations (Katz & Kahn, 1978) and the related input–process–outcome (I-P-O) team effectiveness model (McGrath, 1984) that suggest inputs like leadership improve system outcomes by shaping effective interaction processes among interdependent system components. Rather than specifying specific behaviors constituting leadership, the functional approach views leadership as a role. The leader’s role is to translate the demands and needs of the environment, task, and team members into a pattern of leader behavior that will enable the team to be successful (Zaccaro, Rittman, & Marks, 2001).

The specifics of how leaders foster effective teamwork is informed by two theoretical perspectives. First, Kozlowski and colleagues (Kozlowski, Gully, McHugh, Salas, & Cannon-Bowers, 1996; Kozlowski, Gully, Salas, & Cannon-Bowers, 1996) extended functional leadership theory to the team context and suggested that effective team leaders align their behavioral inputs with the developmental needs of the team. Progressively, team leaders initially serve mentoring and instructional functions early in team formation and development and later serve coaching and facilitating roles after team members have developed requisite competencies. Early in team development, leaders need to form the team and develop individual members’ capabilities, whereas the later functions require leaders to focus efforts on team building. These functions were succinctly described by Bell and Kozlowski (2002) as team development and team performance management.

Second, a recent theoretical extension to team process theory posits that teams cycle through recurring transition and action phases (Marks, Mathieu, & Zaccaro, 2001). Building on extant I-P-O models, team inputs result in outcomes by way of transformation processes within both the transition and action phases of performance episodes, and the requisite processes differ in each of the two phases. In transition phases, teams need processes like goal setting, mission analysis, and strategy development. The outcomes of these processes (e.g., plan quality) in turn serve as inputs to the subsequent action phase in which essential processes include coordination and backup behavior.

The two models are complementary in their depiction of team cycles and leader behaviors. Although Kozlowski, Gully, McHugh, et al.'s (1996) and Kozlowski, Gully, Salas, and Cannon-Bowers's (1996) theory delineates specific leader behaviors developmentally needed to facilitate performance from the inception of a team to its maturity, Marks et al.'s (2001) theory further specifies the processes that leadership needs to facilitate within phases of team task accomplishment in developed teams. Taken together, these theories propose that after teams have progressed through initial formative stages, effective leaders need to serve coaching and facilitation roles that will enhance transition and action processes within teams. This integrated perspective of team leadership suggests MTS leadership will be effective to the extent that it shapes effective MTS transition processes (i.e., strategizing) and action processes (i.e., coordinating). Although the functional roles ought not differ between teams and MTSs, the target of their actions likely would.

Because MTSs are by definition "teams of teams," leader functions should be homologous across team and MTS levels of analysis (Klein & Kozlowski, 2000). What then is different about leading an MTS? Effective *team* leadership requires synchronization of interdependent team members' actions. Effective *multiteam* leadership balances the management of internal teamwork with a significant emphasis on cross-team interdependencies in response to task and performance environment demands (Marks, DeChurch, Mathieu, Panzer, & Alonso, 2005). To apply Ancona and Chong's (1999) notion of entrainment to MTSs, leaders need to ensure that, in addition to teams entraining to some external pacer, teams also need to temporally align their efforts with those of other systems (i.e., teams) with whom they are tightly coupled. Without the coordinated effort of all teams in the system, it is possible for component teams to be individually successful and yet for the system to fail. Thus, MTS leaders are thought to serve the same functional roles in leading MTSs, but the level of focal processes differs. Table 1 presents a summary of the conceptual underpinnings of MTS leadership. As Table 1 shows, we used Bell and Kozlowski's (2002) team leadership functions as a starting point for our elaboration of MTS leadership functions. Key components of MTS leadership are discussed in the following sections.

Mathieu et al. (2001) articulated that leadership in MTSs contains the added complexity of requiring a dual focus on within-team and cross-team leader functions. Whereas within-team functions maintain synchronization of team members toward proximal team goals, the cross-team function requires leaders to monitor and maintain the alignment of various teams; it is this focus of the leader that ensures individually successful teams work in concert to attain higher level collective outcomes. In the current study, we examined the role of formally appointed leaders who serve this cross-team alignment function. Our MTS task included two distinct interdependent teams, each with one formal leader. In addition, the two leaders were collectively responsible for the cross-team leadership function. *Functional MTS leadership* was defined

Table 1
Multiteam Leadership

Team leadership dimension (Bell & Kozlowski, 2002)	Trained MTS leadership dimension	Phase needed	Description of trained MTS leadership dimension	ACES example of trained MTS leadership dimension
Team development	MTS strategy development	Transition phase	Acquire information relevant to interteam interdependence demands of task environment	Examine mission briefing; observe that at Base 1 there are threatening air targets and nonthreatening ground targets
			Organize and evaluate information regarding overall mission and each team's contribution to overall MTS mission	Develop interaction plan for Base 1 that instructs the air team to clear their targets first while the ground team flies below enemy radar; then after the enemy air targets are destroyed, the ground team "pops up"and destroys the enemy ground targets
			Communicate information to MTS teams in the form of an MTS interaction plan	Inform MTS teams of the interdependence demands of Base 1 and the required interteam interaction
Team performance management	MTS coordinating	Action phase	Monitor needs and requirements of each component team related to interaction with other MTS component teams	As the ground team approaches Base 1, check to see whether the air team has cleared all enemy planes
			Communicate information to component teams about needed interactions with other teams	Instruct the ground team to slow down and decrease their altitude while they wait for the air team to clear an enemy plane

Note. MTS = multiteam system; ACES = Air Combat Effectiveness Simulation.

here as a set of actions engaged in by formally appointed leaders that enable and direct teams in collectively working together.

MTS Leader Strategizing

Planning involves the "development of alternative courses of action for mission accomplishment" (Marks et al., 2001, p. 365). At the team level, good strategies contain information about "member roles and responsibilities, the order and timing of actions, and how task-related activities should be executed" (Marks et al., 2001, p. 365). As teams are composed of individuals, team strategies specify what individual team members should be doing during task accomplishment. MTSs, in contrast, are composed of teams, and so effective MTS strategies need to specify the order and timing of team actions and how each team's task-related activities should be executed in synchronicity with other teams working interdependently toward a common goal. Leader teams play an important part in strategy development because it is often the responsibility of leadership to develop plans (Fleishman et al., 1991). In fact, planning for integration processes is one clear way leaders fulfill Bell and Kozlowski's (2002) first team leader function, "the development and shaping of team process" (p. 17).

Research on planning has found teams usually do not plan on their own (Hackman, Brousseau, & Weiss, 1976; Weingart, 1992), placing a premium on leader planning actions. In order to examine the effects of specific components of leader team strategizing, leader teams were trained to design plans targeted at orchestrating component team efforts. Weingart (1992) divided team planning into three categories: planning for supplies, planning for individual roles, and planning for coordination (group planning). We build on this framework by studying planning for multiteam coordination. Table 1 details leader actions needed to fulfill this function. These actions include (a) acquiring information about the interteam interdependence demands of the task environment, (b) organizing and evaluating information regarding the overall mission and each team's contribution to the overall MTS mission, and (c) communicating information to MTS teams in the form of an MTS interaction plan.

Consistent with the role of MTS leaders as integrators of MTS actions, training MTS leaders to develop plans focused on synchronizing component team actions (MTS leader strategizing) should result in better functional MTS leadership. Leaders trained to develop effective MTS strategy will focus on external task demands that create interdependencies among teams in the MTS and then generate strategies that best integrate the efforts of component teams in order to capitalize on their synergy to achieve collective success.

> *Hypothesis 1:* Leaders trained to develop MTS strategy will exhibit more functional MTS leadership behavior than leaders not trained to develop MTS strategy.

MTS Leader Coordinating

During action phases, leaders should engage in behaviors that will directly enable the smooth synchronization of interdependent actions among teams. These behaviors are somewhat specific to the task environment but generally encompass activities that allow component teams to maintain awareness of the activities of interdependent teams. Such behaviors were prescribed by Kozlowski, Gully, McHugh, et al. (1996) to "provide situation assessment updates to team members, provide information on how the team is doing, what it should be doing, and how it might adjust to the changing situation," and "provide information on what events might be expected to occur in the near future" (p. 280). Other works on leadership in team contexts have identified similar behaviors termed *monitoring* (Komaki, Desselles, & Bowman, 1989), *coaching and assisting* (Hackman & Walton, 1986), *intervention* (Kozlowski, Gully, McHugh, et al., 1996), *facilitating process* (Fleishman et al., 1991), and *event management* (Morgeson, 1997). Finally, these behaviors are in line with Bell and Kozlowski's (2002) second team leader function, "the monitoring and management of ongoing team performance" (p. 17).

Coordinating behavior can be broadly described as any activities that enable subunits to effectively time and sequence interdependent actions. The MTS leader coordinating function was defined here as (a) monitoring needs and requirements of component teams related to their interaction with other MTS component teams, and (b) communicating information to component teams about needed interactions with other teams. Table 1 presents specific examples of leader actions constituting MTS coordinating. Training leaders to monitor and communicate information relevant to interunit interaction should result in more effective functional MTS leadership.

> *Hypothesis 2:* MTS leaders trained to engage in MTS coordinating will exhibit more functional MTS leadership behavior than leaders not trained to engage in MTS coordinating.

MTS Process

Though the specific behaviors included under the term *team process* have varied across studies, coordination captures the essence of combining individual efforts toward a collective goal, and so in this study we examined the effects of leader behaviors on this essential process. Most definitions of coordination capture the elements of interdependent tasks being performed with synchronicity (Zalesny, Salas, & Prince, 1995). Marks et al. (2001) defined team coordination as "the process of orchestrating the sequence and timing of interdependent actions" (pp. 367–368). Coordination at the MTS level can be defined as aligning the sequencing and timing of interdependent actions among teams. Training MTS leaders to develop strategies that focus on interteam activities during transition periods and that facilitate coordinated interteam activities during action phases should result in more effective interteam coordination process.

> *Hypothesis 3:* MTSs whose leaders are trained to develop MTS strategy will exhibit more effective interteam coordination process than those whose leaders are not trained to develop MTS strategy, and the relationship will be mediated by functional MTS leadership behavior.

> *Hypothesis 4:* MTSs whose leaders are trained to enact MTS coordinating will exhibit more effective interteam coordination process than those whose leaders are not trained to enact MTS coordinating, and the relationship will be mediated by functional MTS leadership behavior.

MTS Performance

Team-level research has shown processes like coordination are essential when members are interdependent (Jehn & Shah, 1997; Mathieu, Heffner, Goodwin, Salas, & Cannon-Bowers, 2000). Lord and Rowzee (1979) found leader coordinating behavior improved team performance when team members were interdependent. Likewise, in MTSs whose component teams are highly interdependent, smooth synchronization of team actions should enhance the performance of the overall MTS. Leader behavior should impact overall system performance to the extent that it facilitates smooth interaction among system components, or teams.

Ancona and Caldwell (1992) examined the relationship between external team coordinating behaviors and team-level performance in a field study of new product development teams and found task-coordinator activities were positively related to four external measures of group performance. Similarly, Denison, Hart, and Kahn (1996) supported a model of cross-functional team effectiveness in which coordination with other teams was included as a contextual factor impacting team-level process. Although these studies underscore the importance of interunit coordination to the performance of individual teams, they did not address the importance of interunit coordination to higher level collective outcomes.

The organizational theory literature provides some evidence linking interteam coordination to organizational performance. Pinto, Pinto, and Prescott (1993) found perceived cooperation among health care functional units related positively to perceptions of task performance. When teams are interdependent such that the goals of multiple teams contribute to a larger system goal and/or one team's goal accomplishment is prerequisite to another team's performance, interteam coordination is critical. Otherwise, it is conceivable for component teams to be individually successful and yet for the system to fail. It follows that an essential function of leadership in MTSs is to engage in behaviors that lead to effective interteam coordination process, and thereby improve MTS-level performance. Figure 1 illustrates the conceptual model being tested.

> *Hypothesis 5:* MTS functional leadership behavior will positively predict MTS performance, and the relationship will be mediated by interteam coordination process.

Just as individual team members' actions contribute to team performance, we expected intrateam coordination to predict MTS performance. However, a central notion of MTS theory is that although MTSs are composed of teams, effective process among interdependent subunits is critical for effectiveness (Mathieu et al., 2001). Consistent with this theoretical proposition, we expected intrateam process to predict MTS performance, and MTS or interteam process to add incrementally to the prediction of performance beyond the effects of within-team processes.

> *Hypothesis 6:* Interteam coordination will add uniquely to the prediction of MTS performance beyond both intrateam coordination process and team-level performance.

Method

Participants and Design

Participants included 384 undergraduate psychology and business students from a large southeastern university. Participants formed 64 six-

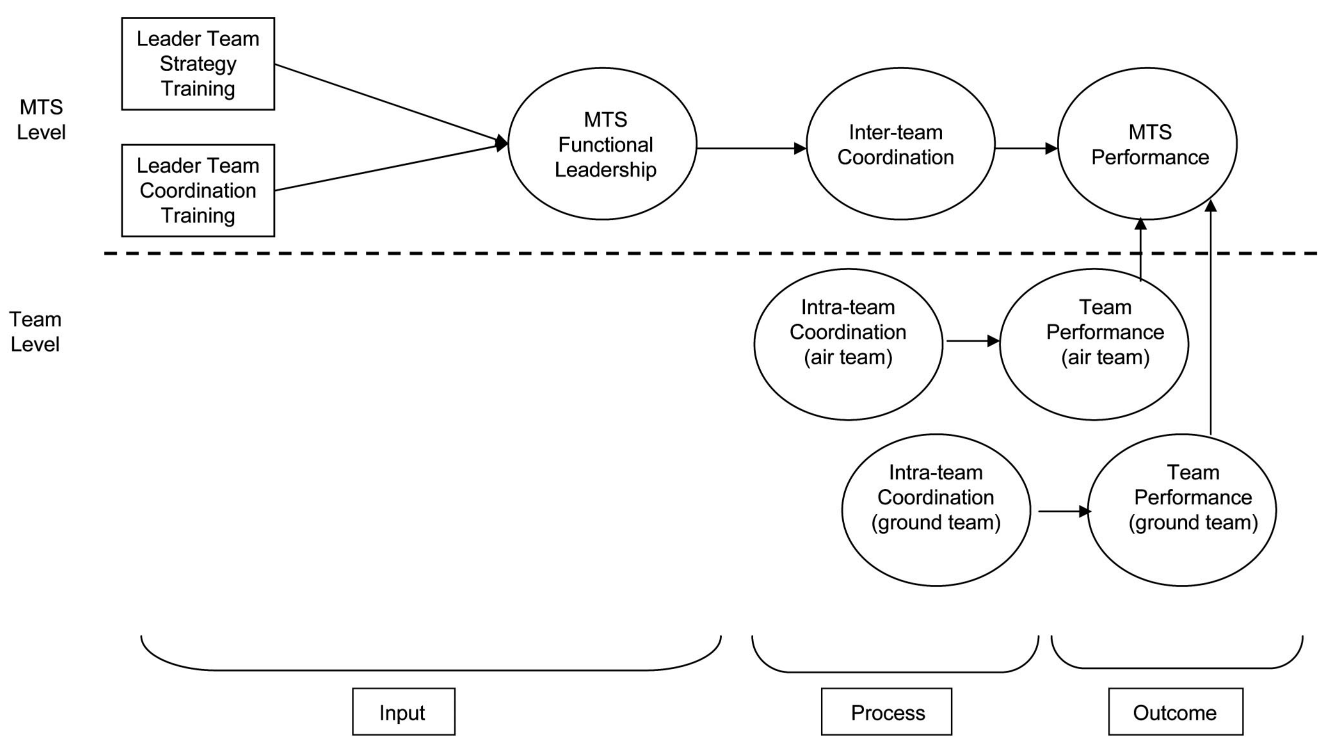

Figure 1. Summary of proposed relationships between multiteam system (MTS) leadership, interteam coordination, and MTS performance.

person MTSs; each MTS was tested in a separate session. A 2 (MTS strategy training vs. control) × 2 (MTS coordination training vs. control) between-subjects design was used in which team leaders within an MTS were trained to highlight focal cross-team processes (i.e., strategizing or coordinating). MTS leadership, intra- and interteam coordination process, and team and MTS performance were all measured variables.

MTS Simulation

A modified version of the Air Combat Effectiveness Simulation (ACES; Mathieu, Cobb, Marks, Zaccaro, & Marsh, 2004) was used to model an MTS composed of a two-person air team, a two-person ground team, and a two-person leadership team. Both leaders were charged with ensuring MTS success, though each leader was assigned the role of directing the efforts of one component team. The ACES platform enabled all aspects of the team's environment to be scripted so that all MTSs encountered the exact same events, and enemies were programmed to respond in a predictable fashion. Four parallel battle mission tasks were constructed for the MTSs to perform; three served as training missions and the fourth as the experimental mission after which performance was assessed. For each mission task, MTSs were instructed to eliminate enemy occupation of a battlefield. This required the destruction of four groupings of air- and ground-based targets. To ensure interdependence within the MTS, one component team was equipped with missiles capable of locking onto air-based targets only, whereas the other was equipped with missiles capable of locking onto ground-based targets only. Thus, it was not possible for one team to perform the MTS tasks working alone.

All three teams were located in a single room, and the 6 participants could easily see one another. However, they had large computer monitors in front of them and were able to view only the simulation activity depicted on their respective monitors. Each flight team consisted of a pilot and a weapons specialist and was equipped with either air or ground missiles. Within teams, the two members were highly interdependent. One party operated the joystick that flew the plane and fired weapons, and the other manipulated keyboard functions to navigate, select weapons, and lock onto targets. The two flight teams were interdependent as the air and ground targets were colocated and programmed to attack both teams. So without the other team, a given team could destroy only one type of target (i.e., air or ground) and could not defend itself against the other target type. Each flight team viewed its own pilot screen, and it was possible to view the location of the other team from either pilot screen.

The leaders were situated behind two monitors; one monitor displayed the pilot screen for the air team and the other the screen for the ground team. One leader viewed the ground team's pilot screen and the other leader the air team's pilot screen. Both leaders knew how to monitor both teams' actions from either radar screen, though most MTSs operated by having one leader guide each component team. The two leaders sat next to one another and could interact in the course of leading their respective teams. Leaders could only monitor information and verbally communicate with their teams; they could not physically assist in performing any component of the MTS task.

All six MTS members could freely communicate with all other MTS members via microphone-equipped headsets, and both within-team and cross-team communication occurred simultaneously. MTS members used position names to address one another and were instructed to begin every communication with the position name of the person (e.g., eagle pilot) or the team (e.g., eagle team) to whom they were speaking.

Procedure

Each MTS was tested in a separate 5-hr session that commenced in three general phases: introduction (1 hr), training (3 hr), and task engagement (1 hr). In the introduction phase, participants provided informed consent and completed a battery of measures including intelligence and psychomotor ability. Team assignments were then made by first selecting the two members with the highest intelligence test scores for the leader team and then the two members with the highest psychomotor ability scores for the pilot roles.[1] Other team members were selected from the pool of participants so that the gender and ethnic composition of the teams would be evenly stratified within treatment conditions.

Each team's members were first trained independently on their role-specific duties before the two teams were brought together to practice working as a unit. The four flight team members received task training on the simulation and then flew two training missions without the leader team. The leader team received a shortened version of the flight team training and a combination of leader training modules based on their randomly assigned treatment conditions. For the final training activity, all teams were brought together to fly a practice mission and were coached on basic task duties. The task engagement phase began with a 10-min leader planning session after which the leader team had 10 min to meet with the flight teams before the mission. All MTS members then proceeded to the simulation room to fly the mission.

Manipulations

We manipulated two cross-team leader functions—strategizing and coordination facilitation—to examine their effects on MTS process and performance. The manipulations trained leaders to engage in actions believed to facilitate MTS integration.[2] These functions were chosen on the basis of theoretical work on team leadership, though in the experimental conditions, leaders were trained to engage in team leader activities that would facilitate teamwork between teams.

MTS leader strategy training. Leaders engage in effective MTS strategizing by (a) acquiring information relevant to the interteam interdependence demands of the task environment, (b) organizing and evaluating information regarding each team's contribution to the mission, and (c) communicating this information to MTS component teams before the mission (see Table 1). Two versions of a 40-min training module were developed to train MTS leaders to engage in strategy behaviors. Learning objectives common to both the control and experimental versions were for leaders to (a) understand the information provided in a mission briefing, (b) be able to develop a mission plan, and (c) be able to communicate the mission plan to the MTS component teams during a planning session. In the experimental version of the training, the second learning objective was expanded to (b) be able to develop a mission plan that specifies how the air and ground teams should work together as they approach each part of the mission. In this way the manipulation was designed to train leaders in the experimental condition to develop a plan that specified how teams would synchronize their actions during the mission. Leaders in the control condition were merely trained to develop and communicate a strategy that contained information about team and MTS tasks.

Both control and experimental versions of the strategy training consisted of a PowerPoint presentation (15 min), a videotaped MTS planning session (5 min), and a practice planning session (20 min). The presentation given to experimental teams first introduced the elements of an effective strategy and then instructed leader teams as to how it should be developed. This was

[1] We used these selection criteria as opposed to a random process because pilot testing revealed the task duties of the leaders were the most cognitively demanding and required participants to quickly learn a lot of unfamiliar information, and the pilot positions required a great deal of hand–eye coordination. By reducing the variability of participants on these critical knowledge, skills, and abilities, we hoped to gain a clearer understanding of the processes under investigation.

[2] It is important to note that training was used in this study to induce specific sets of leader actions of interest and not to validate particular training programs.

accomplished by informing leader teams of four basic situations they could anticipate in the coming missions. For each situation, the leader team was taught the appropriate order and timing of team actions, based on the type of interdependence between teams. For example, one of the situations involved an enemy plane flying in the vicinity of enemy tanks. In this situation the air team would need to destroy the enemy plane before the ground team even approached the tanks. The ground team would then need to slow down and lower their altitude (a defensive measure) as they waited for the air team to destroy the enemy plane. Here the situation required the efforts of both teams, and orchestrating the appropriate timing of each team's actions was critical to the success of the MTSs. Finally, leader teams were given a practice planning session that emulated the one they would encounter later with their teammates. During the practice session, an experimenter provided structured feedback on the effectiveness of the plan communicated.

Control teams received a more general presentation instructing them that it was their role on the MTS to develop a strategy and were introduced to the types of information available for planning (e.g., target locations, available weapons) but were not taught specifically how to plan for multiteam interaction (e.g., correct sequence of team actions). The control teams were also given a planning practice session and were provided with task-based feedback only.

MTS leader coordination training. The coordination manipulation was designed to train MTS leaders to directly facilitate cross-team coordination during action phases. MTS leaders effectively coordinate their teams by (a) monitoring the needs and requirements of each component team as they relate to other teams and (b) communicating information to their team about another team (see Table 1). Two versions of leader coordination training were developed. The learning objectives common to both versions were for leaders to be able to (a) monitor the location and progress of both teams during a mission and (b) communicate information about each team's location and progress throughout the mission. The experimental version expanded these objectives such that leaders should be able to (a) monitor the location and progress of teams as related to their interaction with other teams in the system and (b) communicate information about each team's location and progress to other teams throughout the mission. Essentially, although all leaders were taught how to monitor and communicate information about task accomplishment, only the experimental leaders were instructed specifically to communicate cross-team information (e.g., inform Eagle that Wolf is engaged with a surface-to-air missile).

All leaders were trained by watching a prerecorded video of an MTS flying a mission while listening to an experimenter point out instances of leader behaviors. Leaders were informed that the purpose of this training was to teach them how and when to assist teams in working together during the mission. Next an experimenter turned on two videotapes that played on two televisions located side by side. These monitors were labeled with the team names and looked identical to the leader team stations in the simulation room. The videos were of an MTS flying a mission.

In the experimental condition, the video contained instances in which the leader team (on the video) was effectively coordinating the two teams, and the experimenter followed a script that outlined each of those instances to the trainees. During the final sequence on the videotapes, the experimenter asked the trainees what information needed to be communicated, and the trainees were provided feedback on their coordinating.

In the control condition, the video differed only in that the leader team did not communicate coordination information. The task-related coordinating of the leaders was identical to that of the experimental video. The experimenter also pointed out task-relevant content in the mission but did not reference the leaders' coordination facilitation role. Trainees were also asked what information to communicate at the end of the sequence and were given feedback on the task-relevant accuracy of their coaching.

Manipulation checks. We used five manipulation checks to examine the effects of the training manipulations on task/simulation knowledge (e.g., how to destroy an enemy), leader task/simulation knowledge (e.g., how to monitor the progress of the teams), MTS leader strategy knowledge (e.g., how to specify coordination plans to teams before the mission), and MTS coordination knowledge (e.g., how to specify coordination information to teams during the mission). Essentially, it was important that our manipulations of leader functions not alter either of the task/simulation knowledge measures and alter only the target MTS leader function.

The first four manipulation checks consisted of short multiple-choice questionnaires. The team task knowledge measure consisted of 10 questions based on screen capture diagrams of the flight teams. For example, 1 question asked what target the ground team currently had selected. The leader task knowledge measure consisted of 4 questions designed to assess the knowledge of how to perform the leader task (e.g., how to monitor interteam actions). The leader strategy manipulation check consisted of 4 items asking leaders about the appropriate plan for a given situation. Finally, the leader coordinating manipulation check consisted of 4 items designed to measure the leader team's knowledge of how and when to effectively monitor and communicate interteam information. These four manipulation check measures were administered as a set following the administration of both types of leader training. As an additional check on the strategy function, we created an MTS planning measure consisting of a count of the number of statements related to MTS integration that were written down on the leaders' maps for the practice and experimental missions.[3] Two coders independently evaluated the maps; ratings correlated .77 ($p < .01$) for the practice mission and .79 ($p < .01$) for the experimental mission. The four scores (i.e., two assessments of two plans per MTS) were then averaged, and the resulting score was used as a check on the MTS strategy manipulation.

We examined differences on the set of five manipulation check measures as a function of the two training manipulations in a 2 (strategy training) × 2 (coordination training) factorial multivariate analysis of variance (MANOVA). Correlations among the measures of different aspects of leader knowledge ranged from .08 (*ns*) to .30 ($p < .05$). The two measures of MTS strategy (i.e., MTS strategy knowledge and MTS planning) correlated .60 ($p < .01$). The multivariate interaction term was not significant, Wilks's $\lambda = .98$, $F(5, 56) = 0.24$, *ns*. A significant main effect was found for the strategy manipulation, Wilks's $\lambda = .32$, $F(5, 56) = 24.18$, $p < .01$, but not for the coordination manipulation, Wilks's $\lambda = .87$, $F(5, 56) = 1.69$, *ns*, across the set of five dependent measures.[4] Next, we examined each manipulation check using a 2 (strategy training) × 2 (coordination training) factorial analysis of variance (ANOVA) with the average leader team score on the manipulation check scale as the dependent variable. These results are presented in Table 2, and the corresponding means and standard deviations are presented in Table 3. Consistent with the MANOVA results, no significant interactions were present across any of the manipulation check measures. As expected, no significant mean differences were observed on the basis of experimental manipulations for either the team or leader task knowledge measure. For both MTS strategy manipulation checks, only the strategy training led to mean differences in strategy knowledge, $F(1, 63) = 83.00$, $p < .01$, or in the amount of MTS leader planning, $F(1, 63) = 57.91$, $p < .01$. For the coordination manipulation check, only the coordination training produced mean differences in coordination knowledge, $F(1, 63) = 8.49$, $p < .01$. In sum, these results indicate the training conditions did not result in improved knowledge of the task. Further, results indicate each manipulation cleanly impacted its target leadership construct, as evidenced by the lack of additional main effects or

[3] We used the maps for both the practice and experimental missions because there were MTS planning points that could have been made by the leaders during the practice session that they would not repeat during the experimental mission. By using both maps, this measure captured all leader MTS planning.

[4] This result was to be expected because two of the five measures were strategy checks whereas only one was a coordination check.

Table 2
Multivariate and Univariate Analysis of Variance for Manipulation Check Measures

Dependent variable	Source (independent variable)	*df*	*F*	η^2	*MSE*
	Multivariate analysis of variance				
Flight team task knowledge	Strategy training (SP)	5, 56	24.18**	.68	
Leader task knowledge	Coordination training (CP)	5, 56	1.69	.13	
MTS Strategy knowledge	SP × CP interaction	5, 56	0.24	.02	
MTS planning					
MTS Coordinating knowledge					
	Analysis of variance				
Flight team task knowledge	SP	1	1.17	.02	
	CP	1	0.34	.01	
	SP × CP interaction	1	0.17	.00	
	Error	60			0.56
Leader task knowledge	SP	1	1.67	.03	
	CP	1	0.12	.00	
	SP × CP interaction	1	0.01	.00	
	Error	60			0.28
MTS strategy knowledge	SP	1	83.00**	.58	
	CP	1	0.16	.00	
	SP × CP interaction	1	0.00	.00	
	Error	60			0.35
MTS planning	SP	1	57.91**	.49	
	CP	1	0.28	.01	
	SP × CP interaction	1	0.91	.02	
	Error	60			14.42
MTS coordinating knowledge	SP	1	0.70	.01	
	CP	1	8.49**	.12	
	SP × CP interaction	1	0.34	.01	
	Error	60			0.68

Note. MTS = multiteam system.
** $p < .01$.

interactions; therefore, contamination of the manipulations was not evidenced.

Measures

MTS functional leadership. Functional MTS leader behavior was assessed with two distinct measures. First, the four nonleader MTS members responded to a six-item subordinate report scale that assessed the quality of leader team actions. The items are listed in the Appendix. Alpha reliability for the six-item scale was .82. Individual responses to each item were then averaged per individual.

Although the leader team behavior measure was completed by individual team members, the target construct resides at the multiteam level of analysis. For conceptual consistency, all items were worded with the leader team and MTS as referents. Empirical justification for aggregating individual scores to the MTS level was obtained by calculating the $r_{wg(j)}$ index of within-group agreement (James, Demaree, and Wolf, 1984). This method of estimating agreement essentially compares average observed variances within groups on each item with that which would be expected on the basis of a uniform distribution. The resulting coefficients range from 0 to 1, with higher values indicating greater agreement among group members on the target construct. The median $r_{wg(j)}$ across MTSs was .97. As this indicates substantial within-group agreement, individual scores were then averaged per MTS, and the resulting MTS-level composite was used in all remaining analyses.

We also measured MTS functional leadership with behaviorally anchored rating scales (BARS). MTS functional leadership was defined as monitoring and communicating critical cross-team information to component teams. Functional leadership was evaluated by two subject matter experts (SMEs) trained to identify functional leadership actions. One SME rated all 64 MTSs, and the other rater was randomly chosen from a pool of three SMEs. SMEs rated leader team behavior on a scale ranging from 1 (*hardly any skill*) to 5 (*complete skill*). Leader teams exhibited "complete skill" by (a) monitoring the location and progress of both component teams and all enemies and (b) relaying critical information about each of the component teams to one another throughout the mission. Conversely, leader teams exhibiting "hardly any skill" almost never (a) monitored the location of component teams and enemies or (b) relayed critical information about each of the component teams to one another. The two ratings were correlated to provide an index of rater reliability ($r = .77$, $p < .01$). Ratings were then averaged per MTS, and the resulting composite variable was used in the main analyses.

Coordination process. We measured both intra- and interteam coordination process. Interteam coordination was assessed with two methods. First, BARS ratings were made by the same pool of SMEs that was used to rate functional leadership behavior. Two SMEs rated each MTS; 1 SME rated all 64 MTSs, and the 2nd SME was randomly selected from a pool of 10 SMEs. The ratings of functional leadership and interteam coordination were made by separate SMEs. In other words, a total of 4 SMEs directly observed each MTS; 2 rated interteam coordination, and 2 rated leadership. The rating scale provided a judgment of the MTSs' skill at smoothly synchronizing joint actions; anchors ranged from 1 (*no or hardly any skill*) to 5 (*complete skill*). Interrater reliability was assessed by

Table 3
Cell Means and Standard Deviations (in Parentheses) for Manipulation Check Measures

Training and group	Coordination training	
	Control	Experimental
Dependent measure = Flight team task knowledge		
Strategy training		
Control	8.48 (0.70)	8.50 (0.87)
Experimental	8.59 (0.80)	8.78 (0.58)
Dependent measure = Leader task knowledge		
Strategy training		
Control	3.44 (0.73)	3.50 (0.50)
Experimental	3.63 (0.39)	3.66 (0.40)
Dependent measure = MTS strategy knowledge		
Strategy training		
Control	2.41 (0.78)	2.47 (0.74)
Experimental	3.75 (0.37)	3.81 (0.31)
Dependent measure = MTS planning		
Strategy training		
Control	3.21 (0.92)	9.53 (0.95)
Experimental	2.80 (0.98)	10.94 (0.95)
Dependent measure = MTS coordination knowledge		
Strategy training		
Control	2.35 (0.81)	2.83 (0.88)
Experimental	2.41 (0.92)	3.13 (0.67)

Note. Observed scores ranged from 7 to 10 on the flight team task knowledge measure, from 2 to 4 on the leader task knowledge measure, from 0 to 17.5 on the multiteam system (MTS) planning measure, and from 1 to 4 on both the MTS strategy and coordination knowledge measures.

correlating the two ratings (r = .69, $p < .001$). The ratings were then averaged and the composite used in subsequent analyses.

One limitation of BARS ratings is that they are able to capture only overt or explicit coordination that is directly observable by an SME through communication. The literature on coordination has identified two types of coordination: explicit and implicit (Van de Ven, Delbecq, & Koenig, 1976). It is unlikely that implicit coordination would be captured by these ratings. Entin and Serfaty (1999) found that more effective teams relied more on implicit than explicit coordination strategies, and so the omission of these behaviors would represent a threat to the validity of the current study. We used the BARS ratings as an indicator of explicit coordination; in addition, we developed a second measure of coordination designed to capture implicit synchronization.

Our second method of measuring coordination involved identifying acts that require interteam coordination and assessing the quality of coordination that was used during the completion of these acts. The current simulation task required the flight teams to time and sequence their actions in a certain way in order to destroy all enemy targets at a given base without being destroyed. Therefore, one way to evaluate coordination process is to record and evaluate the sequencing of actions in interdependent settings. Each mission task was designed so that teams would be interdependent as they approached each waypoint. On the basis of the arrangement of targets at the waypoint, there was a best way to coordinate the actions of the two teams with regard to which team approached first and which targets were fired at first. Thus, how flight teams actually timed their arrival and ordered the destruction of targets is an indicator of how smoothly they coordinated interdependent actions. During the experimental sessions, an experimenter used the leader team's monitors to complete the event-based coordination measure. Resulting interteam coordination scores could range from 0 (*no events correctly sequenced*) to 16 (*all events correctly sequenced*). Scores obtained by the current sample of MTSs ranged from 2 to 16.

For additional conceptual clarification of the level of effects, we also measured intrateam coordination process. Unlike interteam coordination, intrateam coordination involves the smooth synchronization of team members' actions (Marks et al., 2001). In our simulation environment, intrateam coordination was the synchronization of the actions of each team's pilot and weapons specialist. Intrateam coordination was assessed with a BARS rating completed by the same pool of SMEs that rated interteam coordination. The rating scale provided a judgment of the air and ground teams' skill at smoothly synchronizing the actions of the pilot and the weapons specialist; anchors ranged from 1 (*no or hardly any skill*) to 5 (*complete skill*). Because there were 2 teams performing during each session, this resulted in one rating of each team's process per MTS. We had an additional SME present whenever possible to provide an additional rating of intrateam process. Two ratings were made on 54 ground combat teams; the correlation between the ratings was .62 ($p < .01$). Two ratings were made on 61 air combat teams; these ratings correlated .68 ($p < .01$). We then used the average of the two ratings for intrateam coordination when available and the single rating in the remaining teams.

Team performance. Team performance is the extent to which each component team accomplishes its goals. Each team was given the goals of surviving the mission undamaged and destroying primary and secondary targets. Although team-level performance was not a focal variable in this study, we included it to clarify the level of relationships under examination. Team performance scores were computed on the basis of survival status and target destruction as follows: Each team earned up to 30 points for survival, up to 60 points for primary targets, and up to 60 points for secondary targets. The ground team was assigned three primary and six secondary targets; the air team was assigned three primary and four secondary targets. This number of targets was chosen to attempt to even out the task difficulty of the two teams as much as possible and to try to make each team's task challenging but achievable to an MTS composed of undergraduate students. Extensive pilot testing was used to determine this arrangement of targets. Team performance scores could range from 0 to 150; actual scores in our teams ranged from 0 to 150.

MTS performance. MTS performance is the extent to which the highest level collective goal is reached. As an example, in an MTS composed of a firefighting team, an EMT team, a surgical team, and a recovery team, a relevant index of MTS performance would be patient survival or lives saved (Mathieu et al., 2001). In the current simulation, MTSs were instructed to destroy four bases of enemy operation. Each base required component teams to work together so that all targets were destroyed and both F-22's remained undamaged. Therefore, MTS performance was operationalized as the number of bases successfully destroyed and ranged from 0 (*no bases destroyed*) to 4 (*all four bases destroyed*). No partial credit was assigned because the performance measure was intended to capture MTS-level performance. This measure was developed to capture the goal attainment of the MTS, as opposed to just summing an index of component team performance (e.g., number of targets destroyed). The interdependence among component teams is a defining aspect of an MTS, and so MTS-level performance measures need to identify the collective goal and quantify the degree of goal attainment. The current study's MTSs were given the ultimate goal of disabling four enemy bases on a battlefield, which required the actions of all three (i.e., air, ground, and leader) component teams.

Results

Table 4 presents descriptive statistics and intercorerelations for all key study variables. The two measures of MTS leadership correlated .50 ($p < .01$), whereas the two measures of interteam coordination process correlated .60 ($p < .01$). Our general analytic strategy involved three sets of analyses. The first two hypotheses predicted differences in MTS functional leadership based on our training manipulations. We present the results of both an overall MANOVA on the set of leadership measures and follow-up one-way ANOVAs on each measure separately. Hypotheses 3, 4, and 5 predict mediated relations between leader training, functional leader behavior, interteam process, and MTS performance. We present hierarchical regressions testing these hypotheses that essentially replicated the mediation tests by using the alternate measures of the leadership and coordination constructs. Finally, we present a hierarchical regression testing Hypothesis 6 that examined the unique contribution of within-team processes in predicting MTS performance after we controlled for all team-level predictors.

Effects of MTS Leader Training

MTS leader training and leader behavior. Hypotheses 1 and 2 posited training MTS leaders in two key components of MTS leadership, strategy (Hypothesis 1) and coordinating (Hypothesis 2), would result in more functional MTS leadership behavior. We used a 2 × 2 factorial MANOVA to examine differences in the two measures of functional team leadership based on leader training (see Table 5). Results supported both hypotheses. No interaction was observed, Wilks's $\lambda = .96$, $F(2, 59) = 1.18$, *ns*, yet there were significant multivariate main effects for both the strategy, Wilks's $\lambda = .84$, $F(2, 59) = 5.56$, $p < .01$, and coordinating, Wilks's $\lambda = .75$, $F(2, 59) = 9.80$, $p < .01$, training manipulations. We followed up the multivariate test with factorial ANOVAs for each leadership measure. Both MTS leadership measures showed significant main effects for the leader coordinating manipulation. For the leader strategy manipulation, only the main effect for the SME rating of leadership was significant, a point we return to in the Discussion section. Table 6 reports means and standard deviations for each of the leadership measures by training condition. Taken together, these results suggest that, overall, leader teams who were trained in MTS strategy or coordination engaged in more effective MTS functional leadership behavior than did those not trained in MTS strategy or coordinating.

MTS leader training and cross-team coordination. Hypotheses 3 and 4 predicted MTSs whose leaders were trained for either MTS strategy (Hypothesis 3) or coordinating (Hypothesis 4) would exhibit more effective interteam coordination than would those not trained in these target MTS leader roles and that the effects would be mediated by MTS functional leadership behavior. We examined the first part of Hypothesis 3 using a 2 × 2 MANOVA with the two interteam coordination measures as dependent variables (see Table 7). Results showed a significant multivariate main effect for strategy training, Wilks's $\lambda = .80$, $F(2, 59) = 7.28$, $p < .01$, but not for coordination training, Wilks's $\lambda = .93$, $F(2, 59) = 2.21$, *ns*. Univariate tests revealed strategy training produced a significant difference in explicit interteam coordination, $F(1, 60) = 14.77$, $p < .01$, and a marginally significant difference in implicit interteam coordination, $F(1, 60) = 3.49$, $p < .10$. Leader coordination training resulted in a significant difference in implicit, $F(1, 60) = 4.02$, $p < .05$, but not explicit, $F(1, 60) = 2.74$, *ns*, interteam coordination. These results suggest that strategy training had a strong impact on the resulting coordination between teams; strategy training accounted for 20% of the variance in explicit coordination and 6% of the variance in implicit coordination. Leader coordination training showed weaker effects on interteam coordination, explaining 6% of implicit coordination variance and 5% of explicit coordination variance.

MTS leader training and within-team coordination. Our theoretical framework proposed that MTS leader behaviors impact outcomes by way of interteam, and not team-level, processes. Furthermore, the manipulations targeted MTS synchronization activities, as opposed to within-team synchronization; we therefore expected both leader training manipulations to alter inter- but not intrateam process. We tested this expectation using 2 × 2 ANOVAs on intrateam coordination (see Table 8). The first ANOVA compared within-team coordination levels of the ground teams as a function of the leader training manipulations; results for the interaction and main effects were all nonsignificant. Similarly, we found no significant differences in air team coordination levels

Table 4
Descriptive Statistics and Variable Intercorrelations at the Multiteam System (MTS) Level of Analysis (N = 64)

Variable	*M*	*SD*	1	2	3	4	5	6	7	8	9	10	11
1. Strategy training	—	—	—										
2. Coordination training	—	—	.03	—									
3. Leadership (team report)	3.78	0.60	.10	.37**	(.82)[a]								
4. Leadership (SME rating)	3.14	1.17	.36**	.46**	.50**	(.77)[b]							
5. Intrateam coordination (ground)	3.65	0.72	−.09	.16	.26*	.33**	(.62)[b]						
6. Intrateam coordination (air)	3.70	0.84	.17	−.09	.30*	.32**	.27*	(.68)[b]					
7. Interteam coordination (explicit)	2.94	1.06	.43**	.20	.44**	.70**	.33**	.36**	(.69)[b]				
8. Interteam coordination (implicit)	10.00	3.16	.23†	.25**	.26*	.46**	.37**	.24†	.60**	—			
9. Team performance (ground)	105.31	35.90	−.11	−.06	−.02	.03	.38**	.11	.15	.31*	—		
10. Team performance (air)	109.77	33.04	.02	.11	.41**	.22†	.07	.28*	.26*	.45**	−.01	—	
11. MTS performance	1.84	0.98	.03	.22†	.48**	.29*	.35**	.29*	.45**	.63**	.38**	.69**	—

Note. SME = subject matter expert.
[a] Coefficient alpha for six-item leader behavior scale across 254 individuals. [b] Interrater correlation for SME ratings.
† $p \leq .10$. * $p \leq .05$. ** $p \leq .01$.

Table 5
Multivariate and Univariate Analysis of Variance for Leadership

Dependent variable	Source (independent variable)	*df*	*F*	η^2	*MSE*
	Multivariate analysis of variance				
Leadership (SME rating)	Strategy training (SP)	2, 59	5.56**	.16	
Leadership (team report)	Coordination training (CP)	2, 59	9.80**	.25	
	SP × CP interaction	2, 59	1.18	.04	
	Analysis of variance				
Leadership (SME rating)	SP	1	10.85**	.15	
	CP	1	17.84**	.23	
	SP × CP interaction	1	1.18	.02	
	Error	60			0.95
Leadership (team report)	SP	1	0.52	.01	
	CP	1	9.28**	.13	
	SP × CP interaction	1	0.11	.01	
	Error	60			0.32

Note. SME = subject matter expert.
** $p \leq .01$.

as a function of the leader training manipulations. Table 9 reports the means and standard deviations for the ANOVAs on both the interteam and intrateam coordination process indices. These analyses demonstrated that training leaders to engage in strategy development that integrated the actions of multiple teams led to better interteam coordination (implicit and explicit), whereas training leaders to monitor and inform teams of critical interteam information (i.e., coordination training) resulted in better implicit but not explicit coordination.

Notably, implicit coordination reflects the extent to which teams are behaviorally synchronized, whereas explicit coordination reflects the extent of overt communication-based attempts to synchronize across teams. Although both training manipulations improved coordination between teams, they did so somewhat differently. Strategy training predominantly affected explicit coordination, whereas coordination training affected behavioral or implicit coordination. Thus, training leaders in the coordination function seems to have enabled them to actually do the coordinating; that is, through their verbal instructions they coached individual teams so their actions were coordinated with the overall system without necessarily enabling the teams to coordinate better themselves.[5] Conversely, strategy training, through its potent impact on explicit coordination, seems to work by passing on information to MTS members that enables them to more effectively maintain their alignment.

A final critical point regarding the impact of these training manipulations is that they did not, either directly or interactively, affect team-level coordination process; training leaders in MTS strategy or coordinating did not improve the functioning of the individual teams. We now turn our attention to the question of how and why MTS leader training influenced interteam coordination.

Table 6
Cell Means and Standard Deviations (in Parentheses) for Leadership Measures

Training and group	Coordination training: Control	Experimental
Dependent measure = Leadership (SME rating)		
Strategy training		
Control	2.37 (1.14)	3.99 (0.53)
Experimental	3.66 (0.49)	4.01 (0.54)
Dependent measure = Leadership (team report)		
Strategy training		
Control	2.37 (1.14)	3.13 (1.00)
Experimental	2.91 (1.00)	4.20 (0.70)

Note. Observed scores on the subject matter expert (SME) measure of leadership (averaged across raters) ranged from 1 to 5, and the range for the team report leadership scale (averaged across team members and items) was from 2.29 to 4.88.

Testing MTS Leadership as a Mediator

The second part of Hypothesis 3 and Hypothesis 4 proposed that leader training would impact interteam coordination through improved MTS leadership. We used hierarchical regression analysis to test each requirement for mediation (Baron & Kenny, 1986); the full results are presented in Table 10. Because the mediator, leadership, and the dependent variable, interteam coordination, were each assessed with two measures, we replicated the mediation test across the four combinations of measures. Table 10 presents the dependent variables across the top row, and the independent variables in the first column. In Models 1 and 2 we regressed each measure of MTS leadership on two dummy-coded vectors representing the leader training manipulations; these models captured the relationship between the independent variables

[5] We thank an anonymous reviewer for this suggestion.

Table 7
Multivariate and Univariate Analysis of Variance for Interteam Coordination Process

Dependent variable	Source (independent variable)	*df*	*F*	η^2	*MSE*
	Multivariate analysis of variance				
Interteam coordination (explicit)	Strategy training (SP)	2, 59	7.28**	.20	
Interteam coordination (implicit)	Coordination training (CP)	2, 59	2.21	.07	
	SP × CP interaction	2, 59	1.02	.03	
	Analysis of variance				
Interteam coordination (explicit)	SP	1	14.77**	.20	
	CP	1	2.74	.05	
	SP × CP interaction	1	1.95	.03	
	Error	60			0.89
Interteam coordination (implicit)	SP	1	3.49†	.06	
	CP	1	4.02*	.06	
	SP × CP interaction	1	1.10	.02	
	Error	60			9.17

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

(leader training manipulations) and the mediators (measured leader behavior). In Models 3 and 4 we regressed each coordination measure on the leader training vectors, capturing the relationships among the independent variables and the dependent variable (interteam coordination) to be mediated. Models 5 and 6 regressed explicit interteam coordination first on the proposed mediator and then on the independent variables; Model 5 tested mediation by the SME rating of leadership, whereas Model 6 tested mediation by the team report rating of leadership. Models 7 and 8 regressed implicit interteam coordination on the proposed mediator and then on the independent variables; Model 7 examined mediation by way of the SME rating of leadership and Model 8 by way of the team report leadership rating.

The necessary preconditions for mediation are significant relations between the independent variables and the mediators in Models 1 and 2, between the independent variables and the dependent variables in Models 3 and 4, and between the mediators and the dependent variables in Models 5, 6, 7, and 8 (Mathieu & Taylor, in press). Given these relationships, mediation is supported if the relationship between the independent variables and the dependent variables is reduced or eliminated when the mediator variable is taken into account (Baron & Kenny, 1986). We also present results of the Sobel test for indirect effects (Sobel, 1982).

Strategy training → leadership → interteam coordination. With regard to Hypothesis 3, strategy training was significantly related to SME-rated leadership (see Model 1; $\beta = .34$, $p < .01$) but not to team-rated leadership (see Model 2; $\beta = .09$, *ns*). Thus, SME-rated leadership was a potential mediator, whereas team-rated leadership was not. In looking at the relation of strategy training to the dependent variables, a significant relation was found with explicit coordination (see Model 3; $\beta = .43$, $p < .01$), and a marginally significant relation was found with implicit coordination (see Model 4; $\beta = .22$, $p < .10$). Taken together, these results suggest the relations between strategy training and both types of interteam coordination could potentially be mediated by SME-rated, but not team-rated, leadership; thus, we focus on Models 5 and 7, which report the relations between strategy training and interteam coordination while controlling SME-rated leadership. The third precondition for mediation was met in both Models 5 and 7; SME-rated leadership (the mediator) was significantly related to explicit ($\beta = .70$, $p < .01$) and implicit ($\beta = .46$, $p < .01$) interteam coordination (the dependent variables). The regression

Table 8
Analysis of Variance for Intrateam Coordination Process

Dependent variable	Source (independent variable)	*df*	*F*	η^2	*MSE*
Intrateam coordination (air to ground)	Strategy training (SP)	1	0.55	.01	
	Coordination training (CP)	1	1.60	.03	
	SP × CP interaction	1	2.14	.03	
	Error	60			0.51
Intrateam coordination (air to air)	SP	1	1.79	.03	
	CP	1	0.52	.01	
	SP × CP interaction	1	0.15	.00	
	Error	60			0.72

Table 9
Cell Means and Standard Deviations (in Parentheses) for Intrateam and Interteam Coordination Process Measures

Training and group	Coordination training: Control	Coordination training: Experimental
Dependent measure = Intrateam coordination (air-to-ground team)		
Strategy training		
Control	3.74 (0.68)	3.70 (0.75)
Experimental	3.34 (0.72)	3.83 (0.70)
Dependent measure = Intrateam coordination (air-to-air team)		
Strategy training		
Control	3.59 (0.95)	3.52 (0.92)
Experimental	3.95 (0.73)	3.72 (0.77)
Dependent measure = Interteam coordination (explicit)		
Strategy training		
Control	2.46 (1.11)	2.52 (0.90)
Experimental	3.03 (0.93)	3.75 (0.78)
Dependent measure = Interteam coordination (implicit)		
Strategy training		
Control	8.94 (2.67)	9.67 (2.90)
Experimental	9.56 (3.83)	11.88 (2.58)

Note. Observed scores ranged from 1.5 to 5 for intrateam coordination (air-to-ground team; averaged across raters), from 1 to 5 for intrateam coordination (air-to-air team; averaged across raters) and interteam coordination (explicit; averaged across raters), and from 2 to 16 for implicit interteam coordination.

coefficient for strategy in Model 5 (β = .19, $p < .05$) showed support for partial mediation, whereby the relationship between leader strategy and explicit interteam coordination was partially mediated by SME-rated leadership. Table 10 also reports results of the Sobel test for indirect effects (Sobel, 1982). Results of the Sobel test also supported an indirect effect between strategy training and explicit coordination, as mediated by leadership (SME-rated). Model 7 tested for mediation between strategy training and implicit coordination. Here the coefficient for strategy (β = .08, *ns*) was largely reduced and nonsignificant after the mediator was included, supporting full mediation. The Sobel test also supported an indirect effect. These results show some support for Hypothesis 3 but point to potentially meaningful differences in the manner in which MTS strategy training impacted interteam coordination, a point we return to in the Discussion section.

Coordination training → leadership → interteam coordination. Next, we tested the mediation proposed by Hypothesis 4. Models 1 and 2 showed significant relations between the leader coordination manipulation and both measures of functional leadership as mediators ($\beta_{\text{SME-rated}}$ = .44, $p < .01$; $\beta_{\text{team-rated}}$ = .36, $p < .01$). Coordination training was significantly related to implicit coordination (Model 4; β = .24, $p < .05$) but not to explicit coordination (Model 3; β = .19, *ns*). These results support both ratings of leadership as potential mediators and qualify the relation between coordination training and explicit coordination, if found, as distal mediation. The relations between both leadership measures and

Table 10
Regression Results Testing Leadership as a Mediator of the Relationship Between Multiteam System (MTS) Leader Training and Interteam Coordination (N = 64 MTSs)

Independent variable	Model 1: Leadership (SME)	Model 2: Leadership (team)	Model 3: Interteam coordination (explicit)	Model 4: Interteam coordination (implicit)	Model 5: Interteam coordination (explicit), controlling for leadership (SME)			Model 6: Interteam coordination (explicit), controlling for leadership (team)			Model 7: Interteam coordination (implicit), controlling for leadership (SME)			Model 8: Interteam coordination (implicit), controlling for leadership (team)		
	β	β	β	β	ΔR^2	β	Sobel	ΔR^2	β	Sobel	ΔR^2	β	Sobel	ΔR^2	β	Sobel
Leadership	—	—	—	—	.49**	.70**		.19**	.44**		.21**	.46**		.07*	.26*	
Strategy training	.34**	.09	.43**	.22†	.05*	.19*	2.91**	.15**	.39**	0.73	.01	.08	2.67*	.07	.21†	0.65
Coordination training	.44**	.36**	.19	.24*		−.12	3.53**		.05	2.28*		.06	2.39*		.18	1.22
Total R^2	.32**	.14**	.22**	.11*	.54**			.35**			.22**			.14*		

Note. Dashes indicate that the variable was not included in the equation. SME = subject matter expert; Sobel = results of Sobel (1982) test for indirect effects.
† $p < .10$. * $p < .05$. ** $p < .01$.

both types of coordination were significant, as indicated by the coefficients reported in Model 5 ($\beta_{\text{SME-rated leadership}} = .70$, $p < .01$), Model 6 ($\beta_{\text{team-rated leadership}} = .44$, $p < .01$), Model 7 ($\beta_{\text{SME-rated leadership}} = .46$, $p < .01$), and Model 8 ($\beta_{\text{team-rated leadership}} = .26$, $p < .05$). Finally, we examined the relations between coordination training and each type of interteam coordination while controlling for each rating of leadership. Results across all four tests support full mediation, as the betas were all reduced from Models 3 and 4 and were all nonsignificant while accounting for measured leadership. In Models 5 and 6, the relations between coordinating and explicit coordination while controlling for SME-rated leadership ($\beta_{\text{coordinating}} = -.12$, *ns*) and team-rated leadership ($\beta_{\text{coordinating}} = .05$, *ns*) were small and nonsignificant. Sobel tests showed significant indirect effects between coordination training and interteam coordination (explicit), by way of both SME- and team-rated leadership. Because the direct relation between coordination training and explicit coordination was not significant, we qualified this as support for distal mediation. Nonetheless, coordination training showed a significant relation to both leadership measures, and both leadership measures were significantly related to interteam coordination.

Models 7 and 8 illustrated that when SME-rated leadership was controlled, the relation between coordination training and implicit coordination was also nonsignificant ($\beta_{\text{coordinating}} = .06$, *ns*), and when team-rated leadership was controlled, the relation was similarly nonsignificant ($\beta_{\text{coordinating}} = .18$, *ns*). The Sobel test also supported a significant indirect effect with SME-rated leadership but not with team-rated leadership. Because without controlling for leadership, Model 4 showed a significant positive relation between coordination training and implicit interteam coordination, this evidence is indicative of full mediation. In sum, Hypothesis 4 received strong support; the effects of the leader coordination training manipulation on both implicit and explicit interteam coordination were fully mediated by both measures of MTS functional leadership.

Testing Interteam Coordination as a Mediator

Hypothesis 5 proposed that MTS functional leadership would positively predict interteam coordination and, in turn, MTS performance. This hypothesis captures the essence of the MTS I-P-O model under investigation; interteam coordination was posited as a transformation process that would mediate or explain the effects of MTS functional leadership on MTS-level performance. Although we developed leader training manipulations as a means of creating variability in our focal leader behaviors, our study's primary objective was to test the idea that MTS functional leadership, which targets teamwork processes at the MTS level, would relate positively to MTS-level performance and that the effect would be mediated by cross-team coordination.

Hierarchical regression results testing this prediction are presented in Table 11. In Models 1 and 2 we regressed each index of coordination on SME-rated leadership. SME-rated leadership was positively related to both explicit coordination ($\beta_{\text{SME-rated leadership}} = .70$, $p < .01$) and implicit coordination ($\beta_{\text{SME-rated leadership}} = .46$, $p < .01$). Similarly, in Models 6 and 7 we regressed the two indices of coordination on team-rated leadership; team-rated leadership evidenced a significant positive relationship with both explicit coordination ($\beta_{\text{team-rated leadership}} = .44$, $p < .01$) and implicit coordination ($\beta_{\text{team-rated leadership}} = .26$, $p < .01$). In Models 3 and 4 we regressed MTS performance on SME-rated leadership and team-rated leadership, respectively. Both the SME ($\beta_{\text{SME-rated leadership}} = .29$, $p < .05$) and team ($\beta_{\text{team-rated leadership}} = .48$, $p < .01$) ratings of MTS leadership positively predicted MTS performance. The preceding regressions essentially linked both measures of MTS leadership (independent variables) to both types of interteam co-

Table 11
Regression Results Testing Interteam Coordination as a Mediator of the Relationship Between Multiteam System (MTS) Functional Leadership and MTS Performance (N = 64 MTSs)

Independent variable	Interteam coordination (explicit) ΔR^2	β	Interteam coordination (implicit) ΔR^2	β	MTS performance ΔR^2	β	MTS performance, controlling for leadership (explicit coordination) ΔR^2	β	Sobel	MTS performance, controlling for leadership (implicit coordination) ΔR^2	β	Sobel
	Model 1		Model 2		Model 3		Model 4			Model 5		
Interteam coordination	—	—	—	—	—	—	.20**	.45**		.40**	.63**	
Leadership (SME)	—	.70**	—	.46**	—	.29*	.00	−.04	3.18**	.00	.00	3.31**
Strategy training	—	—	—	—	—	—	.05	−.18		.02	−.12	
Coordination training	—	—	—	—	—	—		.17			.06	
Total R^2	.49**		.21**		.09*		.25**			.42**		
	Model 6		Model 7		Model 8		Model 9			Model 10		
Interteam coordination	—	—	—	—	—	—	.20**	.45**		.40**	.63**	
Leadership (team)	—	.44**	—	.26**	—	.48**	.10**	.36**	2.24*	.11**	.34**	1.99*
Strategy training	—	—	—	—	—	—	.02	−.16		.02	−.14	
Coordination training	—	—	—	—	—	—		.03			−.06	
Total R^2	.19**		.07*		.23**		.32**			.53**		

Note. Dashes indicate that the variable was not included in the equation. SME = subject matter expert; Sobel = results of Sobel (1982) test for indirect effects.
* $p < .05$. ** $p < .01$.

ordination (mediators) and to MTS performance (dependent variable), meeting the preconditions for mediation.

Coordination as a mediator of SME-rated leadership and MTS performance. In Models 4 and 5 we regressed MTS performance on interteam coordination while controlling for SME-rated leadership. In both models, interteam coordination positively predicted MTS performance ($\beta_{\text{explicit coordination}} = .45, p < .01$; $\beta_{\text{implicit coordination}} = .63, p < .01$), and the coefficients for SME-rated leadership were substantially reduced and nonsignificant while controlling for either index of coordination ($\beta_{\text{SME-rated leadership/explicit coordination}} = -.04$, *ns*; $\beta_{\text{SME-rated leadership/implicit coordination}} = .00$, *ns*). Results of the Sobel tests also showed significant indirect effects. For completeness, we entered the two training vectors into the equation after coordination and leadership to examine any remaining direct effects of the manipulations on MTS performance. After coordination and leadership were controlled for, all betas associated with the manipulation vectors were nonsignificant, as was the change in R^2. Thus, with the SME rating of MTS leadership, we found support for full mediation between leadership and MTS performance by way of interteam coordination.

Coordination as a mediator of team-rated leadership and MTS performance. We replicated this test with team-rated leadership in Models 9 and 10. When MTS performance was regressed on both interteam coordination and the team rating of leadership, both coordination indices positively predicted performance ($\beta_{\text{explicit coordination}} = .45, p < .01$; $\beta_{\text{implicit coordination}} = .63, p < .01$). Although the coefficients for leadership (with either index of coordination controlled for) were reduced with the inclusion of coordination ($\beta_{\text{team-rated leadership/explicit coordination}} = .36, p < .01$; $\beta_{\text{team-rated leadership/implicit coordination}} = .34, p < .01$), they were still statistically significant, supporting partial mediation. The Sobel tests were significant, further supporting the presence of significant indirect effects. We again entered the training vectors in a final step to examine any potential direct effects from the training manipulations, and none were found. All betas were nonsignificant, and the change in R^2 was nonsignificant.

In sum, MTS leadership as rated by the team members positively predicted interteam coordination (explicit and implicit) and MTS performance, and the effect was partially mediated by interteam coordination. Taken together, these analyses support Hypothesis 5. An interesting distinction was found in the nature of the relationships between leadership and performance observed depending on who evaluated the leaders: SMEs or team members. The effects of SME-rated leadership on performance were fully mediated by interteam coordination, whereas those of team-rated leadership were only partially mediated by interteam coordination.

Testing Incremental Variance Explained by Interteam Coordination

To further clarify the target level of these effects, Hypothesis 6 proposed that interteam coordination would predict additional variance in MTS performance beyond that of intrateam coordination and team-level performance. We used hierarchical regression to test this hypothesis; MTS performance was regressed first on intrateam coordination, then on team-level performance, and finally on interteam coordination process (see Table 12). Whereas lower level variables such as intrateam coordination and especially team-level performance should have strong effects on MTS performance, interteam coordination should account for unique incremental variance in MTS performance after intrateam coordination and team-level performance have been controlled for. In Model 1, MTS performance was regressed on intrateam coordination of both the air and ground teams; both coefficients were positive and jointly explained 16% of the variance in MTS performance. In Model 2, performance scores of the air and ground teams were entered; both were significantly positively related to MTS performance and predicted an additional 50% of MTS performance variance. In Model 3a, explicit interteam coordination was added, explaining an additional 3% of the variance in MTS performance. Repeating this final step with implicit coordination explained an additional 4% of MTS performance variance. In total, intrateam coordination, team performance, and interteam coordination accounted for 70% of the variance in the performance of these MTSs.

Taken together, results were largely supportive of the study's six main hypotheses. First, training MTS leaders in strategy development and coordinating behavior targeted at facilitating MTS-level process generally resulted in better MTS functional leadership and interteam coordination. Second, MTS leader behavior and inter-

Table 12
Hierarchical Regression of Multiteam System (MTS) Performance on Team and MTS-Level Predictors (N = 64)

Independent variable	Dependent variable = MTS performance			
	Model 1	Model 2	Model 3a	Model 3b
Intrateam coordination (ground)	.29*	.17*	.12	.11
Intrateam coordination (air)	.21†	.02	−.03	.01
Team performance (ground)	—	.32**	.31**	.27**
Team performance (air)	—	.68**	.65**	.58**
Interteam coordination (implicit)	—	—	—	.25**
Interteam coordination (explicit)	—	—	.21*	—
ΔR^2	—	.50**	.03*	.04**
Total R^2	.16**	.66**	.69**	.70**

Note. All regression coefficients are standardized. Dashes indicate that the variable was not entered in the equation.
† $p \leq .10$. * $p \leq .05$. ** $p \leq .01$.

team coordination process positively predicted MTS performance. Finally, although there were some interesting differences in the patterns of mediation across measures of leadership and coordination, we generally found training influenced MTS leadership, which in turn influenced interteam coordination; similarly, MTS leadership influenced interteam coordination and, in turn, MTS performance. Notably, the effects of leader training on explicit interteam coordination were partially mediated by leadership, whereas the effects of implicit interteam coordination were fully mediated by leadership. Similarly, the effects of SME-rated MTS leadership on MTS performance were fully mediated by interteam coordination, and the effects of team-rated MTS leadership on MTS performance were only partially mediated by interteam coordination. Furthermore, interteam coordination predicted significant incremental variance in MTS performance after we controlled for within-team process and team-level performance.

Discussion

Here we studied MTSs composed of three teams: a leader team and two operational teams. We trained leaders in two forms of process facilitation—strategy development and coordinating—and then examined the leaders' interactions with the operational teams. These behaviors were chosen on the basis of an integration of Kozlowski, Gully, Salas, and Cannon-Bowers's (1996) developmental model of team leadership and Marks et al.'s (2001) recurring phase model of team effectiveness.

MTS Leader Training and Functional Leadership

At the onset, we expected training leaders in either MTS role (i.e., strategy or coordinating) to affect both the experts' and team members' view of functional leadership. On the contrary, we found that training leaders in MTS strategy affected SME ratings of functional leadership but did not affect team member ratings of their leaders. Thus, MTS members did not seem to have perceived the value of MTS leader strategy behaviors. Because MTS strategy training enabled teams to coordinate more effectively during the mission, it clearly did add value to these MTSs. This has important implications for the measurement of team leadership. Perhaps because leader behaviors during the transition period were one step removed from the mission, their value was not as transparent to team members as it was to SMEs. In contrast, MTS coordination training improved both SME and team member ratings of functional leadership, suggesting that both experts and team members perceived the value of leader actions that occurred during task accomplishment (i.e., action phase).

MTS Leader Training and Cross-Team Synchronization

Although both leader training manipulations improved interteam coordination, interesting differences were found. Strategy training had a stronger effect on explicit coordination, whereas coordination training had a stronger effect on implicit coordination, suggesting the manner in which each leader function improves the system may differ. Leader strategy training seems to have enabled teams to initiate and enact more effective coordination during the action phase. Conversely, coordination training seems to have had a direct impact on the behavioral, implicit coordination of the teams. Thus, although leaders trained in the strategy role communicated information that prompted teams to coordinate better among themselves, leaders trained in the coordinating role communicated information that directly produced coordinated actions between teams.

Differences in the Mechanisms of MTS Leadership

The mediation patterns linking leader training, functional leadership, and interteam coordination also differed for each type of training. For strategy training, the SME rating of functional leadership fully mediated the effects of strategy training on implicit coordination and only partially mediated the effects of strategy training on explicit coordination. Thus, training leaders in MTS strategy led them to assist the teams in working together during the mission, which resulted in more effective cross-team behavioral synchronization (i.e., implicit coordination). However, the effects of leader strategy training on explicit coordination were only partially mediated by leadership, suggesting a net direct effect of leader strategy training remained after SME ratings of leader behavior were controlled for. Clearly there seems to be an additional unmeasured mechanism through which strategy training enables teams to initiate their own cross-team coordination. One interpretation is that leadership functions enacted during transition phases that target planning actions are a more empowering form of leadership than those enacted during action phases. It appears that, to some extent, the strategy-trained leaders were able to elicit higher levels of interunit coordination than control leaders, not only because they exhibited more effective functional leadership but also through an unidentified mechanism such as shared mental models, higher efficacy, and/or more effective task strategies. Mental model theory would predict these leaders invoked knowledge structures within MTSs that, in addition to functional leadership, enabled higher levels of interunit coordination during the action phase. The application of mental model theory to MTSs represents one exciting avenue for future research.

The effects of coordination training were much more straightforward. Training leaders in the coordination function prompted better functional leadership, which, in turn, resulted in more effective implicit and explicit coordination between teams.

Beyond the effects of our manipulations, there were also interesting differences in how the two measures of functional leadership related to MTS performance. The SME rating of functional leadership was positively related to both explicit and implicit coordination and to MTS performance, and both forms of coordination fully mediated the relationship between SME-rated leadership and MTS performance. In contrast, the relationship between team member-rated leadership and MTS performance was only partially mediated by coordination. Thus, although our findings revealed that team member ratings were less sensitive to the leader strategy function we manipulated, which in turn affected coordination, they explained variance in performance not explained by coordination. Perhaps team member ratings captured additional aspects of leadership (e.g., interpersonal or relational functions) not perceptible to SMEs.

Limitations

Possibly the largest limitation of the current study is the use of short-term teams performing a laboratory simulation task to model a complex MTS. Although the lab and experimental elements of the study afforded strict control over extraneous variables and the manipulation of leader functions, it is likely that contextual factors present only in field settings set important boundary conditions on the relationships examined in this study. Nonetheless, research on MTSs is in its infancy, and so research that maximizes internal validity is critical at this stage of the research cycle. Further, multiteam ACES is an elaborate simulation that has been refined by researchers in the last few years to best simulate a complex, MTS performance setting. We argue that sound laboratory investigations are needed to elucidate the functional forms of key relationships (e.g., the I-P-O form supported in this work) and that follow-up work is needed that examines the nature of these relationships in applied settings.

The Importance of Research on MTSs

The current study represents an advance in investigating higher level collective outcomes. MTS theory (Mathieu et al., 2001) proposed a new unit of analysis that, although frequently employed in many applied team settings, is virtually unstudied. Our task was designed to model a situation in which a collective goal could be achieved only through the effective integration of multiple team efforts. We found that leader team behaviors targeted not at team member actions but at team actions predicted coordination process and ultimate performance. These findings extend team-level relationships to a new unit of inquiry, the MTS. We distinguished and measured team coordination (i.e., that which occurs between individuals within a team) and interteam coordination (i.e., that which occurs between entire teams relating to other teams). Similarly, we distinguished and measured both component team performance (e.g., survival, friendly damage aversion, and target destruction of each component team) and MTS performance (e.g., number of enemy bases completely disabled by the MTS). Embedded in our tests of these focal relations are analyses clarifying the target level of effects. MTS leader training prompted the leader teams to engage in better MTS leadership; MTSs whose leaders were trained in focal MTS synchronization functions more effectively coordinated multiple team efforts than did those whose leaders were not trained in MTS functions. Also notable is what MTS training did not affect; training leaders in MTS process facilitation roles did not improve the functioning of individual teams, rather it helped the entire collective of teams align what each team was doing with the efforts of other teams. Furthermore, cross-team coordination process predicted unique incremental variance in multiteam performance beyond that of team-level processes and team performance. Thus the "whole," in this case MTS performance, was more than simply the sum of the parts, individual team process and performance levels. How effectively teams worked together was a key predictor of MTS collective success.

One critical difference between teams and MTSs is the nature of key transformation processes. In teams, members must effectively combine member roles in order to succeed. In MTSs, our findings indicate that team goal attainment efforts must be effectively synchronized, a process that we term *interteam coordination*. In this study, MTS leaders trained in interteam planning and coordination skills were able to align and integrate efforts across teams in the system, yielding superior MTS performance. We believe MTS leaders should serve as liaisons among interdependent teams, monitoring their performance and integrating team effort at the appropriate times. MTS leadership is responsible for orchestrating the correct timing, sequencing, and level of cross-team integration. In this study, we demonstrated this with a three-team MTS, which is a relatively simple form of an MTS. We expect leader planning and interteam coordination functions become increasingly critical as the number of component teams and the extent of their interdependencies increase.

This study focused on the influence of leader strategy development and coordination, both skills that enable MTS leadership to attain horizontal alignment of component team efforts. However, there are other critical leadership skills worthy of studying. MTS leaders also have to maintain vertical alignment of goal hierarchies, ensuring the attainment of superordinate goals of the MTS. Mathieu et al. (2001) highlighted other MTS leadership roles, including integrating resources across teams in the MTS, specifying functional interdependencies in the system, and facilitating coordinative regulatory systems. Further, boundary spanning requirements for MTS leaders are extensive and vital, because MTSs must main flexibility and cohesive operations in dynamic, turbulent environments. Future studies should further articulate and investigate these MTS leadership roles as they influence MTS effectiveness.

Future Research Directions

Although we tested two components of team leader behavior, we did not explore the role of team leaders in the initial formation and development of teams and MTSs. Kozlowski, Gully, Salas, and Cannon-Bowers (1996) proposed additional roles including mentoring and instructing that are in need of empirical examination. The teams in this study had been working together sufficiently long enough to have met, learned their roles, and learned to work together as individual teams; thus, we tested propositions regarding two components of the leader facilitator role. Future work is needed that tests propositions regarding the leader's role in earlier stages of team development.

Another exciting avenue for future work on MTS leadership involves the effect of processes among leaders on system functioning. Although our leaders operated as a unit in many respects, we did not include measures of their internal dynamics. Furthermore, it is likely that our utilization of team-delivered leader training helped these leaders develop very similar schemas regarding how to lead the MTS. In many applied MTS settings where leaders are the primary managers of the interface between teams, discrepancies in certain aspects of leaders' schemas could be particularly detrimental to overall system functioning.

As was pointed out by Ancona and Caldwell (1992), Mathieu et al. (2001), and others, a great deal is known about the effective interactions within teams, but very little is known about the external dependencies of teams. Despite the abundance of MTSs in modern organizations, relatively little is known about how large systems of teams interact effectively. Even less is known about the efficacy of interventions for leveraging their success. The current study provides a first look at how leadership and coordination process impact performance in MTSs. Future research is needed that explores these relationships across team task types and in more applied field settings. In addition to leadership, other interventions like communication technology and decision support systems need to be examined.

Implications and Conclusions

A primary motivation for this research was to inform a pressing issue in today's team-based organizations. Several important implications have been supported. First, as the context of an MTS is significantly more complex and demanding of member resources than is working in a single team, these results suggest leader teams can greatly improve the functioning of the system by both developing plans that specify interunit cooperation during transition phases and working to facilitate coordination during action phases. Though we examined action teams performing a military-like task, we would expect leadership to serve a similar integrative role in most teams that experience recurring transition and action phases.

Our results suggest both leader functions improve MTS functioning, though through somewhat different mechanisms. Our overall pattern of findings shows leader strategy training was more strongly related to coordination process than was leader coordination training. Conversely, leader coordination training was more strongly related to performance than was strategy training. In situations in which it is either not possible or desirable to have leader teams present during task execution, our results suggest training leaders to target their planning actions at the interunit level to maximize subsequent coordination process. In contrast, when leader teams will be present during task execution, coordination training's significant correlation with performance suggests training leaders to monitor and communicate interunit actions and identify critical interdependencies during task engagement. Because we did not find significant interactions between the two types of leader training on either functional leadership or coordination process, the two types of training foci appear to represent individually viable options for training effective MTS leaders.

An additional noteworthy aspect of these findings is that the current sample of leaders was not necessarily more expert than team members were at the task at hand. In fact, the leaders received less extensive simulation training than did team members. Despite this fact, leaders were able to effectively improve the performance of their systems by engaging in MTS leadership behaviors that included monitoring and informing teams about component team actions. This can be attributed to the effectiveness of the skill-based leader training that participants were exposed to prior to task execution. Another important implication of this study is that skill-based training can realize functional leadership improvements in individuals who do not have leadership experience. Our training models contained three important elements of effective skill-based training environments: opportunities for learning concepts and behaviors, practice, and feedback (McDonald-Mann, 1998). Organizations that rely on MTSs and action teams with high levels of planning and interteam coordination needs may consider the development of context-specific training courses that teach critical leadership skills.

Prior research has demonstrated significant biases tend to develop as a result of team cohesiveness that prevent effective interteam interaction (Janis, Deutsch, Krauss, Goktepe, & Scheier, 1991; Sherif, 1966). However, consistent with prior work on the importance of interteam processes to team-level performance (Ancona, 1988, 1990; Ancona & Caldwell, 1992; Denison et al., 1996), the current study found interteam coordination significantly predicted multiteam performance. Thus, in the absence of leadership, the current results underscore the importance of balancing efforts to maximize intra- and interteam processes.

Just as constantly changing environmental contingencies such as markets and competitors require businesses to move past maximizing individual performance and look toward the optimization of larger systems of interconnected teams like MTSs, organizational research must move beyond the exploration of isolated within-team processes and develop both conceptual and empirical work that refocuses the lens outward. At the most basic level, this means predicting dependent variables that occur at higher levels of analysis. MTSs provide a new unit of analysis at which some relations may be similar to those found in small groups (i.e., I-P-O) and others may be different. The current work developed and tested a preliminary research framework for extending team-level leadership and process relationships to MTSs. Initial evidence suggests leader behavior is critical in shaping effective coordination across teams (i.e., I-P relationship) and that improved system performance results by way of this improved process (i.e., I-P-O).

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Appendix

Functional Multiteam System Leadership Items

1. The leader team frequently informed us of the other team's location.
2. The leader team kept us aware of the location of all targets.
3. The leader team did a good job of helping us work with the other team.
4. We rarely knew if the other team was taking out their targets. (reverse-scored item)
5. The leader team rarely told us when we were entering enemy radar. (reverse-scored item)
6. The leader team informed us of all hostile targets as we approached each waypoint.

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