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The Impact of Task- and Team-Generic Teamwork Skills Training on Team Effectiveness

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Keywords

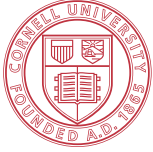
task, team-generic, teamwork, skills, training, team, members, effectiveness, coordination, collaborative problem solving, problem, communication, program, person, project, behavior

Comments

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This paper has not undergone formal review or approval of the faculty of the ILR School. It is intended to make results of Center research available to others interested in preliminary form to encourage discussion and suggestions.

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Abstract

This study examined the effects of training team members in three task- and team-generic teamwork skills: planning and task coordination, collaborative problem solving, and communication. We first examined the degree to which task- and team-generic teamwork skills training impacted team performance on a task unrelated to the content of the training program. We then examined whether the effects of task- and team-generic teamwork skills training on team performance were due to the transfer of skills directly related to planning and task coordination, collaborative problem solving, and communication. Results from 65 four-person project teams indicated that task- and team-generic teamwork skills training led to significantly higher levels of team performance. Results also indicated that the effects of task- and team-generic teamwork skills training on team performance were mediated by planning and task coordination and collaborative problem solving behavior. Although communication was positively affected by the task- and team-generic teamwork skills training, it did not mediate the relationship between task- and team-generic teamwork skills training and team performance. Theoretical and practical implications of these results are discussed, as well as possible limitations and directions for future research.

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The Impact of Task- and Team-Generic Teamwork Skills Training on Team Effectiveness

The nature of the workplace has changed over the last several decades as organizations have shifted to team-based work structures (e.g., Cannon-Bowers, Oser, & Flanagan, 1992; Ilgen, 1994; Kozlowski & Bell, 2003). Researchers estimate that over 80% of organizations employing more than a hundred workers utilize teams (Cohen & Bailey, 1997). Many of these workers are asked to integrate into team environments, knowing full well that the team will disband in the near future. Members of these fast acting, temporary project teams usually have a specific task to accomplish and are expected to be self-managing, capable of handling novel situations, and willing to invest in a continuous learning process (e.g., Allred, Snow, & Miles, 1996). Project team members are considered “experts selected for specialized skills and contributions to the team’s collective expertise” (Sundstrom, 1999, p. 19). Project teams have become the norm within many organizations (e.g., Cohen & Bailey, 1997; Sundstrom, McIntyre, Halfhill, & Richards, 2000), representing one third of all teams operating in the United States (Gordon, 1992). For example, Boeing utilized project teams to design and develop components for their 777 airliner (Dumaine, 1994).

Unfortunately, the transition to these types of team-based work structures has not always been a smooth one (Marks, Sabella, Burke, & Zaccaro, 2002). Project teams are frequently unsuccessful, and this is often attributable to a lack of teamwork skills on the part of the members who are usually chosen for their functional technical skills and not their teamwork skills. Team members can be unprepared, lacking the teamwork skills required to work as an interdependent unit (Mohrman, Cohen, & Mohrman, 1995). The inability of team members to interact and work together effectively can negatively influence both team and organization effectiveness (e.g., Ellis et al., 2003; Marks et al., 2002). As a result, managers have identified training as a key factor in the success of work teams (Wellins, Byham, & Dixon, 1994).

Although efforts have been directed toward developing effective training programs for employees who are, or will be, working in team environments (e.g., Stevens & Yarish, 1999), to date researchers have focused on developing task- and team-specific team training programs (e.g., Liang, Moreland, & Argote, 1995; Marks et al., 2002; Marks, Zaccaro, & Mathieu, 2000). However, project team members, who transition from task to task and team to team, need task- and team-generic teamwork skills training programs, which focus on developing skills that can be applied in a variety of contexts (Cannon-Bowers, Tannenbaum, Salas, & Volpe, 1995). Researchers have yet to determine whether task- and team-generic teamwork skills training programs are successful at improving team effectiveness (Chen, Donahue, & Klimoski, 2004).

Therefore, the purpose of this study is to examine the effect of task- and team-generic teamwork skills training on team effectiveness. The training program we examine focuses on three teamwork skills that are particularly important for project team members: planning and task coordination, collaborative problem solving, and communication. We propose that task- and team-generic teamwork skills training in planning and task coordination, collaborative problem solving, and communication has the potential to positively affect project team performance, even though the components of the task are completely unrelated to the content of the training program and the team members have no prior experience working with one another. We then propose that this improvement in project team performance is due to the transfer of skills directly related to planning and task coordination, collaborative problem solving, and communication.

The results of this research have several potentially important implications. First, to our knowledge previous research has not examined the utility of generic teamwork skills training for enhancing team performance. This study begins to address this gap in the literature. Second, this study also examines the process by which generic teamwork skills training influences team performance. Exploring the mechanisms by which this type of team training operates promotes theory building surrounding generic teamwork skills training. Finally, the

results of this study have important practical implications in organizational settings, because our findings provide insight into how organizations can leverage the benefits and avoid the pitfalls associated with the implementation of fast-acting, temporary project teams. In the following sections we review the literature on generic teamwork training and present the hypotheses that were examined in the current research.

Task- and Team-Generic Teamwork Skills

The success of team training programs depends on conducting a thorough team training analysis, starting with a skills inventory to identify the competencies that are needed (Salas, Burke, & Cannon-Bowers, 2002). Competencies include “(1) the requisite knowledge, principles, and concepts underlying the team’s effective task performance; (2) the repertoire of required skills and behaviors necessary to perform the team task effectively; and (3) the appropriate attitudes on the part of team members (about themselves and the team) that foster effective team performance” (Cannon-Bowers et al., 1995, pp. 336-337). These teamwork skills can be categorized into one of four groups depending on whether they are specific or general to a particular team and specific or general to a particular task.

In the typical organization there are many different types of teams (e.g., project, production, action), and each type of team has different characteristics and, therefore, different training needs. Production teams, for example, have fairly stable membership and tend to perform a small range of tasks repetitively. These types of teams would benefit most from training on task- and team-specific teamwork skills (Salas et al., 2002), such as knowledge of team members’ characteristics and specific compensation strategies (Cannon-Bowers et al., 1995). In contrast, the life span of project teams is often one work-cycle. Teams members with highly differentiated expertise are brought together to tackle a particular problem and often disband when the project is completed. Because project teams work on a variety of tasks with a variety of members, there is a need for more general competencies that are transportable across teams and tasks (Salas et al., 2002). It is these qualities that make generic teamwork

skills training a good fit for organizations that utilize project teams on a regular basis. More team- or task-specific training is a less appealing option for project teams because, as Salas et al. (2002, p. 242) note, "These members would be in a constant state of retraining."

Past research has identified five categories of task- and team-generic teamwork skills: (1) conflict resolution skills, (2) collaborative problem solving skills, (3) communication skills, (4) goal setting and performance management skills, and (5) planning and task coordination skills (Cannon-Bowers et al., 1995; Stevens and Campion, 1994; Swezey & Salas, 1992). Due to the demands that project teams face, we argue that three sets of generic teamwork skills will be particularly important for project team effectiveness: planning and task coordination, collaborative problem solving, and communication. Planning and task coordination refers to team members' capacity to plan and coordinate activities, information, and interdependencies among team members. Collaborative problem solving refers to team members' capacity to effectively identify situations requiring participative problem solving and to utilize the proper degree and type of participation. Communication refers to team members' capacity to understand communication networks, and to utilize decentralized networks to enhance communication where possible (Stevens & Campion, 1994). In the next section we discuss the importance of these three dimensions of teamwork skills for project team performance, and examine the potential for enhancing these skills through a generic team training program.

The Effects of Task- and Team-Generic Teamwork Skills Training on Team Performance

A number of studies have examined the effectiveness of a variety of task- and team-specific teamwork skills training programs, including cross training (e.g., Marks et al., 2002), team coordination training (Prince & Salas, 1993), team leadership training (Tannenbaum, Smith-Jentsch, & Behson, 1998), and team dimensional training (Smith-Jentsch, Salas, & Baker, 1996). Most studies find that these types of team training programs positively influence team effectiveness (see Cannon-Bowers & Salas, 1998).

However, only two studies have focused specifically on the effects of task- and team-generic teamwork skills training. Smith-Jentsch et al. (1996) trained 60 undergraduates in team performance-related assertiveness, which can be defined as the ability of team members to share their opinions with their teammates in a manner that is persuasive to others. The results indicated that, relative to a control group that received no training, the three task- and team-generic teamwork skills training programs produced more positive attitudes regarding team performance-related assertiveness and one program significantly affected performance-related assertive behavior. Chen, Donahue, and Klimoski (2004), in an effort to specifically focus on teamwork skills that are task- and team-generic, designed a course to train undergraduate students in conflict resolution, collaborative problem solving, communication, goal setting and performance management, and planning and task coordination. Results indicated that the training program significantly increased the levels of students' teamwork knowledge and skills. Although these studies provide an indication that generic team training can be used to enhance individuals' teamwork skills, neither study examined whether task- and team-generic training has a positive influence on team effectiveness.

Despite the lack of results in the training literature, researchers have shown that planning and task coordination, collaborative problem solving, and communication skills positively influence team effectiveness. Planning and task coordination skills have been shown to represent essential self-management activities within team contexts (e.g., Goodman, Devadas, & Hughson, 1988; Shea & Guzzo, 1987). Given team members' interdependence, they must coordinate their activities in order to function as a single unit (e.g., Brannick & Prince, 1997). The importance of coordinating activities is amplified in project teams, where work activities and task demands differ across team members because they each have unique job responsibilities and unique workloads (Allred, Snow, & Miles, 1996). Planning and task coordination skills integrate the activities of team members (e.g., Larson & Schaumann, 1993) and allow them to anticipate and deal with workload distribution problems (Porter et al., 2003) or

potential weaknesses within the team (Marks et al., 2002). As a result, planning and task coordination skills have been shown to positively affect team performance (e.g., Weingart, 1992).

Because they are self-managed, project teams can also benefit from collaborative problem solving skills (Stevens & Campion, 1994). Indeed, project team members are expected to take the initiative to solve problems on their own without help from other employees within the organization. In addition, project team members are often expert specialists and it is therefore essential for all team members to work together closely to produce the team's outputs (Sundstrom et al., 1990). When team members get involved and collaborate with one another, the team can come up with a greater range of perspectives when diagnosing the problem and when coming up with a solution (e.g., Laughlin & Ellis, 1986; Levine & Moreland, 1990). Involving team members when a problem arises is effective because team members take ownership of and accept the solutions they come up with. They also become more committed to implementing their own recommendations (e.g., McGrath, 1984).

Finally, because project team members depend on one another for information, they need to utilize their communication skills to make sure the team is efficient and effective. Researchers have suggested that team members need to understand and utilize communication networks within the team (Stevens & Campion, 1994). Team members need to keep up-to-date on their teammates' domains of expertise, communicate new information to the team member with the relevant area of expertise, and ask for information from the team member who possesses the requisite expertise (e.g., Wegner, 1987; Wegner, Erber, & Raymond, 1991). Without communication, teams cannot collectively process information (Hinsz, Tindale, & Vollrath, 1997). As a result, effective communication represents one of the major components of most models of team performance (e.g., Campion, Medsker, & Higgs, 1993; Gladstein, 1984).

As an illustrative example of the effects of planning and task coordination, collaborative problem solving, and communication skills, Olivera and Argote (1999) described a case study involving a project team faced with designing a compact computer system for organizations with limited desk space. Sub-components of the computer system were assigned to separate team members. The team members responsible for the power supply system were unaware of the size restrictions and made a critical error by designing a desktop power system. Other team members could have easily corrected the error, but they failed to share that knowledge with the entire team. Because the team postponed meeting until the day before the system was introduced to the public, the problem could not be fixed in time. Similar problems occurred during construction of the Hubble Space telescope. The Perkin-Elmer Corporation, who was hired to develop the mirror for the telescope, utilized a project team consisting of a variety of experts, including an optical engineer by the name of Roderic Scott. During the construction of the mirror, the team faced a number of technical and manufacturing problems that were difficult or impossible to solve. However, despite the fact that he was willing and able to provide assistance, Scott was never asked to help in the process. By failing to correct the design problems that they encountered, the project team sent a faulty mirror into space and jeopardized the entire mission (Capers & Lipton, 1993).

Researchers have suggested that these three skills are susceptible to team training (Davis, Gaddy, Turney, & Koontz, 1986; Dyer, 1984; Liang, Moreland, & Argote, 1995). However, no one has examined the effects of task- and team-generic teamwork skills training in planning and task coordination, collaborative problem solving, and communication on team effectiveness. Because this type of training program is exactly what project team members need (Salas et al., 2002), we hypothesize the following:

H1: Task- and team-generic teamwork skills training in planning and task coordination, collaborative problem solving, and communication skills will positively affect project team performance.

However, organizations are much less likely to adopt training programs if the specific skills are not transferred to the job (Machin, 2002). Broad and Newstrom (1992) define transfer of training as “the effective and continuing application, by trainees to their jobs, of the knowledge and skills gained in training” (p. 6). We expect team performance to improve because project team members are able to transfer the task- and team-generic teamwork skills covered in training to the job. As a result, we hypothesize that:

H2: The effects of task- and team-generic teamwork skills training on project team performance will be mediated by the team’s ability to engage in planning and task coordination.

H3: The effects of task- and team-generic teamwork skills training on project team performance will be mediated by the team’s ability to collaboratively solve problems.

H4: The effects of task- and team-generic teamwork skills training on project team performance will be mediated by the team’s ability to communicate.

Method

Research Participants

Participants included 260 students from an introductory management course at a large Midwestern University who were arrayed into 65 four-person teams (34 control teams and 31 training teams). In exchange for their participation, each earned class credit and all were eligible for cash prizes (up to \$40 per session) based upon the team’s performance. All participants were informed of the opportunity for a cash award before signing up for the research and 40% of the teams received a cash award.

Task

Participants engaged in a modified version of the Distributed Dynamic Decision-making (DDD) Simulation (see Miller, Young, Kleinman, & Serfaty, 1998). The DDD is a dynamic command and control simulation requiring team members to monitor activity in a geographic region and defend it against invasion from unfriendly air or ground tracks or tracks that enter the region. The objective of the simulation is to maximize the number of team points, which can be

accomplished by identifying tracks that enter the space, determining whether they are friendly or unfriendly, and, if unfriendly, keeping them out of restricted areas (see below). Teams with the most points were awarded the cash prizes.

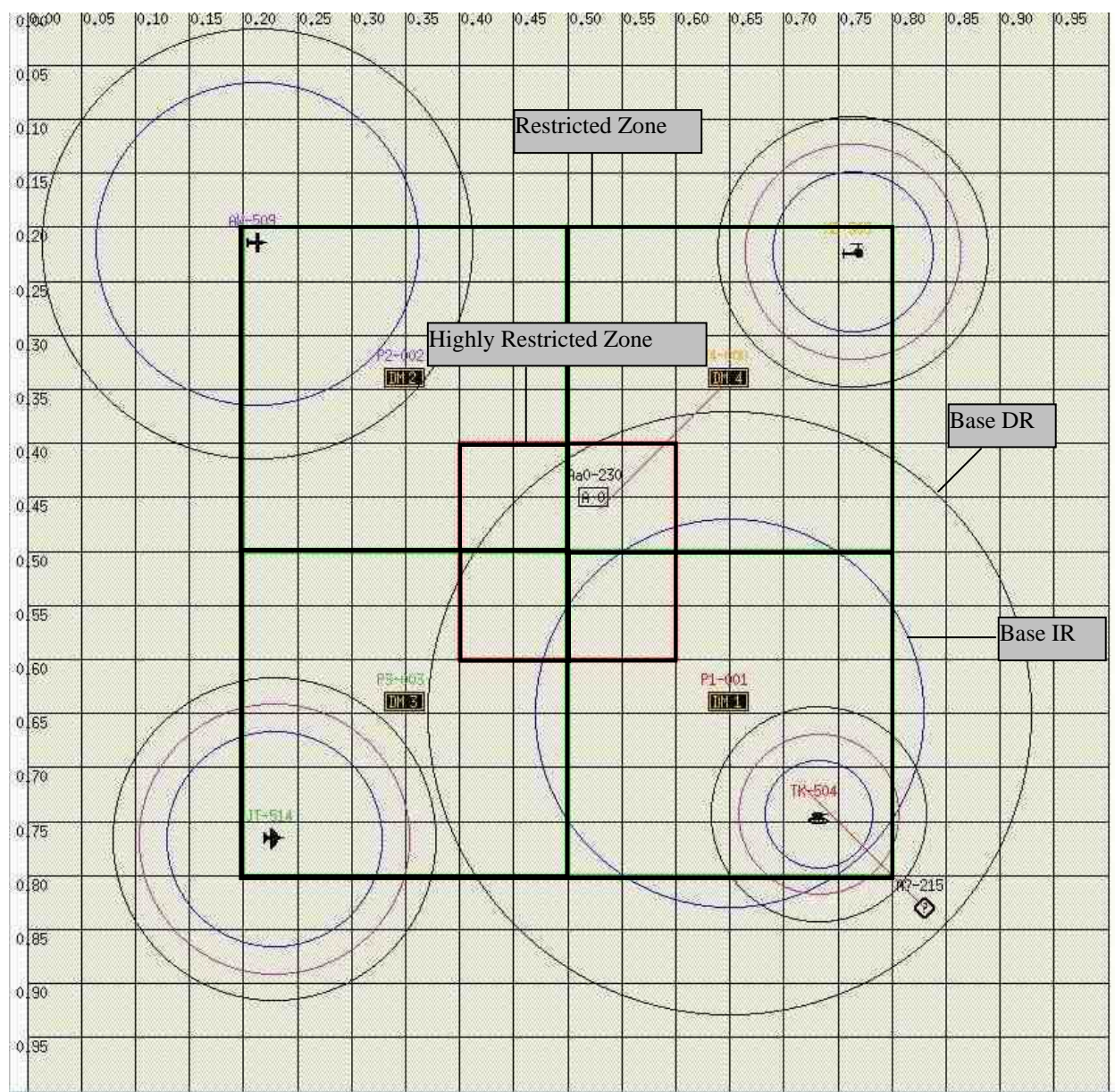
The DDD was chosen to test the hypotheses outlined in this study because it allows for the observation of numerous teams performing the same task under the same type of experimental conditions. As a result, it allowed for the manipulation of task- and team-generic teamwork skills training while being able to assess planning and task coordination, collaborative problem solving, and communication. Because team members participating in the DDD have highly specialized roles, are brought together for a short amount of time, are self-managing, and are faced with novel situations, the DDD closely simulates a project team environment. This type of task and this type of team are commonly observed in organizations (see Beersma et al., 2003).

The DDD grid. Figure 1 is a display of the geographic region, which is partitioned into four quadrants of equal size. Each team member in a four-person team is assigned responsibility for one of the four quadrants and operates from a workstation labeled DM-1 (Decision Maker 1) through DM-4 in the figure. In the center of the screen is a 4 by 4 square designated as the “highly restricted zone,” which is nested within a larger 12 by 12 square called the “restricted zone.” Outside the restricted zones is a neutral space. Each team member in the configuration illustrated in Figure 1 is responsible for an equal portion of highly restricted, restricted and neutral space.

Bases and vehicles. On the screen, DM1-DM4 represent the physical location of each team member’s home base of operation. Assigned to each base are four assets, or vehicles, that may be used to defend the space (i.e., keep unfriendly tracks out of restricted areas). Each base was assigned one type of asset in order to create high levels of work-team differentiation characteristic of project teams. DM1 was assigned four surveillance aircraft (AWACs), DM2 was assigned four tanks, DM3 was assigned four helicopters, and DM4 was assigned four jets. The

bases and vehicles have a combination of rings around them. The outermost ring is referred to as the detection ring, which allows each team member to see tracks on the screen. The inner ring, which is called the identification ring, allows team members to identify whether the track is friendly or enemy. The tank, helicopter, and jet also have a third ring between the detection and identification rings representing the area in which the approaching track can be engaged in.

Figure 1
The DDD Grid, Including Bases, Vehicles, and Tracks



Vehicles vary on four capabilities: vision, speed, fuel capacity, and power. Capabilities are distributed among the vehicles so that each has both strengths and weaknesses. For example, the AWACs has the greatest range of vision but no power to engage unfriendly tracks. Tanks, on the other hand, have the highest level of power but their range of vision is small and their speed is slow. Table 1 provides capability values for each vehicle.

Table 1
Summary of Assets and Tracks

	Duration (in min.)	Assets Speed	Vision	Power	Speed	Tracks Power	Nature	Need to Disable
Assets								
Tank	8:00	slow	very limited	high (5)				
Helicopter	4:00	medium	limited	med. (3)				
Jet	2:00	very fast	far	low (1)				
AWACs	6:00	fast	very far	none				
Tracks								
A0					Fast	none	Friendly	TK, HE, JT
A1					Fast	low (1)	Enemy	TK, HE, JT
A3					Fast	med. (3)	Enemy	TK, HE
A5					Fast	high (5)	Enemy	TK
G0					Slow	none	Friendly	TK, HE, JT
G1					Slow	low (1)	Enemy	TK, HE, JT
G3					Slow	med. (3)	Enemy	TK, HE
G5					Slow	high (5)	Enemy	TK
U+ (A0)					Fast	none	Friendly	TK, HE, JT
U- (A1)					Fast	low (1)	Enemy	TK, HE, JT
UX (A3)					Fast	med. (3)	Enemy	TK, HE
U# (A5)					Fast	high (5)	Enemy	TK

Notes: For vehicles: *duration* = amount of time a vehicle may stay away from the base before needing to refuel, *speed* = how fast the vehicle travels across the game screen, *vision* = refers to the range of vision the vehicle has to both see and identify tracks, *power* = the ability of the vehicle to engage enemy tracks. For tracks: *nature* = whether the track is an enemy or friend, *speed* = how fast the track travels across the game screen, *need to disable* = which of the vehicles can successfully engage the track.

Tracks. Tracks enter the screen from the sides of the grid with a line (i.e., a vector) attached to them indicating the direction they are proceeding through the space. Initially, when tracks enter someone’s detection ring, they show up as unidentified, which is represented by a small diamond with a question mark in the middle (see Figure 1). Once the track enters someone’s identification ring, it can be identified. When tracks are identified, the diamond turns

into a box with a letter and a number inside of it, as shown by track Aa0-230 in DM4's highly restricted zone in Figure 1. Inside the box it says A0, which, according to Table 1, means that it is a quick moving friendly track.

Actions taken towards tracks. Once a track is identified as unfriendly, a team member can engage the track by moving an asset near enough so that the track is within the attack ring. If the asset has enough power, the track can be disabled (see Table 1). Team members can make the decision to engage a track on their own. However, because each team member has only one type of asset, they must work interdependently with their teammates. For example, DM1, who has the four AWACs planes, cannot engage any enemy tracks in his or her quadrant.

Procedures

When participants arrived for their scheduled three-hour experimental session, they were randomly assigned to either the training or control condition. Individuals assigned to the training condition participated in a 30-minute task- and team-generic teamwork skills training session, while individuals in the control condition were immediately placed in a four-person team. After the task- and team-generic teamwork skills training session, individuals were assigned to a four-person team with the three team members who had also undergone the training. Participants were seated in close proximity to one another at four networked computer terminals. Verbal communication was the only method of communication allowed during the task. Team members were free to talk as much or a little as they wanted. Participants were then trained on the declarative and procedural aspects of the DDD command and control simulation as a team, which took approximately 60 minutes.

After the 60-minute practice session, team members completed the one-hour experimental session. During the experimental session, planning and task coordination, collaborative problem solving, communication, and team performance were measured.

Generic Teamwork Skills Training Manipulation

Having done our team training analysis for project teams and having selected planning and task coordination, collaborative problem solving, and communication as our three team skills, the next step was to effectively design and deliver the training program (Salas et al., 2002). Although there are a variety of different training methods, we utilized a lecture format. Instructional methods such as lectures are considered acceptable training methods depending on the situation (e.g., Kraiger, Ford, & Salas, 1993; Salas & Cannon-Bowers, 1997) and have been used in a number of studies (e.g., Smith-Jentsch et al., 1996). For training project teams in task- and team-generic skills, Cannon-Bowers et al. (1995) note that lecture-based training at the individual level may be the most appropriate strategy.

To construct our training lecture, we developed an instructional guide containing a number of case studies. The nine case studies (i.e., three per KSA) we created were designed to highlight the critical aspects of planning/task coordination, collaborative problem-solving, and communication identified by Stevens and Campion (1994). Each case study set up a work-related problem that could occur in any team situation, giving participants several options regarding the appropriate course of action (see Appendix A). Participants would each individually choose a course of action and then the experimenter would read a short explanation of why the correct answer was an effective response and why the incorrect answers were ineffective responses. Past research has shown that combining positive and negative model displays is an effective means of training interpersonal skills (e.g., communication), particularly when those skills must be generalized to novel contexts (Baldwin, 1992). After reviewing the positive and negative examples, participants moved to the next case study. When participants finished all nine case studies, they were instructed to continue to think about how to apply the recently learned task- and team-generic teamwork concepts once they began training in the DDD.

Although these three teamwork KSAs are important in the DDD environment, the training was not task or team specific and was instead designed to provide trainees with task- and team-generic teamwork skills. That is, the training provided participants with no information regarding situations they might encounter in the DDD. The training was also conducted at the individual-level. That is, team members were trained individually without any interaction with their soon-to-be teammates. We chose to train team members at the individual level based on recommendations in the literature. Specifically, researchers have suggested that training task- and team-generic teamwork skills should be done at the individual level to ensure the skills remain generic and do not take on team-specific components (Salas et al., 2002).

Measures

Planning and task coordination. Planning and task coordination refers to team members' capacity to plan and coordinate activities, information, and interdependencies among team members. In this study, team members' skills were highly specialized. For example, DM1 had all four AWACs planes stationed at his or her base. If DM1 needed to engage any enemy tracks entering entered his or her quadrant, he or she had to coordinate and work interdependently with his or her teammates. Due to vision restrictions, this included DM1's ability to effectively communicate with his or her teammates. Similar situations occurred for DM2, DM3, and DM4. For instance, when DM2 encountered a large number of enemy tracks in his or her restricted zone, he or she had to get help from DM3 and DM4 due to the speed of the tanks at his or her base. Because all four team members required assistance in order to deal with the task demands, planning and task coordination was measured by counting and summing together the number of times team members successfully engaged and cleared enemy tracks from their teammates' quadrants.

Collaborative problem solving. Collaborative problem solving refers to team members' capacity to effectively identify situations requiring participative problem solving and to utilize the proper degree and type of participation. Once teams began the 60-minute experimental session,

they were faced with a problem that they needed to solve collaboratively, which was adapted from Ellis et al. (2003). Teams encountered four types of unknown tracks that, once identified, appeared as U+, U-, UX, or U#. Each symbol corresponded to an air track that possessed one of four potential power levels (0, 1, 3, and 5 respectively). Teams had to match each symbol with its level of power as quickly as possible in order to minimize any loss of points during the game. For instance, if DM4 engaged a UX with a jet, which has a power of 1, the track would not be destroyed and DM4 would know that its power was greater than 1. If DM3 engaged and destroyed the same track with a helicopter, which has a power of 3, DM3 would know that the track had a power of 1 or 3. If the two collaborate and effectively communicate with one another, the team would figure out that the UX has a power of 3.

To measure collaborative problem solving, we examined the effectiveness and efficiency with which the U tracks were engaged. An effective engagement was defined as clearing an unfriendly track and efficient was defined as clearing the track using an asset with the exact power required. Therefore, during effective and efficient engagements, teams matched the power of an unfriendly unknown track with the power of an asset (e.g., engaging a U- with a jet). This situation indicated that the team had the requisite knowledge and skill and had solved the problem. However, there were situations where the team only partially solved the problem by effectively engaging U tracks without being efficient. For instance, the U-, which had a power of 1, could be engaged with the helicopter, tank, and jet. If teams attacked it with a helicopter or tank, it was unclear whether the team figured out the exact power of the track, but it was clear that the team figured out that the track was unfriendly. Finally, there were situations where the teams failed to solve the problem by ineffectively and inefficiently engaging the U tracks. For example, if teams engaged the U+ or engaged a U track without enough power, clearly the team had failed to figure out anything about the unknown track. Based on the efficiency and effectiveness of teams' behaviors toward the U tracks, we utilized the following scoring system:

+2 Effective and efficient engagements

- +1 Effective engagements
- 2 Ineffective and inefficient engagements

Communication. Communication refers to team members' capacity to understand communication networks, and to utilize decentralized networks to enhance communication where possible. Other researchers have suggested that the amount of work-related information shared by team members represents a good indication of the degree to which the team members understand and utilize communication networks within the team (e.g., Gladstein & Reilly, 1985). As noted earlier, team members were only allowed to communicate verbally with one another. Therefore, we observed each team performing the task and coded each instance of task-related information sharing during the task (e.g., "My tanks are on their way to DM3" or "There are a dozen targets entering DM4's restricted area").

One of two experimenters coded communication for the 65 teams. In order to ensure that the coding was accurate and consistent, both experimenters coded 10 (15.38%) of the teams and interrater agreement was assessed. Cohen's (1960) κ has been supported as a good index of agreement when presence/absence coding schemes are used. In this study, $\kappa = .86$, which indicated that the two experimenters evidenced acceptable levels of interrater agreement (see Landis & Koch, 1977). As a result, the remaining 55 teams were divided between the two experimenters.

Team performance. Team performance was measured by examining team members' behavior toward the non-U tracks. Teams in this study had two main objectives: (1) engage enemy tracks as quickly as possible once they entered one of the forbidden zones and (2) allow friendly tracks to roam freely across the screen. These two objectives were reflected in the team's offensive and defensive scores during the game. The team's offensive score started at 1,000 points and went up 5 points every time an enemy track was cleared from one of the forbidden zones. If a team member cleared an enemy track outside the forbidden zones or cleared a friendly track anywhere on the screen, the team's offensive score dropped by 5 points.

The team's defensive score started at 50,000 and decreases for every second an enemy resided within the restricted zone. Team performance was measured by standardizing and combining teams' offensive and defensive scores.

Results

Manipulation Checks

The acquisition of declarative knowledge (e.g., facts, principles) is the basic goal of most training programs and is required for higher order skill development. To evaluate declarative knowledge, a number of techniques can be used, including multiple-choice, true-false, or free recall tests (Kraiger, Ford, & Salas, 1993). In this study, we utilized Stevens and Champion's (1994) teamwork KSA test to evaluate whether project team members participating in generic teamwork skills training evidenced any change in their knowledge of effective teamwork KSAs. The teamwork KSA test is a 35-item multiple choice test designed to assess 14 individual-level KSA requirements for teamwork, including conflict resolution, collaborative problem solving, communication, goal setting and performance management, and planning and task coordination. First, we found that team members trained in task- and team-generic teamwork skills scored significantly higher on the planning and task coordination dimension ($M = 4.06$, $SD = .91$) than individuals in the control condition ($M = 3.43$, $SD = 1.18$), $t(258) = 4.94$, $p < .01$. Second, trained team members scored significantly higher on the collaborative problem solving dimension ($M = 5.28$, $SD = 1.67$) than individuals in the control condition ($M = 4.68$, $SD = 1.72$), $t(258) = 2.94$, $p < .01$. Third, participants in the training condition scored significantly higher on the communication dimension ($M = 8.03$, $SD = 1.83$) than individuals in the control condition ($M = 7.20$, $SD = 1.87$), $t(258) = 3.73$, $p < .01$. Finally, individuals who received the task- and team-generic teamwork skills training scored significantly higher on the overall teamwork KSA test ($M = 24.35$, $SD = 3.81$) than individuals in the control condition ($M = 22.46$, $SD = 4.23$), $t(258) = 3.77$, $p < .01$. These findings provide strong evidence that our training program successfully increased participants' knowledge of critical teamwork KSAs.

Tests of Hypotheses

Means, standard deviations, and intercorrelations among the variables examined in this study are reported in Table 2. Our first hypothesis suggested that task- and team-generic teamwork skills training in planning and task coordination, collaborative problem solving, and communication skills would lead to higher levels of team performance. As shown in Table 2, results from the correlation analyses demonstrated a significant relationship between task- and team-generic teamwork skills training and team performance ($r = .36, p < .01$). Task- and team-generic teamwork skills training explained a 13% of the variance in team performance. Thus, Hypothesis 1 was supported.

Table 2
Means, Standard Deviations, and Intercorrelations Among Study Variables

Variable	Mean	SD	1	2	3	4	5
1. Generic Teamwork Skills Training	0.48	0.50	--				
2. Collaborative Problem Solving	24.49	14.64	.35**	--			
3. Planning and Task Coordination	15.41	2.93	.42**	-.05	--		
4. Communication	89.75	36.77	.44**	.28*	.32**	--	
5. Team Performance	.00	1.59	.36**	.40**	.37**	.27*	--

Note: N=65. Task- and team-generic teamwork skills training was coded 0 for no training and 1 for training. Significance values are based on 1-tailed tests. * $p < .05$ ** $p < .01$

Hypothesis 2 proposed that planning and task coordination would mediate the relationship between task- and team-generic teamwork skills training and team performance. In order to test for mediation, it is necessary to demonstrate that (a) the independent variable is correlated with the dependent variable, (b) the independent variable is correlated with the mediating variable, (c) the mediating variable affects the dependent variable when controlling for the independent variable, and (d) relationship between the independent variable and the dependent variable becomes negligible or is reduced significantly when controlling for the mediating variable (Baron & Kenny, 1986; Judd & Kenny, 1981; Kenny, Kashy, & Bolger, 1998).

Because task- and team-generic teamwork skills training was significantly related to team performance, the first requirement for mediation was satisfied. The second requirement for mediation was also supported as task- and team-generic teamwork skills training was

significantly related to planning and task coordination ($r = .42, p < .01$). Task- and team-generic teamwork skills training accounted for approximately 18% of the variance in planning and task coordination. The third requirement for mediation was tested by regressing team performance on task- and team-generic teamwork skills training and planning and task coordination. Planning and task coordination was significantly related to team performance when controlling for task- and team-generic teamwork skills training ($\beta = .26, p < .05$), which passes the third mediational requirement. Regarding the fourth requirement for mediation, regression analyses indicated that, after controlling for planning and task coordination, the variance in team performance accounted for by task- and team-generic teamwork skills training was reduced from 13% to 5%. This reduction was statistically significant by Sobel's (1982) test, $Z = 1.98, p < .05$. Thus, Hypothesis 2 was supported.

Hypothesis 3 proposed that collaborative problem solving would mediate the relationship between task- and team-generic teamwork skills training and team performance. Because task- and team-generic teamwork skills training was significantly related to team performance, the first requirement for mediation was satisfied. As shown in Table 2, the correlation analyses indicated that task- and team-generic teamwork skills training was also significantly related to collaborative problem solving ($r = .35, p < .01$). Task- and team-generic teamwork skills training accounted for 12% of the variance in collaborative problem solving behavior, which fulfilled the second mediation requirement. To test the third requirement for mediation, team performance was regressed on task- and team-generic teamwork skills training and collaborative problem solving. Collaborative problem solving was significantly related to team performance when controlling for task- and team-generic teamwork skills training ($\beta = .32, p < .05$), satisfying the third mediational requirement. After controlling for collaborative problem solving, the variance in team performance accounted for by task- and team-generic teamwork skills training was reduced from 13% to 5%. This reduction was statistically significant by Sobel's (1982) test, $Z = 2.10, p < .05$, supporting Hypothesis 3

Hypothesis 4 proposed that communication would mediate the relationship between task- and team-generic teamwork skills training and team performance. Because task- and team-generic teamwork skills training was significantly related to team performance, the first requirement for mediation was satisfied. As shown in Table 2, the correlation analyses indicated that task- and team-generic teamwork skills training was also significantly related to communication ($r = .44, p < .01$). Task- and team-generic teamwork skills training accounted for 19% of the variance in communication, which fulfilled the second mediation requirement. To test the third requirement for mediation, team performance was regressed on task- and team-generic teamwork skills training and communication. Communication was not significantly related to team performance when controlling for task- and team-generic teamwork skills training ($\beta = .14, ns$), failing the third mediational requirement. Thus, Hypothesis 4 was not supported.

In sum, although task- and team-generic teamwork skills training positively influenced all three skill dimensions, only planning and task coordination and collaborative problem solving mediated the relationship between task- and team-generic teamwork skills training and team performance. Our results suggest that task- and team-generic teamwork skills training improved team performance because team members successfully transferred planning and task coordination and collaborative problem solving skills learned in training to the task environment. In support of this notion, the amount of variance in team performance explained by task- and team-generic teamwork skills training is reduced from 13% to 0% when controlling for both planning and task coordination and collaborative problem solving.

Discussion

The prevalence of teams in organizations places a premium on employees' ability to interact and work effectively with others in interdependent work environments. As the nature of work has become more complex and dynamic, project teams have become the norm within many organizations (Cohen & Bailey, 1997; Sundstrom et al., 2000). The features of these

teams, such as high work-team differentiation and variable work-cycles, make them well suited for the challenges of a complex and constantly changing work environment. Yet, project teams are frequently unsuccessful and these failures have often been blamed on a lack of teamwork skills on the part of team members (Marks et al., 2002). One challenge with these teams is that members are often selected for their functional expertise rather than their ability to work in team environments (Mohrman et al., 1995). In addition, project teams are typically isolated from external work units, which limits outside interference but also means that effectiveness is almost solely a function of internal group processes (Sundstrom et al., 1990).

Given these demands and challenges, it is critical to identify interventions that can provide project team members with the teamwork skills that are essential for success. In this study, we examined the effects of a training program that focused on three task- and team-generic teamwork skills: planning and task coordination, collaborative problem solving, and communication. We examined not only the impact of this training on overall project team performance but also whether the effects were due to the team members' ability to transfer what was learned in training to the task environment.

First, our results indicated that task- and team-generic teamwork skills can be trained, which supports the findings of other researchers (Chen, Donahue, & Klimoski, 2004). Team members who were trained in task- and team-generic teamwork skills scored two points higher on Stevens and Campion's (1994) teamwork KSA test. Although two points does not seem like much, the difference in scores between the training and control conditions is practically significant and represents a large jump in percentile (Chen, Donahue, & Klimoski, 2004). Stevens and Campion (1999) found that a two-point differential on the teamwork KSA test translates into meaningful differences in teamwork-related job performance.

Task- and team-generic teamwork skills training also positively influenced behavior related to planning and task coordination, collaborative problem solving, and communication. Team members who were trained in task- and team-generic teamwork skills displayed a 17%

increase in planning and task coordination behavior, a 51% increase in collaborative problem solving behavior, and a 43% increase in communication when compared to control teams. Team members were clearly able to transfer the ideas presented in the task- and team-generic teamwork skills training.

Second, our results indicated that teams composed of members who received the task- and team-generic teamwork skills training had significantly higher levels of overall team performance, despite the fact that the training was unrelated to the DDD simulation and did not involve any team member interaction. Although several researchers have suggested that there exist a set of teamwork skills that generalize across different tasks and contexts (e.g., Stevens & Campion, 1994), this is the first study to show that training individuals in task- and team-generic teamwork skills can improve the effectiveness of the team. Based on our results, task- and team-generic teamwork skills training represents one of several viable approaches organizations can take to enhance the level of teamwork skills among employees. One benefit of task- and team-generic teamwork skills training is that it is not tailored to a specific team or task and, therefore, can be used to develop training programs that are offered simultaneously to a broad range of employees. In addition, task- and team-generic teamwork skills training reduces the need for organizations to retrain employees before each new team assignment. These two benefits should not only reduce training costs but also enhance organizational flexibility by making it possible for individuals to transition more quickly and effectively from one team environment to another.

Third, results indicated that the effects of task- and team-generic teamwork skills training on team performance were due to the team members' ability to engage in planning and task coordination and collaborative problem solving behavior. Our results suggest that the type of task- and team-generic teamwork skills training implemented in this study will be beneficial for teams and tasks where performance relies on planning and task coordination and collaborative problem solving skills. This suggests that task- and team-generic teamwork skills training will

transfer to the job as long as organizations follow fundamental training design principles. In particular, the first step of any training effort should be a training needs assessment that identifies the skills that are useful across a wide variety of team contexts. Based on this information, an organization could prioritize the teamwork skills and focus its task- and team-generic teamwork skills training on those teamwork skills that are likely to have the largest impact for the largest segment of the employee population. Based on our results, employees will evidence behavior directly related to the task- and team-generic teamwork skills covered in training.

Our results, however, failed to support the idea that the effects of task- and team-generic teamwork skills training on team performance are due to the increased communication among team members. Task- and team-generic teamwork skills training significantly influenced the level of communication in the team, and the level of communication in the team significantly influenced team performance. However, when controlling for task- and team-generic teamwork skills training, communication had little impact on team performance. This set of findings indicates that the level of communication within the team was correlated with team performance because both were caused by the task- and team-generic teamwork skills training (see Kenny, Kashy, & Bolger, 1998).

The teams literature has repeatedly noted the difficulties surrounding measurement of the communication construct. Generally, the literature has traditionally treated communication as a “more is better” construct (e.g., Campion, Medsker, & Higgs, 1993; Campion, Papper, & Medsker, 1996; Gladstein & Reilly, 1985). However, several researchers have found that more communication does not necessarily translate into more effective teams (e.g., Tesluk and Mathieu, 1999). For example, in this study, team members could have shared the same task-related information with each other ten times. While this blocks communication networks within the team, it does not help the team perform better. However, planning and task coordination skills and collaborative problem solving skills rely heavily on effective communication skills. In

support of this idea, communication was significantly correlated with both planning and task coordination ($r = .32, p < .01$) and collaborative problem solving ($r = .28, p < .05$). Therefore, the transfer of effective communication skills may have been included in our measures of planning and task coordination and collaborative problem solving.

Limitations and Directions for Future Research.

A few limitations of the current study should be highlighted. First, we employed lecture-based training, which is only one of a number of techniques that organizations can utilize when training task- and team-generic teamwork skills. Although researchers have suggested that a lecture format is an effective and efficient means of conducting task- and team-generic teamwork skills training (Cannon-Bowers et al., 1995), methods that are more interactive or experiential, such as those incorporate role-playing, practice, or behavior modeling, may be equally or more effective (Salas, Burke, & Cannon-Bowers, 2002). While we agree that future research would benefit from an examination of different training techniques such as web-based training, we found that the more efficient method of lecture-based training had a significant influence on team effectiveness. This finding is consistent with a recent meta-analysis by Arthur, Bennett, Edens, and Bell (2003) which revealed that, despite their poor image, lectures are one of the more effective organizational training methods.

Second, because this study was conducted in a laboratory context, future research needs to examine the external validity of these results. On the one hand, there were certain features of this task and our participants that did achieve what Berkowitz and Donnerstein (1982) referred to as "mundane realism." For example, most weapons directors or those operating consoles in command-and-control simulations are approximately the same age and education level as our sample. Furthermore, many of these command-and-control crews have limited histories and, due to frequent rotation, limited futures together. Finally, the participants were engaged in a psychologically engaging task and they were aware of cash bonuses that were available to the top performing teams. Therefore, we believe the training and task

environment created sufficient “psychological realism.” On the other hand, the consequences of the research participants’ decisions were not as severe or dramatic as they would be in a real situation. However, one needs to keep the nature of the research question in mind when assessing the relevance of external validity. We are concerned more with the developing and testing the effects of task- and team-generic teamwork skills training than with command and control itself. Because there is no reason to think that a task- and team-generic teamwork skills training program could not be applied in this context, this context serves as a meaningful venue for testing our hypotheses. We are simply asking the “can it happen” question, which according to Ilgen (1986), is exactly the type of question that bears investigation in this type of a laboratory setting. Furthermore, researchers have estimated that the correlation between the effect sizes obtained in the field and those obtained in the lab generally exceed .70 (Anderson, Lindsey, & Bushman, 1999). For this and other reasons, as Cook and Campbell (1979) note, “a strong case can be made that external validity is enhanced more by many heterogeneous small experiments than by one or two large experiments” (p. 80). Thus, we are confident that the external validity of our findings will become evident after other researchers replicate our work in field settings and in additional experiments conducted with different samples and tasks.

Conclusion

As organizations increasingly restructure work around teams, and project teams in particular, it will be critical to identify techniques that can be used to prepare individual employees for the unique challenges and demands of team environments. Team training programs that focus on team and/or task specific skills may have limited applicability in today’s dynamic and fast-paced work environments. One potential solution to these dilemmas may be task- and team-generic teamwork skills training. The advantage of such training is that it provides individuals with the skills needed to perform across a broad range of team and task environments. Our findings demonstrate that task- and team-generic teamwork skills training can enhance team members’ teamwork skills, which ultimately facilitates overall project team

effectiveness. Although future research is needed to extend our results to different sets of teamwork skills, team types, and tasks, it appears that generic teamwork skills training may serve as a valuable tool in organizations' efforts to realize the potential of team-based work structures.

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Appendix A

You have just graduated with a bachelor's degree in engineering. To find a job, you send your resume around to various organizations in the area. Fortunately, Titan Motor Company is looking for engineers and they set up an interview. At the interview, you impress them with your charm and they hire you on the spot to help them design the new Titan Comet Coupe in Iowa City, Iowa.

Upon starting your job, you are immediately faced with an issue that your design team needs to resolve. You must decide what type of fabric to use for the interior of the car. You, along with two of your three teammates, want to use polyester. However, your fourth team member is adamantly against polyester and opts for suede instead. His voice gives the impression that he is certain that suede is the best choice and no one is going to change his mind. He thinks he has given the impression that he is a confident decision-maker. But, by refusing to discuss the issue, he ends up creating a situation where you and the other teammates feel hesitant to open up to him. You want to be part of a team where everyone has a chance to participate. Everyone should be able to communicate openly and supportively with each other. What do you think leads to the most open and supportive environment?

- a) Positioning yourself properly in the communication network.
- b) Learning how to communicate non-verbally with your teammates.
- c) Paying attention to where you are on the social ladder within the team.
- d) Improving the quality of your interpersonal relationships with your teammates.