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The Effects of Team-Skills Training on Transactive Memory and Performance

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The existence of effective transactive memory systems in teams has been found to enhance task performance. Methods of developing transactive memory are therefore an important focus of research. This study aimed to explore one such method, the use of a generic team-skills training program to develop transactive memory and subsequent task performance. Sixteen three-member teams were all trained to complete a complex collaborative task, prior to which half the teams ($n = 8$) completed a team-skills training program. Results confirmed that those teams that had been trained to develop a range of team skills such as problem-solving, interpersonal relationships, goal setting, and role allocation evidenced significantly higher team skill, transactive memory, and performance than those that were not trained in such skills. Results are discussed with reference to the wider transactive memory literature and the mechanisms through which team-skills training could facilitate the more rapid development of transactive memory.

Keywords: *team-skills training; team skill; transactive memory; team development; trust*

The concept of shared cognition has been considered as a valuable commodity in team research for a number of years. Researchers have argued that it is one of the contributing factors that explain the difference between good and poor team performance, especially with respect to superior team interaction and well-coordinated behavior (Cannon-Bowers, Salas, & Converse, 1993; Kerr & Tindale, 2004). In addition, the literature suggests that sharing knowledge among team members also promotes

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enhanced turn taking, interpretation of cues, and decision making, all of which lead to more effective teamwork (Cooke, Salas, Cannon-Bowers, & Stout 2000; Klimoski & Mohammed, 1994; Mohammed & Dumville, 2001). In their conceptualization, Cannon-Bowers and Salas (2001) posited that team members' knowledge of each other is one important aspect of shared cognition. They, and others (e.g., Mathieu, Heffner, Goodwin, Salas, & Cannon-Bowers, 2005; Moreland & Myaskovsky, 2000), have suggested that to work effectively together, team members need to develop an understanding of each other in terms of their strengths and weaknesses and levels of expertise. One way in which this area has been theoretically considered is that of transactive memory.

Transactive memory has been defined as the combination of the knowledge held by each team member and the awareness of what information other members in the team hold (Hollingshead, 1998a, 1998b; Wegner, 1987, 1995; Wegner, Erber, & Raymond, 1991). The literature makes a further distinction between *transactive memory*, which is memory held at the individual level, and *transactive memory systems*, which describes how members actively use transactive memory to cooperatively encode, store, and retrieve information (K. Lewis, 2003). Transactive memory systems therefore enable a team to allocate information between members and, through knowing that an individual member has expertise about a particular issue, facilitate the access of that information during task performance as and when it is required. Early work in transactive memory focused on relational couples, where partners developed a cooperative cognitive system through relying on each other as memory aids. Wegner further posited that this concept could be extended to groups, and based on this proposal, more recent research has focused on the role of transactive memory in ad hoc experimental and organizational teams (e.g., K. Lewis, 2003; Moreland, 1999; Moreland & Myaskovsky, 2000).

Transactive Memory and Training

In the group research literature, there is growing evidence that transactive memory can enhance team performance (Austin, 2003; Hollingshead, 1998a, 1998b; K. Lewis, 2003, 2004; Liang, Moreland, & Argote, 1995; Moreland, 1999; Moreland & Myaskovsky, 2000). Given this link, it is pertinent to ask how the development of transactive memory can be facilitated. As Kozlowski and Ilgen (2006) comment in their recent review on enhancing the effectiveness of teams, one way in which effectiveness may be enhanced is through training. Some of the earliest work on transactive memory in teams was carried out by Moreland and his colleagues in a series of studies that considered the extent to which transactive memory mediated the relationship between task training and team performance (Liang et al., 1995; Moreland, 1999; Moreland & Myaskovsky, 2000). In these studies, Moreland operationalized transactive memory in terms of memory differentiation, task coordination, and task credibility. *Memory differentiation* was considered to be the degree to which individual members of the team specialized in remembering different aspects of the task. *Task coordination* was the ability of team members to work effectively together while carrying out the task. It incorporated greater cooperation between team members, less confusion, and fewer misunderstandings. Finally, *task credibility* was the degree to which group members trusted one another's task expertise. Participants were trained how to build an AM radio, either individually or in a group. A week later, participants who were trained individually were placed into groups, and their performance at the task was compared with that of the intact training groups. It was found that those groups that had trained together on the task performed better, making fewer errors than those whose members had been individually trained. Analysis revealed that these performance differences could be explained by the existence of higher levels of transactive memory in groups that trained together. It was argued that the task-training environment in which team members trained together provided opportunities to learn about other members' expertise, which facilitated the access of that information during task performance.

Extending the work of Moreland and his colleagues, Rulke and Rau (2000) proposed that group task training provides an excellent context for the early stages of transactive memory systems development, notably the encoding and storage of information about expertise. The training environment enables team members to identify who has expertise in specific domains and find gaps in expertise that can then be filled by each team member through coordinated effort. Observational analysis of groups with high transactive memory found that these teams displayed cycles of interaction that began with team members asking questions about the task or making statements indicating that they had no expertise. This was followed by knowledgeable members making declarations of expertise and a subsequent evaluation of knowledge distribution within the team. The final part of the cycle involved coordinating the assignment of domains of expertise among team members to fill any knowledge gaps identified during evaluation. Rulke and Rau also noted that the frequency of the different types of interaction within this cycle shifted over time, with a greater frequency of information encoding early on in team interaction, which gradually decreased as transactive memory systems became more fully developed. Conversely, they found that the frequency of interactions evaluating shared knowledge increased over time. They proposed that this cycle of interaction established shared knowledge within the group that could then be drawn on during task performance.

Rulke and Rau's (2000) findings are further supported by K. Lewis (2004) in her longitudinal study of the natural development of transactive memory systems in organizational teams. She found that the planning stage in team activity was critical to transactive memory systems development, arguing that the frequent interaction during this stage helped to develop accurate perceptions of knowledge distribution within the team. In addition, she proposed that this stage provided the opportunity for members to build up a common understanding of the task and how each member's different expertise fitted together. More recently, K. Lewis, Lange, and Gillis (2005) proposed that transactive memory systems are learning systems incorporating location information and transactive processes that operate in a cycle to facilitate the learning of and subsequent performance of a task. As with Rulke and Rau, they propose that transactive processes of interaction and communication function to facilitate the encoding, storing, and retrieving of knowledge relevant to the task. In their study, K. Lewis et al. propose that Learning Cycle 1 occurred during the task training of individual groups such that group members learned location information about task expertise distribution, improved the task expertise of individual members, and developed new collective knowledge. Furthermore, groups used this learning to improve performance when subsequently undertaking the same task a week later. Therefore, a training environment has been shown to facilitate transactive memory systems development by allowing time for engaging in a variety of transactive processes.

The importance of training for the development of transactive memory, therefore, appears to be well founded. Of interest, however, is that research investigating training has focused exclusively on task training and the technical and procedural processes of performing the task, as is the case with Moreland's work (Moreland, 1999; Moreland & Myaskovsky, 2000). In so doing, it has ignored the possible role of specifically training team process interactions to help develop transactive memory and transactive memory systems. This is surprising because, as indicated above, much of this early research on transactive memory identifies the importance to its development of team process skills, such as planning, coordination, and role allocation, which are important elements of two of the three components of transactive memory—task coordination and memory differentiation (K. Lewis, 2004;

Moreland, 1999, Rulke & Rau, 2000). In addition, this exclusive focus on task skills is inconsistent with a number of team development models that have argued that both team skills and task skills are necessary to maximize successful team performance (e.g., Morgan, Glickman, Woodard, Blaiwes, & Salas, 1986; Tuckman, 1965). Morgan et al. (1986) defined *task skills* as the technical skills required to perform a task, such as task demands and operating skills, and *team skills* as the skills necessary for people to work effectively as a team, such as coordination and effective communication. Clearly, the performance of a complex task demands a level of task skill without which the team could not successfully complete the task. For example, one cannot drive a car without a certain amount of procedural knowledge. The centrality of task-skills training to performance clearly justifies the prior interest in this type of training in the earlier work on transactive memory. However, similarly, tasks that require high levels of team member interdependency will need the additional element of team skills for members to work efficiently together (Bass & Barrett, 1981; Glickman et al., 1987; Stanton, Ashleigh, Roberts, & Zu, 2001; Tuckman, 1965). For example, Stanton et al. (2001) found that effective teams were those that were more interdependent, as evidenced by more frequent and higher quality interactions. Similarly, Tuckman (1965) proposed that good interpersonal relationships between team members must be established if they are to focus effectively on the performance of their task. Furthermore, and importantly in relation to this study, Bass and Barrett (1981) found that effective team interaction modified the development of individual task skills by providing cues and reinforcing behaviors important for learning the task. Consistent with this, Glickman et al. (1987), in their research on the team development, argue that teamwork skills such as coordination and cooperation are more important than task skills early on in the team training process because it is unreasonable to expect teams to produce optimal task performance without first understanding how they can work together as interdependent teams. During later stages of development, team and task skills become equally important, and a focus on both is needed for teams to be effective. Together, these findings suggest that superior team skills improve team interaction and support the development of effective task skills, perhaps in part through promoting the development of transactive memory processes.

The concepts surrounding the dual importance of team and task skills in models of team development have been incorporated into the field of shared cognition. For example, research in the area of shared mental models (SMM), a concept broader than but related to transactive memory, suggests that effective team performance requires the development of both task-related and team-related SMM (Mathieu et al., 2005). Consequently, ensuring the development of both these types of SMM should be a critical element of any type of team training. In their article, Mathieu et al. (2005) also consider the importance of both the quality of the models held by team members and the sharedness of the models. For example, it may be that more than one effective mental model exists for how to best perform a task, but members may hold different effective models rather than the same model, leading to confusion and disrupted performance. In such situations, training that can ensure that task models are not only high in quality but also shared by all members will be important to performance, as disagreements resulting from different models are likely to damage team processes. Relating these ideas to transactive memory, we suggest that it could be that team members have a good understanding of who knows what but hold different cognitive models of how that expertise fits together. Team-skills training should lead to the development of team processes that are more likely to identify such differences in conceptualizations of the task, allowing members to reconcile discrepancies. This type of training should be more effective in achieving this aim compared to task-skills training alone, as the latter does not directly focus on interpersonal interactions; rather, it assumes that these evolve naturally while learning about the task.

Clearly, the above research relating to team processes has implications for optimizing levels of two of the components of transactive memory, specifically memory differentiation and task coordination. Higher levels of team process skills may also affect the third component of transactive memory within teams: *task credibility*, defined by Moreland (Liang et al., 1995; Moreland, 1999; Moreland & Myaskovsky, 2000) as the trust that team members have in each other's knowledge of the task. Although trust in others' task expertise might be one construct of trust, it should be acknowledged that there are additional constructs that are also important in understanding one person's experience of trust in another. Current theory generally argues for a multidimensional model of trust (Ashleigh & Nandakhumer, 2007; Blois, 1999; Luhmann, 1988; Mayer, Davis, & Schoorman, 1995; Rousseau, Sitkin, Burt, & Camerer, 1998). For example, based on the work of J. D. Lewis and Weigert (1985) and Cummings and Bromiley (1996), Ashleigh and Stanton (2001) identified three different dimensions: emotive (e.g., a feeling of team interdependency and commitment), cognitive (e.g., sharing the same team mental model), and behavioral (e.g., quality of interaction). Although definitions of transactive memory have led researchers to focus exclusively on team members' trust in others' task knowledge, one could speculate that other constructs are also important in the development and use of transactive memory systems. For example, simply trusting another team member's task knowledge may not be enough to actively use transactive memory systems because sharing knowledge within teams may be impeded if there is no trust in terms of members' commitment to each other and in their confidence in each other or if they do not have the ability to interact effectively. Consistent with this, research has established that the concept of trust underlies the sharing and transference of vital knowledge (e.g., Dirks & Ferrin, 2001; Mayer et al., 1995). It has also been argued that in high-trust environments, individuals are more likely to evidence cooperative behavior in terms of open communication and are more predisposed to sharing knowledge (Sharkie, 2005). Arguing from this perspective, it could be said that trust is an antecedent of knowledge sharing. Relating this idea to transactive memory, higher levels of trust established early on should facilitate the initial development of transactive memory systems when the team needs to encode, store, and evaluate shared knowledge.

To date, there has been little research that considers the effects of team-skills training on trust. The interpersonal models of team-skills training are argued to specifically develop mutual trust as a team outcome (Beer, 1976; Woodman & Sherwood, 1980). In support of this, Kegan and Rubenstein (1973) and Walter (2000) found that team building increased trust in organizational work groups. Although these evaluations of team-building programs suggest that they do nurture mutual trust and respect, there is little research evidence to support explanations for these effects. Consequently, one can only speculate how trust is developed in training. One possible explanation is that team-skills training provides an ideal context for team members to learn about each other in a safe environment—an idea consistent with the literature on psychological safety and learning behavior (Edmondson, 1999). Team-skills training offers multiple opportunities for teams to perform tasks where there are no negative consequences of poor performance. In fact, training is usually designed in such a way as to support the development of team processes, thus ensuring relatively successful task performance. Even if the team does fail in a task, trainers divert emphasis to the importance of the resulting learning point rather than to the failure itself. Under such circumstances, people may be more willing to risk disclosure of personal information and accept that others will do the same to help the team learn about itself and improve its performance. In addition, as training progresses and the members see their own and other members' team skills and performance improve, their mutual trust in one another's ability to work together as a team will be enhanced. Thus, there may be a reciprocal relationship between trust and performance. Team-skills training thus provides more opportunities for the trust-performance link to be reinforced. Therefore, we hypothesize that team-skills training will increase trust not only in terms of its more narrow use, as currently defined with respect to transactive memory as task credibility, but also more widely in relation to the trust required for the initial sharing and evaluation of knowledge.

How Should Team Skills Be Developed? The Effectiveness of Training

Although the importance of team skills has been identified, questions have been raised as to how these skills develop. Some authors argue that team skills develop naturally through time spent together, implying that specific team process training is not required (Harrison, Mohammed, McGrath, Florey, & Vanderstoep, 2003; Moreland & Myaskovsky, 2000). In contrast, others propose that team skills need to be facilitated through training (Michaelson & Black, 1994; Porter, 1993; Prichard, Bizo, & Stratford, 2006; Prichard, Stratford, & Bizo, 2006; Prichard, Stratford, & Hardy, 2004) and that even if team skills do develop naturally, such unfacilitated development is likely to take place through trial and error and therefore take longer. Such a time delay is likely to be particularly problematic for one-off task groups and newly formed groups that are often expected to achieve high levels of performance immediately. Therefore, at a minimum, benefits are likely to accrue from teams-skills training by accelerating and ensuring team skill development, at least in the short term. Given that the early planning stages are a critical time in the development of transactive memory systems, there should be an advantage to those teams with a high level of team skill that can optimize the use of this time.

Team-skills training is a broad and fuzzy term that has been used to describe a range of different training approaches, such as team building (Salas, Rozell, Mullen, & Driskell, 1999) and team self-correction strategies (Blickensderfer, Cannon-Bowers, & Salas, 1997). Within these different approaches there are many variations in the team skills addressed for development, such as goal setting, interpersonal relations, and role clarification (Beer, 1976; Buller & Bell, 1986; Woodman & Sherwood, 1980). Training directed at goal setting emphasizes the setting of goals and objectives, the identification of obstacles to achieving goals, and action planning to determine how goals are to be reached and obstacles overcome. The interpersonal model focuses on the development of open communication, mutual trust, and cohesion. Role clarification models emphasize the different interacting roles that people play in a group situation and aim to increase each person's knowledge about the roles played by others. Although other models have been proposed, these incorporate elements of the models already described. For example, Dyer's (1987) general problem-solving model incorporates many of the elements of the goal-setting model. In practice, although these models may serve as a basis for interventions, training programs increasingly encompass all of these models in a generic team-skills training framework (Prichard et al., 2004). Relating these generic skills back to the literature on transactive memory discussed above, it is easy to see how they should support the development and use of transactive memory systems if they could be developed through training.

A considerable literature from applied settings reports research relating to the effectiveness of team training (for reviews, see Kozlowski & Ilgen, 2006; Salas et al., 1999; Woodman & Sherwood, 1980). This literature generally reports positive effects of team training interventions (e.g., Adair, 1986; Belbin, 1981, 1993; Dyer, 1987). However, reviewers have raised questions over many studies, claiming that findings are often ambiguous in their interpretations (e.g., Salas et al., 1999; Woodman & Sherwood, 1980). Primarily, reviewers have criticized much of the research on the basis of inadequate methods, such as the lack of a control group, or of linking training to job behaviors that do not always equate to job effectiveness. As a consequence, these reviewers have voiced caution as to the effects of team building on group performance. For example, Salas et al. (1999) concluded in their review that there is no improvement in objective measures of performance as a result of team-building interventions and only a slight gain in subjective performance measures. However, Macy and Izumi (1993), in a meta-analysis of the effects of a number of human resource management techniques on performance, found that team development interventions were among the most effective.

With regard to some of the methodological issues previously identified and in an attempt to bring some empirical clarity to the research area, Prichard and her colleagues (Prichard et al., 2004; Prichard, Bizo, et al., 2006; Prichard, Stratford, et al., 2006) found in both controlled laboratory and field studies significant effects of team-skills training on both objective measures (e.g., group learning) and subjective measures (e.g., team member cohesion). These studies compared the performance of student teams that received team-skills training with matched control groups that had no training and found that trained teams showed higher levels of a range of team skills that were associated with better performance on collaborative learning tasks. Although Prichard et al.'s findings support the use of team-skills training for educational learning tasks, there is currently no comparable research to replicate this effect with other types of tasks. This is a concern, as there is considerable evidence that task type influences the relationship between team member behavior and performance (Steiner, 1972). Therefore, in addition to exploring the impact of these processes on the development of transactive memory systems, this study also extends the earlier work of Prichard et al. by exploring the effects of team-skills training on the development of team processes used in performing a complex collaborative task in which the desired outcome of performance is a group product rather than individual learning per se.

In summary, prior research on transactive memory, together with the research on team development and the wider literature on shared cognition, all support the hypothesis that team-skills training should enhance the development of transactive memory systems in terms of all three of its components through the use of more efficient team skills such as planning, coordination, role allocation, performance monitoring, and trust development. Although the literature clearly shows that transactive memory is facilitated by task training, we argue that it may not be enough to know who knows what about the task if team members lack the necessary skills to distribute and communicate this knowledge effectively within the team. Therefore, this study investigates the added benefits of training specific team skills such as planning, problem solving, and delegating appropriate roles for members according to their natural strengths and weaknesses. It is considered that when such behaviors are optimized across team members performing a complex collaborative task, transactive memory will be enhanced, which in turn will improve task performance. Therefore, this study will address the following three hypotheses:

Hypothesis 1: Teams that receive team-skills training will display a higher level of team skill on a complex collaborative task than teams that do not receive training.

Hypothesis 2: Teams that receive team-skills training will display higher transactive memory across all three components (task coordination, memory differentiation, and task credibility) than teams that do not receive training.

Hypothesis 3: Teams that receive team-skills training will perform a complex collaborative task better than teams that do not receive team-skills training.

Method

Design

This study used a hierarchically nested design in which 3 randomly assigned people were nested within 16 different teams, yielding a total of 48 individuals. Under experimental conditions, each team was required to assemble an AM radio having previously received training for this task. Teams assembled the radio under one of two conditions; team-skills training (n = 8 teams) or no team-skills training (n = 8 teams). Teams in these two conditions were compared across two task performance variables (procedural recall and the percentage of components correctly installed), team process measures, transactive memory, and trust. Earlier research has shown that where training is of a short duration (90 minutes), matching the time spent in training with an alternative activity for those in the no team-skills training condition does not improve the performance of those groups (Prichard, Stratford, et al., 2006). That is, performance benefits do not accrue simply as a consequence of a limited length of time spent together in the absence of training. In addition, Moreland, Argote, and Krishnan (1998) used a team-building exercise to explore the possibility of time-matching leading to superior transactive memory and found that matching had no effect. Therefore, for the purposes of this study, a time-matching condition was not included in the design.

Participants

Forty-eight undergraduate students (22 women and 26 men) participated in the study. They were recruited through flyers handed out in campus buildings and subjected to a number of selection criteria to exclude people who had prior team-skills training experience and any electronics experience. Participants were paid £5 per hour for taking part in the study, and an additional £100 prize was awarded to the best performing team. The mean age of participants was 19.2 years (range = 18-23 years). Participants were assigned to 3-person teams such that teams contained either 1 woman and 2 men or 2 women and 1 man. Exploratory analysis of all variables found no evidence of differences based on team gender composition.

Material and Equipment

Similar to research by Moreland et al. (1998), participants learned how to assemble a Radio Shack radio kit (Model 28-179). To ensure the task could be completed in the 30-minute time frame available for task performance, only the AM section of the radio was built. In addition, some sections of the kit were preassembled: Location numbers were copied onto the back of the circuit board and the amplifier, speaker, tuner, and battery and AM/FM and on/off switches were fitted into place but not wired. To assist in the radio assembly, participants were provided with a small screwdriver and a number of spare component parts in case of breakage.

Participants were required to complete a series of postexperimental questionnaires to measure their perceptions of team processes and trust in other team members. Team processes were measured using a self-report instrument developed in earlier work by Prichard (2002). This measured five team processes that related to the objectives of the training program—level of planning, time management, role allocation, task monitoring, and effectiveness of working together—rated on a 7-point scale (1= *low*, 7 = *high*). This questionnaire was therefore a test of whether teams in the team-skills training condition reported higher team skill levels that could be correlated with observed team behaviors (see below).

Although the task credibility aspect of trust was measured through the direct observation of teams, consistent with the literature reviewed above, it was felt that other aspects of trust were also likely to be important in the development of transactive memory systems. Therefore, a multidimensional trust questionnaire, the Perceptual Model of Trust (Ashleigh, 2002; Ashleigh & Stanton, 2001), was used to explore this further. This 37-item questionnaire measured trust around three dimensions: emotive, cognitive, and behavioral. Example items for the emotive dimension include “I felt confident with other team members” and “I felt a sense of loyalty towards other members of my team.” Example items for the cognitive dimension include “I think there was a lack of understanding in the team” (reverse scored) and “I think that team members fulfilled each other’s expectations.” Example items for the behavioral dimension include “I relied on other members of the team to do what they said they would” and “I worked openly with other members of the team.” Self-ratings were measured on a 5-point scale (1 = *low*, 5 = *high*).

Teams-Skills Training

The team-skills training was based on the BP Amoco by the Chalybeate Team Development in Universities program (see Prichard et al., 2004, for more detailed description of training). This program addresses a range of generic team skills, incorporating models such as general problem solving, interpersonal relations, and role clarification, as discussed above, but it was modified slightly to further emphasize the development of role allocation, time management, and equality of participation. So, for example, in developing problem-solving ability, teams were trained to develop specific strategies of identifying the aims of the team goal and gather information about the task in terms of variables such as resources, member expertise, and experience. They were then trained how to use this information to generate and evaluate possible solutions and identify, plan, and perform a best approach of how this would be done. Finally, teams were trained to continually monitor, give feedback, and review the team process throughout this problem-solving approach.

The environment for this type of team-skills training is experiential in nature and designed around the principles of Kolb's (1984) learning cycle. Students work together in teams on a variety of tasks. Each task provides the focus for a subsequent facilitated review activity in which students have the opportunity to reflect on what happened during the task with the other team members. From this process, students are able to integrate their experience with other information and knowledge they have, develop greater understanding of why things happened in the way that they did, and establish key learning points for future team tasks. During the training, students go through a number of iterations of this learning process; however, in the case of this study, only one iteration of the task review process was used. At the beginning of the training, the experimenter established objectives and agreed on a set of ground rules with participants to guide subsequent team activities. Following this, participants were required to perform a team training task (to plan and build a tent blindfolded). On completion of this task, the experimenter facilitated a review of the team's performance that was supplemented with direct instruction in relation to the key training objectives identified above. The training session ended with a review of the key learning points to be applied to the next activity. The training lasted 90 minutes.

Procedure

Participants were required to meet on two occasions, 1 week apart. The sequence of events was determined by the experimental condition, such that participants took part in either one or both of two training sessions. Teams in the team-skills training condition began the study by attending the team-skills training detailed above. This was followed by a 20-minute demonstration of the radio-building task during which time the experimenter explained how to perform the task according to a predetermined script.

Participants were then given 30 minutes in which to practice building the radio in the expectation of having to build it unassisted the following week. At all stages of the training period, participants were allowed to ask questions of the experimenter. At the end of the task-training session, participants were reminded that they would be required to return the following week to complete the task unaided, when their performance would be assessed as a team. In addition, they were asked not to discuss the radio-building task prior to meeting at the next session.

Each team returned 1 week following training to perform the radio-building task. Consistent with Moreland (1999), this session began with each team being given a blank sheet of paper and asked to recall as much as they could about how to build the radio. Participants were given 10 minutes to complete this task as a team, during which time they were not allowed to ask the experimenter anything. Teams were then given 30 minutes to complete the radio-building task unaided after which they were required to individually complete trust, workload, and team processes questionnaires. Participants were videotaped during their performance of the task for subsequent analysis. Finally, all participants were debriefed, thanked, and paid for their participation. The procedure was identical for teams in the no team-skills training condition, with the exception of team-skills training, which was omitted.

Results

Justification for Group-Level Analysis

Data collected for team process skill and trust were measured at an individual level through self-report questionnaires. However, analysis of such individually obtained data can prove problematic when applied to group research, as issues arise as to the nonindependence of participants working in a particular team. Kenny and La Voie (1985) discuss that participants' responses to self-report measures may be influenced by their team members, therefore violating notions of nonindependence required for traditional methods of analysis. An alternative to individual-level analysis is group-level analysis, which uses the means for each team calculated as the average of each member's response for any given variable. Where nonindependence is present, group-level analysis is more appropriate. To determine the correct level of analysis for this data set, intraclass correlations were carried out to check for the presence of nonindependence across the sample. The intraclass correlations were found to be significantly different from zero, and it was therefore concluded that nonindependence could not be assumed (r_I = .76, $p < .05$ and r_I = .75, $p < .05$, for team skill and trust, respectively). Consequently, both of these measures were analyzed at the group level. All other measures were collected at the group level.

Video Observational Analysis

The performance of each team on both the task training and the task itself was videotaped for subsequent analysis. In addition, audio recordings of each team were taken so that verbal interactions could be transcribed to assist in the coding process. Using the videotapes and transcripts together, each team's performance was coded for behaviors that were linked to the three variables examined in this study: transactive memory, team skills, and trust. For a full list of each of the variables rated, please refer to Table 1. All of the 16 videotapes were coded by three judges, one of whom was unaware of the study's research hypotheses. The coding process began with a training period in which all judges developed an agreed conceptualization of the behaviors associated with each of the variables. For example, each of the three subcomponents of transactive memory was rated in a manner consistent with Moreland's research (Liang et al., 1995; Moreland, 1999; Moreland & Myaskovsky, 2000). Therefore, memory differentiation was assessed based on the distribution of expertise in the team, such as whether one person had expertise in relation to a specific area of the task.

Similarly, task coordination was assessed on how efficiently the teams worked on the task in terms of their levels of cooperation, confusion, and misunderstanding. By way of another example, problem solving in the task-training stage was based on the setting of aims, identification of information (e.g., expertise and experience), and identification and evaluation of solutions. Following the training period, each video was independently rated by the judges and then subjected to Cohen's kappa reliability analysis. Generally, acceptable levels of reliability were achieved (kappas of .75 or higher that were all significant at $p < .05$ or higher). In two instances—motivation and planning during the performance of the task—kappa values did not reach .75. For both of these variables, the videos were rated again by two of the three judges to reconcile differences. The analysis performed on the task-training videos was more limited than that for the task itself, focusing solely on problem solving and planning. The intention was to explore differences in the preparation of these variables in relation to subsequent task performance because these early stages have been shown to be important in relation to transactive memory systems development.

Table 1
Means and Standard Deviations of Transactive Memory, Team Skill, Video Observation, and Trust Ratings

	Team-Skills Training		No Team-Skills Training		*t* Test Statistic	Effect Size
	M	*SD*	*M*	*SD*	(*df* = 14)	(Cohen's *d*)
Transactive memory index	6.03	0.38	3.96	0.41	10.6***	5.6
Task coordination	6.31	0.50	4.75	0.50	9.6***	3.2
Task credibility	5.79	0.56	5.13	0.53	2.5*	1.4
Memory differentiation	6.00	0.93	2.00	0.93	8.6***	4.6
Team-skill index	5.48	0.55	3.90	1.20	3.4**	1.8
Planning	4.75	1.04	3.5	1.70	1.8*	1.0
Time management	6.13	0.84	4.63	0.92	3.4**	1.8
Task monitoring	5.88	0.64	4.13	1.12	3.8**	2.0
Role allocation	5.75	0.71	3.38	1.51	4.0***	2.2
Work group effectiveness	4.88	0.84	3.88	1.36	1.8*	1.0
Video observation measures						
Overall time management	5.88	2.10	2.13	1.36	4.2***	2.3
Number of time checks	5.25	2.92	0.75	1.12	4.1***	2.2
Role allocation	6.00	0.93	2.00	0.93	8.6***	4.6
Equality of verbal participation	6.25	0.71	4.13	0.84	5.5***	3.0
Equality of physical participation	5.63	1.30	3.63	1.69	2.7**	1.1
Motivation	4.50	0.50	3.33	0.64	4.0***	2.2
Quality of interaction	5.71	1.58	3.08	0.75	4.2***	2.3
Problem solving in task training	5.00	1.41	1.13	0.35	7.5***	4.0
Percentage of time spent interacting	76.5	8.3	60.4	9.6	3.6**	1.9
Number of speech turns during task	392.5	119.4	263.8	101.5	2.3*	1.2
Trust overall	4.34	0.25	3.94	0.17	3.5**	2.0
Emotive	4.41	0.33	3.99	0.16	3.1**	1.6
Cognitive	4.21	0.25	3.81	0.12	3.9**	2.2
Behavioral	4.34	0.25	3.94	0.29	2.8*	1.6

*$p < .05$. **$p < .01$. ***$p < .001$.

Team Skills

For each team process, the mean for each team was calculated from individual responses and then compared across conditions. Teams with a higher level of team skill should perceive greater planning, time management, task monitoring, role allocation, and work group effectiveness within their teams. Consistent with this expectation, results confirmed that the five team process scales were strongly correlated with one another, so we averaged them together to produce a team-skill index (Cronbach's $\alpha = .93$ at group level and .88 at individual level). The means and standard deviations of the individual scales and the team-skill index are summarized in Table 1. Team-skill index scores differed significantly across training conditions, $t(14) = 3.38$, $p < .01$, Cohen's $d = 1.84$, with trained teams showing higher levels of team skill than untrained teams.

In addition to the self-report measures of team skill, video observational data from the performance of the task itself was analyzed for evidence of team skill. Three areas were considered that related to the training objectives: time management, role allocation, and equality of participation. Means and standard deviations for these observational data are presented in Table 1. There were two time management measures taken from the video data: overall time management and number of time checks. The mean overall time management rating for the team-skills training condition was significantly higher than the no team-skills training condition, $t(14) = 4.24$, $p < .001$, Cohen's $d = 2.27$. In addition, the mean number of time checks for teams in the team-skills training condition was also significantly higher than for teams in the no team-skills training condition, $t(14) = 4.1$, $p < .001$, Cohen's $d = 2.18$. These findings were consistent with the self-reported time management measure. Correlation of the self-report and video data were found to be significant ($r = .74$, $n = 16$, $p < .001$). Observational data for role allocation found that trained teams showed significantly higher levels of distributing roles than untrained teams, $t(14) = 8.6$, $p < .001$, Cohen's $d = 4.6$. This finding was consistent with the self-reported measure of discussing roles. Correlation of this self-report and video data were found to be significant ($r = .73$, $n = 16$, $p < .01$). Observations of both verbal and physical equality of participation were found to be significantly higher in trained teams than untrained teams, $t(14) = 5.5$, $p < .001$, Cohen's $d = 2.98$; $t(14) = 2.7$, $p < .05$, Cohen's $d = 1.41$, for verbal and physical equality of participation, respectively. Finally, groups that had been trained in team skills spent significantly more time conversing about the task and had a significantly higher number of speech turns across members than those that did not receive training, $t(14) = 3.6$, $p < .01$; $t(14) = 2.3$, $p < .05$, for percentage of time in conversation and number of speech turns, respectively.

In addition to video observational analysis of the task, further analysis was carried out on the task-training data, with the aim of exploring for differences between how teams used their task-training time. Although not specifically hypothesized, it was considered that teams in the team-skills training condition would display higher levels of problem-solving activities for subsequent task performance during this phase than teams that received no team-skills training. The mean overall problem-solving rating for the team-skills training condition was significantly higher than the no team-skills training condition, $t(14) = 7.52$, $p < .001$, Cohen's $d = 4.03$.

In summary, consistent with Hypothesis 1, teams that undertook team-skills training evidenced higher levels of team process skills than teams that did not receive the training.

Transactive Memory

Consistent with the work of Moreland (1999), a transactive memory index was calculated from the average observational ratings of task coordination, task credibility, and memory differentiation for each team's task performance (see Table 1 for means and standard deviations). The mean rating for transactive memory was higher in the team-skills training condition than in the no team-skills training condition. A *t* test revealed that this difference was significant, $t(14) = 10.6$, $p < .001$. Furthermore, when considered at the level of individual dimensions, in each case ratings were significantly higher in the team-skills training condition than in the no team-skills training condition (see Table 1 for *t* test results and effect sizes). Correlational analysis examined the relationship between team skill and transactive memory. A significant positive association was found such that those teams that reported a high level of team skill also evidenced high transactive memory ($r = .78$, $n = 16$, $p < .01$). In addition, significant and positive correlations were also found between transactive memory and the five observation measures relating to the team-skills training (see Table 2).

Therefore, in summary, consistent with Hypothesis 2, teams that received team-skills training evidenced enhanced transactive memory both overall and also across all three components.

In a further analysis of the trust aspect of transactive memory, the trust questionnaire was analyzed to consider the wider dimensions of trust. Reliability analysis was performed to calculate the internal consistency of the trust questionnaire. The alpha reliabilities for all items on the trust scale and for each of the three dimensions were good (Cronbach's $\alpha = .91$, .81, .76, and .79 for overall trust, emotive, cognitive, and behavioral dimensions, respectively). Trust scores were calculated for each team member as an average of the 37 items of the trust questionnaire. From this, the mean for each team was calculated and compared across conditions. As at the individual level, the group-level alpha reliabilities for all items on the trust scale and for each of the three dimensions were good (Cronbach's $\alpha = .94$, .84, .82, and .87, for overall trust, emotive, cognitive, and behavioral dimensions, respectively). Exploration of the data revealed a significant

Table 2
Correlations for Key Dependent Variables and Video Observation Measures

Variable	1	2	3	4	5	6	7	8	9
1. Transactive memory index	1.0								
2. Team-skill index	.78**	1.0							
3. Trust overall	.74*	.69**	1.0						
4. Performance	.66**	.53*	.48	1.0					
Video observation measures:									
5. Problem solving in task training	.84**	.63**	.60*	.52*	1.0				
6. Overall time management	.74**	.66**	.44	.54*	.73**	1.0			
7. Role allocation	.96**	.70**	.75**	.59*	.86**	.69**	1.0		
8. Equality of verbal participation	.79**	.59*	.63*	.77**	.83**	.64**	.83**	1.0	
9. Equality of physical participation	.63**	.32	.55*	.34	.54*	.33	.60*	.48	1.0

*$p < .05$. **$p < .01$. ***$p < .001$.

outlier in the data set that deviated from the mean by more than 2 standard deviations. Therefore, this case was removed from all subsequent analysis of the trust variable. The mean score for the team-skills training condition was higher than the no team-skills training condition (see Table 1). A *t* test revealed that this difference was significant, $t(13) = 3.53$, $p < .01$, Cohen's $d = 1.98$. The data were further analyzed for each of the three dimensions: emotive, cognitive, and behavioral. In each case, the mean score for the team-skills training condition was higher than the no team-skills training condition (see Table 1). A *t* test revealed that differences between the two conditions were significant for each dimension (see Table 1 for *t* test results and effect sizes).

The video data were analyzed for evidence of behaviors that might support the higher levels of trust in trained teams. These were necessarily limited to the behavioral dimensions of trust, that is, variables that could actually be observed. Raters assessed each team on the level of motivation observed among team members and on the quality of their interactions, both of which would predictably be higher in teams reporting higher levels of trust. Motivation was rated based on levels of team effort, apathy, and overall motivation to succeed. It was found that trained teams displayed higher levels of motivation than untrained teams, $t(14) = 4.04$, $p < .001$, Cohen's $d = 2.23$. Quality of interaction was rated on levels of positive feedback, information sharing, and overall team interaction. It was found that trained teams displayed a better quality of interaction than untrained teams, $t(14) = 4.2$, $p < .001$, Cohen's $d = 2.34$. Each of these observational measures was found to be significantly correlated with the behavioral dimension of the trust questionnaire ($r = .57$, $n = 15$, $p < .05$; $r = .65$, $n = 15$, $p < .01$ for motivation and quality of interaction, respectively).

Finally, correlational analyses were performed to explore the relationships between trust and transactive memory and between trust and team skill. A strong association was found between overall trust and transactive memory such that those teams reporting high levels of trust also evidenced high levels of transactive memory ($r = .74$, $n = 15$, $p < .01$). In addition, a strong association was found between overall trust and the team-skill index, such that those teams reporting high levels of trust also reported high levels of team skill ($r = .69$, $n = 15$, $p < .01$). Trust was also found to correlate with the observed measures of team skill, with the exception of time management, which showed no association (see Table 2).

Task Performance

For each team, the total score of correctly installed components was calculated against a standardized assembly error scoring sheet adapted from Moreland (1999). The highest possible score achievable was 86, indicating zero errors. The mean score for the team-skills training condition ($M = 81.3$, $SD = 4.1$) was higher than the no team-skills training condition ($M = 69.1$, $SD = 9.0$). A t test revealed that this difference was significant, $t(14) = 3.5$, $p < .01$, Cohen's $d = 1.87$. This means that teams that received team-skills training performed better at the task, making fewer assembly errors, than teams that did not receive team-skills training. Pearson's chi squared revealed a relationship between type of training and whether the task was completed within the 30-minute deadline, $\chi^2(1, n = 24) = 4.27$, $p < .05$). Within the team-skills training condition the majority of teams (7 teams of 8) completed the task within the time limit, whereas in the no team-skills training condition only a minority (3 teams out of 8) completed the task.

In addition to assessing task performance, prior to attempting the task each team worked together to complete a procedural recall sheet ($n = 16$). This was scored with 1 point for individually mentioning, describing, and explaining correctly all possible components. A total score of 101 was achievable for this task. The mean procedural recall score for each team was calculated. The mean score for the team-skills training condition ($M = 24.3$, $SD = 10.2$) was higher than the no team-skills training condition ($M = 20.6$, $SD = 7.5$). However, t tests revealed that this difference was not significant, $t(14) = 0.8$, $p = .42$).

Finally, correlational analyses were performed to examine the relationships between performance and transactive memory and between performance and team skill. A strong association was found between performance and transactive memory such that high-performing teams also evidenced high levels of transactive memory ($r = .66$, $n = 16$, $p < .01$). In addition, a moderate association was found between performance and the team-skill index, such that high-performing teams also reported higher levels of team skill ($r = .53$, $n = 16$, $p < .05$). Performance was also found to correlate with the observed measures of team skill, with the exception of equality of physical participation, which showed no association (see Table 2). In summary, consistent with Hypothesis 3, those teams that received team-skills training performed the task better than those that did not receive training.

Discussion

Team-Skills Training and the Effect on Team Process Development

The first hypothesis was supported by the results of this study. Analysis of both the team process questionnaire and the observational data demonstrated that in line with the training objectives, the team-skills training was successful in bringing about differences in team-skills behaviors. Team members in this condition reported higher levels of planning, time management, task monitoring, role allocation, and overall work group effectiveness. These findings were highly correlated with the observational measures of time management, role allocation, and problem solving.

The results are therefore consistent with the work of Prichard et al. (2004), who found that a generic team-skills training model, an extended version of the type used in our study, was effective in supporting the development of a range of team skills. In their analysis of individuals' skill development across the duration of a training event, Prichard et al. found that the level of team skills (e.g., planning, time management, agreeing on task and team roles, cooperation, and communication) displayed by group members increased as the training progressed. In addition, the findings of our study are consistent with the more recent laboratory and fieldwork of Prichard, Bizo, et al. (2006) and Prichard, Stratford, et al. (2006), who found that this type of training increased the levels of team skills displayed during subsequent performance of groups on collaborative educational tasks. In using a collaborative task where performance is measured in terms of a group product rather than an individual's learning, the findings presented in this article therefore extend Prichard et al's work by evidencing the generalizability of team-skills training into other types of tasks. A major strength in each of these studies is the methodological rigor adopted, where the use of control conditions was combined with the triangulation of objective and subjective measures of skill level, including self-report and video observation. Thus, together, these findings provide strong empirical evidence that generic team-skills training, of the type used in these studies, is effective in developing higher levels of team skills used by groups.

Team-Skills Training and the Effect on Transactive Memory

Our results also supported the prediction that transactive memory would be more developed in teams that received team-skills training than those that did not. This effect was also found for each of the three dimensions that constitute the transactive memory index, showing that task coordination, memory differentiation, and task credibility are all promoted by team-skills training when compared to task-skills training alone. The observational measures of transactive memory were additionally confirmed by the findings of the two self-report questionnaires. The team process questionnaire offered support for both task coordination and memory differentiation through superior scores for planning, work group effectiveness, task monitoring, and task role allocation, whereas support for the task credibility dimension was provided through the trust questionnaire, which evidenced higher levels of trust in the team-skills training condition. This higher level of transactive memory in the trained condition means that those teams that underwent the team-skills training program had a more accurate shared understanding of each other's knowledge in specific areas of expertise and were better able to use that knowledge during performance of the task.

One particularly interesting finding that warrants further investigation is the significant difference across conditions in levels of problem solving during the task-training phase of the study. As the model of team-skills training used in this study aimed in part to promote the development of problem-solving strategies, the finding that trained teams displayed very high levels of problem-solving skills, such as setting goals, identifying expertise, and evaluating possible solutions, is not surprising. However, in addition, we found that the level of problem solving during task training was strongly and positively correlated with subsequent transactive memory during task performance. Therefore, teams that showed high levels of problem-solving skills during task training also evidenced high levels of transactive memory during subsequent task performance. Likewise, teams that showed low levels of problem-solving skills during task training showed low levels of transactive memory during the task. Establishing this finding means that it is possible to relate our work to K. Lewis's (2004), that the early planning stage of team activity is vital to the development of transactive memory systems. She argued that high levels of team interaction during planning enabled team members to more easily distribute knowledge among themselves. Closer inspection of the way in which Lewis explicates the planning stage reveals how she uses this term in a very broad sense that encompasses the wider issues of problem solving such as information identification and the development of a mutually shared conceptualization of the task. Assuming that the higher levels of interaction observed by Lewis can be accounted for by more engagement in these specific behaviors, her findings clearly relate to those we observed to be differentially displayed by teams in each of the two conditions in this study. Therefore, we speculate that team-skills training developed superior problem-solving skills in groups, which were then used during task training. This in turn helped to develop transactive memory systems beyond a level obtained in teams without team-skills training that had not developed their problem-solving skills to the same level. This is also in keeping with K. Lewis et al.'s (2005) more recent conceptualization of transactive memory systems as learning systems in which shared knowledge is developed through cycles of engagement in transactive processes that encode, store, and retrieve knowledge relevant to the group's task.

This interpretation of our findings is also consistent with the work of Rulke and Rau (2000), who suggested that task training provides an excellent context for the early stages of transactive memory systems development by providing time for the encoding, storage, and evaluation of knowledge of expertise. They found that higher levels of planning early on correlated with actual transactive memory measures. Although task training may allow the time for these transactive processes to occur, there is no guarantee that team members will have the skills necessary or the recognition of a need to engage in such activities. However, by providing members with team skills such as planning, problem solving, role allocation, and so on, we can ensure that these processes do indeed occur in a more effective and reliable way. Although our analysis did not include measurement of encoding as Rulke and Rau's work did, our observational analysis showed that teams that received team-skills training evidenced higher levels of a number of behaviors that should have helped in the encoding stages of transactive memory systems development, by both seeking out and evaluating information about expertise. In addition, in relation to the subsequent stage of retrieval, observational analysis of the task found that a number of the behaviors that may be predicted to facilitate accessing shared knowledge were present at higher levels in teams that received team-skills training. For example, the allocation of roles, the equality of participation, and the quality of interaction were all significantly higher in these teams. Furthermore, these team skills were significantly correlated with transactive memory.

Although the analysis above considers the task coordination and memory differentiation components of transactive memory, the task credibility component also warrants some examination. As hypothesized, the level of task credibility, defined by Moreland (1999) as trust in team members' radio-building knowledge, was found to be significantly higher in teams that experienced team-skills training than those that did not. Clearly, this type of trust is important in the context of transactive memory, a concept that relates to the distribution of team member expertise. However, as previously mentioned, trust in task expertise alone does not capture those elements relating to the preparedness of team members to disclose information early in transactive memory systems development or to whether team members trust others' commitment to the team or ability to work effectively together. A consideration of trust in this broader way requires a multidimensional approach, and therefore, a self-reporting measure of trust was also used in this study, which incorporated three separate dimensions: emotive, cognitive, and behavioral (Ashleigh, 2002; Ashleigh & Stanton, 2001). When measured at the multidimensional level, teams that received team-skills training showed a higher level of trust than those that did not. This means that team members who were trained in team skills developed a better interpersonal relationship with each other. Further analyses found significant differences across the two training conditions for each of the three dimensions of trust. Under the emotive dimension, team members felt more confidence in and commitment to each other. Results in the cognitive dimension meant that team members thought that they shared a similar mental representation of the task and had similar expectations of one another. Finally, higher perceived levels of quality of interaction and communication meant that team members reported that they behaved in a more trusting manner toward each other, a finding that correlated with video observation measures of quality of interaction. These findings confirm that team-skills training facilitated the development of trust consistent with the interpersonal model of team training (Beer, 1976; Kegan & Rubenstein, 1973; Walter, 2000; Woodman & Sherwood, 1980). Indeed, the level of team skill from both self-reports and video observations were also found to correlate with the trust measure. However, this study does not enable us to address the question of how this effect occurs, and at this point, we can only speculate as to whether it is a consequence of the safe environment in which team members are trained. Therefore, further research is necessary to explore the mechanisms through which team-skills training increases trust.

Turning to the relationship between trust and transactive memory, correlational analysis found that there was a significant association between these two variables, such that those teams reporting high levels of trust also evidenced higher transactive memory. Although causal analysis between higher trust in these teams and more developed transactive memory systems could not be performed, as discussed below, it could be argued that consistent with the work of Mayer et al. (1995) and Sharkie (2005), when people are feeling more committed toward each other, share similar expectations, and experience a higher quality of interaction, they are more likely to risk sharing knowledge and make themselves vulnerable to others in the anticipation of expecting reciprocal behavior. We therefore consider that teams that have developed higher levels of trust through team-skills training are more inclined to share knowledge with others, facilitating the development of transactive memory. This is critical not only in the initial encoding stages of development but also during the task, when members need to access this shared knowledge in order to perform successfully.

Team Skill, Transactive Memory, and Performance

The final hypothesis of this study related to differences in team performance across conditions. Specifically, we hypothesized that teams that received team-skills training would perform better than teams without such training. Consistent with this hypothesis, it was found that teams in the team-skills training condition were significantly more likely to finish the task within the time and, crucially, made significantly fewer errors when assembling the radio.

Individually, prior research on each of the variables we considered in this study has shown a relationship with performance. Researchers working in the field of team-skills training have found that trained teams perform better (Prichard et al., 2004; Prichard, Bizo, et al., 2006; Prichard, Stratford, et al., 2006). Researchers in the field of transactive memory have found that this variable can enhance team performance (Austin, 2003; Hollingshead, 1998a, 1998b; K. Lewis, 2003, 2004; K. Lewis et al., 2005; Liang et al., 1995; Moreland, 1999; Moreland & Myaskovsky, 2000). The findings of the study presented in this article reveal that both transactive memory and team skill correlate with performance. So, how can we conceptualize the relationship between team-skills training, team skill, transactive memory, and performance? Referring back to the literature, it is possible to speculate a number of ways in which one or other of the variables—team skill and transactive memory—mediate the relationship between team-skills training and performance. For example, as considered above, it is possible that team-skills training develops higher levels of team skill, which in turn enables the team to develop superior transactive memory systems and subsequent enhanced performance compared to those teams that have not had this type of training. Unfortunately, the restricted sample available for use in this study was not sufficient to perform the necessary mediational analysis to explore these ideas (Tabachnick & Fidell, 1996), and future studies should aim to specifically examine the relationship between these variables by drawing on a bigger sample.

Limitations

In considering the significance of our findings, there are a number of limitations that need to be discussed. First, the sample size in this study was limited. It could further be argued that a sample size of 16 teams makes even the largest effects hard to detect and makes null findings especially inconclusive. However, the findings of this study show that the effects of team-skills training on performance, transactive memory, and team skill are so large that they can be detected even with the small sample used here. Although this was not problematic for testing the effect of team-skills training on the individual dependent variables, it did restrict the opportunity to perform mediational analysis to explore causal pathways between the variables under investigation. Therefore, as discussed above, we believe that future research should explore this further with a large enough sample to successfully execute this analysis and make it less likely that by chance one condition or the other might contain team members who are on average better problem solvers or more intelligent. These factors should ideally be controlled in future studies to eliminate the possibility of their confounding effect, perhaps through the use of an extended battery of baseline measures.

A second concern that should be considered relates to the control condition in which the time spent together was not matched to the trained condition. This was because previous findings based on the time frames used in this study evidenced that the matching of the time spent in training did not negate the advantage to performance (Prichard, Stratford, et al., 2006). In other words, the performance advantage was due to the development of skills learned in training, not due to time spent together. Although this assumption seems plausible for the short study duration used here, questions remain over the potential for team skills to evolve naturally over time to the levels achieved by trained teams. It must also be acknowledged that prior research has not considered the effect of matching for time on transactive memory and trust measures. Therefore, it is recommended that future research explore the effects reported here over longer time frames to determine how long it takes without training for each of the dependent measures—team skill, transactive memory, and trust—to reach the levels found in the trained condition.

Conclusion

The findings of this study have implications for a number of research areas. First, the link between team-skills training and performance adds to the growing body of empirical research supporting the use of this type of training program to enhance the effectiveness of teams. It also fits with the theoretical literature on team development models and the need for teams to develop both task and team skills to maximize performance (e.g., Morgan et al., 1986; Tuckman, 1965). Although questions remain as to whether team skills can develop naturally and to what level, clearly from a practical perspective the rapid development of team skills will be imperative where high levels of performance are immediately required of a newly formed team. Therefore, this research has implications for managing teams across organizations. Second, this research extends the work on transactive memory by demonstrating that training together in team skills and task skills leads to the development of stronger transactive memory systems than those achieved by task-skills training alone. This is consistent with Mathieu et al. (2005) and their discussion of the need to develop both team and task SMM, with task-skills training promoting the development of task mental models and team-skills training promoting the development of team mental models. The findings enable us to broaden our understanding of transactive memory, and further research is warranted to explore the mechanisms through which this occurs, consistent with our earlier discussions relating to the facilitation of transactive processes. Furthermore, we would argue that team-skills training should precede task training, rather than vice versa, so that teams are able to optimize the benefits of task training through the use of the superior team skills developed in team-skills training.

In summary, we believe that findings from this study go some way in contributing to the literature on team-skills development, transactive memory, and trust and provide a starting point from which to consider how team-skills training interacts with these variables to have an impact on team performance.

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