SLIPPAGE IN THE SYSTEM: THE EFFECTS OF ERRORS IN TRANSACTIVE MEMORY BEHAVIOR ON TEAM PERFORMANCE

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INTRODUCTION

Organizations are increasingly relying on project and action teams, made up of members possessing highly developed and distinct areas of expertise, for completing complex tasks. Such teams are highly adaptable and allow organizations to take advantage of the diverse knowledge of highly skilled team members (Mathieu et al., 2000). However, the successful coordination of distributed expertise requires an implicit structure for assigning responsibility for new information within the team based on a shared conception of one another's expertise. This structure represents the team's transactive memory system, defined as the cooperative division of labor for learning, remembering, and communicating relevant team knowledge (Wegner, 1987).

Although researchers have consistently shown that the implicit coordination provided by transactive memory positively affects team performance (e.g., Ellis, 2006; Lewis, 2003), the benefits of transactive memory systems depend heavily on team members' ability to accurately identify the expertise of their teammates and communicate expertise-specific information with one another. This introduces the opportunity for errors to enter the system, as the expertise of individual team members may be misunderstood or misrepresented, leading to the reliance on information from the wrong source or the loss of information through incorrect assignment. As Hollingshead notes, "information may be transferred or explicitly delegated to the 'wrong' individual in the system, e.g., one who does not have responsibility for that type of information or is unlikely to remember it due to a lack of expertise" (1998: 427). While researchers recognize the likelihood of such behavioral errors, little research has examined their potential impact in teams.

The current study, therefore, focuses on the effects of errors in transactive memory behavior on the emergence of team cognitive structures and resultant performance in the initial stage of team interaction. To develop our hypotheses, we first discuss the types of behaviors involved in the development and operation of transactive memory systems, identify where errors may arise, and discuss their effects on team performance. Then, we attempt to uncover the cognitive processes underlying those effects. More specifically, we introduce mental model accuracy and transactive memory cognitions and suggest that each mediates the negative relationship between errors in transactive memory behavior and team performance. While the possible risks of faulty transactive memory system development have been acknowledged in prior research, it has also been suggested that transactive memory errors can be easily corrected and their effects on performance subsequently minimized (Hinsz et al., 1997). The current study challenges this assumption and in doing so advances our understanding of not only the relationship between errors in transactive memory behavior and team performance but also the mechanisms that might help explain this relationship.

Errors in Transactive Memory Behavior

Transactive memory develops and operates in teams through the communication of expertise-specific information between team members. Consequently, communication plays a vital role in the team's transactive memory system (Hollingshead, 1998; Lewis, 2003), allowing team members to delegate or assign responsibility for learning and storing new information to certain individuals (Wegner, 1987). According to researchers, communication in transactive memory systems can be broken down into three specific behaviors: directory updating, information allocation, and retrieval coordination (e.g., Ellis, 2006; Hollingshead, 1998).

Through directory updating, team members learn about each other's areas of expertise by sharing or requesting information about "who knows what." Through information allocation, specific information is communicated to the team member that possesses the relevant area of expertise to apply it. Through retrieval coordination, team members use their "directory of directories" to request information from the teammate with the proper area of expertise.

Given that the team's transactive memory system relies on directory updating, information allocation, and retrieval coordination, we propose that there are numerous opportunities for human error to enter the system. Directory updating errors occur when team members misstate information about their own area of expertise, giving other members a false view of the breadth of their knowledge. Information allocation errors occur when a team member shares information with a teammate who lacks the proper expertise to apply it. Retrieval coordination errors occur when a team member requests information from a teammate based on a mistaken understanding of his or her area of expertise.

When critical information is shared with or requested from the wrong person, team members must recognize the incorrect information, resolve conflicting claims about each team member's area of expertise, and identify the individual with whom the information should be shared. In each instance, even when team members identify an error, they must allocate attention and time to fixing their mistakes, detracting from team performance (e.g., Ellis, 2006; Hinsz et al., 1997). As a result, we hypothesize the following:

Hypothesis 1: Errors in transactive memory behavior (i.e., directory updating, information allocation, and retrieval coordination) will negatively affect team performance.

Although we expect that errors in transactive memory behavior will negatively affect team performance, we are also interested in why such problems occur. Ilgen et al.'s (2005) IMOI model suggests specific cognitive mechanisms through which such errors might exert their influence. The model proposes that teams develop over multiple stages, with the emergence of mediating processes and states within each stage influencing team outcomes in the next. In this model, teams initially go through a "forming" stage of interaction, in which they develop the cognitive structures of transactive memory and team mental models. These two emergent cognitive states serve as implicit coordination mechanisms that mediate the effects of team member information sharing on team performance. Because the benefits of transactive memory cognitions and team mental models hinge on the quality of information exchanged during this stage, inaccurate communications may significantly hamper team effectiveness. Therefore, we expect both mental model accuracy and transactive memory cognitions to be directly affected by errors in transactive memory behavior and to mediate the effects of errors in transactive memory behavior on team performance.

Transactive Memory Cognitions

Transactive memory cognitions focus on the distinctiveness of team members' knowledge and their evaluation of how that knowledge is distributed and shared within the team (Lewis, 2003). Organizational researchers examining transactive memory as an emergent cognitive state have defined it as "a combination of knowledge possessed by each individual and a collective awareness of who knows what" (Austin, 2003: 866). Researchers have shown that

transactive memory cognitions exhibit a significant positive relationship with team performance (e.g., Austin, 2003; Lewis, 2003).

Because the emergence of transactive memory cognitions is dependent on the accurate exchange of expertise related information, we suggest that they are highly susceptible to errors in transactive memory behavior. When these errors occur, team members' perceptions of how knowledge is distributed and shared within the team become uncertain and inaccurate. Furthermore, when team members hear conflicting accounts of who knows what, or receive information or requests for information unrelated to their own specialty, they can no longer rely on the expertise of their teammates and credibility is inhibited. Finally, when team members receive faulty information regarding who knows what within the team, and give and request information from team members with the wrong expertise, members will be unable to understand how to coordinate their efforts and utilize each other's expertise.

Based on our arguments, we expect that errors in transactive memory behavior will negatively affect transactive memory cognitions and team performance. Given that transactive memory cognitions have been consistently linked to coincident and future team performance (e.g., Lewis, 2003), and based on the theoretical arguments of Ilgen et al. (2005), we suggest errors in transactive memory behavior affect team performance through impairing the emergence of transactive memory cognitions. Therefore, we hypothesize that:

Hypothesis 2: Errors in transactive memory behavior will negatively affect transactive memory cognitions.

Hypothesis 3: The effects of errors in transactive memory behavior on team performance will be partially mediated by transactive memory cognitions.

Mental Model Accuracy

A team mental model is an organized knowledge structure, or psychological map, that depicts how the characteristics, duties, and needs of teammates fit with one another (e.g., Mohammed, Klimoski, & Rentsch, 2000). Each map differs in its level of accuracy and similarity across team members. However, the effect of errors in transactive memory behavior in the relationship between mental model similarity and accuracy is unclear. For example, if team members share incorrect information regarding their area of expertise, they may exhibit highly similar mental models that are highly inaccurate.

The development of accurate interrole knowledge depends on the exchange of expertise-specific information within the team, making it highly vulnerable to errors in transactive memory behavior. When team members erroneously identify expertise, team-interaction mental models will suffer as team members develop inaccurate conceptions of each other’s roles and responsibilities. For example, when directory updating errors occur, both the team member sharing incorrect expertise and any team member(s) receiving the information will generate inaccurate psychological maps of how their characteristics, duties, and needs fit with one another. As a result, researchers suggest that the identification and correction of communication errors represent critical steps in the development of accurate team-interaction mental models (Kozlowski et al., 1996).

Based on our arguments, we expect that errors in transactive memory behavior will negatively affect team-interaction mental model accuracy and team performance. Given that

team-interaction mental model accuracy has also been linked to concurrent and future team performance (e.g., Edwards et al., 2006; Ellis, 2006), and given the theoretical rationale set forth by Ilgen et al. (2005), we suggest that team-interaction mental models represent a second mechanism through which errors in transactive memory behaviors influence team performance, leading to the following hypotheses:

Hypothesis 4: Errors in transactive memory behavior will negatively affect team-interaction mental model accuracy.

Hypothesis 5: The effects of errors in transactive memory behavior on team performance will be partially mediated by team-interaction mental model accuracy.

METHODS

Participants included 276 students from introductory management courses at a large Southwestern University who were arrayed into 69 four-person teams. In exchange for their participation, each earned class extra credit and all were eligible for cash prizes (up to $120 per team) based upon the team's performance. Participants engaged in a modified version of the Distributed Dynamic Decision-making (DDD) program, a computerized, dynamic command and control simulation requiring four team members of equal status to monitor a geographic region and defend it against invasion from unfriendly tracks, which are radar representations of enemy forces moving through the region.

A description of the task and DDD procedures is available in Ellis (2006). In this study, team members were assigned specific areas of expertise by splitting up the vehicles and knowledge regarding the tracks.

RESULTS

Given their extremely low base rate, we did not include retrieval coordination errors in our hypotheses tests. Hypothesis 1 proposed that errors in transactive memory behavior would negatively affect team performance. For Hypotheses 1, directory updating errors were negatively related to team performance ($r = -.37$, $p < .01$), explaining a significant 14% of the variance. Information allocation errors ($r = -.05$, n.s.), on the other hand, failed to exhibit a significant relationship with team performance, offering partial support for Hypothesis 1.

Hypothesis 2 proposed that errors in transactive memory behavior would negatively predict transactive memory cognitions. Directory updating errors negatively predicted transactive memory cognitions ($r = -.33$, $p < .01$), explaining a significant 11% of the variance. However, information allocation errors ($r = -.04$, n.s.) failed to exhibit a significant relationship, indicating partial support for Hypothesis 2.

Hypothesis 3 proposed that the relationship between errors in transactive memory behavior and team performance would be partially mediated by transactive memory cognitions. As directory updating errors were negatively related to team performance, but information allocation errors were not, only directory updating errors satisfied the first mediational requirement. The second mediational requirement, that the independent variable significantly predicts the mediator, was supported for directory updating errors in testing the second hypothesis. Transactive memory cognitions significantly affected team performance when

controlling for directory updating errors ($\beta = .34$, $p < .01$), satisfying the third mediational requirement. After controlling for transactive memory cognitions, the variance in team performance accounted for by directory updating errors was reduced from 14% to 6%. This reduction was significant by Sobel's (1982) test, $Z = -2.06$, $p < .05$. Therefore, Hypothesis 3 was partially supported.

Hypothesis 4 proposed that errors in transactive memory behavior would negatively affect team-interaction mental model accuracy. Directory updating errors negatively predicted team-interaction mental model accuracy ($r = -.43$, $p < .01$), explaining a significant 19% of the variance. Information allocation errors, however, failed to significantly relate to team-interaction mental model accuracy ($r = .01$, n.s.). These results provide partial support for Hypothesis 4.

Hypothesis 5 proposed that the relationship between errors in transactive memory behavior and team performance would be partially mediated by team-interaction mental model accuracy. Again, only directory updating errors satisfied the first mediational requirement. From Hypothesis 4, directory updating errors significantly affected mental model accuracy, meeting the second mediational requirement. Team-interaction mental model accuracy significantly affected team performance when controlling for directory updating errors ($\beta = .45$, $p < .01$), satisfying the third mediational requirement. After controlling for team-interaction mental model accuracy, the variance in team performance accounted for by directory updating errors was reduced from 14% to 3%. This reduction was significant by Sobel's (1982) test, $Z = -2.78$, $p < .01$, providing partial support for Hypothesis 5.

IMPLICATIONS

The results of this study clearly and consistently implicated one specific type of error in transactive memory behavior. When team members engaged in directory updating errors, team performance suffered. In addition, we found that the performance deficiencies resulting from directory updating errors were partly due to breakdowns in transactive memory cognitions and team-interaction mental model accuracy. Results regarding information allocation errors and retrieval coordination errors, on the other hand, were less consistent. While information allocation errors did not significantly predict team performance, mental model accuracy, or transactive memory cognitions, the implications of retrieval coordination errors could not be determined due to their low frequency in the current study.

The results of this study build on recent research that has identified transactive memory as an important predictor of team effectiveness (e.g., Austin, 2003; Lewis, 2003). To date, research has concentrated on the positive effects of transactive memory on team performance. However, researchers have suggested that even when operating smoothly, transactive memory can result in confusion, lost information, and delays in information sharing (Hollingshead, 1998; Wegner, 1987). Yet very little work has been done to examine the possible drawbacks of reliance on transactive memory systems. Our results address this issue by demonstrating the potential fallibility of team members' attempts to initially develop and utilize a system for learning, remembering, and communicating relevant team knowledge. Although previous research has acknowledged the likelihood of these errors, the presumption has been that they can be corrected through sufficient discussion and their effects on performance subsequently minimized (Hinsz et al., 1997). However, our results suggest that team members fail to adequately challenge the validity of claims of expertise that do not impinge on their own

knowledge domain (Stewart & Stasser, 1995). This has implications for not only team performance but also the development and emergence of team cognition.

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