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Alanah Davis
University of Nebraska at Omaha

Deepak Khazanchi
University of Nebraska at Omaha, khazanchi@unomaha.edu

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The Influence of Transactive Memory on Mutual Knowledge in Virtual Teams: A Theoretical Proposal

Alanah Davis
University of Nebraska at Omaha
alanahdavis@mail.unomaha.edu

Deepak Khazanchi
University of Nebraska at Omaha
khazanchi@unomaha.edu

ABSTRACT

Advancements in information technologies (IT) have enabled the ability to exchange knowledge within and across organizations through virtual teams. However, the ability to effectively communicate and share knowledge in virtual settings can become a difficult task due to the complex nature of both the virtual context and the technology used to support them. This paper argues that transactive memory theory can explain how mutual knowledge enhances virtual team performance. We present a conceptual model and theoretical propositions for the study of the relationship between transactive memory and mutual knowledge in virtual teams.

KEYWORDS

Mutual knowledge, common ground, common knowledge, shared knowledge, transactive memory theory, virtual teams.

INTRODUCTION

Advancements in information technologies (IT) have enabled the ability to exchange knowledge within and across organizations through virtual teams. However, the ability to share knowledge and effectively communicate can become a daunting task in this virtual setting because of the complex nature of both the virtual context and the technologies used to support them. The development of a shared understanding is critical for ensuring that any differences caused by the characteristics of virtuality are minimized.

Virtual teams have been described as teams whose members are separated by time and space and who have been brought together to accomplish a goal by conducting communication predominately through technology (Lipnack et al. 1997). Current research on knowledge sharing and information transfer in virtual teams suggests that "sharing of existing knowledge leads to the creation of new knowledge" (Chua 2001). Furthermore, conflict results due to uneven information among virtual team members (Hinds et al. 2003). This uneven information can result from a failure to share uniquely held information or not including all team members on certain messages. Thus it is important for virtual team members to interact and develop a mechanism for engendering shared meaning and potentially enhancing virtual team processes and performance. This common understanding or shared knowledge has been termed "mutual knowledge" and is defined as "*knowledge that communicating parties share and that each party knows that they both possess*" (Davis et al. 2006; Krauss et al. 1991).

DeSanctis and Monge (1998) assert that transactive memory systems, "the context-specific and unique communication processes that develop within a group and guide knowledge sharing, can be formalized and re-applied when groups are dissembled and re-arranged." In this paper we posit that transactive memory can impact virtual team performance and satisfaction both directly and through mutual knowledge. We conceptually analyze this theory by reviewing previous literature in these two areas and constructing a model describing the influence of transactive memory on mutual knowledge on virtual teams' performance.

The rest of the paper is organized as follows. The next section summarize the literature on mutual knowledge followed by a discussion of transactive memory theory We then integrate these ideas and present a conceptual model and theoretical propositions for the study of the relationship between transactive memory and mutual knowledge in virtual teams. The final section provides some implications for future research in virtual teams.

MUTUAL KNOWLEDGE IN VIRTUAL TEAMS

There is ample evidence in the literature to demonstrate that mutual knowledge is necessary for group communication (Cramton 2001; Davis et al. 2006; Dennis 1996; Frey et al. 2005; Krauss et al. 1991). Breakdowns in mutual knowledge result in a number of communication problems. Specifically these problems can include poor decision quality (Dennis 1996) and extra time spent correcting failures of mutual knowledge (Krauss et al. 1991). In a study of students working in dispersed teams to create a business plan for an online store front, Cramton (2001) found that breakdown in mutual knowledge occurs due to the following reasons: failure of one party to perceive the context and situation the other party had intended, failure to distribute information to all team members through a failure in communication media, such as undelivered or undeliverable e-mail messages, difficulty in both communicating and understanding the quality of information, time lag caused by access and transport speeds, and misinterpretation of the meaning of silence.

In contrast to the above view, some researchers argue that a lack of mutual knowledge is necessary for communication (Oakhill et al. 1996). In particular, "it is a lack of mutual knowledge, and hence an asymmetry between speaker/writer and listener/reader, that typically prompts a linguistic interchange. Thus, both the speaker/writer's and the hearer/reader's knowledge (and their knowledge of each other's knowledge) determine how individuals ought to be described, and how descriptions will be understood" (Oakhill et al. 1996). This view essentially implies that mutual knowledge is not needed for effective group communication.

We have argued previously that despite these two contrary views, mutual knowledge is necessary for virtual team communication and can impact virtual team inputs, processes, and outputs (Davis et al. 2006). Although no quantitative measures for mutual knowledge exist in the extant literature -- most studies use a qualitative approach, one possible way to operationalize mutual knowledge is to assess the degree of information and knowledge sharing (implicit/explicit) and the team members' awareness of its sources or their ability to know where to find it (Cramton 2001; Krauss et al. 1991; Weick et al. 1993).

TRANSACTIVE MEMORY THEORY

Transactive memory was originally introduced by Wegner, Giuliano, and Hertel (1985) as the communication among a combination or grouping of individual minds. The theory describes how both small and large groups can come together and develop complex "group minds" or memory systems that can be potentially more effective than any of the single individuals that comprise the group (ibid). The following example illustrates transactive memory for a pair (or small group).

> "Suppose we are spending an evening with Rudy and Lulu, a couple married for several years. Lulu is in another room for the moment, and we happen to ask Rudy where they got the wonderful stuffed Canadian

> goose on the mantle. He says, 'We were in British Columbia…,' and then bellows, 'Lulu! What was the name of that place where we got the goose?' Lulu returns to the room to say that it was near Kelowna or Penticton-somewhere along Lake Okanogan. Rudy says, 'Yes, in that area with all of the fruit stands.' Lulu finally makes the identification: Peachland" (Wegner et al. 1985).

Transactive memory theory is useful in explaining how individuals remember things. The theory relies on transactive encoding, storage, and decoding or retrieval (Wegner 1986; Wegner et al. 1985). In the encoding stage, group members discuss information, where it is going to be stored, and in what form it is going to be stored (Wegner 1986). Encoding can take on any of the following forms direct instruction (e.g. John, remember his name.), assigning common labels (e.g. What was that?), responsibility (e.g. Is this yours?), and preferred location (e.g. I'll be in charge of that.).

According to Wegner (1986), an effective transactive memory system should not leave the encoding or responsibility of storing information to chance. It should be made clear and explicit which individual is going to be responsible for what information (Wegner 1986). Additionally, research suggests that teams with a well developed transactive memory system have established similar labels and categories for encoding and retrieving information (Hollingshead 1998).

After information has been encoded and stored, transactive retrieval relies on individuals in a group accepting the responsibility for knowledge (Wegner 1986). With transactive retrieval, each person in a group does not need to remember everything the group needs to know. It is most important that each person or team member remembers who is likely to have certain information in the future. "This interdependence produces a knowledge-holding system that is larger and more complex than either of the individuals' own memory systems" (Wegner 1986). For example, if a virtual team member has a question about job duties they could go to the project manager to ask who is assigned to a specific task. In this case it is not important that the team member know what all the other team members are assigned to, but more important for them to know who has that information (in this case the project manager).

Studies of transactive memory can explain the behaviors of couples and dyadic relationships (Hollingshead 1998; Wegner 1986; Wegner et al. 1985), as well as similar systems in larger groups (Lewis 2003; Wegner 1995). The larger group work has presented the ideas of transactive encoding, storage, and decoding in terms of a computer network (Wegner 1995). In this research transactive memory is said to be made up of the following three stages (ibid, p. 326): directory updating: the process of team member learning where knowledge is stored, information allocation: the process of assigning knowledge to the team member(s) whose expertise is best suited for specific knowledge, and retrieval coordination: the process of retrieving knowledge by taking advantage of knowing where the knowledge is stored.

Additionally, Lewis (2003) referenced three different stages of transactive memory systems: specialization (differences in team member's knowledge), credibility (opinion of reliability of other team member's knowledge), and coordination (effective knowledge processing). He used these concepts to develop Likert-type measurement scales for each dimension of transactive memory in organizational settings and also validated the scale in three studies (refer Figure 1).

Specialization
1. Each team member has specialized knowledge of some aspect of our project.
2. I have knowledge about an aspect of the project that no other team member has.
3. Different team members are responsible for expertise in different areas.
4. The specialized knowledge of several different team members was needed to complete the project deliverables.
5. I know which team members have expertise in specific areas.

Credibility
1. I was comfortable accepting procedural suggestions from other team members.
2. I trusted that other members' knowledge about the project was credible.
3. I was confident relying on the information that other team members brought to the discussion.
4. When other members gave information, I wanted to double-check it for myself. (reversed)
5. I did not have much faith in other members' "expertise." (reversed)

Coordination
1. Our team worked together in a well-coordinated fashion.
2. Our team had very few misunderstandings about what to do.
3. Our team needed to backtrack and start over a lot. (reversed)
4. We accomplished the task smoothly and efficiently.
5. There was much confusion about how we would accomplish the task. (reversed)

Note: All items use a 5-point disagree-agree response format, in which 1 = *strongly disagree*, 2 = *disagree*, 3 = *neutral*, 4 = *agree*, and 5 = *strongly agree*.

Figure 1. Transactive Memory System Scale Items (Lewis, 2003)

TRANSACTIVE MEMORY AND MUTUAL KNOWLEDGE IN VIRTUAL TEAMS

In the previous sections, we have summarized the notion of mutual knowledge in virtual teams as well as research on transactive memory theory. We theorize that transactive memory is a precursor to mutual knowledge and that transactive memory influences virtual team performance and satisfaction through mutual knowledge, as well as directly. Previous research has identified performance and satisfaction as the main virtual team outputs in research (Powell et al. 2004). Performance specifically refers to the effectiveness of the team, while satisfaction refers to a team member's perception of contentment (ibid). Figure 2 illustrates this notion and is followed by a set of propositions based on the model.

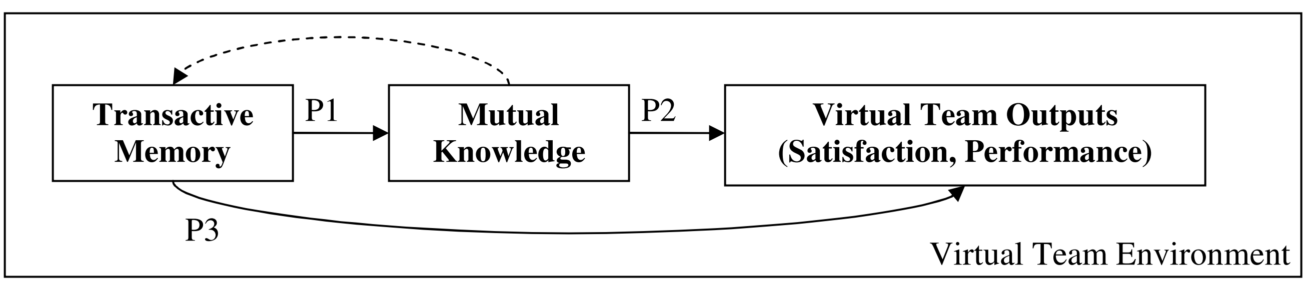

Figure 2. Mutual Knowledge as a Mediator of Transactive Memory and Virtual Team Outputs

Proposition 1: In virtual teams, higher transactive memory leads to higher mutual knowledge.

We believe that high transactive memory, thanks to an effective transactive memory system in virtual teams, will lead to high or increased mutual knowledge among team members. For example, we mentioned in the previous section that an effective transactive memory system does not leave the storing of information to chance and that it necessitates that team members be clear who is responsible for certain information. Therefore, transactive memory tells a virtual team member who is responsible for what information. If one has good or high transactive memory then one has better coordination (Faraj et al. 2000). Better coordination means more sharing of information which implies better mechanisms for increased mutual knowledge. Additionally, a lack of transactive memory can explain the lack of mutual knowledge in virtual team environments. In other words groups with low transactive memory will have low mutual knowledge. This is because knowledge is produced in a group setting through individuals sharing both information and common understandings (Beccera-Fernandez et al. 2001). In traditional group settings, effective knowledge sharing practices are necessary for making knowledge available between team members (ibid). Additionally, researchers have found that a transactive memory system alone does not mean that a team member will benefit and it will result in increased team performance (Akgun et al. 2006). This provides additional support for our proposition that mutual knowledge and transactive memory together improve virtual team outputs. Teams with an effective transactive memory system are better able to locate and share their expertise more effectively than teams with a less developed transactive memory (Faraj et al. 2000). Similarly, there is empirical evidence to show that "a transactive memory system without a collective mind is not enough to explain teams' performance" (Yoo et al. 2001). The authors' notion of collective mind is clearly no different than mutual knowledge.

Proposition 2: In virtual teams, higher transactive memory leads to high levels of virtual team performance and satisfaction through higher mutual knowledge.

This proposition suggests that higher transactive memory means higher mutual knowledge, which in turn means higher virtual team performance and satisfaction. Stasser and Stewart (1992) found that group decisions often reflect the common knowledge shared among the team members. Thus, greater the mutual knowledge within a virtual team, the better the team performance, the better virtual team members are able to perform their tasks, and the quality of the final decision is higher (Malhotra et al. 2001). Furthermore, based on a study of undergraduate students in four class sections at a university Beranek (2000) found that groups are more cohesive and also tend to communicate more openly, exert more influences on members to conform to group norms, and display higher task satisfaction. This is supported by the work of Hollenbeck, DeRue and Guzzo (2004) who found that face-to-face teams trained together perform better than individual-based learning teams. The researchers indicate that the shared understanding (mutual knowledge) of the task results in better performance. Additionally, in a field study of 86 IS departments, Nelson and Cooprider (1996) found that shared knowledge mediates the relationship between performance, trust, and influence. They also found that increasing the levels of shared knowledge between groups' leads to increased performance. This directly supports our proposition that mutual knowledge is a mediating influence in the relationship between transactive memory and virtual team performance.

Proposition 3: In virtual teams, higher transactive memory can directly lead to higher levels of virtual team outputs (performance and satisfaction).

Research building on the original ideas of Wegner, Giuliano, and Hertel (1985) has shown that organizational work groups can improve team performance by using transactive memory systems, especially on complex tasks that require knowledge contributions from all team members (Yoo et al. 2001). Additionally research on software development teams has found support for the hypothesis that teams who can recognize where expertise is needed and know where to find it is positively related to team performance (Faraj et al. 2000). Furthermore, a study top management in the banking industry from Rau (2005) confirmed her hypothesis that the location dimension (i.e. knowing which team member knows what information) of team transactive memory positively influences team performance.

Proposition 4: In virtual teams, technology (IT) can be used to improve mutual knowledge by increase transaction memory attributes and in consequence mutual knowledge.

Prior research in virtual settings suggests that transactive memory can be created through the use of IT that supports the components of transactive memory -- directory updating, information allocation, and retrieval coordination (Griffith et al. 2003). Yoo and Kanawattanachai (2001) also propose that "in virtual team environments where a high degree of cognitive interdependence among team members is required for successful decision-making, an effective coordination of knowledge as well as carefully interrelated actions among members are important determinants of team performance” (p. 188). Similarly, DeSanctis and Monge (1998) conclude that mutual understanding can be enhanced and facilitated by formalization and reapplication of transactive memory systems using contextually rich electronic communications.

CONCLUDING REMARKS

The ability to effectively communicate and share knowledge in virtual setting can become a difficult task due to the complex nature of both the virtual context and the technology used to support them. A review of the literature describes the concepts of both mutual knowledge in the context of virtual teams and the theory of transactive memory. In this paper we hypothesize that transactive memory theory can explain and predict how mutual knowledge enhances virtual team performance. Based on this thesis, we present a theoretical model and related propositions. A practical implication of our proposal is that virtual teams need to pay special attention to developing their transactive memory when their teams are originally formed. This can be done by sharing their backgrounds and area of expertise with the team so that members can have a basis for identifying and locating information or knowledge and its potential source.

Our understanding of how transactive memory can impact mutual knowledge in virtual teams’ processes and performance needs further empirical investigation. We expect to conduct further research that empirically tests the proposed theoretical model. Additionally, it is unclear from our review of the literature whether or not higher mutual knowledge leads to higher transactive memory. We suspect that this might be the case and that there is the possibility that there is an iterative relationship between the two notions. However, future research should be completed to fully understand this relationship.

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