How Performance Feedback and Reflection Affect Transactive Memory

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Research on transactive memory has showed the positive effects of training together. This study investigated how feedback and reflection affect transactive memory in settings where there is no time for elaborate team training. Newly formed teams were given accurate, false or no feedback about their individual performance on a prior administration of an intellective task. Team receiving no feedback either were given time for reflection to discuss their prior performance or not. Our findings suggest the need to support newly-formed teams in their attempt to determine how expertise is distributed among its members along with the potential of feedback to create transactive memory systems.

INTRODUCTION

Teams are of great importance to organizations. This is mainly because teams incorporate the expertise of more than one person, making them especially flexible and capable of solving complex problems in short time. However, to manage this expertise and to engage in coordinated teamwork, team members need to learn about one another's domains of expertise (cf. Faraj & Sproull, 2000; Littlepage, Robinson, & Reddington, 1997; Moreland, 1999; Wegner, 1987). We define expertise as the specialized knowledge and skills that individuals bring to the team. Over time, through selfdisclosure and shared experiences, members learn who the expert is across knowledge domains (Hollingshead, 1998b). The knowledge held by individual group members coupled with an awareness of the distribution of that knowledge has been described as transactive memory (Wegner, 1987; see also Smith-Jentsch, Kraiger, Cannon-Bowers, & Salas, 2009).

Past research on transactive memory has mainly focused on dyads, such as dating couples (e.g., Wegner, Erber, & Raymond, 1991; Hollingshead, 1998a), and on the benefits of group training as a mechanism to develop it (e.g., Prichard & Ashleigh, 2007; Moreland & Myaskovsky, 2000; Liang, Moreland, & Argote, 1995). The current research will elaborate on the possibilities of developing transactive memory through external feedback of performance data of individual team members to the team, prior to teamwork (cf. Bonner, Baumann, & Dalal, 2002; Littlepage et al., 1997). Besides the possibilities for supporting virtual teams, this may also be especially interesting for newly formed or ad hoc teams. We define ad hoc teams as teams composed of members that have typically never, or incidentally, worked with one another that are called impromptu into being to react to a sudden but unexpected situation. In these situations there often is no time for elaborate team training or team-building activities and alternatives for transactive memory development need to be considered. By first describing past research on transactive memory and feedback, this paper intends to present a coherent overview of the literature, which will lead to the current hypotheses.

Transactive Memory Systems

Naturally occurring teams develop transactive memory by explicitly establishing relative expertise, making assertions about their domains of expertise in conversations, asking questions about others' expertise, and spending time demonstrating their knowledge to their team members (Hollingshead, 1998a, 1998b). As such, developing transactive memory requires considerable discussion among team members and observations of social behavior. Transactive memory systems have been defined as cooperative divisions of labor for learning, remembering and communicating relevant knowledge (Hollingshead, 2001; Wegner, 1987). When team members work on a shared task, they are likely to develop an understanding of the individual skills that exist in the team. Often some kind of specialization occurs in a team as members divide responsibilities and share individual knowledge for the benefit of the team. As mentioned, transactive memory combines the knowledge possessed by particular team members with a shared awareness of who knows what.

Theoretically, by dividing responsibilities, the cognitive labor per person is decreased and the team as a collective can retrieve more information than an individual ever could. The benefits of transactive memory are obvious. By recognizing skills, team members can anticipate instead of react, and can divide tasks based on expertise (Wittenbaum, Vaughan, & Stasser, 1998). Indeed, a number of studies indicate that transactive memory facilitates team coordination, task assignment, and more effective utilization of member knowledge (Faraj & Sproull, 2000; Lewis, Lange, & Gilles, 2005; Liang et al., 1995; Littlepage, Hollingshead, Drake, & Littlepage, 2008; Moreland, 1999).

Although numerous studies on the effects of transactive memory have been conducted, only few have studied methods other than training to enhance the development of transactive memory (cf. Kozlowski & Ilgen, 2006). One method that seems capable of fast implementation of transactive memory is providing teams with feedback on members' performance, prior to teamwork (Brandon & Hollingshead, 2004; Moreland & Myaskovsky, 2000). This allows teams to develop perceptions of the performance level rankings within the team. By giving teams feedback on their relative expertise on building radios, Moreland and Myaskovsky found that transactive memory systems were enhanced and team and memory performance were improved.

Feedback and Reflection

The recognition and implementation of expertise is crucial for team performance (Bunderson, 2003). Several studies acknowledge that team performance increases when members receive cues about who in the team knows what (Moreland & Myaskovsky, 2000; Stasser, Vaughan, & Stewart, 2000). Diagnostic information on performance is important for teams to recognize and utilize expertise (Bonner et al., 2002), and, hence, for the development of transactive memory. As mentioned, one possible method to increase insight in member's expertise is through the use of explicit performance feedback (Littlepage et al., 1997). Feedback generally contains information with the intention to increase current performance. Indeed, Henry, Strickland, Yorges, and Ladd (1996) found that group members better recognized expertise when they received feedback on members' performance. Moreover, Anseel, Lievens, and Schollaert (2009) found that reflection combined with feedback enhanced performance improvement better than feedback alone. Reflection without feedback did not lead to performance improvement. It seems that teams have a need to discuss performance data and possibly even use this to build a new expertise system, before taking action.

Assigning task responsibilities to individual team members based on external feedback of member expertise can lead to a rough fit between member knowledge and task demands (cf. Littlepage et al., 2008). Consequently, we expect teams to develop complementary patterns of specialized knowledge that expand the total amount of knowledge available to team members (e.g., Liang et al., 1995; Littlepage et al., 2008; Moreland & Myaskovsky, 2000). More precisely, we expect that team members that receive feedback about their relative performance on a specific task (i.e., external outcome feedback), and are able to discuss their performance with their fellow team members prior to working together on the same specific task build better transactive memory systems leading to better performance and more accurate knowledge retrieval than teams that receive no feedback prior to teamwork.

The literature remains inconclusive, however, whether teams could enhance their transactive memory through internal or self-generated performance feedback as well (cf. Bonner et al., 2002). Teams that do not receive feedback, but have an opportunity to discuss their expertise, could still perform well if they correctly establish individual members' expertise in the subject area (cf. Hollingshead, 1998a). However, we expect that team members need a good deal of time to correctly assert the total amount of knowledge available to all team members and, consequently, will start working with less developed transactive memory than teams that receive accurate external feedback prior to teamwork.

Finally, because it can be difficult in business practice to provide for accurate performance appraisal all of the time, it is also interesting and important to investigate the effects of providing teams with false team member performance data prior to teamwork. We expect that teams that receive false feedback and get an opportunity to discuss this are prone to develop inaccurate transactive memory systems, which should result in poor team performance since teams failed to correctly identify expertise. In fact, it is possible that teams trust the members with the least expertise to perform the best, which means they could even perform worse than teams that do not receive performance feedback at all, neither internal nor external.

METHOD

Participants and Task

One hundred-and-two students (43 male and 59 female) participated in the study. Participants were paid \notin 45 (%70) for taking part in the study. An additional \notin 90 (\$140) prize was promised to the team that performed best to enhance motivation. Their age ranged from 18 to 35 years (M = 23.6, SD = 3.7). Participants were randomly assigned to 34 three-person mixed-gender teams.

For the experiment a modified and computerized version of Trivial Pursuit was used. The quiz consisted of 120 questions divided over six categories, consistent with the six original Trivial Pursuit categories. The questions were selected from the complete set of questions from the original Trivial Pursuit Genus 2003 edition from Hasbro and the original Trivial Pursuit Family 2006 edition from Horn Abbot International Limited and tested on clear language and understanding and to the extent they provoked team discussion.

Questions were presented as multiple-choice items to participants, with one correct answer and three incorrect answers to choose from. Participants were asked to select the best possible answer out of the choices. The quiz did not have, contrary to the original Trivial Pursuit quiz, a time limit for answering the questions. Because the questions are commercially available there was a chance that our participants had some familiarity with the questions in our quiz. Our observations during the experiment and an assessment at the end of the experiment, however, showed this not to be the case.

Procedure and Independent Measures

In the first phase of the experiment all participants answered 120 quiz questions individually. Participants were instructed to perform the task at their best and as fast as they could. Participants were not allowed to look up answers or communicate with others during the test. Then, participants were assigned to one out of four possible feedback conditions: an accurate feedback condition, a false feedback condition, a self-generated feedback condition, and a no feedback condition. A Latin square design was applied to ensure that the feedback conditions were equally divided across order of appearance. The conditions are discussed in more detail below.

In the *accurate feedback condition* teams were given the individual quiz scores for each participant. Each member was

handed a computer generated score table with the score of every member on each category. The scores were briefly explained by the experiment leader to avoid interpretation errors. Teams were given ten minutes to discuss their scores and relative expertise on each category and instructed to do so. A digital egg timer was placed at the centre of the room showing the remaining time for discussion.

In the *false feedback condition* teams were also given the individual quiz scores for each participant. However, we inverted the individual quiz scores before handing them to the participants. For example, when a participant had a score of 70% correct for Literature this score was changed to a 30% correct score. Participants who scored relatively high were told they scored relatively low and vice versa. Again, teams were given ten minutes to discuss their scores and relative expertise on each category and instructed to do so. The purpose of this condition was to provide teams with inaccurate transactive memory.

In the *self-generated feedback condition* teams were not given any feedback on the individual quiz scores. Instead, teams were given an empty scoring sheet and were instructed to discuss their performance on each category with their team members. Again, teams were given ten minutes to discuss their scores and relative expertise. This condition was included to investigate the effects of self-generated feedback on transactive memory and team performance.

Teams in the no feedback condition were neither given feedback nor an opportunity to discuss their areas of expertise with each other. Instead, teams in this condition were assigned to a filler task: a ten minute team assignment to identify and discuss solutions to traffic jams. This created an opportunity for teambuilding without getting feedback on prior task performance.

After the feedback manipulation, the participants were sent back to their individual rooms. Then, the experiment leader explained to the participants that they would get another quiz, however, this time they had to complete it as a team. In fact, teams were given the same 120 quiz questions but in a different random order to minimize memory recall influences. The team members could speak to each other through headsets and an audio connection.

All participants were placed behind a computer screen on which we presented the quiz questions. One member was randomly assigned to select the answer to each question. The team was instructed, however, that they had to reach consensus first before this person could make a decision. Teams were informed that their team performance was measured by the number of correct answers in combination with the average time needed for each question. Time pressure was evoked to create a need for specialization within the team.

Dependent Measures

We chose to collect both objective performance data and subjective data. Collecting subjective data has the benefit that it may provide significant insights not obtainable by objective methods, such as user opinions and preferences (cf. Cushman

& Rosenberg, 1991). Below we will discuss these measures into more detail.

Team performance. Team performance was defined as the team's quiz score, with a maximum of 120 points given there were 120 questions. To control for individual differences on the individual quiz score and to account for earlier findings that teams perform at the level of the best individuals (see, for example, Bonner et al., 2002), we subtracted the quiz scores on prior individual administrations of the quiz from the total quiz score to measure the team's overall progress.

Transactive memory. A summated rating scale was developed and administered at the end of the experiment to capture the perceived accuracy and sharedness of the TMS. The scale contains one item from the Lewis (2003) scale and two items from the scale originally used by Moreland and Myaskovsky (2000). The rating scale items were measured on 7-point Likert scales. The three items used are: "I know which team members have expertise in specific areas" (to a little extent – to a great extent), "How much do you know about the knowledge of your teammates" and "How much do your teammates know about your knowledge" (very little - very much). (3 items, Cronbach's $\alpha = .77$).

RESULTS

A one-way between-subjects analysis of variance (ANOVA) was conducted at an alpha level of .05 to compare the effects of feedback strategies on our dependent variables. All analyses were performed at the team level to account for statistical interdependence. Table 1 summarizes the means and standard deviations for the dependent variables across feedback conditions.

Table 1. Cel	l means	and stand	lard o	leviations.
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	Feedback condition					
	Accurate	False	Self-generated	No		
Dependent						
Team	19.38	11.70	17.38	15.59		
Performance ^a	(1.49)	(1.94)	(5.52)	(3.75)		
Transactive	4.93	4.71	5.16	3.98		
Memory ^b	(1.67)	(0.83)	(1.37)	(1.67)		

Note. Values enclosed in parentheses represent standard deviations.

^aThe values represent mean team scores on the task minus mean individual pre-test scores. The theoretical maximum score is 120. ^bThe values represent mean scores on seven-point Likert scales.

Team Performance

The ANOVA showed a significant effect of feedback on relative quiz scores for the four conditions, F(3, 29) = 6.476, p = .002, $\eta_p^2 = .401$. Post hoc comparisons using LSD indicated that the mean score for the false feedback condition (M = 11.70, SD = 1.94) was significantly different than the accurate feedback condition (M = 19.37, SD = 1.49), the selfgenerated feedback condition (M = 17.37, SD = 5.52), and the no feedback condition (M = 15.58, SD = 3.75). Moreover, the accurate feedback condition differed significantly from the no feedback condition. However, the accurate feedback condition did not significantly differ from the self-generated feedback

condition. Further, the no feedback condition did not significantly differ from the self-generated feedback condition. Taken together, these results suggest that feedback on how expertise is distributed among team members affects team performance. More specifically, false feedback on how expertise is distributed was found to impair team performance. Our results also suggest that providing accurate team member performance data to the team, prior to teamwork, has a positive effect on performance. However, it should be noted that teams that were not given any feedback on the individual quiz scores, but were given an equal amount of time to discuss their relative expertise in a structured way, performed as good as teams in the accurate feedback condition.

Transactive Memory

The ANOVA revealed a significant difference between conditions on the perceived quality of transactive memory, *F* (3, 28) = 8.804, p = .00, $\eta_p^2 = .49$. Post hoc analyses using LSD revealed that the no feedback condition (M = 3.98, SD = 1.67) differed significantly from the accurate feedback (M = 4.93, SD = 1.67), the false feedback (M = 4.71, SD = 0.83), and the self-generated feedback condition (M = 5.16, SD = 1.37). Furthermore, the self-generated feedback condition, but not from the accurate feedback condition. Taken together, these results suggest that participants that had the opportunity to discuss individual task-performance data, whether self-generated or not, prior to teamwork, perceived their transactive memory as being more accurate and shared than teams without this opportunity.

DISCUSSION

Our results revealed one overarching finding: False beliefs about knowledge distribution in teams can have serious consequences for transactive memory and team performance. Teams receiving false team member performance data prior to teamwork, and, hence, that developed false transactive memory systems, performed worse than teams receiving no external feedback. Below, we will discuss the results and the limitations of our research, and draw implications for practice as well as for the design of support for newly formed teams.

First, teams receiving accurate external feedback on team member performance prior to teamwork or teams that do not receive external feedback but have an opportunity to discuss their expertise performed better than teams receiving false feedback. Moreover, teams receiving accurate external feedback performed better than teams receiving no feedback at all, indicating that providing accurate team member performance data to the team, prior to teamwork, is beneficial to teamwork. However, we found no difference on team performance between teams receiving no external feedback, whether there was an opportunity to discuss prior individual performance in the team or not. This shows that, at least for the current intellective task, discussing expertise without the team member performance data to back it up is not the most effective strategy to improve overall team performance. The most logical explanation is that teams failed to correctly identify the existing expertise within the team. In the selfgenerated feedback condition teams were instructed to fill in a score sheet with their estimates of their individual scores for each category in the quiz and then discuss these with their fellow team members. However, as we observed, members were not always able to give rational estimates of their own performance. Sometimes participants reported scores below the chance level of five correct answers. It seems that, at least for this task, the failure to correctly identify one's own strengths and weaknesses had a negative effect on team performance.

Second, teams receiving false feedback performed significantly worse than other teams. This is likely caused by an inaccurate transactive memory. However, the influence of disappointment and confusion could also be an important reason for lower team performance. Our observations provide some insights into what actually happened to teams receiving false feedback: We found that teams relied overly strong on the wrong person when answering quiz questions, even though this person was clearly given the wrong answers. With one exception, which was excluded from the analysis, all teams accepted the individual guiz results to be true without any clear signs of doubt. We think this was partly caused by the fact that we presented the quiz scores to the whole team, and participants apparently did not want to question their negative feedback in public. We believe this situation is not an extreme situation and could happen in real-world organizations as well. The possibility of receiving false feedback might have unexpected results in the field as the results can be underestimated, and especially hard to detect in time. Clearly, this is an interesting topic for future research.

Third, teams receiving false team member performance data prior to teamwork had equal perceptions of the teams' ability to correctly identify expertise within the team as teams receiving accurate feedback. Moreover, our results suggest that it is not the quality of the feedback discussed prior to teamwork, but the discussion itself that leads to elevated team perceptions of the teams' ability to correctly identify expertise among its members.

This study has contributed to the current transactive memory research in several ways. First, the present results indicate that transactive memory can be developed and tested in a distributed setting with ad hoc teams receiving no prior training, which improves the external validity on this topic. Second, the notion that teams can actually generate inaccurate transactive memory systems based on false beliefs of knowledge distribution is a new addition to the current transactive memory research.

To conclude, this study shows not only the benefits of accurate, external outcome feedback on distributed team performance, but also the negative effects of false feedback, and consequently, inaccurate transactive memory on team performance. This is not a finding that should be discarded easily for inaccurate transactive memory systems are to be found in natural occurring teams all around us, often in plain sight. In the military, for instance, expertise is predominantly communicated non-verbally through rank, patches and uniform. Other important markers of expertise, like experience on the job or specialized training are less transparent and are harder to assess in a short time. This means one can mistakenly expect certain expertise by rank, while the officer at hand can be new, and, in fact, still has a lot to learn. One can imagine the possible impact of false beliefs in expertise, such as leadership skills, in a combat situation. Clearly, more research is needed in investigating the mechanisms of expertise management.

Moreover, the current research shows the benefits of selfgenerated (i.e., internal) feedback on performance. The possible practical implications of this finding are evident: Not only would this be an easy method to improve team performance. It would also be a method which can be implemented in a short time. Perhaps more importantly, it would also be a low-cost method. Instead of enrolling in an expensive performance appraisal system, employees should simply be invited, either in an introduction round at the start of projects or in a digitized template on the intranet, to give a short but structured introduction about their strengths and weaknesses in relation to their work. Overall, given the absence of accurate quantitative performance data in most real-world teams, self-generated feedback is a very effective strategy to enhance team performance and transactive memory.

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