We Are Not in Sync, But We Think We Are: Actual versus Perceived Temporal Team Mental Models

Jacqueline Marhefka
Pennsylvania State University

Susan Mohammed
Pennsylvania State University

Katherine Hamilton
Pennsylvania State University

Rachel Tesler
United States Department of Defense

Vincent Mancuso
MIT Lincoln Laboratory

Michael McNeese
Pennsylvania State University

Despite the increasing number of failures blamed on team members' lack of synchronization, little is known about the consequences of members thinking they are in sync but are not in actuality. We expanded the nascent research on temporal team mental models (TMM) by examining the relationship between perceived and actual temporal TMM similarity on team performance. Mismatches between perceiving and actually being on the same temporal page were detrimental to performance in that teams took longer to complete tasks. Findings support that both perceiving to be in sync and actually being in sync are essential for team success.

INTRODUCTION

The year 2014 saw the largest outbreak of the Ebola virus, causing widespread illness and death in West Africa and beyond (Gulland, 2015). Such destruction may have been ameliorated had medical researchers and the World Health Organization (WHO) been better synchronized. Due to a lack of coordination amongst the researchers and a lack of attentiveness between the researchers and the WHO, the most ideal treatment was not identified and implemented in a timely fashion (Gulland, 2015).

Although the researchers may have believed they were in sync with each other and the WHO, it is evident in hindsight that they were not. Unfortunately, this incident is not an isolated one. When team members across diverse settings such as hospitals (Reddy, Pratt, Dourish & Shabot, 2002), retail (Liu, Mantin & Wang, 2013), and economic policy-making (Gieve & Provost, 2012) fail to coordinate *when* specific events should take place or *when* tasks should be completed, inferior performance resulted. As illustrated in the importance of timely communication, pacing, and coordination, temporality matters and how people perceive temporality matters.

Despite how common this scenario may be across teams, little is known about the potential mismatch between actual team mental model (TMM) sharedness and teams' perceptions of sharedness. TMMs, a type of team cognition, refer to the shared, organized understanding of the key elements in a team's environment (Mohammed, Ferzandi & Hamilton, 2010). The opening illustration highlights a weakness of TMM research: the failure to address discrepancies between perceptions and reality regarding sharedness, especially about time. That is, the perception of TMM similarity or sharedness held by team members may not be the same as the actual similarity, creating incongruities that negatively affect team outcomes. As shown in the response to the Ebola outbreak, team members may think that they are on the same page, although they are actually not. Distinct from other types of team cognition, the TMM literature has tended to utilize actual, objective measures of how similar team members' mental representations are rather than perceptual TMM measures of whether team members think that their mental models are similar (e.g., Mohammed, Klimoski, & Rentsch, 2000). Because most studies do not simultaneously assess both, a recent review called for future research to examine the relationship between actual and perceived TMM sharedness (Mohammed et al., 2010). In this paper, we aim to address this unheeded research recommendation.

In addition to the importance of considering the discrepancies in actual versus perceived similarity, another deficiency of TMM research exemplified in the Ebola example is inadequate attention to time. Despite the increasing number of team failures blamed on the team members' lack of synchronization and coordination, the incorporation of explicit time-related aspects has been neglected in team studies (Mohammed, Hamilton & Lim, 2009) and in team cognition research in particular (Mohammed, Tesler & Hamilton, 2012). Temporality has specifically been noted as currently lacking in TMMs (Mohammed et al., 2010; Mohammed et al., 2012), and the numerous calls to more fully incorporate temporal dynamics in team cognition studies (e.g. Gevers, Rutte & van Eerde, 2006; Mohammed et al., 2010; Mohammed & Nadkarni, 2014; Santos, Uitdewilligen & Passos, 2015) have largely gone unheeded. Rather than "timework" (when), the emphasis in TMM research has been on taskwork (what) and teamwork (who and how) content (Mohammed et al., 2010). However, in an exciting, recent development, nascent research has begun to examine temporal TMMs as common views held by the team about the time-related aspects of performing collective tasks (Mohammed, Hamilton, Tesler, Mancuso & McNeese, 2015). Showing promise, initial evidence supported temporal TMMs increasing team performance outcomes (Mohammed et al., 2015; Santos et al., 2015).

Addressing these two key needs in the TMM literature, the purpose of this study is to examine the interactive effects of perceived and actual similarity of temporal TMMs on team performance. The present study contributes theoretically, empirically, and practically to the TMM literature. First, the study helps resolve a long-standing theoretical debate in the TMM literature regarding the role of perceptions of sharedness (Mohammed et al., 2010). Whereas some researchers argued that teams must perceive themselves as being on the same page in order to truly have a shared TMM (Klimoski & Mohammed, 1994), others claim that teams may have common TMMs but be unaware of the extent of similarity (Rentsch et al., 2009). Although we know that team perceptions can greatly impact a variety of outcomes (e.g. Barden & Petty, 2008; Clarkson, Hirt, Jia & Alexander, 2010; Tormala, Clarkson & Petty, 2006), most TMM research has examined only actual sharedness. Therefore, as a second, empirical contribution, this study would simultaneously assess both perceived and actual levels of sharedness. A review of the TMM literature recommended that future research "contrast matches and mismatches between perceived and actual TMM similarity…and performance" (Mohammed et al., 2010, p. 904). Answering this call, the current study examines the influence of both actual and perceived sharedness and whether their interaction accounts for additional variance in predicting team performance.

A third, practical contribution is that study results could lead to several useful applications, such as helping to diagnose which teams are not in sync, paving the way for targeted and tailored training. For example, corrective feedback and interventions directed toward improved performance could be personalized for teams who incorrectly perceive they are in sync when they are actually not. Additionally, training could be provided to help teams become more cognizant of temporal issues contributing to poor performance. This research may also assist with temporal pacing adjustments to achieve higher levels of sharedness. Fourth, the study contributes to emerging research on temporal TMMs, which has shown promise, but is in its infancy (Mohammed et al., 2015; Santos et al., 2015). By addressing how team perceptions of temporal sharedness compare with reality, this study expands the research base on temporal TMMs.

THEORETICAL BACKGROUND

Team Mental Models

Team cognition describes how knowledge is gathered and held within a team and includes more specific constructs such as TMMs, transactive memory systems, and team situation awareness (Mohammed et al., 2012). TMMs differ from other forms of team cognition in two key ways. First, TMMs subsume greater breadth of content, including taskwork (what the team must do in order to complete goals), teamwork (how and who team members must interact with in order to complete the task), and "timework" (when team members need to complete tasks) (e.g. Cooke, Kiekel & Helm, 2001; Mohammed et al., 2015). Second, TMMs capture both content and structure whereas other types of team cognition assess only content. Structure refers to the relationships between concepts in team members' heads (Mohammed et al., 2010). Examples of TMM measures assessing content as well as structure include paired comparison ratings, in which participants rate the similarity of pairs of various concepts (Mohammed et al., 2000), or concept mapping, in which participants place concepts in an ordered structure for themselves and their other team members (Marks, Sabella, Burke & Zaccaro, 2002). Other types of team cognition such as transactive memory systems (Lewis, 2003) or group learning (Edmonson, 1999) use Likert scales to examine content, ignoring structure.

A meta-analysis concluded that TMMs are an important contributor to team performance above and beyond other behavioral or motivational states and team processes (DeChurch & Mesmer-Magnus, 2010a). Specifically, TMMs have been positively related to performance outcomes such as work quality, volume, efficiency, and timeliness, as well as to enhanced team processes (DeChurch & Mesmer-Magnus, 2010a). Several team failures have been blamed on a lack of TMM similarity (Mohammed, Hamilton, Sanchez-Manzanares & Rico, 2017), including surgical errors (Santos et al., 2012), airline disasters (Bell & Kozlowski, 2011) and space mission failures (Bearman, Paletz, Orasanu & Thomas, 2010).

Two properties of TMMs are similarity and accuracy (Mohammed et al., 2010). TMM similarity represents how convergent or consistent team members' mental models are with each other (Rentsch, Small & Hanges, 2008). In this study, we focus on TMM similarity because, in comparison to accuracy, similarity has more consistent results, is more frequently studied, and is the construct of interest when comparing actual TMMs to perceptual TMMs (Mohammed et al., 2010).

Actual and Perceived Sharedness

In addition to similarity and accuracy, perceptual and structured represent two forms of team cognition (DeChurch & Mesmer-Magnus, 2010a). Perceptual cognition consists of general attitudes, beliefs, values, and expectations of team members. To measure the team's awareness of their level of TMM similarity, team members respond to Likert scale items addressing how similar they feel components of the TMM are or the extent to which they feel team members were on the same page (Rentsch et al., 2008). A sample item assessing perceived temporal cognition is "Team members had the same opinion about meeting deadlines" (Gevers et al., 2006). In contrast, structured cognition is the actual organization, pattern, and arrangement of team knowledge. TMMs are commonly measured via paired comparison ratings or concept maps, which provide quantitative indicators of how similar individuals' mental maps are (Mohammed et al., 2010).

Parallel to the perceptual and structured cognition distinction, we refer to perceived and actual TMM similarity in the current paper. Perceived TMM similarity describes subjective assessments of the extent to which team members are on the same page and are reported by team members themselves. Actual TMM similarity refers to objective assessments of the extent to which team members are on the same page, as calculated by measures independent of team members' perceptions. Because of the emphasis on TMM structure and objectively comparing whether team members' mental maps are similar, perceptions of sharedness have not received as much attention in the TMM literature. Although not unpacked in the TMM literature, there are plenty of examples in other literatures where perceived versus actual phenomena have been contrasted. Across various research domains, perception contributes in a unique way beyond actuality on a variety of outcomes, including attitudes (Barden & Petty, 2008), resource depletion (Clarkson et al., 2010) and resisting persuasion (Tormala et al., 2006).

Disagreement still remains regarding whether demonstrating actual similarity is enough to qualify as a shared mental model, or whether team members also have to perceive that they are in agreement (Mohammed et al., 2010). For example, Klimoski and Mohammed (1994) indicated that one component of a TMM is reflection of internalized perceptions and assumptions, meaning that teams should share an understanding that they are on the same page. Conversely, Rentsch and colleagues (2009) argue that a team may have a high level of knowledge similarity, qualifying as a TMM, but be ignorant of consensus. It is difficult to test these competing views when studies do not examine actual sharedness and perceived sharedness concurrently.

Based on Rentsch and colleagues' (2009) proposition, there are four resulting categories when conceptualizing perceived and actual sharedness as a 2 X 2 matrix. One category is a true positive in which a team believes it is in sync and is in actuality, and the opposite is a true negative in which a team does not perceive being in sync and is not in reality. A false positive occurs when a team perceives that it is in sync, but is not in actuality. Finally, a false negative occurs when a team perceives that it is not in sync, but actually is. Of specific interest are the latter two mismatches, which may have negative influences on team outcomes. These out-of-sync combinations may be particularly heightened for temporal TMMs, as time may be discussed less explicitly than what must be done or how it should be done to perform a task (Mohammed et al., 2015).

Temporal Team Mental Models

Although the majority of TMM literature has focused on taskwork elements (what) or teamwork components (how, who), time-related issues (when) have been neglected (Mohammed et al., 2009). However, temporal TMMs are receiving increasing attention. A temporal TMM is defined as "agreement among group members concerning deadlines for task completion, the pacing or speed of activities, and the sequencing of tasks" (Mohammed et al., 2015, p. 696). Deadlines indicate the specific time by which a task should be completed (Blount & Janicik, 2002). Pacing refers to how team members distribute effort towards completing a task over time (Blount & Janicik, 2002). Sequencing describes when steps must be completed in a specific order. Overall, high temporal TMM similarity occurs when team members are on the same page regarding deadlines and pacing, and the ordering of subsequent steps (Mohammed et al., 2015). Despite the importance of these three temporal elements, only three studies have empirically measured actual temporal TMM similarity, and all found direct or conditional positive effects on team outcomes (Mohammed et al., 2015; Santos et al., 2015; Santos, Passos & Uitdewilligen, 2016).

HYPOTHESES

Team Performance

Main Effect

Two meta-analyses have confirmed that TMMs positively predict team performance (DeChurch & Mesmer-Magnus, 2010a, 2010b). Temporal TMMs have also been found to positively influence performance (Mohammed et al., 2015, Santos et al., 2015). Teams that developed temporal TMM similarity were better able to foster compatible work patterns by understanding and foreseeing the actions of other team members (Mohammed et al., 2015). Task activities were then better coordinated, which positively affected team performance outcomes (Gevers et al., 2006). Expecting to replicate these findings, we predict:

Hypothesis 1: Actual temporal TMM similarity will have a positive effect on team performance.

Moderated Hypothesis

When perceived temporal TMM similarity is higher, the relationship between actual temporal TMM similarity and team performance is expected to be more positive. When teams agree that they are performing tasks in the expected order or working at the anticipated pace, reports of rapport, understanding, and communication increase (DePaulo & Bell, 1990; Lakin, Jefferis, Cheng & Chartrand, 2003). Increased understanding and communication of temporal elements then facilitates better coordination of team actions, ultimately positively impacting performance (Blickensderfer, Cannon-Bowers & Salas, 1998; Cannon-Bowers, Tannenbaum, Salas & Volpe, 1995; Rico, Sanchez-Manzanares, Gil & Gibson, 2008). When teams do not perceive they are in sync, the relationship between actual temporal TMM similarity and performance is expected to be less positive. Although teams may have higher levels of actual temporal TMM sharedness, if teams perceive lower levels of similarity, they are less likely to feel the encouragement to communicate more frequently with each other, detracting from performance.

Taking a different perspective, we suspect that findings of affective-cognitive consistency (Schleicher, Watt & Greguras, 2004) would parallel the variables in this study to suggest stronger effects when criteria are in sync. Affective-cognitive consistency impacts the strength of job attitudes, such that when affective-cognitive consistency is low, there is less strength in the relationship (Schleicher et al., 2004). Following the above logic, if the actual temporal TMM (analogous to the cognitive component of the attitude), is not consistent or in sync with perceptions (analogous to the affective component of the attitude), the relationship between actual temporal TMM similarity and performance will not be as positive as when they are consistent. Just as high affective-cognitive consistency results in a more positive relationship between attitudes and performance, high levels of consistency between the actual and perceived temporal TMM sharedness should result in a more positive relationship with team performance when sharedness is high than if the perceived temporal TMM differs from the actual state.

To summarize, higher levels of performance will result from teams that perceive their team to be and actually are on the same temporal page, and lower levels of performance from teams that perceive they have and actually do have lower levels of sharedness. Teams that actually have higher temporal TMM sharedness but do not perceive that they do will have lower performance than those that do perceive it.

Hypothesis 2: The relationship between actual temporal TMM similarity and performance is moderated by perceived temporal TMM similarity, such that the relationship will be more positive when perceived temporal TMM similarity is higher than lower.

METHOD

Participants

The study consisted of 546 undergraduate participants from a large mid-Atlantic university, who were randomly assigned to teams consisting of three members (resulting in 182 teams). The mean age of participants was 20.15 years (*SD* = 1.01), with 69% being Caucasian and 57% being female. Participants were primarily in their first, second, or third year of undergraduate study. Students received course credit or extra credit in return for participation.

NeoCITIES Simulation

Students participated in NeoCITIES (McNeese et al., 2005; Mohammed et al., 2015), an emergency crisis management team computer simulation in which participants had to respond to a range of disaster situations. Each team member was randomly assigned to one of three roles: fire/emergency medical services (EMS), police, or hazardous materials (HazMat). Each role had several resources to allocate. For instance, fire/EMS had trucks, ambulances, and fire investigators to utilize. Emergency situations of varying types and levels arose, and participants attempted to coordinate with other team members to determine the severity of the event, send the appropriate type and amount of resources at the correct time, and determine what resources other team members needed to address the situation. Resources were limited, and sending excessive resources to a minor event could cause a delay in response to a more serious emergency due to the time required to recall resources (Hellar & McNeese, 2010). They communicated exclusively via instant messaging in a chat box.

The simulation was designed to study team cognition and team performance (McNeese et al., 2005), with dynamic and uncertain situations. The environment in the simulation changed depending on the students' responses, meaning that if a minor situation was not dealt with quickly, it could escalate into a larger issue. Lower complexity situations only required one role to respond (e.g. fire), while high complexity scenarios required two or all three roles to cooperate. Several temporal components were incorporated into the simulation. For certain events, deadlines were imposed. Other events required the three units to arrive in a precise order (e.g. fire to ensure safety, police to arrest suspects, HazMat to investigate). As each member received unique information, it was critical that they communicate in order to successfully solve interdependent tasks.

Procedure

The current study was part of a larger data collection, which included three manipulated variables: individual reflexivity (reflecting individually on one's performance), group reflexivity (reflecting as a group on the team's performance), and storytelling (conveying audio and visual information about the need for team collaboration and timing in an engaging manner using the principles of narrative). These interventions were examined for their potential positive influences on team cognition (see Mohammed et al., 2017 for an overview). They were controlled for in the analyses, but not of substantive interest in this study.

Participants were randomly assigned to teams and roles (fire, police, HazMat) when they entered the lab. After completing an electronic survey measuring demographic information, participants were instructed on how to play the NeoCITIES simulation. Participants practiced individually for five minutes to understand the basic elements involved in the simulation. They then practiced for five more minutes with other team members on a more complex, interdependent scenario. After reviewing how they performed on the training scenarios and the correct solutions to those events, they played two performance simulation rounds lasting for 15 minutes each. After each round, teams were given feedback on how well they performed together as a team and completed an online survey, including perceived temporal TMM and actual temporal TMM components. The storytelling, individual reflectivity, and team reflexivity manipulations occurred following the first performance round in the order listed. Experimental sessions lasted about two and a half hours.

Measures

Perceived temporal TMM similarity was collected through responses to six survey items after the second performance round. Items were patterned after Gevers et al. (2006) and adapted to the NeoCITIES simulation. A sample item included "In our team, we had the same opinion about when to arrive at certain events". Cronbach's alpha for this scale was .90. The intraclass correlation coefficients were ICC(1) = .23 and ICC(2) = .47. The median and mean $r_{wg(j)}$s were .96 and .90, respectively, indicating very strong agreement among team members (LeBreton & Senter, 2008). Together, these coefficients justified aggregating individual responses of perceived TMM similarity to the team-level.

Actual temporal TMM similarity was measured at the end of the second performance round through concept mapping, a popular TMM measurement tool (Marks, Zaccaro & Mathieu, 2000). Participants individually filled in three boxes (one for each role: fire, police, HazMat) indicating the sequence of the units for a given event, meaning which role should respond first, second, then third. For each dyad, one point was awarded for each shared link, and the number of shared links across the three dyads was summed to yield a team score. Higher scores indicated more shared responses (Mohammed et al., 2015).

Team performance was measured objectively via the NeoCITIES simulation at the end of the second round. Because temporality was of particular interest to this study, timeliness in completing interdependent tasks was used as the performance measure. The NeoCITIES simulation calculated the average duration (in seconds) it took teams to respond to events. For ease of interpretation, the average duration was inverted (D'Innocenzo, Mathieu, & Kukenberger, 2016; Kellermanns, Walter, Lechner & Floyd, 2005) so that shorter average duration represents higher timeliness. Because NeoCITIES is an emergency crisis management simulation valuing speed, higher timeliness corresponds to better team performance.

Controls. Several variables that are potentially related to TMMs and performance were controlled for in this study. Manipulations of individual reflexivity, group reflexivity, and storytelling were included as controls. As cognitive ability is positively predictive of team performance (Bell, 2007), mean team GPA was included as a control variable. The percentage of females on the team was also a control variable, since gender composition has been found to affect performance (Baugh & Graen, 1997). Previous experience has also been found to be a positive predictor of TMMs (Rentsch & Klimoski, 2001), so virtual experience (self-reported experience in a virtual environment) was controlled for. To consider the possible performance advantage that may result from previous exposure to emergency situations (e.g., prior EMT training), knowledge of emergency response protocols was also controlled for.

RESULTS

Data Analysis

Hierarchical regression was used to test the hypotheses at the team-level. Control variables were entered in Step 1. In Step 2, actual temporal TMM similarity was entered. Step 3 added the perceived temporal TMM similarity measure. The interaction between the actual temporal TMM similarity and perceived temporal TMM similarity was entered in Step 4.

Descriptive Statistics

Table 1 indicates that actual TMM similarity is not related to perceived TMM similarity, demonstrating the distinctiveness of the constructs. As predicted, actual temporal TMM similarity was positively related to timeliness (performance) ($r = .19$, $p < .01$).

TABLE 1
DESCRIPTIVE STATISTICS AND CORRELATIONS

	M(SD)	1	2	3	4	5	6	7	8	9
1. Group reflexivity condition [a]	.34(.95)	-								
2. Individual reflexivity condition [a]	.32(.95)	-.51**	-							
3. Storytelling condition [a]	-.05(1.00)	.04	.01	-						
4. Team percent of females [b]	0.58(.32)	.13	-.03	.18*	-					
5. Mean team GPA	3.23(.28)	-.03	.03	-.12	.14	-				
6. Experience in virtual environment	1.89(.56)	.18*	.01	-.08	-.16*	.06	-			
7. Knowledge of emergency response protocols	1.66(.46)	.01	.01	.05	-.11	-.14	.11	-		
8. Actual temporal TMM similarity	.90(.32)	.18*	-.14	-.01	-.03	.01	.06	.02	-	
9. Perceived temporal similarity	3.78(.46)	.12	-.08	-.03	-.07	.10	.08	-.01	.01	-
10. Performance	-57.55(11.94)	-.05	.10	.13	.15*	.02	.06	.04	.19**	-.36**

Note. N = 182 teams.
[a] Contrast coded variable: control = -1; Group reflexivity/individual reflexivity/storytelling = 1
[b] Team gender composition of team, percent of females ranging from 0 (all males) to 1.00 (all females)
[*] $p < .05$, two-tailed; [**] $p < .01$, two-tailed

Tests of Hypotheses

Hypothesis 1 predicted that actual temporal TMM similarity would have a positive effect on performance. As seen in Table 2, actual similarity significantly related to increased timeliness (β = .22, $p < .01$). Actual temporal TMM similarity explained a significant 5% unique additional variance in the timeliness beyond controls and perceived similarity ($\Delta R^2 = 0.05$, $p < .01$). Therefore, Hypothesis 1 was supported.

Hypothesis 2 predicted that perceived temporal TMM similarity would moderate the relationship between actual temporal TMM similarity and performance such that the relationship would be more positive when perceived similarity is higher. Perceived temporal TMM similarity significantly moderated the effect of actual similarity on timeliness (performance) (β = .16, $p < .05$). The interaction explained an additional 2% unique variance in performance beyond controls and main effects ($\Delta R^2 = 0.02$, $p < .05$).

TABLE 2
HIERARCHICAL REGRESSION ANALYSES TESTING THE EFFECT OF ACTUAL AND PERCEIVED TEMPORAL TMM SIMILARITY ON PERFORMANCE

	Step 1			Step 2			Step 3			Step 4		
F		1.47			2.47**			5.23**			5.31**	
R^2		.06			.10**			.22**			.24**	
ΔR^2		.06			.05**			.11**			.02**	
Variable	*b*	*SE*	*β*	*b*	*SE*	*β*	*b*	*SE*	*β*	*b*	*SE*	*β*
Step 1: Controls												
Individual Reflexivity Condition	.87	1.09	.07	1.06	1.06	.08	.97	1.00	.08	1.10	.99	.09
Group Reflexivity Condition	-.82	1.13	-.07	-1.22	1.11	-.10	-.68	1.05	-.05	-.46	1.04	-.04
Storytelling Condition	1.23	.91	.10	1.24	.89	.10	1.24	.83	.10	1.41	.83	.12
Gender Composition	6.19	2.93	.17*	6.65	2.87	.18*	5.34	2.70	.14*	5.23	2.67	.14
Experience in a virtual environment	2.14	1.65	.10	2.02	1.61	.10	2.30	1.51	.11	2.86	1.52	.13
Mean team GPA	-1.68	3.21	-.04	-1.80	3.14	-.04	-.17	2.96	-.01	-.10	2.93	-.01
Knowledge of emergency response	.82	1.95	.03	.77	1.91	.03	.72	1.78	.03	.86	1.77	.03
Step 2: Actual Similarity												
Actual Temporal TMM Similarity				8.20	2.73	.22**	7.96	2.56	.21**	7.46	2.55	.20**
Step 3: Perceived Similarity												
Perceived Temporal TMM Similarity							-8.93	1.80	-.34**	-9.93	1.84	-.38**
Step 4: Interaction												
Actual x Perceived Similarity										13.61	6.14	.16*

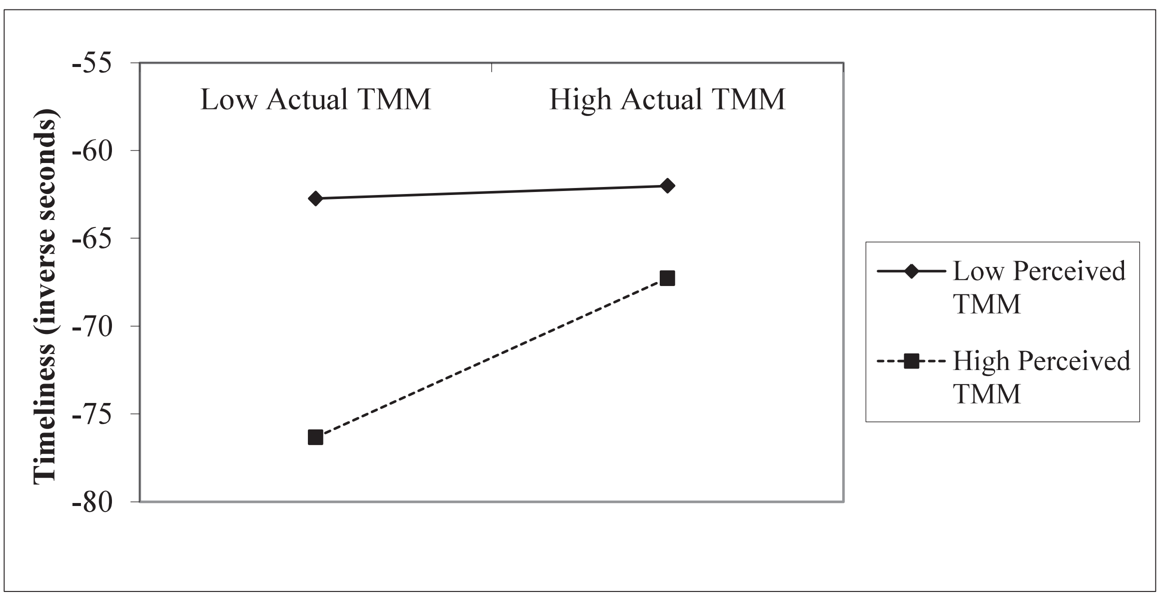
Note. $N = 182$ teams.
*$p < .05$; **$p < .01$

Exploring this interaction using simple slope analysis showed that actual temporal TMM similarity was a significant predictor of timeliness for teams with high perceived temporal TMM similarity (t = 3.28, p = .001), as expected (Aiken, West & Reno, 1991). Although teams with high actual similarity and high perceived similarity were slightly less timely than those with low perceived similarity (t = -2.40, p < .05), teams with low actual similarity and high perceived similarity were much less timely than those with low perceived similarity (t = -4.79, p < .001). However, actual similarity was a weaker and no longer a significant predictor of timeliness for teams with low perceived similarity (t = -0.90, p > .05), as shown in Figure 1. As the actual similarity and performance relationship was more positive when perceived similarity was higher, this pattern lends support to Hypothesis 2.

DISCUSSION

Overall, there were several notable findings. First, as expected, actual temporal TMM similarity was positively related to timeliness of task completion. Second, teams with a mismatch between actual and perceived similarity experienced lower performance (timeliness), even lower than those who had both low actual and low perceived similarity. When actual temporal TMM similarity was lower, higher perceived temporal TMM similarity was associated with lower performance. In other words, when teams thought that they were in sync, but actually were not, timeliness was lower. This mismatch between perceived and actual temporal TMM similarity when actual similarity was low was particularly disadvantageous. When teams are not in sync but members think they are, teams perform worse.

FIGURE 1
THE INTERACTIVE EFFECTS OF ACTUAL AND PERCEIVED TEMPORAL TMM SIMILARITY ON PERFORMANCE



Note. High perceived temporal TMM slope is significant (t = 3.28, p = .001) while low perceived temporal TMM slope is insignificant (t = -.90, p > .05).

Although it would seem that teams that were not in sync and knew that they were not should have lowest performance (timeliness), mismatches were even more detrimental. Clarkson and colleagues (2010) reported similar harmful outcomes regarding mismatched actual versus perceived depletion. Individuals who were given feedback stating they should be less depleted (perceived) while actually in a high depletion condition (actual), or actually had low levels of depletion but were told they should be having high levels, were less persistent in the task, made more errors and had a longer response time than individuals who were told they should be depleted and were also actually depleted.

Implications

The impact of perceived similarity has been debated in the TMM literature (Klimoski & Mohammed, 1994, Rentsch et al., 2009), but has not received much emphasis to date (Mohammed et al., 2010). Addressing this void by measuring perceived and actual TMM similarity simultaneously, the current study found that actual temporal TMM similarity was not significantly related to perceived similarity, illustrating their independence. Indeed, including both the perceived and actual temporal TMM similarity in the model accounted for additional variance in predicting performance over just one or the other. Some teams' perceptions and actual temporal TMM similarity were in sync whereas others' were not. As inferred by Rentsch and colleagues (2009), there were teams who had high actual similarity but low perceptions of similarity. Further, there were teams who reported high similarity, though actual temporal TMM similarity was low. Therefore, perceived sharedness is an important factor to consider in TMM similarity beyond actual sharedness. The empirical contribution of measuring both the actual and perceived similarity at once allowed for an examination of mismatched teams. The results of this study corroborated the notion that when teams are not in sync, harmful outcomes on performance result. Teams were less timely when they had low actual similarity, but high perceived levels.

This study expands the literature on temporal TMMs by comparing the impact of actual and perceived temporal similarity on performance. Although shown to contribute unique variance above and beyond taskwork or teamwork TMMs (Mohammed et al., 2015), temporal TMMs have been less commonly studied than the more traditional content types (Mohammed et al., 2015). Perceived temporal similarity accounted for unique variance beyond actual temporal TMM similarity, and the interaction between the two accounted for unique variance over main effects. Study results revealed the importance of having synchrony between actual and perceived temporal TMM similarity.

As a practical implication, managers and team members should be aware that perceptions of temporal TMM similarity do matter. It may be beneficial for managers to provide feedback to teams regarding actual similarity to correct for imprecise perceptions. In addition to being made aware of whether the team is on the same page, training to achieve a high level of sharedness on temporal pacing may be of use.

Limitations and Future Directions

Because they are less studied but have been shown to have valuable implications for important team outcomes, examining temporal TMMs was a study strength. However, results may not be generalizable to other types of TMM content. Future research should compare actual versus perceived TMM similarity for taskwork and teamwork content. Similarly, because the performance outcome in this study was timeliness, alternative forms of performance such as quality or quantity should be investigated.

A high degree of task interdependence, dynamic events, decision making and immediate feedback through the NeoCITIES simulation made it an excellent tool to study temporal TMM similarity. However, teams only worked together for about two and a half hours; therefore results may be more applicable to newly formed teams. Future research should examine the differences between perceived and actual TMMs in long-term teams. The NeoCITIES simulation also had teams communicate via instant chat message. Exploring how performance outcomes are impacted when teams interact face to face or experience delays in communication, such as due to time zone differences, is another direction for future studies.

As the content of the concept maps was based specifically on the NeoCITIES simulation (ordering the units to respond to particular events), we collected actual TMM measures following the performance rounds, as has been done in previous studies (Ellis, 2006; Mohammed & Ringseis, 2001). If we had collected the concept maps prior to performance, participants would not have been able to complete them due to unfamiliarity with the content (Ellis, 2006). Therefore, it is important to note that the study design does not allow causality to be claimed between TMMs and team performance.

Because temporal TMM similarity was shown to positively predict performance, examining how team members can get on the same page regarding time through training would be a beneficial future research direction. Training teams to communicate explicitly regarding pacing, sequencing, and deadline interpretation may be an effective method for improving temporal TMM similarity, as temporality may be assumed more than directly discussed in teams (Mohammed et al., 2015).

CONCLUSION

There has been a specific call to understand "how are team processes and outcomes affected when team members think that they are on the same temporal page, but actually are not, versus when team members are actually on the same temporal page, but think they are not?" (Mohammed et al., 2015, p. 706). The short answer provided by these study findings is "negatively." That is, when teams thought they were temporally in sync but were actually not, performance declined. Given the importance of both perceived and actual temporal TMM similarity, teams should work towards increasing perceptions of sharedness as well as actually having similarity.

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