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Sharing time and goals in dyads: how shared tenure and goal interdependence influence perceived shared mental models

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Abstract

Purpose – An underlying assumption in the shared mental model (SMM) literature is that SMMs improve whilst team members work together for longer. However, whether dyad members indeed have higher perceived SMMs with higher shared tenure has not been explored. This study aims to, therefore, firstly, investigate this idea, and we do so by focusing on perceived SMMs at the dyadic level. Secondly, because in today's fast-paced world perceived SMMs often need to be built quickly for dyads to perform, we assess if goal interdependence can reduce the dyadic tenure required for higher perceived SMM similarity. Thirdly, we analyse if these processes are related to dyadic performance.

Design/methodology/approach – We collected a dual-source sample of 88 leader–member dyads across various industries. We conducted PROCESS analyses to test their first-stage moderated mediation model.

Findings – Results showed that dyadic tenure was positively related to perceived SMM similarity, and that goal interdependence moderated this relationship. Additionally, perceived SMM similarity mediated the relationship between dyadic tenure and dyadic performance. Lastly, the overall moderated mediation model was supported.

Originality/value – We contribute to the perceived SMM literature by: investigating perceived SMMs in dyads, testing a key idea regarding the influence of dyadic tenure on perceived SMMs and investigating how goal interdependence may prompt perceived SMM similarity earlier in dyadic tenure and, ultimately, improve dyadic performance.

Keywords Perceived shared mental models, Tenure, Goal interdependence, Dyads, Teams, Shared mental models

Paper type Research paper

Introduction

When two team members start working together, they need to develop a working relationship and, therefore, they need to build a good understanding about, for example, how



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to execute their work and how to interact with one another. In other words, within a dyad, a shared mental model (SMM) – i.e. the “shared, organized understanding and mental representation of knowledge about key elements of the team’s relevant environment” (Mohammed and Dumville, 2001, p. 90) – needs to arise. Importantly, without a mutual awareness that the mental model of each individual in a dyad is similar to that of the other – i.e. perceived SMM similarity – team members may not reliably act on and hence benefit therefrom (Burtcher and Oostlander, 2019; Marhefka *et al.*, 2020; Müller and Antoni, 2020, 2022; van Rensburg *et al.*, 2022).

Considerable team-level research on (perceived) SMMs has shown that SMMs increase team communication (Mathieu *et al.*, 2000), coordination (Müller and Antoni, 2020), creativity (Santos *et al.*, 2015), adaptation and performance (Uitdewilligen *et al.*, 2018) and reduce team conflict (Santos and Passos, 2013). However, only one study was explicitly conducted at the dyadic level (Cassidy and Stanley, 2019), but this study did not focus on *perceived* SMMs. We argue this lack of dyadic perceived SMMs studies is an important oversight, as the most basic and fundamental way in which a mental model can first be shared is within the relationship of two team members (Klimoski and Mohammed, 1994). This is notable, as the team-level focus of much of past research risks obscuring relational richness by neglecting this crucial dyadic level of analysis (Mohammed *et al.*, 2021). Past studies on team cognition have typically glossed over dyads as the first instance of *sharedness* of cognition between individuals, opting instead for the aggregation of individuals into teams (DeChurch and Mesmer-Magnus, 2010a). While this is certainly useful and appropriate for numerous types of research, it does sacrifice a deeper understanding regarding the nuances that would firstly emerge in dyads before being carried over to the team (Mohammed *et al.*, 2021). In truth, teams represent more than aggregated representations from individual sources. Instead, teams can be viewed as collectives of individuals who are dyadically linked to one another with unique interpersonal relationships (Mohammed *et al.*, 2021; Park *et al.*, 2020). We therefore take a critical step in understanding these fundamental dyadic relationships by adopting a focus on perceived SMMs (van Rensburg *et al.*, 2022).

At present, how and when such perceived SMMs arise between two team members is largely unknown. Some insights can be extracted from a few past studies that have examined whether and how team members come to share mental models over time (Kneisel, 2020; Levesque *et al.*, 2001; Santos and Passos, 2013). Yet, although tenure has been mentioned as a factor that *could* influence SMMs (cf. Mohammed *et al.*, 2021), and while this notion is implicit in much SMM research, it has never been explicitly developed nor tested. From these sources within the (perceived) SMM literature, we argue that the longer two team members work together (i.e. have longer shared *dyadic tenure*), the higher their perceived SMM similarity is. Thanks to a new measure of perceived SMM (van Rensburg *et al.*, 2022), testing such ideas has recently become more feasible. Thus, we aim to put this core assumption underlying the SMM literature under empirical scrutiny.

If we argue that the perceived SMM similarity is higher among two team members with increasing dyadic tenure, a next question becomes whether this process can be accelerated. Today’s business world is becoming increasingly competitive and dynamic, and people have to collaborate, and achieve high levels of performance, in a short amount of time (Santistevan and Josserand, 2019). Additionally, they may need to work on a different project with different people, and again collaborate and perform in a short time, and so on. In such settings, getting high perceived SMM similarity quickly is very important. In other words, waiting for perceived SMM similarity to increase,

just by working longer together, is no longer an option in many contemporary settings. Hence, our question: what can be done to more rapidly increase perceived SMM similarity between two individuals?

While it may be possible to redesign work in a way that SMMs are required for effective task execution, it is a far simpler matter to reframe goals in such a way as to emphasise the existing interdependencies between members of a team. We therefore argue that an answer to this question can be found in a key notion underlying many literatures – such as work design (Raveendran *et al.*, 2020) and leadership (Fausing *et al.*, 2015) – namely that team members tend to share more information, collaborate more closely and generally trust each other more when their goals are common, shared and aligned (i.e. when they have high goal interdependence; Van der Vegt and Janssen, 2003). Therefore, we argue that perceived SMM similarity can be reached earlier in dyadic tenure by having high goal interdependence within the dyad, due to its motivational impact. We further expect that having higher SMM similarity should be beneficial for their dyadic performance.

Overall, we aim to contribute to scientific knowledge in three key ways. Firstly, by conducting a study on *perceived* SMM similarity at the *dyadic* level, we expand the limited knowledge on these topics in the SMM literature. Most prior research was on the team level and not on perceived SMMs, and this has obscured its constituent relational foundations and the relevance of perceptions in SMMs (Mohammed *et al.*, 2021). Secondly, we explore a core (yet often implicit) notion underlying much of the SMM literature, namely, that perceived SMM similarity increases the longer two team members work together. By exploring if this core idea has theoretical and empirical merit, we strive to provide more solid evidence-based management insights (cf. Rousseau and Barends, 2011) on which the field of perceived SMMs can build in the future. Thirdly, we contribute by assessing if, and how, the length of tenure needed to get to high perceived SMM similarity can be reduced. We do so by assessing the effects of goal interdependence, which also expands scholarly understanding about the role of work design for perceived SMMs. Our study also holds relevance for practitioners, as they can use this knowledge to increase and accelerate perceived SMM similarity in contemporary business settings. Figure 1 displays the conceptual model that we will elaborate on below.

Theory and hypothesis development

Dyadic tenure as an antecedent of perceived shared mental model similarity

SMMs are instrumental in enabling collaborative social groups, such as dyads, to work together effectively and ultimately achieve high performance (Cannon-Bowers *et al.*, 1993; Klimoski and Mohammed, 1994; Mohammed *et al.*, 2017, 2021). SMMs are emergent states and the product of complex collective processes (Marks *et al.*, 2001).

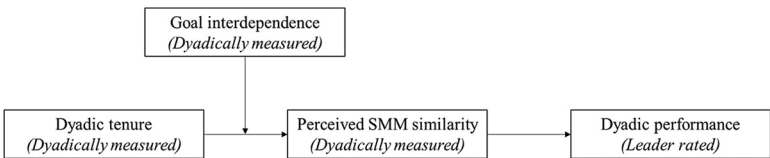


Figure 1.
Hypothesised model

Source: Figure by authors

They emerge as team members collaborate, and are shaped by the team members' collective behaviour, for instance, through learning (Van den Bossche *et al.*, 2011) or reflexivity (Abrantes *et al.*, 2022; Kneisel, 2020). More specifically, if the two members of a dyad have higher SMM similarity, they would be better able to predict each other's work behaviour and hence respond in a manner that better suits the task and dyad demands (Cannon-Bowers *et al.*, 1993). Consequently, having higher SMM similarity amongst team members is usually beneficial.

A caveat to this statement is that SMMs may exist without the awareness of the dyad members. Mental models are inherently individual constructs regarding work, and sharedness is usually implied via SMM structure in terms of the similarity between mental model representations, and their accuracy relative to specific tasks (DeChurch and Mesmer-Magnus, 2010a; Edwards *et al.*, 2006; Lim and Klein, 2006). However, such structural measures do not assess if the members are actually aware of their SMMs. Not being aware of SMMs prevents team members from drawing upon them, and this limits their ability to predict or understand each other's behaviour (Rentsch *et al.*, 2009). While research on perceived SMMs is sparse, some recent studies (Marhefka *et al.*, 2020; Müller and Antoni, 2020, 2022) have started to address the call for greater understanding of such perceptions of SMMs and how they influence team performance (Mohammed *et al.*, 2010, 2021). For example, Marhefka *et al.* (2020) conducted a study with virtual teams and found that perceived temporal mental model similarity positively predicts team viability but negatively predicts team performance. Other studies with virtual teams have shown that mental model perceptions of information and communication technology (ICT) are positively associated with team coordination and team performance (Müller and Antoni, 2020, 2022). Nevertheless, past studies that have looked into perceived SMMs have faced critical limitations by drawing on instruments that were over-simplified, as most studies only considered one type of perceived SMM (e.g. temporal SMMs, Marhefka *et al.*, 2020; ICT mental models, Müller and Antoni, 2022). We thus follow and expand recent development by investigating the scarcely studied perceived SMMs where they are likely to first emerge – i.e. in dyads.

We focus on the *antecedents* of perceived SMM, because in the wider research on SMMs, most attention has been paid to outcomes (Ellis, 2006; Mathieu *et al.*, 2000, 2010; Marks *et al.*, 2002; Santos *et al.*, 2015). Past studies have shown that factors such as team composition, team interventions and contextual factors contribute to SMMs (Resick *et al.*, 2010; Santos *et al.*, 2021), yet none has specifically studied tenure. The closest to studying tenure, were studies that analysed SMMs over time (Levesque *et al.*, 2001; Mathieu *et al.*, 2000; Santos and Passos, 2013), however, this has generally been observed at specified moments spanning a specific period under controlled conditions (e.g. short-lived teams' lifespans in management competitions; Santos and Passos, 2013; Uitdewilligen *et al.*, 2023). Additionally, in the few studies that (implicitly) investigated time or tenure related constructs (Levesque *et al.*, 2001; Mathieu *et al.*, 2000; Santos and Passos, 2013), scholars did not account for the time team members *shared* in working together. We argue it is important to focus on *dyadic* tenure, as it is during this *shared and overlapping* experience that team members have the opportunity to obtain and understand information relating to one another's understanding of their work and, in doing so, develop perceived SMMs. Expanding upon prior work that showed collective tenure is of particular relevance for motivational states (Gonzalez-Mulé *et al.*, 2020), we focus on the time dyadic partners have spent working with each other.

Specifically, we argue that by working together longer, dyad members have more opportunity to develop their shared cognition through information sharing and collective

learning (Grand *et al.*, 2016; Van den Bossche *et al.*, 2011). For example, with longer shared tenure, team members have more opportunities to listen to each other, share experiences to better understand their roles relative to one other another and exchange ideas and points of view. By engaging in such behaviours, the dyadic members can get higher perceived SMM similarity. We therefore hypothesise:

H1. Dyadic tenure positively relates to perceived SMM similarity.

The moderating role of goal interdependence

The extent of dyad members' perceived SMMs is not only a product of the processes described above, because the context in which the dyad works can influence the extent of these processes. A key context of collaborative structures in organisations, such as dyads, is that team members are dependent on each other to reach their goals to a greater or lesser degree (Van der Vegt *et al.*, 2010). Goal interdependence refers to the collaborative nature of dyads' shared goals in terms of the extent to which one member of a dyad's goals achievement is conditional to his or her dyad partner's goals being met as well (Tjosvold and Halco, 1992; Van der Vegt and Janssen, 2003). For instance, dyads working in highly competitive sales contexts may have lower goal interdependence, given the emphasis placed on individual performance and achievement, whereas surgical teams are likely to have higher goal interdependence, given the shared and aligned goal of assisting their patient. We therefore argue that when the dyad members have high goal interdependence they are more motivated, and able, to work together (Raveendran *et al.*, 2020; Van der Vegt and Janssen, 2003) because members are expected to share more interpersonal knowledge, seek solutions and compromises to problems and hence come to shared representations of knowledge more readily (cf. Kozlowski *et al.*, 1999; Uitdewilligen *et al.*, 2023; Van den Bossche *et al.*, 2006). Cronin and Weingart (2007) argue that shared goal representations and outcomes are essential for effective teamwork as goal interdependent members are more inclined to integrate their discrepant perspectives and knowledge. This can create a motivational state and underlying condition that enables and promotes high perceived SMM similarity (DeChurch and Mesmer-Magnus, 2010b; Mathieu *et al.*, 2000).

Goal interdependence could therefore enhance and facilitate the processes dyad members engage in that shape perceived SMM similarity, such as information sharing and mutual learning, so that they engage in these processes earlier in their shared tenure. Research has shown that when goals are seen as being more interrelated, members are more motivated to interact, experiment and collaborate (Park *et al.*, 2013; Van der Vegt and Janssen, 2003). Such behaviours should facilitate building higher perceived SMM similarity, because they provide insights into members' roles and thereby enhance knowing what facets of each other's work are relevant at what point. Higher perceived SMM similarity can thus be reached earlier in dyadic tenure, and the need for longer dyad tenure reduced, when dyads have more interdependent goals. We expect a moderation effect, in that high goal interdependence reduces the effect of dyadic tenure on perceived SMM similarity, as goal interdependence enables higher perceived SMM similarity, earlier in dyadic tenure (i.e. relative to instances of similar dyadic tenure, but where dyad partners have low goal interdependence). As such, we hypothesise that:

H2. Goal interdependence negatively moderates the positive relationship between dyadic tenure and perceived SMM similarity.

The influence of dyadic tenure and perceived shared mental model similarity on dyadic performance

Performance is a key outcome of past studies that focused on the dyadic level (Nahrgang *et al.*, 2009), as it represents team members' fundamental contribution to organisational success (Raveendran *et al.*, 2020). Past research has indicated that collective forms of tenure (Gonzalez-Mulé *et al.*, 2020), such as dyadic tenure, provide team members with experience and knowledge that they can use to improve their functioning over time. As they become more familiar with their tasks and demands, they are more able to respond to the challenges their work entails, which enables them to perform their duties better in an individual capacity (Kozlowski *et al.*, 1999). We expect that increased knowledge and expertise are also important for dyadic function and performance. As explained above, when team members build individual and task-related knowledge and then share that within their dyad, this leads to high perceived SMM similarity. Consequently, we argue that dyadic tenure can enable mechanisms that improve performance, but in their absence, dyadic tenure itself may not exert an influence on dyadic performance. To illustrate, simply working longer together – without actually engaging with each other, sharing knowledge and increasing dyadic functioning – does not provide any process or mechanism by which performance could be improved.

Past research has yielded inconsistent results when studying the effects of perceived SMM similarity on team performance – Santos *et al.* (2015) found no effect of perceived SMM similarity on performance, whereas Marhefka *et al.* (2020) found a negative relationship. We argue, however, that being aware of SMMs enables dyads to reap their benefits. We therefore draw from the wider SMM literature (Mathieu *et al.*, 2000; Mohammed *et al.*, 2010; Rentsch *et al.*, 2009), and argue that dyadic team members' perceived SMM holds a number of benefits to their potential performance. For example, enabling them to predict one another's behaviour or respond to mutual needs, which then enables them to act swiftly and with better coordination when performing their regular tasks or when confronted with novel and challenging situations (Cannon-Bowers *et al.*, 1993; Mohammed *et al.*, 2010). We therefore argue that while dyadic tenure is likely to influence dyadic performance due to increased knowledge and experience, this effect is indirect and takes place via perceived SMM similarity. We therefore hypothesise:

- H3. Perceived SMM similarity mediates the relationship between dyadic tenure and dyadic performance.

The moderated effect of goal interdependence on dyadic performance via perceived shared mental model similarity

From a goal interdependence perspective (Raveendran *et al.*, 2020), meaningful shared consequences and outcomes within a specific interpersonal context ultimately influences motivation and performance (Tjosvold and Halco, 1992). Goal interdependence is likely to create conditions where the shared goals motivate the dyadic team members to perceive, understand and complement each other's points of view (Raveendran *et al.*, 2020; Tjosvold and Halco, 1992). We therefore argue that under conditions of high goal interdependence, dyad members are likely to be more motivated to share knowledge and experiences and therefore get high perceived SMM similarity earlier in their shared tenure, whereas low goal interdependence will have the opposite effect and hamper perceived SMM similarity. Furthermore, we argue that, via the above, higher levels of goal interdependence will drive higher performance, whereas performance will be constrained under conditions of lower

goal interdependence. We therefore expect a moderated mediation effect in that high goal interdependence not only reduces the direct positive effect of dyadic tenure on perceived SMM similarity, but also the positive indirect effect thereof on performance via perceived SMMs. As such, we expect that dyadic performance is higher earlier in dyadic tenure (relative to instances of similar dyadic tenure, but where dyad partners have low goal interdependence). We therefore hypothesise:

- H4.* Goal interdependence acts as a negative first stage moderator in the indirect relationship of dyadic tenure on performance via perceived SMM similarity.

Methodology

Participants

We collected a data set of 88 leader–member dyads, with matched data from both respondents. Dyads reported a mean shared tenure of 2.59 years, ranging from one month to 10.5 years. The mean age of leaders was 38.26 years, 53.4% identified as female and predominantly hailed from The Netherlands (72.7%) and Spain (11.4%). Members' mean age was 32.16 years, 47.7% identified as female and also hailed predominantly from The Netherlands (73.9%) and Spain (9.1%). The sample was drawn from a range of industry sectors, mostly manufacturing (22.7%), health care and social assistance (15.9%) and retail (12.5%). The vast majority of dyads shared the same nationality (89.8%).

Procedure

We designed a dual-source dyadic-level study to test our hypotheses. To obtain the dyads, we invited one leader and one member (who reported directly to the leader) working together in the same team.

Measures

We adapted all measures to be suitable for use at the dyadic level, by implementing a referent shift to focus on the leader–member dyad. Scales for goal interdependence and perceived SMM similarity were computed by taking the item mean of the reported scores from the member and the leader (cf. [Arthur et al., 2007](#)). Dyadic performance was measured via the leader, as leaders are in a unique position to evaluate performance in their working units, given that performance evaluation and associated intervention typically form part of their responsibilities ([Janssen and Van Yperen, 2004](#)). It is for this reason that past research has frequently drawn on leader ratings of performance as a valid and reliable source of data ([Aube and Rousseau, 2005](#); [Nahrgang et al., 2009](#)). To determine the similarity of measures between leader and member, we calculated intraclass correlation coefficients (ICC) for perceived SMM similarity (ICC(1) = 0.557, ICC(2) = 0.715), goal interdependence (ICC(1) = 0.414, ICC(2) = 0.585) and dyadic tenure (ICC(1) = 0.994, ICC(2) = 0.997). In addition, we computed $r_{\text{wg}(i)}$ values for perceived SMM similarity (0.990) and goal interdependence (0.902). This supports use of the data at a “group” level as the ICC(2) values exceeded ICC(1), and the average $r_{\text{wg}(i)}$ values were above the required criteria (> 0.70 ; [Bliese, 2000](#); [James et al., 1993](#)).

Dyadic tenure Participants were asked to enter the number of years and months they had worked together with their dyadic counterparts within the same team. We then calculated the proportional years and used the mean scores between the leader and employee to measure dyadic tenure. Dyadic tenure ranged from 0.08 to 10.5 years.

Goal interdependence We used a three-item scale by [Van der Vegt and Janssen \(2003\)](#) to measure goal interdependence (e.g. “In this relationship, gain for either *Partner* or me means gain for the other”). A seven-point scale (1 = *completely disagree* to 7 = *completely agree*) was used ($\alpha = 0.87$).

Perceived shared mental model similarity We used a 20-item scale by [van Rensburg et al. \(2022\)](#) to measure perceived SMM similarity (e.g. “*Partner* and I have a similar understanding about how we should interact with each other”). A seven-point scale (1 = *strongly disagree* to 7 = *strongly agree*) was used ($\alpha = 0.94$).

Dyadic performance Leaders rated dyadic performance using the three-item scale by [Aube and Rousseau \(2005\)](#). An example item is: “*Partner* and I produce high quality work”. A seven-point scale (1 = *strongly disagree* to 7 = *strongly agree*) was used ($\alpha = 0.80$).

Controls We controlled for contextual aspects, namely, task interdependence ([Van der Vegt and Janssen, 2003](#); $\alpha = 0.65$), task complexity ([Maynard and Hakel, 1997](#); $\alpha = 0.83$) and dyadic intent to remain working within the dyad, as well as demographic aspects, namely, leader and member age, gender and qualification, respectively, as these variables can influence perceived SMMs and dyadic performance (cf. [Niler et al., 2021](#)).

Discriminant and convergent validity

We conducted a confirmatory factor analysis to determine the suitability of our measurement model. As this included a single item measure for dyadic tenure, we followed the procedures of [Richardson and Vandenberg \(2005\)](#) and set the factor loading of this measure to be the square root of a conservative estimated reliability of 0.70. Then, we set the error term to a value of one minus the estimated indicator reliability, multiplied by its variance. All other latent constructs were measured by their respective items. Our (unmodified) model fit ($\chi^2 = 493.448$, $df = 314$, $p < 0.001$, CFI = 0.906, TLI = 0.895, SRMR = 0.077, RMSEA = 0.081) fell slightly below values suggested by [Hu and Bentler \(1999\)](#). However, in light of caution against strict adherence to such rules of thumb that face their own limitations ([Marsh et al., 2004](#)) and the fact that our model’s fit statistics were close to those suggested by [Hu and Bentler \(1999\)](#), we deemed our model to show acceptable fit. In addition, we show that this model fit better to the data than three alternative measurement models ([Table 1](#)). Our measurement model is therefore considered appropriate [1].

Models	χ^2	df	χ^2/df	$\Delta\chi^2 (\Delta df)$	CFI	TLI	SRMR	RMSEA
4-factor model	493.448	314	1.571	–	0.906	0.895	0.077	0.081
3-factor model	641.057	317	2.022	147.609*** (3)	0.831	0.813	0.094	0.108
2-factor model	714.765	320	2.234	221.317*** (6)	0.794	0.774	0.092	0.119
1-factor model	780.811	321	2.432	297.363*** (7)	0.760	0.738	0.102	0.128

Notes: χ^2 = chi-square; df = degrees of freedom; CFI = comparative fit index; TLI = Tucker–Lewis index; SRMR = standardized root-mean square residual; RMSEA = root-mean square error of approximation; 4-factor model = hypothesised measurement model; 3-factor model = grouped goal interdependence with perceived SMM similarity; 2-factor model = grouped dyadically rated variables under one factor; 1-factor model = grouped all variables under one factor. All models are compared with the 4-factor model. *** $p < 0.001$

Source: Table by authors

Table 1.
Confirmatory factor
analyses

Analytical strategy

We conducted a moderated mediation analysis using Model 7 of Hayes' (2022) PROCESS macro (version 4.1) in SPSS (version 28) to test our hypothesised direct effects, moderation, statistical mediation and moderated mediation. Except for the outcome, all variables were standardised. We draw on 5,000 bootstrap samples using 95% confidence intervals to conduct these analyses (Hayes, 2022).

Results*Descriptive results*

The means, standard deviations and correlations of variables in the study are presented in Table 2. There were significant positive correlations between the main variables, such as dyadic tenure and perceived SMM similarity ($b = 0.406, p < 0.01$) and goal interdependence and perceived SMM similarity ($b = 0.455, p < 0.01$). Furthermore, there were some significant positive correlations between the main and control variables, such as goal interdependence and task interdependence ($b = 0.322, p < 0.01$), and dyadic tenure and partners' age ($b = 0.436, p < 0.01$).

Direct effect of dyadic tenure on perceived shared mental model similarity

We analysed if dyadic tenure positively related to perceived SMM similarity. Our results showed this was the case ($b = 0.595, p < 0.001, 95\% \text{CI} [0.388, 0.802]$; see Table 3). *H1* was supported.

Moderation effect of goal interdependence

We expected an interaction effect of goal interdependence on the relationships between dyadic tenure and perceived SMM similarity. As Table 3 shows, the main effect of goal interdependence on perceived SMM similarity was positive and significant ($b = 0.393, p < 0.001, 95\% \text{CI} [0.201, 0.586]$). Furthermore, the interaction effect between dyadic tenure and goal interdependence on perceived SMM similarity was significant and negative ($b = -0.308, p < 0.001, 95\% \text{CI} [-0.474, -0.142]$).

To further explore this interaction effect, we assessed simple slope effects at the $\pm 1\text{SD}$ values of goal interdependence (Aiken *et al.*, 1991). The slopes were significant at low ($b = 0.903, p < 0.001, 95\% \text{CI} [0.597, 1.209]$) and high ($b = 0.287, p < 0.05, 95\% \text{CI} [0.070, 0.504]$) values of goal interdependence (see Table 4). As can be seen in Figure 2, these results indicate that with high goal interdependence perceived SMM similarity are higher earlier in dyadic tenure. *H2* was supported.

Mediating effect of perceived shared mental model similarity

We expected that perceived SMM similarity mediates the relationship between dyadic tenure and dyadic performance. The traditional approach of Baron and Kenny (1986) would suggest that mediation is only possible if the independent variable has a significant direct effect on the outcome variable; however, recent methodological advances (Hayes, 2022; Kenny and Judd, 2014) have shown that a significant direct effect is not a requirement for mediation. In our case, we note such an insignificant direct effect of dyadic tenure on performance (see Table 3). Nevertheless, our results (see Table 4) showed a positive indirect effect of dyadic tenure on performance via perceived SMM similarity ($b = 0.147, \text{bootstrapped } 95\% \text{CI} [0.059, 0.247], [2]$) and we therefore find evidence of statistical mediation from our analyses. *H3* was thus supported.

	<i>M</i>	<i>SD</i>	1	2	3	4	5	6	7	8	9	10	11	12
1 Leader age	38.261	10.496												
2 Member age	32.159	9.598	0.160											
3 Leader gender	1.534	0.502	-0.282**	0.013										
4 Member gender	1.477	0.502	-0.146	-0.135	0.163									
5 Leader qualification	4.296	1.063	0.123	0.116	-0.062	-0.289**								
6 Member qualification	3.841	1.231	-0.001	0.075	-0.177	-0.173	0.555**							
7 Intent to remain in the dyad	4.057	0.957	-0.082	0.215*	0.080	-0.093	0.164	-0.124						
8 Task complexity	4.693	0.986	-0.374**	-0.132	0.079	0.110	0.164	0.337**	0.082					
9 Task interdependence	5.690	0.552	-0.060	0.066	0.207	0.101	-0.095	-0.170	0.108	0.027				
10 Dyadic tenure	2.588	2.181	0.155	0.436**	0.003	-0.064	-0.077	-0.142	0.281**	-0.079	0.179			
11 Goal interdependence	5.271	0.919	-0.099	-0.146	-0.031	-0.080	-0.138	-0.002	0.031	0.266*	0.322**	0.080		
12 Perceived SNM similarity	5.677	0.593	0.088	0.030	-0.036	-0.150	0.067	0.111	0.055	0.084	0.144	0.406**	0.455**	
13 Dyadic performance	6.072	0.628	-0.163	0.128	0.047	-0.049	-0.090	-0.015	0.038	0.161	0.155	0.163	0.376**	0.368**

Notes: *N* = 88 leader-member dyads; **p* < 0.05; ***p* < 0.01; gender: participants could identify as (1) male, (2) female or (3) not disclose gender (no participant selected this third option); qualification: participants were asked to indicate their highest completed qualification ranging from (1) no formal qualifications to (6) doctoral degree

Source: Table by authors

Table 2.
Correlations, means
and standard
deviations

	Main model		Alternative A		Alternative B		Alternative C	
	<i>b</i>	<i>SE</i>	<i>b</i>	<i>SE</i>	<i>b</i>	<i>SE</i>	<i>b</i>	<i>SE</i>
<i>Step 1 outcome: perceived SMM similarity</i>								
Controls								
Task interdependence	−0.092	0.093	–	–	−0.106	0.091	–	–
Task complexity	−0.055	0.102	–	–	0.018	0.088	–	–
Intent to remain in the dyad	−0.039	0.093	–	–	−0.048	0.088	–	–
Leader age	0.037	0.096	0.062	0.088	–	–	–	–
Member age	−0.158	0.097	−0.166 [†]	0.095	–	–	–	–
Leader gender	0.112	0.092	0.092	0.089	–	–	–	–
Member gender	−0.060	0.091	−0.077	0.088	–	–	–	–
Leader qualification	0.106	0.110	0.077	0.103	–	–	–	–
Member qualification	0.155	0.113	0.163	0.102	–	–	–	–
Main effects								
Dyadic tenure (DT)	0.595***	0.104	0.569***	0.100	0.506***	0.095	0.470***	0.089
Moderation								
Goal interdependence (GI)	0.393***	0.097	0.348***	0.087	0.397***	0.093	0.371***	0.085
DT × GI	−0.308***	0.083	−0.296***	0.081	−0.278**	0.083	−0.266**	0.082
<i>Step 2 outcome: dyadic performance</i>								
Controls								
Task interdependence	0.047	0.067	–	–	0.063	0.065	–	–
Task complexity	0.089	0.076	–	–	0.083	0.065	–	–
Intent to remain in the dyad	−0.022	0.072	–	–	−0.005	0.067	–	–
Leader age	−0.104	0.074	−0.133 [†]	0.068	–	–	–	–
Member age	0.131	0.075	0.120	0.073	–	–	–	–
Leader gender	−0.014	0.069	−0.004	0.068	–	–	–	–
Member gender	−0.037	0.069	−0.021	0.067	–	–	–	–
Leader qualification	−0.070	0.083	−0.070	0.079	–	–	–	–
Member qualification	−0.048	0.087	−0.019	0.079	–	–	–	–
Dyadic tenure	−0.049	0.084	−0.045	0.081	0.014	0.074	0.010	0.069
Mediation								
Perceived SMM similarity	0.247**	0.074	0.261**	0.072	0.210**	0.070	0.227**	0.069
<i>R</i> ² Step 1	0.496		0.486		0.431		0.418	
<i>F</i> Step 1	6.151***		8.198***		10.214***		20.114***	
<i>R</i> ² Step 2	0.232		0.212		0.163		0.136	
<i>F</i> Step 2	2.086*		2.658*		3.197**		6.670**	

Table 3.
Results for
moderated mediation

Notes: *N* = 88 leader–member dyads; [†]*p* < 0.10; **p* < 0.05; ***p* < 0.01; ****p* < 0.001; *Alternative A*: hypothesised model with only demographic controls; *Alternative B*: hypothesised model with only contextual controls; *Alternative C*: hypothesised model with no controls
Source: Table by authors

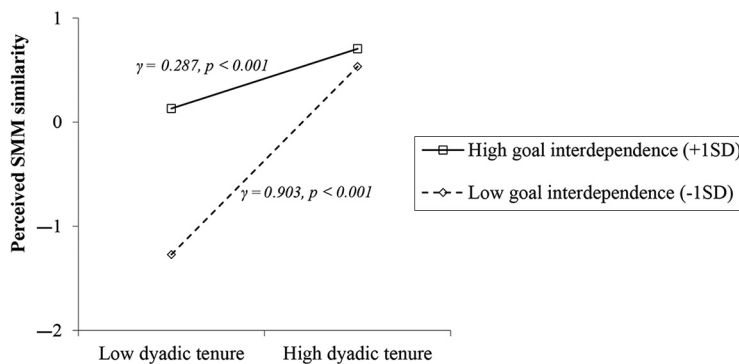
Moderated mediation

As Table 4 also illustrates, the index of moderated mediation for the model was significant (index = −0.076, bootstrapped 95%CI [−0.150, −0.027]), supporting *H4*. [3] Overall, we conclude that our theorising is supported by our analyses. Furthermore, as the last three columns of Table 3 illustrate, this was supported by three alternative models that showed our results remain robust regardless of the inclusion of only demographic controls (age, gender, highest qualification; Alternative A); inclusion of only contextual controls (task interdependence, task complexity, intent to remain in the dyad; Alternative B); or exclusion of all controls (Alternative C).

	<i>b</i>	<i>SE</i>	LLCI	ULCI	Perceived shared mental models
<i>Step 1: Moderation</i>					
<i>Dyadic tenure × goal interdependence → perceived SMM similarity</i>					
Low	0.903***	0.154	0.597	1.209	213
Moderate	0.595***	0.104	0.388	0.802	
High	0.287*	0.109	0.070	0.504	
	<i>Effect</i>	<i>BootSE</i>	<i>BootLLCI</i>	<i>BootULCI</i>	
<i>Step 2: Conditional indirect effect</i>					
<i>Dyadic tenure × goal interdependence → perceived SMM similarity → dyadic performance</i>					
Low	0.223	0.073	0.093	0.380	Table 4.
Moderate	0.147	0.048	0.059	0.247	
High	0.071	0.037	0.002	0.145	
	<i>Index</i>	<i>BootSE</i>	<i>BootLLCI</i>	<i>BootULCI</i>	
Index of moderated mediation	-0.076	0.031	-0.150	-0.027	Results for conditional indirect effects

Notes: *N* = 88 leader–member dyads, **p* < 0.05; ****p* < 0.001

Source: Table by authors



Source: Figure by authors

Figure 2. Interaction effect between dyadic tenure and goal interdependence on perceived SMM similarity

Discussion

Our study shows that when dyad members work together for longer, their perceived SMM similarity is higher, which also improves dyadic performance. Moreover, as theorised, we found that goal interdependence can reduce the need for longer shared tenure between a dyad leader and member, such that higher levels of perceived SMM similarity are achieved in less time working together.

Theoretical implications

This study makes various key theoretical contributions to SMM research specifically (Mesmer-Magnus *et al.*, 2017), and team cognition research more generally (Grand *et al.*, 2016; Niler *et al.*, 2021). Firstly, we respond to the call of Mohammed *et al.* (2021) to shift

focus in SMM research to include the core interpersonal units underpinning perceived SMM similarity (i.e. dyads) that has been neglected in past research. Mental models in their simplest form are contained in the minds of individuals (Johnson-Laird, 1983). Any *shared* mental model will by necessity emerge between a *pair* of individuals (i.e. the dyad). Dyads have been noted as an important grouping by Klimoski and Mohammed (1994) but are still not being widely represented in SMM research nearly three decades later (Mohammed *et al.*, 2021). In this paper, we therefore contribute to the scarce research on perceived SMMs in this core interpersonal building block of any team. In particular, we analyse a key dyadic pairing (i.e. the leader–member dyad) that occurs in most contemporary teams (Beenen *et al.*, 2022; Toader and Martin, 2023) and show that perceived SMM similarity is important to foster dyadic performance. The relevance of our study is not limited to the specific field of SMMs, but also has bearing on the broader field of team cognition. With dyads becoming increasingly important in the broader team cognition literature, given their critical relevance as *the* starting point for emerging shared cognition (cf. Toader and Martin, 2023), we contribute to the broader understanding of dyads' shared tenure in shaping the emergence of team cognition and suggest that, as with perceived SMMs, other types of team cognition (e.g. transactive memory systems or team situation awareness; Guastello *et al.*, 2022; Smith-Jentsch *et al.*, 2009) could be similarly influenced by *shared* tenure as well as job design features like goal interdependence.

Connected to this, we provide additional insight into the relevance of *perceived* SMM similarity. Past research has been predominantly focused on SMM structure, and relatively few studies looked at perceptions of SMMs to date (Marhefka *et al.*, 2020; Müller and Antoni, 2022). As we show, however, perceived SMM similarity is an important field of study as these perceptions are also relevant to dyads' functioning. Specifically, we highlight the importance of being aware of a SMM's existence so that dyad partners are able to act thereon and use it to predict one another's behaviour, and in doing so, foster dyadic performance. While team cognition has typically organised under structured and perceptual cognition (Mesmer-Magnus *et al.*, 2017), strictly dividing cognition along these lines may limit our understanding of constructs like SMM and, in reality, structural and perceptual elements of cognition could be more intertwined. As such, future research can delve deeper into such representations of cognition by examining both structured and perceptual elements thereof (cf. Marhefka *et al.*, 2020; Müller and Antoni, 2022).

Secondly, we contribute to the field of collective tenure by theorising and demonstrating that shared cognition is a mediating mechanism on the relationship between collective forms of tenure and performance (Gonzalez-Mulé *et al.*, 2020; Subramony and Chadwick, 2021). The meta-analysis of Gonzalez-Mulé *et al.* (2020) indicated the relevance of different forms of collective tenure for performance via shared cognition, yet as Subramony and Chadwick (2021) show, more research is needed to unravel the effects of different types of collective tenure. We specifically contribute to this discussion by investigating the *shared* tenure between dyad partners. In doing so, we highlight, and find support for, a key (implicit) assumption underlying the SMM and team cognition literature (DeChurch and Mesmer-Magnus, 2010b) by illustrating that perceived SMMs are contingent not only on one's task experience but also on the *shared* experiences between individuals. We further contribute to these fields by demonstrating the relevance of job design and motivational factors that contribute to this relationship.

Thirdly, we contribute to a greater understanding of the intersection of the goal interdependence (Park *et al.*, 2013; Van der Vegt and Janssen, 2003) and the team cognition literature (DeChurch and Mesmer-Magnus, 2010b; Mathieu *et al.*, 2000). Researchers have argued that more work is required to fully understand how team cognition is shaped by

interdependencies in teams' work (Mesmer-Magnus *et al.*, 2017). We specifically demonstrate the relevance of goal interdependence (Raveendran *et al.*, 2020) as a motivational factor in shaping perceived SMM similarity. While we did not investigate task interdependence as a main variable in our model, we did include this as a control and note the insignificant direct effect on perceived SMM similarity compared to goal interdependence, thus extending from past SMM work that grouped goal and task interdependence as one variable (cf. Van den Bossche *et al.*, 2006). Task interdependence was not only insignificant in our main analysis; we also erred on the side of caution and tested task (instead of goal) interdependence as a moderator, finding further insignificant effects and thus supporting our theorising. Past SMM research has focused more on working structures, instead of working contexts, and hence emphasised the role of tasks over other aspects of job design (DeChurch and Mesmer-Magnus, 2010b). This past focus on structures is understandable, given the dominant orientation towards studying SMMs in terms of task execution and performance (Lim and Klein, 2006). However, this focus did mean that other contextual features (e.g. shared experience beyond short-lived interactions; Santos and Passos, 2013; Uitdewilligen *et al.*, 2023) are less understood in this literature. Our study thus contributes to the SMM field, by showing that goal interdependence can motivate two individuals to come to a shared perception on important features of their work. More broadly, our study illustrates the importance of context when studying perceived SMMs and their consequences. This further contributes to the team cognition literature and augments past findings on different forms of shared cognition, such as transactive memory systems (Aggarwal and Woolley, 2019) or information processing (Nijstad and De Dreu, 2012), that showed in different applications of interdependence as a mechanism by which shared cognition can be better motivated and leveraged.

Strengths, limitations and future research

One strength of our research is that we focused on dyads and could thus explore these often overlooked interpersonal building blocks of teams and their effect on perceived SMMs (Klimoski and Mohammed, 1994; Mohammed *et al.*, 2021). As teams are constructed from several sets of dyads, perceived SMMs are likely built up from multiple unique dyadic perceptions rather than a singular shared (team) perception from content being shared between individuals (Kozlowski and Bell, 2013). Building upon this, future research can investigate triads or networks (cf. King and Sweet, 2021) within teams or conduct cross-level analyses to see how higher levels of analysis, such as the department or organizational level, emerge from lower levels (Kozlowski *et al.*, 1999). In this sense, future research can expand on current work regarding collective tenure (cf. Gonzalez-Mulé *et al.*, 2020; Subramony and Chadwick, 2021) by considering the roles of different dyad pairings and whether some members' shared experience makes a greater contribution than others'. Researchers may even want to explore beyond the organisational level, to focus on the effects of different country-level cultures or industries. In this research, we focused on the dyadic level, yet we hope that others can expand on these foundations to develop such follow-up studies.

Another strength was that we focused on *perceived SMM similarity*, as this has not often been studied in past SMM research (van Rensburg *et al.*, 2022). However, this is also a limitation, as it makes it more difficult to connect to most other research that has focused mostly on SMM structure (DeChurch and Mesmer-Magnus, 2010b; Mesmer-Magnus *et al.*, 2017). While some studies are starting to do so (Müller and Antoni, 2022), future research can do more to compare SMM structure concepts (such as similarity and accuracy; Mohammed *et al.*, 2010) with perceptions. It should be noted that capturing SMM structure is challenging and time-consuming, given that this would typically require extensive task

analyses (DeChurch and Mesmer-Magnus, 2010a; van Rensburg *et al.*, 2022). As such, future research on combining SMM structure and perceptions can benefit from focusing on more structured settings, such as student samples, as field study settings might be too complex and cumbersome at this early stage of this research area.

Lastly, although we used previously published and established scales, our study also contains two minor measurement limitations. Firstly, we studied a temporal construct (i.e. dyadic tenure) cross-sectionally. As tenure is a relatively straightforward construct, which is often assessed in the way we do (Smith-Jentsch *et al.*, 2009), we contend that this is valid at this early stage of knowledge development in this area. Especially, as we expand what most prior studies have done in this regard, as we draw on the perspectives of both leaders and members, aggregated to the dyadic level and then used dyadic (dyadic tenure, perceived SMM similarity, goal interdependence) and individual leader (dyadic performance) data. Hence, our use of two sources is an improvement on many prior studies (Buvik and Tvedt, 2016). While causality cannot be inferred from our cross-sectional data, statistical mediation analyses similar to our have been conducted using such research designs and data sets in other research (cf. Buvik and Tvedt, 2016; Schreuder *et al.*, 2020). Future research can therefore analyse dyads over long periods to determine how changing tenure influences perceived SMM similarity. Secondly, we made use of a perceptual measure of performance (i.e. leader-rated dyadic performance). While future studies may attempt to obtain objective data on dyadic performance, past research has shown that leader-rated measures of performance are valid (cf. Aube and Rousseau, 2005; Nahrgang *et al.*, 2009). Overall our paper adopts a novel lens in addressing an important assumption in SMM literature. In doing so, we make contributions not only to the specific field of SMM research, but also to the broader theory on team cognition.

Practical implications

This study makes important practical contributions. Firstly, we show that practitioners and managers can benefit from designing work in a way that emphasises mutual goals and success so that dyads can become aware of their SMMs sooner. Higher goal interdependence between leaders and members can foster trust and interest in each other's work, and in doing so, secure more regular interaction regarding their work (Van der Vegt and Janssen, 2003), which is fundamental to SMM development.

Secondly, given that we found a link between perceived SMM similarity and dyadic performance, practitioners might want to facilitate the development of perceived SMMs. This can, for example, be done via cross-training (Marks *et al.*, 2002) as this would improve mutual understanding between both team members, via a concept mapping intervention (Santos *et al.*, 2021), as this would allow the dyadic partners to share and integrate important information, or via reflexivity, drawing on shared reflection on successes and failures to integrate information from feedback processes (Abrantes *et al.*, 2022; Gabelica *et al.*, 2014). This would serve not only to develop SMMs but also raise individuals' awareness of their SMMs, thus enabling them to draw on their SMMs to predict one another's behaviour and function better together.

Conclusion

We set out to understand how dyadic tenure could influence perceived SMM similarity, and subsequently dyadic performance, under different levels of goal interdependence. Our results support our theorising by demonstrating that perceived SMM similarity gets higher with increased tenure and by showing that higher goal interdependence enables higher perceived SMM similarity, earlier in dyadic tenure. We also demonstrated that this affects

dyadic performance. By studying perceived SMM similarity at the dyadic level, we open the avenue for theoretical and empirical work on the nuances underlying a construct, which has so far been predominantly studied at the team level. Overall, our study makes novel and important theoretical contributions to the SMM literature, which we hope can help practitioners and scholars alike to better understand perceived SMMs, especially in dyads.

Notes

1. To control for common method variance, we conducted a Harman's single-factor test as well as an unobserved latent variable test (Podsakoff *et al.*, 2003). Harman's test showed that one factor did not account for the majority of variance in our model. The unobserved latent variable test showed that including the unobserved variable to the four-factor main measurement model had little impact on our results and only minor changes were observed in model fit, factor loadings, standardised regression weights and squared multiple correlations when compared to our main model (Johnson *et al.*, 2011). Common method bias was therefore unlikely to be a concern in this study.
2. Simple mediation analysis using Hayes' (2022) PROCESS macro Model 4 showed a similar indirect effect ($b = 0.125$, bootstrapped 95%CI [0.048, 0.234]), supporting this finding.
3. Simple moderation analysis using Hayes' (2022) PROCESS macro Model 1 showed an insignificant overall model coefficient ($p = 0.088$), an insignificant direct effect of dyadic tenure on performance ($b = 0.056$, $p = 0.489$) and an insignificant interaction effect of goal interdependence and dyadic tenure on performance ($b = -0.001$, $p = 0.983$), further supporting our hypotheses. In addition, moderated mediation analysis using Hayes' (2022) PROCESS macro Model 7 with task interdependence as moderator instead of goal interdependence showed an insignificant effect on perceived SMM similarity ($b = -0.049$, $p = 0.624$), an insignificant interaction with dyadic tenure ($b = -0.128$, $p = 0.253$) and an insignificant index of moderated mediation (index = -0.024 , bootstrapped 95%CI [-0.076, 0.026]).

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