The Dynamic Impacts of Shared Leadership and the Transactive Memory System on Team Performance: A Longitudinal Study

Abstract

This research examines how shared leadership affects team performance over time. We argue that shared leadership, conceptualized and measured as team members' network density of mutual leadership and influence, affects team performance because it enhances the team's transactive memory system (TMS) – a system of distribution and retrieval of team members' specialized knowledge. Based on a seven-wave longitudinal study, we developed a dynamic model to capture the mediation effect of TMS and the temporal effect of shared leadership and TMS on future team performance. With observations on the full life cycle of the teams participating in the project, we found that shared leadership had a positive effect on team performance and that TMS mediated this positive relationship. In addition, we found that the effect of shared leadership on team performance was stronger during the early stages of the team life cycle, and again TMS mediated this conditional effect.

Keywords: Shared leadership; team performance; transactive memory system; temporal effect

Introduction

Team leadership is often not exercised by one appointed individual but shared by team members (Manz, Skaggs, Pearce, & Wassenaar, 2015; Pearce & Sims, 2000; Muethel, Gehrlein, & Hoegl, 2012). Such non-hierarchical leadership practice is increasingly common, given the growing importance of sharing, generating, and coordinating knowledge among team members to achieve better team performance (Fitzsimons, James, & Denyer, 2011; Lewis, 2004; Nordbäck & Espinosa, 2019; Pearce, 2004). This phenomenon has been captured by the concept of shared leadership, which refers to “an emergent team property that results from the distribution of leadership influence across multiple team members” (D’Innocenzo, Mathieu, & Kukenberger, 2016, p. 1968). Recent research has documented evidence regarding the positive effect of shared leadership on team performance (D’Innocenzo et al., 2016; Nicolaides et al., 2014; Nordbäck & Espinosa, 2019; Wang, Waldman, & Zhang, 2014; Zhu, Liao, Yam, & Johnson, 2018). However, significant gaps still exist in this body of literature.

First, most prior research has treated shared leadership as a state rather than a dynamic process (Drescher, Korsgaard, Welpe, Picot, & Wigand, 2014). Given the emergent nature of shared leadership (Carson, Tesluk, & Marrone, 2007), it is more rigorous to examine the dynamism of shared leadership longitudinally to determine its effect on team performance (D’Innocenzo et al., 2016), particularly how the evolution of shared leadership influences changes in team performance over time. As has been noted in the literature, most organizational theories are dynamic in nature; yet most empirical studies still follow cross-sectional conceptualization and an empirical research design (see, for example, Ployhart & Vandenberg, 2010). Not surprisingly, little research has been conducted that adopts a longitudinal and dynamic approach to examining this particular issue, with a few rare exceptions (e.g., Drescher et al., 2014). It is therefore no coincidence that a recent review paper (D'Innocenzo et al., 2016; Sweeney, Clarke, & Higgs, 2019; Zhu et al., 2018) called for more longitudinal research examining the dynamic impact of the evolution of shared leadership.

Second, to explain how the evolution of shared leadership influences changes in team performance, we resort to the social capital theory of social network closure (Burt, 2000; Coleman, 1990; Inkpen & Tsang, 2005). Shared leadership represents a leadership network of mutual influence, which can facilitate shared experience (e.g., cultural norms and goals) and better access to information and knowledge among a closed social network (Coleman, 1990; Burt, 2000; Inkpen & Tsang, 2005). One important form of social capital that can be derived from shared leadership is the transactive memory system (TMS), which refers to an emergent system of the distribution and retrieval of team members' specialized knowledge (Lewis, 2003; Lewis, Lange, & Gillis, 2005; Mell, Van Knippenberg, & Van Ginkel, 2014; Wegner, 1995). TMS is indicated by enhanced specialization, coordination, and reliability of knowledge among team members, which in turn enhance team learning and learning transfer (Lewis et al., 2005). It has been widely supported that TMS enhances team performance (Bachrach et al., 2019; Lewis, 2004; Lewis & Herndon, 2011; Mell et al., 2014). Examining how the social network within a team influences the development of TMS has been identified as a key research direction (Lewis & Herndon, 2011).

Finally, understanding the aforementioned dynamic relationships at different temporal stages of the team life cycle can offer additional insights. According to the punctuated equilibrium model (Gersick, 1988; 1991), teamwork develops to experience transition/punctuation at roughly the calendar midpoint of the teamwork. Before this punctuation, teams experience a period of stasis. The transition occurs when there is a sudden shift towards radical change, largely as a result of team members collectively experiencing a heightened awareness of time and the deadline. This model has implications for how team dynamism (e.g., shared leadership and TMS) influences team performance at different stages of the team life cycle. A more detailed explanation of the implications is given in the relevant hypotheses development section. Examining the dynamic impact of shared leadership on team performance over time has strong managerial relevance and implications. Although it is clear that shared leadership should be encouraged for teamwork, it is still not clear in the literature when is the best time for teams to develop shared leadership. Could it be too late for a team to develop shared leadership for it to effective? To answer these kinds of question, we need to examine longitudinally how shared leadership affects team performance over the full life cycle.

In sum, this research aims to make the following contributions to the literature. First, it aims to examine longitudinally how the evolution of shared leadership causes a change in team performance over the whole team life cycle. Second, this research supports the notion that the social capital mechanism (as indicated by change of TMS) explains how shared leadership evolution influences team performance over time. Finally, this research further extends these dynamic effects by examining whether, and how, their effects differ between the earlier and later stages of the team life cycle.

Conceptual Framework and Hypotheses

Shared Leadership

Shared leadership refers to "*an emergent and dynamic team phenomenon whereby leadership roles and influence are distributed among team members*" (D'Innocenzo et al., 2016, p. 1968). This conceptualization is appropriate for our research, as it follows a social network approach, with an emphasis on the dynamic feature of shared leadership. Theoretically, a social network approach highlights the fact that social actors are embedded within a network of multiple relationships (Mayo, Meindl, & Pastor, 2003), supports the idea that the main constructs may emerge non-linearly (Mathieu & Chen, 2011), and makes it possible for leadership to be examined as a shared role that is influenced by individual members (Yukl, 1989). Shared leadership is unlikely to adopt a linear form of change; rather, it is likely to follow a non-linear form of decreasing, increasing, or stabilizing over time for the same team as a result of, for example, a change in tasks, group dynamics, and external forces (Drescher et al., 2014). This non-linear form of change in shared leadership is particularly plausible for a self-managed team because of the absence of a designated team leader.

Methodologically, the network approach asks each team member to evaluate the leadership influence of their teammates, therefore enabling a fine-grained measurement of the construct of shared leadership (Mehra, Smith, Dixon, & Robertson, 2006). In particular, social network density has been proposed to represent and measure shared leadership within a team (Carson et al., 2007). Density refers to the structural property of a social network, which represents the pattern of relationships of its members and their different types of exchange (Sparrowe, Liden, Wayne, & Kraimer, 2001). The more ties (relationships and exchanges) the members of a social network enjoy with one another, the greater the density of the network (Sparrowe et al., 2001). Accordingly, the more shared the leadership within a team, the greater the density of the leadership network (Carson et al., 2007). In sum, density tends to capture the magnitude of shared leadership (DeRue, Nahrgang, & Ashford, 2015).

Research on shared leadership is still limited by the lack of longitudinal studies examining the impact of shared leadership evolution. Drescher et al.'s (2014) study provides new insights into the dynamic nature of how changes in shared leadership lead to changes in team performance due to changes in team trust. However, the study only examined shared leadership during the early stage of the team life cycle, with just three waves of data collection; therefore, it did not observe any moderating effect of time on the relationship between shared leadership and team performance over the team life cycle.

From a social network perspective, it is theoretically pertinent and important to examine the social capital mechanism of how shared leadership influences team performance. As noted by Lin's (1999) discussion on the social network theory of social capital, besides the individual-level social capital of those individuals embedded in a social network, network-based social capital can be applied at group level, which can be viewed as the production and maintenance of a collective asset. At collective level, the social capital of a social network refers to the benefits that can be associated with the structural properties (e.g., density) of a social network (Sparrowe et al., 2001). For example, it has been argued that a close social network facilitates group social capital, including better information flow and team communication (D'Innocenzo et al., 2016), in addition to sharing of cultural norms and common goals (Coleman, 1990; Burt, 2000; Inkpen & Tsang, 2005; Lin, 1999). Accordingly, this research examines how TMS (representing the collective social capital of a group) can explain the impact of shared leadership on team performance.

Transactive Memory System (TMS)

Effective teamwork requires seamless distribution, retrieval, and sharing of team members' knowledge, as well as collective learning. It is critical to have a system to manage such complex knowledge management in teams (DeChurch & Mesmer-Magnus, 2010). The construct of TMS is rooted in transactive memory theory (Wegner, 1987). Transactive memory is memory that depends on knowledge of another person's memory system. How one person stores, encodes, and retrieves information can differ subject to the availability of the information from another person's memory. While transactive memory can only be possessed by an individual, a system of transactive memory (i.e., TMS) can exist among individuals who cooperatively store, retrieve, and communicate information (Lewis, 2003; Wegner, 1987). Transactive memory theory suggests that members of effective teams divide the cognitive labor for their tasks, specialize in different skills and tasks, and rely on one another's domain-specific responsibility to enhance the collective information and knowledge needed for their specific tasks, and those of the whole team (Lewis, 2003; Wegner, 1987).

TMS can be indicated by three types of behavior that manifest when a group has developed TMS: *specialization, coordination,* and *credibility* (Lewis, 2003). Specialization refers to the extent to which team members possess specialized knowledge that is beneficial to the teamwork. Coordination occurs when the differentiated knowledge of team members can be organized effectively. Credibility is defined as the extent to which team members trust the reliability of other members' differentiated knowledge (Lewis, 2003). TMS equips a team with such a system to organize, distribute, retrieve, and coordinate knowledge among team members (Lewis, 2003; Wegner, 1995). We expect that the TMS of the same team would change over time. As noted by Lewis (2004), the pace, focus, and content of work can change, resulting in different knowledge learning, recall, and application for knowledge-worker project teams. Therefore, similar to shared leadership, TMS can take the form of non-linear change along the teamwork life cycle. Therefore, it is important to examine how the changes in shared leadership and TMS are related and how they affect team performance.

Shared Leadership and TMS

We argue that the evolution of shared leadership is positively associated with the evolution of team TMS, which in turn relates positively to changes in team performance. First, an increase in shared leadership density facilitates a better information flow and team communication (D'Innocenzo et al., 2016), which in turn helps to develop the organization and shared meta-knowledge of TMS. An increase in leadership network density is characterized by an increase in the number of ties being connected among team members in a closed network. As a result, teams with shared leadership exhibit a higher degree of multiple sources of leadership and more mutual influence over one another (Carson et al., 2007). The increased number of ties, and the associated multiple sources of leadership and mutual influence, enhance the communication and information flow among team members, which helps teams to build a stronger collective knowledge structure of transactive memory linking individual memories to it. This can also facilitate the development of meta-knowledge (who knows what) and the encoding of relevant knowledge. In addition, the enhanced communication expedites storage of the specialized knowledge among the corresponding members and eases its retrieval (Palazzolo, Serb, She, Su, & Contractor, 2006). Previous research has shown that TMS is positively influenced by the frequency of communication among MBA consulting teams (Lewis, 2004). Hence, when there is an increase in shared leadership density, there is likely to be an increase in TMS. On the other hand, when shared leadership density decreases, the number of ties decreases, which leads to decreases in mutual influence and the degree of multiple sources of leadership among team members. Consequently, it hampers the information flow and team communication, hence weakening TMS.

Second, an increase in shared leadership can enhance shared group experiences, which have been found to be an important antecedent of TMS development (Ren & Argote, 2011). The denser the leadership network within a team, the more opportunities there are for team members to actively develop a consensus (Bergman, Rentsch, Small, Davenport, & Bergman, 2012) and to share cultural norms and common goals (Coleman, 1990; Burt, 2000; Inkpen & Tsang, 2005; Lin, 1999). As noted by DeRue et al. (2015, p. 1194), “in dense leadership structures...many or most group members actively set goals for the group, motivate each other to accomplish those objectives, and reinforce the group culture”. This shared experience helps to link individual team members’ memories to develop meta-knowledge in terms of who knows what among team members; it also helps to ease knowledge retrieval. In addition, it strengthens the motivation and empowerment for team members to develop, identify, and reveal their own areas of expertise and knowledge, and to locate the specialized knowledge in the team. On the other hand, a decrease in shared leadership density will result in less interaction among team members and fewer opportunities to develop shared group experiences, which in turn can lead to less effective knowledge coordination and confidence among team members when replying to one another's specialized knowledge. In short, it weakens TMS.

Hypothesis 1: Team shared leadership change has a positive effect on TMS change.

The Mediating Role of TMS

So far, we have established that shared leadership positively influences TMS. To establish the mediating effect of TMS, we further need to demonstrate the positive effect of TMS on team performance. As noted earlier, teams with TMS exhibit three typical behaviors: specialization (team members possess specialized knowledge that is beneficial to the teamwork); coordination (the differentiated knowledge of team members can be organized effectively); and credibility (team members trust the reliability of other members' differentiated knowledge) (Lewis, 2003). Teams with TMS are able to effectively organize, distribute, retrieve, and coordinate knowledge among team members (Lewis, 2003; Wegner, 1995). With TMS, team members are able to locate and gain access to the specialized knowledge among other team members, and they are able to confidently rely on one another's knowledge and coordinate their differential knowledge to complete team tasks and enable new learning. For example, in a new product development team with members with credible marketing, sector, and engineering expertise, the team, with sufficient coordination, can put the various types of knowledge together effectively to create a new product that is not only technically superior but also desired by consumers. On the contrary, if the team consists of members with engineering expertise only, or the members cannot trust or coordinate with one another, it is more likely to develop a product that is technically competent but not wanted by consumers. The literature has provided abundant evidence that teams with TMS are more likely to perform better as a result of their unique advantage in knowledge management (Lee, Bachrach, & Lewis, 2014; Lewis, 2003, 2004; Zhang, Hempel, Han, & Tjosvold, 2007). Given that shared leadership positively influences TMS, which in turn positively affects team performance, we expect TMS to mediate the relationship between shared leadership and team performance. Therefore, we propose that:

Hypothesis 2: Team TMS change has a positive effect on team performance change.

Hypothesis 3: Team TMS change mediates the positive effect of team shared leadership change on team performance change.

The Temporal Effect

As noted earlier, shared leadership is emergent and dynamic. Its relationship with team performance can vary according to the evolution of the teams over time. We argue that the indirect effect of shared leadership on team performance will weaken over time, as a result of the weakened effect of TMS on team performance during the later stage of the team life cycle. We argue that TMS change tends to have a stronger positive effect on team performance during the earlier stage of the team life cycle, compared to the later stage. Based on the logic of moderated mediation (Preacher, Rucker, & Hayes, 2007), the indirect effect of shared leadership change (via TMS change) on team performance will be stronger, accordingly, during the earlier stage of the team life cycle. We explain this effect in detail next.

According to Gersick's (1988; 1991) model, teamwork evolves non-linearly but tends to experience a transition at roughly the calendar midpoint of the teamwork. Teamwork progresses "through an alternation of stasis and sudden appearance—long periods of inertia, punctuated by concentrated, revolutionary periods of quantum change" (Gersick, 1988, p. 16). Before the punctuation/transition, teams experience a period of stasis. The transition occurs when there is a sudden shift toward radical change, largely due to team members collectively experiencing a heightened awareness of time and the deadline. During the earlier stage, teams are typically characterized by inertial movement, with varying work accumulation, learning, and experience within their own frameworks (Gersick, 1991). This inertial movement is disrupted by radical change of a transitional point (typically the midpoint), which catalyzes the development of new or revised frameworks for the later stage (Gersick, 1991). This model has implications for how team dynamism (e.g., shared leadership and TMS) influences team performance at different stages of teamwork, particularly before and after the midpoint of the team life cycle. Therefore, we broadly follow Gersick's punctuated equilibrium model to develop the hypotheses regarding the temporal effects of shared leadership and TMS on team performance.

During the earlier stage, because team performance can generally be hampered by the typical characteristics of inertia and stasis of teams in the earlier life cycle, any additional forces that energize the team could have a potentially profound impact on team performance. Teams that have developed stronger shared leadership during the earlier stage exhibit comparative advantages over other teams because of the stronger TMS that can develop from shared leadership. These teams are equipped with deepened specialist knowledge, held by different team members, more effective knowledge coordination among members, and stronger confidence in one another's knowledge and expertise (Lewis, Belliveau, Herndon, & Keller, 2007). These advantages can help to overcome some of the limitations caused by the inertia and stasis of teams in the earlier stage of the life cycle. However, if there is any sharp weakening of shared leadership during the earlier stage of the team life cycle, when the team development is still immature, the comparative advantage of TMS obtained previously can disappear quickly. Indeed, research has found that disruption to TMS can significantly undermine the comparative advantage of groups with established TMS (Lewis et al., 2007). We further suggest that this undermining effect of TMS disruption is stronger, particularly during the earlier stage of the team life cycle, because of the lower level of learning transfer that can be obtained from TMS during this earlier stage. In other words, particularly during the earlier stages of the team life cycle, the shared leadership change can make a bigger difference when it comes to differentiating between high-performance and low-performance teams, so that teams with stronger enhancement in shared leadership will outperform those with weaker enhancement in shared leadership, because of the same effect of TMS. At the later stage, according to Gersick's model, the radical change (revolution) tends to happen for most teams, which drives less successful teams to develop a collective sense of urgency in achieving the tasks and meeting the deadline (Gersick, 1988). Accordingly, the comparative advantage derived from the shared leadership change will be less striking at the later stage of the team life cycle.

Even for the same team, the shared leadership change tends to have a diminishing positive impact on team performance over time. If the team can quickly develop stronger shared leadership in the earlier stage, this enables the development of TMS quickly and the teams can then effectively capitalize on the strengths and expertise of all team members to perform their earlier tasks. Over time, in the later stage of the team life cycle, the fluctuation of shared leadership in a team will have a weaker indirect impact on term performance, as a result of the weaker impact of TMS on team performance. In the later stage, these teams are generally well established and mature because of repeated cross-learning, with generally stronger routine establishment and the previously developed abstract and generalized knowledge of the tasks. Even with weakened shared leadership and TMS in the later stage, these teams are able to perform relatively well because of the positive performance momentum, team cohesion (Mathieu, Kukenberger, D'innocenzo, & Reilly, 2015) and collective efficacy (Myers, Payment, & Feltz, 2004), among other things, that are generated in the earlier stage. Second, when a team cannot establish shared leadership (and hence TMS) during the earlier stage of the team life cycle, but instead only begins to build shared leadership (and hence TMS) at a later stage, its impact will be less striking because earlier task under-performance can prevent the team from performing subsequent tasks properly at the later stage. Therefore, we propose:

Hypothesis 4: The positive indirect relationship between the shared leadership change and team performance change through TMS change is moderated by the team life cycle. Specifically, the shared leadership change has a stronger (weaker) indirect positive effect on team performance change through TMS change during the early (late) stage of the team life cycle.

Method

Sample and Data Collection

The data for this study was obtained from a longitudinal study of management professionals attending a full-time postgraduate program in management studies at a leading business school. Our longitudinal research design and analyses of 119 team observations were able to alleviate concerns about the possible reverse causal relationship between TMS and shared leadership (Drescher et al., 2014). Similar to previous studies on TMS (Lewis, 2004) and shared leadership (Carson et al., 2007), the participants were young management professionals, typically having a few years of working experience in a business environment or degree-level learning on business and management, and therefore being similar in age (e.g., around 23 to 25 years of age). Over a period of two months, the participants were required to work as teams to complete an online simulation project, *Marketplace* (Shapiro and

McGougan, 2003), on strategic marketing. The simulation started in the first week of the first term when the participants were first enrolled on the program. With nearly half a million users, *Marketplace* is a family of more than twenty marketing and business simulations, which has been widely used by business professionals around the world. "*Marketplace* is a powerful yet entertaining way to learn how to compete in a fast-paced market. …Working in teams, participating teams build an entrepreneurial firm, experiment with strategies, compete with other participants in a virtual business world filled with tactical detail, and struggle with business fundamentals and the interplay among marketing, manufacturing, logistics, human resources, finance, accounting, and team management. Participants take control of an enterprise and manage its operations through several decision cycles. Repeatedly, they must analyze a situation, plan a strategy to improve it, and then execute that strategy out into the future. They face great uncertainty both from the outside environment and from their own decisions. Incrementally, the participants learn to skillfully adjust their strategy as they discover the nature of real-life decisions, conflicts, trade-offs, and potential outcomes" (*Marketplace*, 2003, p. 1). Participants were assigned to teams by a full-time program coordinator, who coordinated the administration and operation of the module. Prior to forming teams and assigning projects, the program coordinator had access to information about the knowledge, skills, academic achievement, and professional experience of each individual. Teams were staffed to represent a balance of disciplines, including marketing, finance, accounting, information systems, and human resources management, as well as past academic performance. Teams of 4–6 members were formed from all of the course enrollees, who came from 30 different countries; 59.6% of them were female. Of the 104 enrollees in this research, we examined the response rates in all of the teams in which there were non-responders. Following this check, three teams were not included in the analysis, since there were fewer than three member responses, and their performance scores remained zero throughout all the simulation periods. Thus, the responses and the performance scores from the three teams were likely to provide unreliable results. We then included the remaining teams in the analysis. As a further check, we compared survey respondents and non-respondents with respect to gender, country, and the mean levels of all the research variables measured at different periods, and we found no significant differences between the groups.

All project teams were assigned to undertake a computer simulation project to manage a new PC Marketing Division to enter the microcomputer business. The teams were responsible for introducing a new line of microcomputers into several international markets. During the project, each team made seven rounds of decisions to decide on strategic issues before the end of each week, including designing a marketing plan for a new product. After the decision had been made, the online simulation system generated the performance scores of each team for the period leading up to the decision week. Exposure to the performance scores allowed the teams to reflect on their past decisions, build on their past performances, and make adjustments to the past decision-making parameters for the next round.

Members of the teams were asked to complete an online questionnaire before the end of each decision week. Participants were told that the purpose of the surveys was to record their team interactions and communication (none of them were aware of the study's hypotheses). We assured participants that their responses would be kept confidential and not revealed to other team members in order to maintain respondent anonymity and minimize evaluation apprehension. We sent weekly emails to participants to remind them to answer the surveys by the end of each week before the start of the next round of simulation decisions in the following week. In total, there were 17 teams, with a total of 119 team observations.

Measures

Team Performance

We used performance scores generated by the simulation system as the measure of team performance during each period. Logged values were used in the models to normalize this variable. The performance score was computed for the period t in the following way:

Performance Score (t) = Financial Performance (t) × Market Performance (t) × Marketing Effectiveness (t) × Investment in Future (t) × Wealth (t)

The multiplicative relation of components captures the balanced scores of the overall performance in each of the individual areas (e.g., financial, marketing). Specifically, the instructor manual of Marketplace provides details of how each of the individual performance indicators are defined and measured. First, financial performance measures how well each team has been able to create profits for its shareholders. This is computed by dividing net profit by the total revenue of the firm. Second, market performance is a measure of how well each team is able to create and fulfill demand in its target segments. Third, marketing effectiveness is a measure of how well each team has satisfied the needs of customers. The quality of the brands and adverts is evaluated by the primary and secondary target segments, and the satisfaction scores are averaged to obtain a measure of marketing effectiveness. Fourth, investment in the firm's future is a measure that reflects the willingness of the team to spend current revenue on future business opportunities. It is measured by computing the proportion of current revenue spent on activities with a long-term payback, such as research and development and new sales outlets. Fifth, creation of wealth is a measure of how well the executive team has been able to add wealth to the initial investments of stockholders. According to the manual of www.marketplace-simulation.com, the simulation uses a balanced score, which “provides a single number that can be compared between companies (teams). As such, it is the main indicator for evaluating your performance in the market.” There are several reasons for employing the balanced scorecard to measure performance. “First, it provides a balanced indicator that includes all functional areas of the firm, plus short-term and long-term and customer and stockholder considerations. Thus, it forces participants to take an integrative perspective in managing the firm. Second, it provides a single number with which to grade the teams in an environment where there are many factors that can determine success. In short, top managers must be good at managing all aspects of the firm. The balanced scorecard puts this perspective into practice. It focuses attention on multiple performance measures and multiple decision areas. None can be ignored or downplayed. The best managers are strong in all areas measured" (Cadotte, 2008, p. 1). This score is the same measure that was used in the simulation program to determine the winning teams, and the same measure of performance was used as the basis for more objective decisions, such as selecting and awarding top teams that achieved the best performance in terms of performance scores.

Shared Leadership

In line with social network theory, we suggest that the changing pattern of shared leadership can be conceptualized as an increase in the density of the teams' leadership networks. Specifically, within a leadership network, individuals rely on their teammates for leadership, and we can therefore observe an increase in density when such a reliance on one another for leadership grows within the team (Carson et al., 2007).

According to social network theory, density describes the overall level of different types of exchange among members of a social network (Sparrowe et al., 2001). According to Sparrowe and his colleagues, "Density is analogous to the mean number of ties per group member. The more ties each group member enjoys with the other group members, the greater the density of the network" (2001: 317). In our study, relationships between team members developed when one team member perceived another to be developing leadership influence in the team. Therefore, following Carson et al. (2007), we consider the density of a leadership network to be the mean number of relationships per team member involved in leadership influence. Operationally, network density is a measure of the proportion of the total possible relationships in a given network (Wasserman & Faust, 1994). Accordingly, network density can be an appropriate measure of shared leadership, capturing the degree to which leadership influence is distributed among a relatively high or relatively low proportion of team members (Carson et al., 2007). Thus, we measured shared leadership following a social network approach using density. Specifically, every team member rated each of his/her peers (from 1 = "not at all" to 7 = "to a very great extent") on the following question: "To what degree does your team rely on this individual for leadership?" To calculate density, we followed the measurement approach for valued relations by summing all values and then dividing that sum by the total number of possible ties among team members (Sparrowe, Liden, Wayne, & Kraimer, 2001). Agreement across respondents' ratings of their team members was assessed, and it demonstrated adequate inter-rater reliability (average Rwg > 0.70 with a uniform null distribution, average ICC[1] > .25, and ICC[2] > .71). Our final decision to aggregate the measures was made based on the distribution of agreement and both Rwg and ICC(1) and ICC(2) coefficients (Biemann et al., 2012). Social network measures are especially sensitive to missing data. For this measure, the overall response rate of our sample was 74%. Specifically, the response rates for each week were: 95%, 73%, 71%, 67%, 71%, 68%, and 71%, respectively. The response rates for weeks 4 and 6 deserve closer attention. To examine the issue of missing data, we carried out the following checks and corrections. First, we checked survey respondents and non-respondents with respect to gender, country, and the mean levels of all the research variables measured at different periods; we found no significant differences between the non-respondent and the respondent group, suggesting that the data was not contaminated by non-response bias in any significant way. Second, we used two commonly utilized methods to treat missing data by calculating the measure on shared leadership, namely: (i) complete case analysis, that is, the reduction of the data set to the completely observed cases; and (ii) imputation by reconstruction. Compared with complete case analysis, this method can avoid the loss of data by imputing observations for the missing values. We followed Stork and Richards (1992), who suggest reconstructing the missing part of the network using the observed incoming relations of the missing actors. Moreover, we "maintain cautious optimism for network imputation, especially if the missingness remains below 20 or 30 percent" (Gross & Jansa, 2016, p. 191). Third, we then compared the results on the shared leadership measure derived from both methods described above, and the final substantive results in our models remained unchanged.

TMS

We measured TMS using a 15-item scale (Lewis, 2003), and we used a 7-point disagree/agree scale and averaged member responses to form a TMS composite score. The sample items were: "Each team member has specialized knowledge of some aspect of our project"; "Our team worked together in a well-coordinated fashion"; and "I was comfortable accepting procedural suggestions from other team members." The TMS scale consists of three separate sub-scales (first-order indicators): specialization, credibility, and coordination (Lewis, 2003). To test for discriminant validity, we performed a confirmatory factor analysis by specifying a higher-order factor with three dimensions, and the results yielded a good fit to the data (CFI = .94, TLI = .92, RMSEA = .07, SRMR = .06). The reliability of the 15-item TMS measure average α was 0.85 (with minimum value at 0.81). The TMS measure was designed to be used at team level, so we evaluated the homogeneity of member responses within teams using the $Rwg_{(J)}$ index (George, 1990) before aggregating scores. The average $Rwg_{(J)}$ values (James, Demaree, & Wolf, 1984) for overall TMS at all periods were larger than 0.80 using the uniform null distribution. Considering that the source of TMS variation comes from both within and between teams, we calculated ICC scores with average ICC[1] > .26 and ICC[2] > .71. These values suggested that responses from members on the TMS items could be aggregated to team level. Our final decision to aggregate the measures was made based on the distribution of agreement and both Rwg and ICC(1) and ICC(2) coefficients (Biemann et al., 2012).

Control Variables

We included a number of controls. First, we controlled for the effects of gender diversity and country diversity of teams (Carson et al., 2007) in order to address these possible alternate explanations for shared leadership, TMS, and team performance. Previous research has shown significant effects for demographic heterogeneity on team outcomes (Williams & O'Reilly, 1998). Gender diversity and country diversity were measured using Teachman's index, which captures how team members are distributed among the possible categories of a variable (Teachman, 1980). In addition to the gender diversity and country diversity of teams, we also included one time-varying control, namely, team self-esteem (TSE), which is explained in more detail next.

Self-esteem, as a positive self-perception, can occur at different levels of an organization: individual, team, and organizational (Gardner & Pierce, 1998; Pierce & Gardner, 2004). In our research the focal level was at team level. TSE refers to team members' positive evaluation of their adequacy and worthiness as team members (Lin, Baruch, & Shih, 2012), similar to the notion that organization-based self-esteem refers to organizational members' positive self-perception as organizational members (McAllister & Bigley, 2002). We chose TSE as a control variable for a number of reasons. First, self-esteem at collective levels has been found to positively relate to individual-level performance (Pierce & Gardner, 2004) and collective performance at team level (Lin et al., 2012; Pierce &

Gardner, 2004). Second, as noted earlier, prior research on shared leadership found that team confidence and collective self-efficacy of team members (Nicolaides et al., 2014) can explain how shared leadership influences team performance. These variables are conceptually similar to TSE. By controlling the effect of TSE, we were able to perform a more rigorous and conservative test of the mediating effect of TMS, as TSE is largely able to capture the effects of the above two mediators proposed in the literature. TSE was measured with 10 items using a 7-point Likert scale (Pierce, Gardner, Cummings, & Dunham, 1989), for example, “I count around here” and “I am taken seriously.” Before presenting the questions, we instructed respondents to think about the messages they had received from the attitudes and behavior of their team members during the previous week. To test for validity of TSE, we performed a confirmatory factor analysis, and the results yielded a reasonably good fit to the data (χ^2 = 310.57, df = 35; χ^2/df = 8.87, CFI = .92, TLI = .90, SRMR = .04). The reliability of the 10-item TSE measure average α was 0.95. The average $Rwg_{(J)}$ values for overall TSE at all periods were larger than 0.80 using the uniform null distribution. Considering that the source of TSE variation originates from both within and between teams, we calculated ICC scores with average ICC[1] > .14 and ICC[2] > .70. These values suggested that member responses on the TSE items could be aggregated to team level.

Although the constructs TMS and TSE are theoretically and empirically distinct, they are positively correlated. Thus, to ensure discriminant validity, we used the average variance extracted as a check (Fornell & Larcker, 1981), and the results suggest that the criterion was met for the constructs because the AVE was larger than 0.5, and yet the squared correlation between constructs was less than 0.4.

In the models we also included seven period dummies to alleviate heteroskedasticity and concerns about unobservable effects’ estimation (Van den Bulte & Lilien, 2001). The period dummies allowed us to control for any time-changing factors, ranging from task change to task complexity, which were constant across the teams in the data set but varying over time. Period 1 is the base period. To capture the temporal effects of shared leadership and TMS, we created a time dummy, where simulation period 1–4 was coded 1, spanning the early stage of the team cycle, and period 5–7 was coded 0, indicating the late stage of the team cycle. Such a dichotomization fits well with the life cycle of the teams, where period 4 is the midpoint. Moreover, the dichotomization also reflects the task change of the project over the team life cycle. From periods 1 to 4, team tasks were focused on making different and new decisions in setting up the business. Such decisions related to tasks that are typical of teams in the early stage of the team life cycle, including organizing the teams, naming the firms, analyzing initial market information, establishing strategic directions, and test-marketing brands. In contrast, from periods 5 to 7, the focus of decisions migrated to the tasks of refinement, that is, making adjustments to the past strategies developed in periods 1–4 based on past performances and team learning.

We did not include team size as a control, since all the teams were equally sized or nearly equally sized. Project demand was also not relevant in this case, since all the teams were facing similar tasks of similar difficulty. Coaching was also not relevant, since all the teams had the same coach and equal time accessing the coach. The coach treated all team members equally, without prejudice. As discussed earlier, all team members were similar in both age and number of years of working experience.

Results

Model Free Evidence

Before we formally test our hypotheses, we first present some initial evidence from the data. As shown in Figures 1a and 1b, the mean values of shared leadership and TMS were not linear over the whole team life cycle. This pattern, together with the significant changes in the standard deviations of both shared leadership and TMS, provided some initial evidence that teamwork evolved non-linearly over the team life cycle. However, such evidence was only preliminary, being based on the overall mean of all the teams.

Insert Figure 1a and 1b about here

To further explore the underlying patterns of how shared leadership and TMS change over time, and how they are related to team performance, in Figures 2a, 2b, and 2c it can be seen that we adopted a more refined view of high-, mid-, and low-performing teams over their whole life cycle. There are two notable patterns in Figure 2.

Insert Figure 2a, 2b and 2c about here

First, the TMS of high-performing teams demonstrated a pattern of slight increase over the whole team life cycle, whereas the pattern for performance presented a steeper increase in the early periods. A similar trend can be observed in the mid-performing teams. Such patterns provided preliminary evidence of a stronger effect of TMS on team performance in the early period of the team life cycle. This diminishing effect of TMS on team performance echoed the findings of previous research on TMS, which showed that the direct impact of task-oriented communication on team performance significantly diminishes after the midpoint of a team life cycle, as TMS is more developed and adjusted based on past team performance feedback (Kanawattanachai & Yoo, 2007).

Second, for low-performing teams, TMS demonstrated a pattern of slight decrease in the early periods and recovery in the later periods. Similarly, shared leadership of low-performing teams also showed a pattern of recovery in the later period. Such patterns are consistent with the theory of the punctuated equilibrium model (Gersick, 1988). Specifically, at the later stage, the radical change (evolution) drove the less successful teams to develop a new framework (e.g., shared leadership and TMS) for their teamwork and a collective sense of urgency in achieving the task and meeting the deadline. Accordingly, the performance of low-performing teams saw an improvement in the latter period (from period 6 to period 7).

In Figure 3 we compare the one-period lagged relationship between shared leadership and TMS. The figure on the left-hand side shows a consistent pattern, where an increase (or decrease) of shared leadership (t) in an earlier period corresponds to an increase (or decrease) of TMS in the later period (t+1). In contrast, the figure on the right-hand side demonstrates a rather different picture, where TMS (t) fluctuates constantly but shared leadership (t+1) shows a pattern of steady increase. The contrasting patterns in the two figures suggest a causal relationship between shared leadership (t) and TMS (t+1), and not the other way round, although a more rigorous test is needed. Given the patterns presented in Figures 2 and 3, one would also expect – similar to the stronger effect of TMS on team performance in the early period of the team life cycle – shared leadership to exhibit a stronger effect in the early period. Next, we discuss how we formally tested the hypotheses.

Insert Figure 3 about here

Data Analyses Approach

To test our hypotheses, we used the generalized estimating equations (GEE) method (Zeger & Liang, 1986). Specifically, we first estimated the proposed GEE model specifications using the first differences model (Allison, 1990), which can yield unbiased estimates of the causal effect of an independent variable (e.g., shared leadership) on a dependent variable (e.g., TMS) (Finkel, 1995). Then, as a robustness check, we used a conditional change model (Plewis, 1985) by including a one-period lagged team performance as an independent variable (e.g., at period t) to predict future team performance in the following period (e.g., at period t+1) (Finkel, 1995). In light of the sample size, bootstrapping standard errors were used to make the appropriate adjustment (Hardin, 2001; Horwitz & Horwitz, 2012).

The GEE method has been widely used in organizational and psychological research (Ballinger, 2004), management (Boone, Van Olffen, & Van Witteloostuijn, 2005; Crossland, Jinyong, Hiller, & Hambrick, 2014), strategy (Krause, Priem, & Love, 2015), innovation (Wang & Li-Ying, 2015), and entrepreneurship studies (Engelen, Neumann, & Schwens, 2015). This method accounts for intra-cluster correlation and allows its use in a number of situations: repeated measures data, data involving sequences of related decisions, and a range of other circumstances where conditional independence across observations is unlikely (Zorn, 2001). In particular, this approach deals effectively with the estimation issues in our data set, including repeated measures of teams across a few time periods, dependent variables dependent on prior period observations, endogeneity where regressors are correlated with prior period errors, and heteroskedasticity and serial correlation within teams.

We followed the procedure suggested in the literature in the selection of the best-working correlation structures and models (Cui, 2007); for example, we examined AR(1) and AR(2) statistics to test for serial correlation in the error terms. We also log-transformed variables with skewed distributions, and we estimated variance inflation statistics to confirm that multicollinearity did not unduly influence our estimates.

To test H3 we took the following steps to check if: (1) shared leadership positively predicts TMS, (2) TMS positively predicts future team performance, and (3) the direct effect of current shared leadership on future team performance weakens or becomes non-significant when the effect of TMS is accounted for. As a robustness check, we also assessed the presence of mediation and the statistical significance of our findings with bootstrapping (Hayes, 2009; Zhao, Lynch Jr, & Chen, 2010). The results were consistent.

Bootstrapping is one of the most powerful methods for testing intervening variable effects (Hayes, 2009; J. Williams & MacKinnon, 2008). For our sample, bootstrapping offered additional advantages; specifically, it helped with the inferences of GEE for the longitudinal data. Past research has shown that bootstrapping yields a consistent approximation of the distribution of the regression estimate and a consistent approximation of the confidence sets (Cheng, Yu, & Huang, 2013), particularly with small sample corrections in GEE analysis (Horwitz & Horwitz, 2012; Mancl & DeRouen, 2001). Specifically, we used bootstrapping with 10,000 runs. After the corrections, the corresponding results achieved a significant reduction in inflated type I errors and a more conservative estimation of error terms, providing stronger support for our hypotheses (Morel, Bokossa, & Neerchal, 2003; Westgate & Burchett, 2016).

To test H4, we conducted a moderated mediation test on the prediction of the moderating effect of the time dummy on the mediating role of TMS on the positive relationship between shared leadership and future team performance. Drawing on Muller, Judd, and Yzerbyt (2005), the moderated mediation test required simultaneous estimation of the following equations:

(1) $Y = a_0 + a_1 \times X + a_2 \times W + a_3 X \times W + \varepsilon_1$

(2) $M = b_0 + b_1 \times X + b_2 W + b_3 X \times W + \varepsilon_2$ and

(3) $Y = c_0 + c_1 \times X + c_2 \times M + c_3 X \times W + c_4 \times W + c_5 \times M \times W + \varepsilon_3$

where M is the mediator variable (TMS), W is the moderator variable (time dummy), X is the independent variable (current shared leadership), and Y is the dependent variable (future team performance). Thus, in order for H_4 to hold, we needed to estimate all three models and show that a_1 was significantly different from zero and a_3 was not, while b_1 and c_5 were both significant (Muller et al., 2005).

We also further tested the causality of our hypotheses and alleviated the concern about alternative explanations, which is discussed further in the Robustness Checks section. To further test that TMS and shared leadership were distinctive constructs, we conducted a correlation analysis at each time point. As shown below, the Pearson correlation coefficients were low enough to be consistent with the presence of two distinctive constructs: -0.12, 0.00, 0.09, 0.16, 0.24, 0.31, and 0.32.

Hypotheses Testing

Table 1 provides the descriptive statistics. In Table 1 we can see that the three key variables (performance, shared leadership, and TMS) were moderately correlated. This result eased the concern that mediation analysis is often misapplied to cases in which the measured mediator M is the same construct as either X or Y (Mathieu, Maynard, Rapp, & Gilson, 2008).

Insert Table 1 about here

In testing H1 to H3, as shown in Tables 2 and 4, model specifications in Models 1–4 suggest that the results are in line with the mediation testing logic that: (1) in Table 2 Δ shared leadership positively predicts Δ TMS, with a coefficient of 0.18 ($p < .05$), and in Table 4 shared leadership positively predicts TMS, with a coefficient of 0.20 ($p < .05$); (2) in Table 2 Δ TMS positively predicts Δ future team performance, with a coefficient of 0.23 ($p < .10$), and in Table 4 TMS positively predicts future team performance, with a coefficient of 0.42 ($p < .05$); (3) in Table 2 Δ shared leadership positively predicts Δ future team performance, with a coefficient of 0.27 ($p < .05$), and in Table 4 shared leadership positively predicts future team performance, with a coefficient of 0.29 ($p < .10$); and (4) in Table 2 the direct effect of Δ shared leadership on Δ future team performance is weaker when the effect of TMS is accounted for, with an insignificant coefficient of 0.05 ($p > .10$), and in Table 4 a pattern is shown that is similar to using the conditional change model. Taken together, these results suggest that TMS fully mediates the positive effect of teams' current-period shared leadership on future team performance, which provides strong support for H1 to H3. As a robustness check, we followed suggestions by Hayes (2009) and Zhao, Lynch Jr, and Chen (2010); the results were consistent. Thus, H1, H2, and H3 are supported.

Insert Table 2 about here

In Table 3, in Model 1, the interactive term "Δ TMS (t) × time dummy" is positive and significant, with a coefficient of 1.0 ($p < .01$), suggesting that Δ TMS has a more positive relationship with Δ team performance during the early stages of the team life cycle.

The results of the moderated mediator test presented in Models 3C in Table 3 and Table 5 provide additional support for H3 because the direct effect of shared leadership on future team performance is non-significant in both models (0.11, p >.10) and (-0.09, $p > .10$).

In testing H4, as shown in Table 3, in Models 3A, 3B, and 3C, Δ shared leadership $_{(t)}$ is significantly different from zero (0.27, $p < 0.05$), and Δ shared leadership $_{(t)}$ × time dummy is not significant (0.01, $p > 0.1$), while Δ shared leadership $_{(t)}$ (0.22, $p < 0.05$) and Δ TMS $_{(t)}$ × time dummy (1.04, $p < 0.01$) are both significant (Muller et al., 2005). Similar patterns appear in Table 5, in Models 3A, 3B, and 3C. Therefore, H4 is supported.

Insert Tables 3, 4, and 5 about here

Robustness Checks and Additional Analyses

We conducted additional analyses to check the causality between shared leadership and TMS. As shown in Table 6, the results of Model 1 demonstrate that Δ shared leadership $_{(t)}$ positively influences Δ TMS $_{(t+1)}$ (β = 0.15, $p < 0.05$). In contrast, the effect of Δ TMS $_{(t)}$ on Δ shared leadership $_{(t+1)}$ is insignificant (β = -0.19, $p > 0.10$). These results confirm our conceptualization of the causality of the relationship between shared leadership and TMS.

Insert Table 6 about here

In addition, for our longitudinal sample, the weekly observation is nested within the same-level unit (i.e., team). Therefore, we used multiple-level modelling (Shen, 2016), which provides proper corrections for small samples to replicate the results from GEE analysis. The results of this particular method using Kenward-Roger corrections (Kenward & Roger, 1997) were consistent with the analysis using GEE with small sample corrections (Li & Redden, 2015).

Finally, we estimated alternative models rather than GEE using models of feasible generalized least squares (Greene, 2012). This method allows estimation in the presence of AR(1) autocorrelation within panels and cross-sectional correlation and heteroskedasticity across panels. Our substantive results remain robust.

Discussion

Theoretical Implications

This research makes several contributions to the literature. First, it contributes to the shared leadership literature by examining longitudinally how shared leadership evolution causes the change in team performance over the whole team life cycle. Unlike most previous studies, which take a more static and cross-sectional approach, this research supports the concept that the change in shared leadership leads to team performance change. This finding offers stronger evidence on the causal relationship between shared leadership and team performance with a dynamic and longitudinal research design and modeling. Although this research is not the first longitudinal study to examine the effect of shared leadership and team performance, the shared leadership literature is predominantly occupied by non-longitudinal studies, with a few rare exceptions, such as Drescher et al.'s (2014) work. Therefore, this study is still a valuable addition to the literature in this field. More importantly, our longitudinal study differs from previous research in that ours covers the whole life cycle of a work team, with seven waves of data collection, while previous longitudinal studies had only the minimum three waves. In this regard, our study is able to capitalize on the full strength of a longitudinal research design. First, it allows us to control for the effect of prior team performance when testing how shared leadership influences TMS and team performance. Second, it enables us not only to test how shared leadership influences TMS and team performance but also to demonstrate dynamically how the change in shared leadership influences the changes in TMS and team performance. Third, it provides stronger confidence in our proposed causal relationship (i.e., shared leadership affecting TMS) by testing the potentially competing reciprocal effect of TMS on shared leadership. Finally, it allows us to test the notion of how the dynamic effect of shared leadership can occur differently at different stages of teamwork, in that the impact of shared leadership on team performance is particularly salient during the early stages of the teamwork life cycle and it tends to lessen over time. This attenuating effect of shared leadership on team performance is explained by TMS, as our research has shown that over time the impact of TMS on team performance decreases. This finding suggests that a simple strategy of leveraging shared leadership and TMS to enhance team performance may be less effective at the end of the team life cycle. To our knowledge, this is the first time that such a temporal effect has been found regarding the impact of shared leadership and TMS.

Second, this research extends the impact of shared leadership on team performance by identifying the social capital mechanism of TMS. One of the main strengths of shared leadership is its ability to develop and capitalize on the various types of expertise of team members and the social capital (e.g., communications, shared experience, common goals, shared cultural norms, and team trust) of the team as a social network (Carson et al., 2007; D'Innocenzo et al., 2016). This social capital derived from shared leadership (as represented by a dense leadership network in a team) is an important antecedent or part of TMS (Ren & Argote, 2011). Research on TMS has also consistently shown that teams with strong TMS are more likely to enjoy a better team performance (Lewis & Herndon, 2011; Ren & Argote, 2011). The social capital mechanism is a conceptually salient mechanism for shared leadership, because, according to social network theory, network closure (with high leadership network density, in the case of shared leadership) generates various types of aforementioned social capital for the network (Coleman, 1990; Burt, 2000).

Finally, this research also contributes to the literature on TMS. Despite the existing literature having accumulated sufficient evidence on the positive effect of TMS on team performance (Ren & Argote, 2011), little research has been conducted to examine the team leadership antecedent of TMS, with the rare exception of the work by Bachrach and Mullins (2019), which focuses on the effect of transformational leadership on TMS. Our research, for the first time, investigates and supports the hypothesis that shared leadership is particularly effective for teams in the development of TMS. Given that shared leadership captures interactions and mutual influence among team members, examining the effect of shared leadership on TMS answers the recent call by Lewis and Herndon (2011) for more research on how team member interaction affects the development of TMS. In addition, it also extends the recent work on the team social network antecedents of TMS (Lee et al., 2014) by focusing on the network of team shared leadership. However, it is important to note that our study differs from that of Lee et al. (2014) in terms of the unit of analyses and the content of the social network ties. Lee et al.'s (2014) study focuses on how the ego-centric social network influences TMS, while our study focuses on the social network property (i.e., density) of a closed group with regard to group members' mutual leadership behavior. In this sense, this research contributes to the TMS literature by supporting the positive effect of shared leadership, as measured by the density of the social network of a group. In addition, by building on the punctuated equilibrium model (Gersick, 1988; 1991) and previous research on the dynamic nature of TMS (Lewis, 2004), our research, for the first time, demonstrates that TMS could be particularly effective for team functioning, especially during the early stages of the team life cycle.

Managerial Implications

Given the pivotal role of shared leadership in the development of TMS, and hence team performance, we suggest that organizations should provide conducive environmental and policy support for work teams to develop shared leadership. Previous research suggests that a supportive team environment and external team coaching are beneficial for the development of shared leadership (Carson et al., 2007). On the other hand, the direct and mediating effect of TMS on team performance suggests that the performance of teams with weak shared leadership could be enhanced by other policies and practices that enhance their TMS. For example, previous research suggests that communications and group task training (Ren & Argote, 2011), and task design characteristics (Lewis & Herndon, 2011), can also influence the development of TMS. Organizations can also resort to these other means to enhance team TMS and performance, particularly for teams with little potential for shared leadership development.

In addition, we also provide insights into the temporal effects of shared leadership and TMS on team performance, where the positive impact of both shared leadership and TMS will attenuate over the team life cycle. This has two important managerial implications. First, the strategy of leveraging shared leadership and TMS to enhance team performance may be more effective in the early stages of the team life cycle. This answers the question about when is the best time to start developing shared leadership. Although, in general, shared leadership is beneficial to teamwork, the inconvenient truth is that the later a team develops shared leadership, the less beneficial it will be. This further strengthens the need for teams to start building shared leadership as early as possible. Second, managers should take into account the temporal interaction between past performance, team tasks, TMS, and team performance, calibrate their improvement efforts on shared leadership and TMS relative to the life cycle of teams (especially during the early stages of teamwork) when their goal is to increase team performance, and monitor both initial levels of shared leadership and TMS and those at the latter stage. Finally, the importance of shared leadership for team performance is particularly relevant for contemporary teams that might consist of team members from different generations, with potentially changing team membership (e.g., the influx of millennials and outflux of boomers). This research suggests that shared leadership might be particularly important for this kind of team, as it can help to build effective knowledge management and sharing among members from different generations, particularly in terms of retaining useful knowledge from the change of team membership.

Limitations and Future Research

This research has a number of limitations that suggest important future research directions. First, although our research covers the whole life cycle of teamwork, it is based on a simulation project by business professionals. Future research should test our framework in the real-life business projects of different organizational settings, with larger samples, longer time periods, and different team tasks. Second, this research examined the mediating role of TMS on the relationship between shared leadership and team performance, but it did not examine how shared leadership affects TMS. Future research should dig deeper into the mediation mechanisms, with a specific focus on other social capital mechanisms, such as trust. Indeed, previous research has supported the idea that shared leadership enhances team trust (Drescher et al., 2014). In addition, future research could look into the moderating variables on the relationship between shared leadership and TMS. The literature suggests that social capital, such as common goals, shared experience, group norms, and communication, might be an important mediation mechanism and team type (e.g., functional versus non-functional; knowledge intensity) as a potential moderator of this relationship. Future research should test these propositions and identify others. Third, it has also been suggested that the TMS structure (centralized versus decentralized) is an important factor in team performance

(Mell et al., 2014). Future research should examine how shared leadership affects the TMS structure.

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Table 1. *Descriptive Statistics*

	Variable	Mean	SD.	1	2	3	4	5	6	7	8	9	10	11	12	13
1	Performance	1.50	1.77	1.00												
2	SL(density)	4.50	0.66	0.28	1.00											
3	TMS	5.07	0.59	0.39	0.32	1.00										
4	Gender diversity	0.64	0.10	0.01	0.01	0.04	1.00									
5	Country diversity	0.54	0.07	-0.11	-0.12	-0.39	-0.08	1.00								
6	TSE	5.87	0.51	0.26	0.28	0.60	-0.04	-0.26	1.00							
7	Period dummy 2	N/A	N/A	-0.34	-0.09	0.01	0.01	-0.01	0.11	1.00						
8	Period dummy 3	N/A	N/A	-0.10	-0.03	-0.05	0.01	-0.01	-0.04	-0.18	1.00					
9	Period dummy 4	N/A	N/A	0.09	0.04	-0.08	0.00	0.02	-0.06	-0.17	-0.17	1.00				
10	Period dummy 5	N/A	N/A	0.03	0.01	0.11	-0.03	0.04	0.03	-0.15	-0.15	-0.15	1.00			
11	Period dummy 6	N/A	N/A	0.24	0.05	-0.02	0.01	-0.01	-0.08	-0.18	-0.18	-0.17	-0.15	1.00		
12	Period dummy 7	N/A	N/A	0.46	0.06	0.08	0.00	-0.02	0.15	-0.17	-0.17	-0.16	-0.15	-0.17	1.00	
13	Time dummy	N/A	N/A	-0.50	-0.09	-0.10	0.00	0.00	-0.06	0.35	0.35	0.34	-0.44	-0.51	-0.49	1.00

Notes: Those correlation coefficients that are larger than 0.23 are significant at .05 level, while those that are larger than 0.28 are significant at .01 level; N/A: not applicable.

The variables of performance, shared leadership, TMS, and TSE change with each period. Their mean values across different periods are shown in the table. N = 119.

Table 2. *The Shared Leadership–Team Performance Relationship Mediated by TMS: Results of First Differences Models*

				Mediation
	Model 1 Δ performance $_{(t+1)}$	Model 2 Δ TMS $_{(t)}$	Model 3 Δ TSE $_{(t)}$	Model 4 Δ performance $_{(t+1)}$
Δ shared leadership $_{(t)}$	0.27*	0.18*	0.24*	0.05
	(0.12)	(0.09)	(0.10)	(0.14)
Δ TMS $_{(t)}$				0.23†
				(0.14)
Δ TSE $_{(t)}$				0.00
				(0.14)
Δ performance $_{(t)}$	-0.28	0.06	-0.13†	-0.21
	(0.28)	(0.08)	(0.07)	(0.20)
Constant	-0.02	0.02	0.06	0.03
	(0.03)	(0.04)	(0.07)	(0.03)
QIC	88.86	48.68	56.65	81.07

Notes: Bootstrapping (10,000 runs) standard errors are in parentheses. We used the generalized estimating equations (GEE) method (Zeger & Liang, 1986). We followed the procedure suggested in the literature in the selection of the best-working correlation structures and models (Cui, 2007). We also log-transformed variables with skewed distributions and estimated variance inflation statistics to confirm that multicollinearity did not unduly influence our estimates.

†$p < 0.1$ * $p < .05$ ** $p < .01$

Table 3. *The Mediating Role of TMS in the Shared Leadership–Team Performance Relationship is Moderated by Early Time Period: Results of First Differences Models*

	TMS temporal effect	Mediation by TMS	Moderated mediation		
	Model 1	Model 2	Model 3A	Model 3B	Model 3C
	Δ performance $_{(t+1)}$	Δ performance $_{(t+1)}$	Δ performance $_{(t+1)}$	Δ TMS $_{(t+1)}$	Δ performance $_{(t+1)}$
Δ shared leadership $_{(t)}$		0.05	0.27*	0.22*	0.11
		(0.14)	(0.14)	(0.10)	(0.16)
Δ TMS $_{(t)}$	-0.43	0.23†			-0.47†
	(0.26)	(0.14)			(0.27)
Δ TSE $_{(t)}$	0.17	0.00	-0.04		0.17
	(0.14)	(0.14)	(0.30)		(0.17)
Δ performance $_{(t)}$	0.07	-0.21	-0.30	0.05	0.05
	(0.18)	(0.20)	(0.36)	(0.08)	(0.18)
Δ shared leadership $_{(t)}$ × time dummy			0.01	-0.07	-0.18
			(0.26)	(0.12)	(0.22)
Δ TMS $_{(t)}$× time dummy	1.00**				1.04**
	(0.35)				(0.35)
Time dummy			-1.19*	-0.07	-0.83**
			(0.46)	(0.14)	(0.21)
Constant	0.01	0.03	1.16	0.08	0.84**
	(0.03)	(0.03)	(0.42)	(0.12)	(0.21)
QIC	79.03	81.07	88.01	49.64	78.20

Notes: Bootstrapping (10,000 runs) standard errors are in parentheses. We used the generalized estimating equations (GEE) method (Zeger & Liang, 1986).
†$p < 0.1$ * $p < .05$ ** $p < .01$

Table 4. *Robustness Check for the results of Table 2: The Shared Leadership–Team Performance Relationship Mediated by TMS (Results of Using Conditional Change Models)*

				Mediation
	Model 1 Performance $_{(t+1)}$	Model 2 TMS $_{(t)}$	Model 3 TSE $_{(t)}$	Model 4 Performance $_{(t+1)}$
Shared leadership$_{(t)}$	0.29†	0.20*	0.25*	0.05
	(0.16)	(0.10)	(0.12)	(0.15)
TMS $_{(t)}$				0.42*
				(0.17)
TSE $_{(t)}$				0.10
				(0.24)
Gender diversity	0.22	0.09	-0.32	-0.02
	(8.71)	(6.26)	(7.57)	(4.65)
Country diversity	-1.14	-2.74*	-1.46	0.67
	(2.43)	(1.20)	(1.26)	(1.41)
Performance $_{(t)}$	0.57†	0.05	0.02	0.70**
	(0.29)	(0.08)	(0.08)	(0.24)
Performance $_{(t-1)}$	0.34	0.02	-0.05	0.23
	(0.31)	(0.07)	(0.07)	(0.16)
Constant	-0.81	0.47	5.62	-1.10
	(5.45)	(4.18)	(4.93)	(3.57)
QIC	113.85	59.48	55.54	85.85

Notes: Bootstrapping (10,000 runs) standard errors are in parentheses. We used the generalized estimating equations (GEE) method (Zeger & Liang, 1986).

We followed the procedure suggested in the literature in the selection of the best-working correlation structures and models (Cui, 2007).

We estimated the proposed GEE model specifications using the conditional change model (Plewis, 1985) by including a one-period lagged team performance as an independent variable to predict team performance in the following period. To save space, the results of period dummies included in the models are not reported here.

†$p < 0.1$ * $p < .05$ ** $p < .01$

Table 5. *Robustness check for the results of Table 3: The Mediating Role of TMS in the Shared Leadership–Team Performance Relationship Moderated by Time Period (Results of Conditional Change Models)*

	TMS temporal effect	Mediation by TMS	Moderated mediation		
	Model 1	Model 2	Model 3A	Model 3B	Model 3C
	Performance $_{(t+1)}$	Performance $_{(t+1)}$	Performance $_{(t+1)}$	TMS $_{(t+1)}$	Performance $_{(t+1)}$
Shared leadership $_{(t)}$		0.05	0.38*	0.28*	-0.09
		(0.15)	(0.18)	(0.12)	(0.20)
TMS $_{(t)}$	0.22	0.42*			0.07
	(0.22)	(0.17)			(0.25)
TSE $_{(t)}$		0.10	0.45**		0.24
		(0.24)	(0.14)		(0.16)
Performance $_{(t)}$	0.80**	0.70**	0.24**	0.03	0.84**
	(0.17)	(0.24)	(0.08)	(0.08)	(0.19)
Performance $_{(t-1)}$	0.21	0.23	0.85**	0.01	0.21
	(0.15)	(0.16)	(0.10)	(0.07)	(0.17)
Shared leadership $_{(t)}$ × time dummy			0.03	-0.13	0.17
			(0.24)	(0.12)	(0.33)
TMS $_{(t)}$× time dummy	0.49†				0.52†
	(0.27)				(0.32)
Time dummy			-1.21**	-0.01	-0.82†
			(0.39)	(0.21)	(0.44)
Gender diversity	-0.07	-0.02	0.21	0.14	-0.05
	(4.26)	(4.65)	(0.68)	(6.31)	(3.71)
Country diversity	0.54	0.67	-0.58	-2.65*	0.50
	(1.18)	(1.41)	(1.16)	(1.20)	(1.15)
Constant	-0.21	-1.10	-2.20	0.03	-0.78
	(2.81)	(3.57)	(1.65)	(4.30)	(2.74)
QIC	101.12	85.85	51.72	59.97	84.09

Notes: Bootstrapping (10,000 runs) standard errors are in parentheses. To save space, the results of period dummies included in the models are not reported here. †$p < 0.1$ * $p < .05$ ** $p < .01$

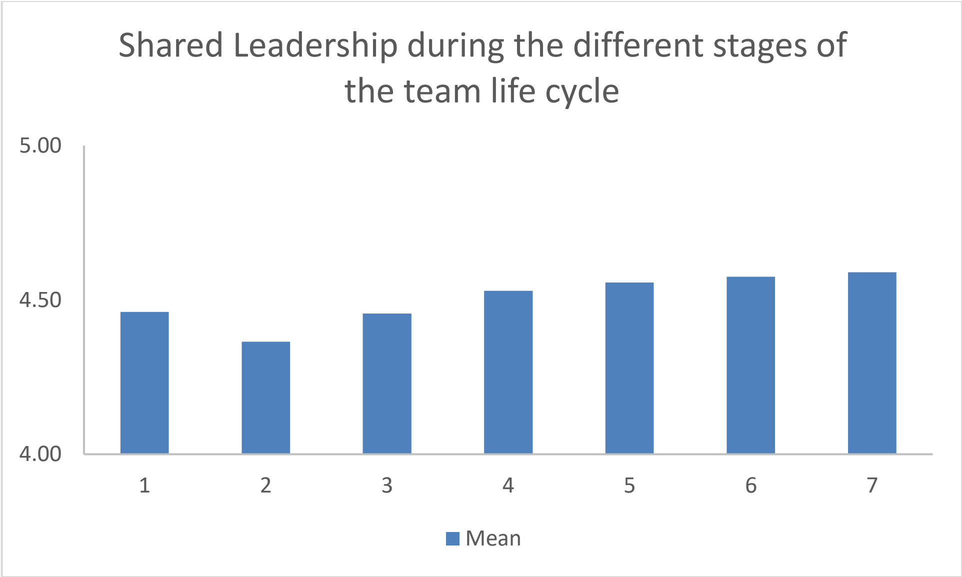
Table 6. *The Effect of Δ Shared Leadership $_{(t)}$ on Δ TMS $_{(t+1)}$*

	Model 1	Model 2
	Δ TMS $_{(t+1)}$	Δ shared leadership $_{(t+1)}$
Δ shared leadership $_{(t)}$	0.15*	-0.45**
	(0.08)	(0.09)
Δ shared leadership $_{(t+1)}$	0.20†	
	(0.11)	
Δ TMS $_{(t)}$	-0.31**	-0.19
	(0.10)	(0.16)
Δ TMS $_{(t+1)}$		0.29†
		(0.17)
Δ performance $_{(t)}$	0.16**	0.03
	(0.05)	(0.11)
Constant	0.05	-0.10
	(0.09)	(0.12)
QIC	41.71	56.21

Note: the results of Model 1 demonstrate that Δ shared leadership (t) positively influences Δ TMS (t+1) ($\beta = 0.15$, $p < 0.05$). In contrast, the effect of Δ TMS (t) on Δ shared leadership (t+1) is insignificant ($\beta = -0.19$, $p > 0.10$). These results provide support to our conceptualization of the causality of the relationship between shared leadership and TMS. Bootstrapping (10,000 runs) standard errors are in parentheses.

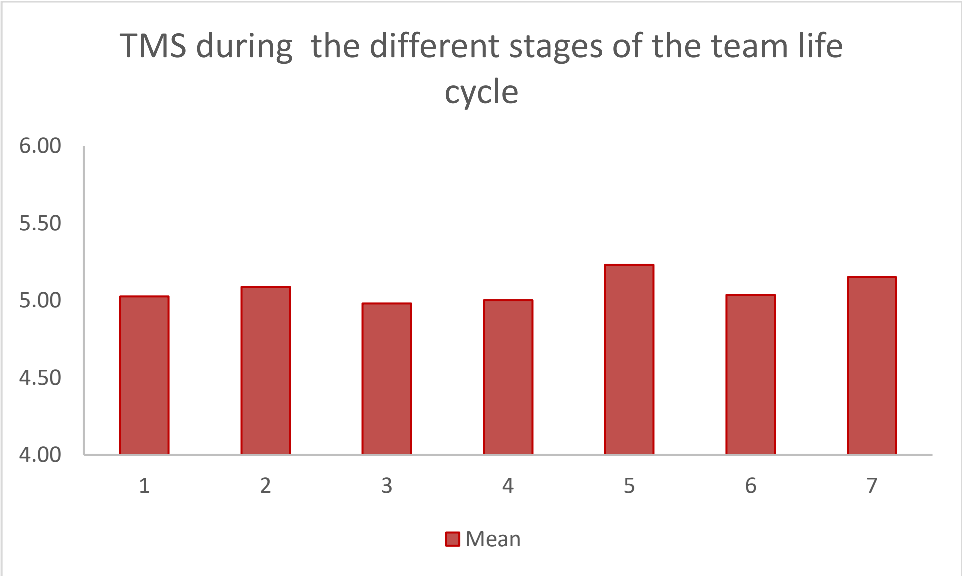
†$p < 0.1$ * $p < .05$ ** $p < .01$

Figure 1a. Shared Leadership during the Different Stages of the Team Life Cycle



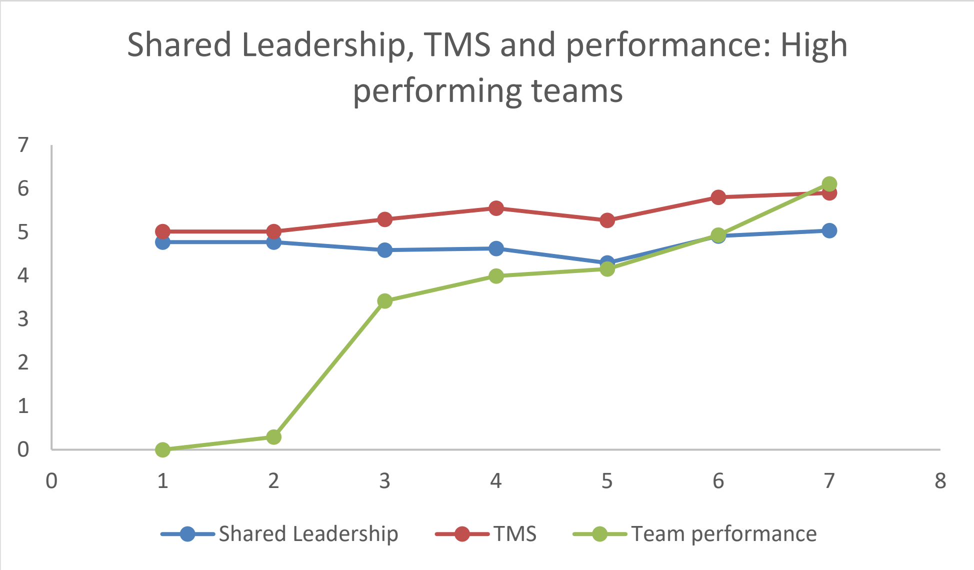
Note: Overall, for all the teams, the mean values of shared leadership in the later stages (e.g., 5, 6 and 7) are higher than those in the early stages (e.g., 1, 2 and 3). The standard deviations from periods 1 to 7 are 0.49, 0.60, 0.68, 0.83, 0.42, 0.78, and 0.78 respectively, which suggests that there are significant variances across teams for each period.

Figure 1b. TMS during the Different Stages of the Team Life Cycle



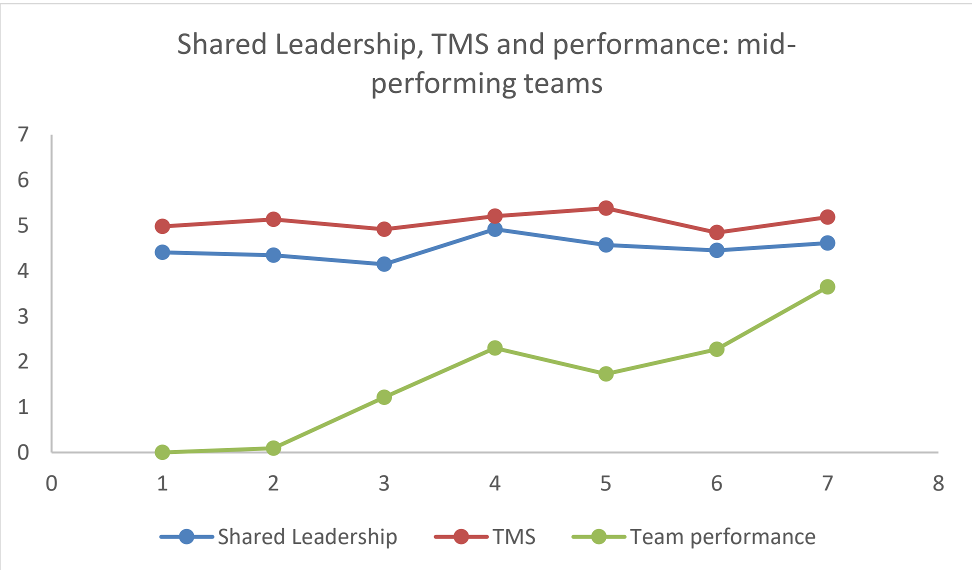
Note: the mean values of TMS in stage 5 are the highest, and in stage 7 they are the second highest. In addition, the mean values of the early stages (e.g., stages 1, 2 and 3) are lower than those in the later stages (e.g., 5, 6 and 7). The standard deviations from periods 1 to 7 are 0.40, 0.38, 0.44, 0.65, 0.75, 0.79, and 0.61 respectively, which suggests that there are significant variances across teams for each period.

Figure 2a. The Temporal Effects of TMS on Performance – High-performing Teams



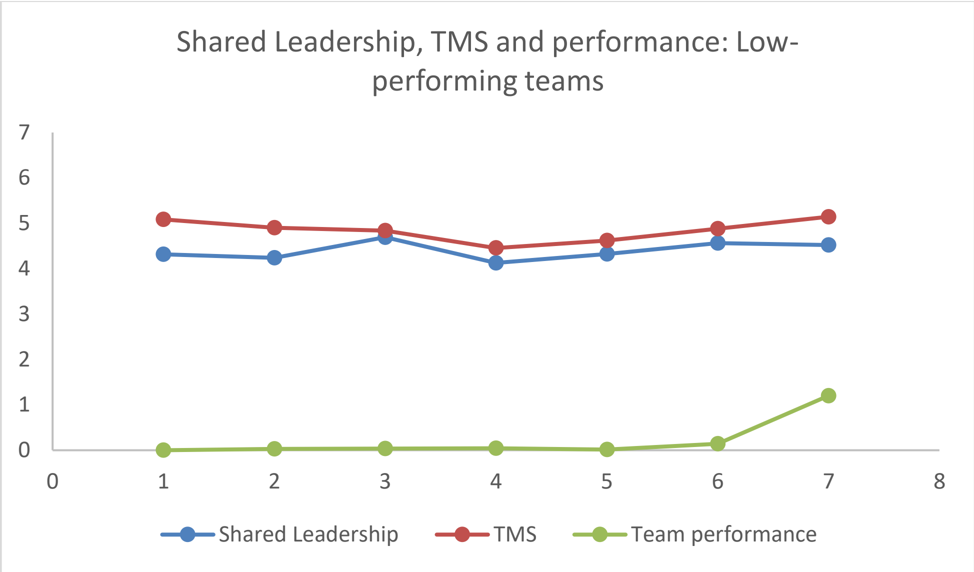
Note: The TMS of high-performing teams shows a pattern of slight increase over the whole team life cycle, while the pattern for team performance presents a steeper increase in the early periods. Such patterns provide preliminary evidence of a stronger effect of TMS on team performance in the early period of the team life cycle.

Figure 2b. The Temporal Effects of TMS on Performance – Mid-performing Teams



Note: The TMS of mid-performing teams shows a pattern of slight increase over the whole team life cycle (there are some fluctuations as well), while the pattern for team performance presents a steeper increase in the earlier periods. Such patterns provide preliminary evidence of a stronger effect of TMS on team performance in the early period of the team life cycle.

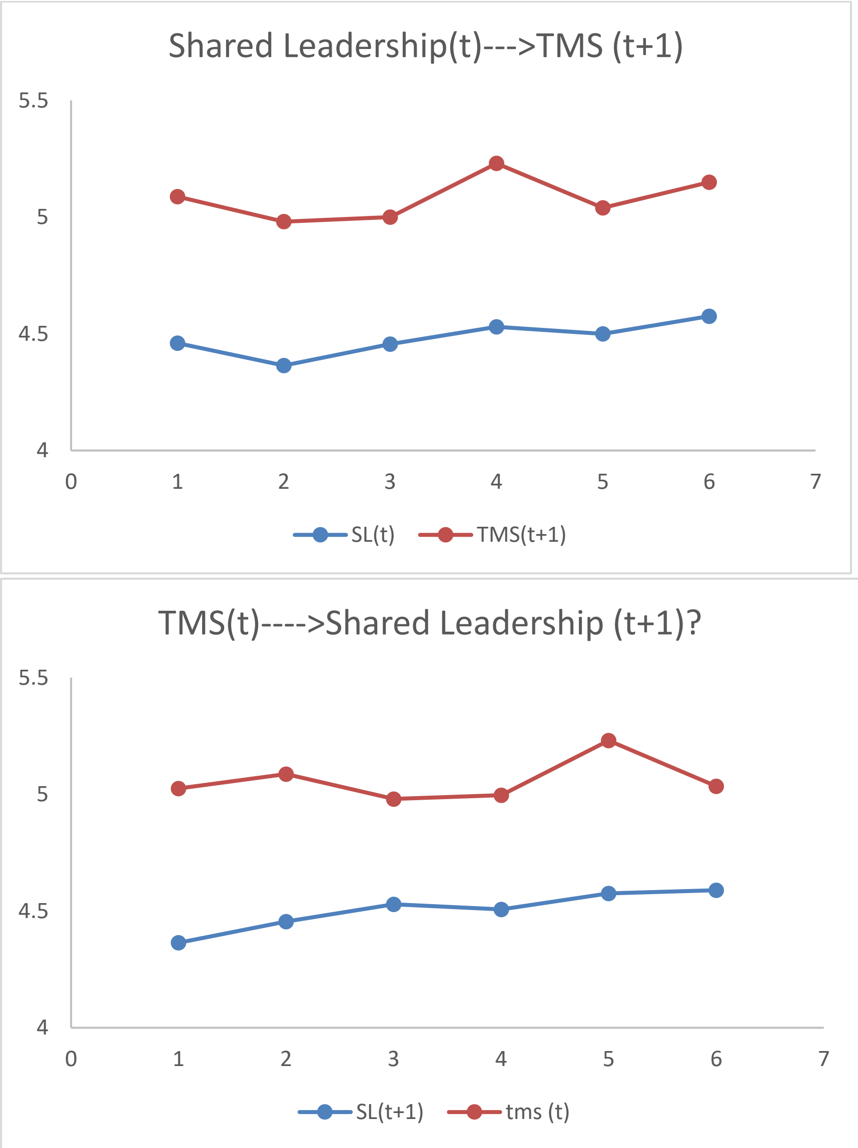
Figure 2c. The Temporal Effects of TMS on Performance – Low-performing Teams



Note: The TMS of low-performing teams shows a pattern of slight decrease in the early periods and then a recovery in the later periods. Similarly, shared leadership also shows a pattern of recovery in the later period. Such patterns are consistent with the theory of the punctuated equilibrium model (Gersick 1988). Specifically, at the later stage, the radical change (evolution) drives the less successful teams to develop a new framework (e.g., shared leadership and TMS) for their teamwork and a collective sense of urgency in achieving the task and meeting the deadline. Accordingly, the performance of low-performing teams witnessed an improvement in the latter period (from period 6 to period 7).

High-performing teams are those teams with team performance that stays at one standard deviation above the mean value of team performance of each period. Low-performing teams are those teams with performance that stays at one SD below the mean; the rest of the teams are mid-performing teams.

Figure 3. The Causal Relationship Between Shared Leadership and TMS



Note: The figure on the top shows a consistent pattern, whereby an increase (or decrease) of shared leadership at time t corresponds to an increase (or decrease) in TMS at time (t+1). In contrast, the figure at the bottom demonstrates a rather different picture, whereby the values of TMS at time t fluctuates constantly and yet the values of shared leadership at time (t+1) shows a pattern of steady increase. The contrasting patterns in the two figures may suggest the causal relationship between shared leadership $_{(t)}$ and TMS $_{(t+1)}$, and not the other way round.