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Emergence of shared leadership networks in teams: An adaptive process perspective ☆

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ABSTRACT

Adaptive leadership theory suggests that shared leadership networks grow in a complex manner. We propose that leadership decentralization (the dispersion of leadership), leadership density (the total amount of leadership), and situationally-aligned leadership (SAL: leadership transitions to those who fit situation requirements) are distinct aspects of a shared leadership network and should be examined together to capture the development of shared leadership process. Through a study of 450 participants in 90 teams, we find that each of these three aspects of shared leadership plays a different role during shared leadership network emergence. Specifically, transactive memory systems (TMS) contribute to decentralized leadership structures, which in turn precipitate more dense leadership networks. We also find that TMS contributes to the most situationally aligned team member engaging in leadership. Both leadership density and SAL predict team performance. We discuss the theoretical and practical implications of these results.

Introduction

Effective leadership is critical for team success (Morgeson et al., 2010). As organizations have become more complex, relying increasingly on empowered and adaptive teams, researchers have realized that our understanding of team processes is incomplete without considering informal leadership behaviors initiated by individuals without designated managerial titles (Neubert & Taggar, 2004). At the meso level, this idea is conceptualized as 'shared leadership,' representing an emergent team capacity in which multiple members assume leadership roles, leading one another either simultaneously or by rotating leadership roles (Carson et al., 2007). In organizational teams, such leadership is best represented as a network of leadership influence ties, consistent with a social network perspective (Wasserman & Faust, 1994). Several meta-analyses provide consistent evidence that shared leadership networks are positively associated with overall team performance (D'Innocenzo et al., 2016; Nicolaides et al., 2014; Wang et al., 2014). In such networks, various patterns of leadership influence within the team are possible, with unique patterns holding different implications for performance (Mayo et al., 2003).

Given shared leadership's implications for team effectiveness, it is important to understand when and how such informal leadership can emerge within teams. However, studies of this phenomenon have been relatively sparse (Lorinkova & Bartol, 2020), perhaps because it has been challenging to fully and accurately model the emergence of shared leadership due to its nature as a multi-faceted construct (D'Innocenzo et al., 2016). These different aspects of shared leadership, such as density and decentralization, are almost exclusively studied independently, in their own theoretical siloes. As a result, although we have developed a substantial body of knowledge regarding how these aspects each work on their own, we have limited understanding of the roles they play alongside each other, and specifically how they can emerge together to create an effective team state of shared leadership. Theoretically, shared leadership is generally understood to develop as leadership roles transition across team members, evolving into a dense structure with most members participating in leadership roles, especially when their expertise and skills fit team needs (Contractor et al., 2012; Pearce & Conger, 2003). However, the precise temporal nature of this process, and exactly how the aspects of shared leadership co-develop, has yet to be well theorized and tested, limiting both our theoretical understanding of the shared leadership process and teams' abilities to put it into practice.

To address this concern, we develop and test a temporal process model of shared leadership development, involving the manifestation

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of all three of shared leadership's important aspects. The first and most commonly studied of these aspects involves the overall amount of leadership in teams, empirically demonstrated by network density (e.g., Carson et al., 2007). A second aspect of shared leadership involves the decentralization of team leadership networks, in that shared leadership involves networks with status equivalence rather than influence concentrated mostly on a single, often-hierarchical leader (e.g., Mayo et al., 2003). Finally, core theory on shared leadership suggests that it is most efficacious due to emergent matches of leaders with situations (e.g., Conger & Pearce, 2003; Erez et al., 2002), or 'situationally aligned leadership' (SAL). That is, individuals with the right knowledge, skills, and abilities for particular situations are theorized to emerge and lead the team in their areas of expertise (Contractor et al., 2012). Theoretically, it is clear that all three aspects are essential to understanding the full scope of the shared leadership concept. However, researchers rarely consider their joint relationships and capabilities. When density or decentralization is examined, usually only one is modeled and treated as if it represents the totality of shared leadership (e.g., Carson et al., 2007; D'Innocenzo et al., 2016; Mayo et al., 2003). When they both appear, they are treated as independent despite extant theory suggesting that they should relate to one another (DeRue et al., 2015). Meanwhile, the situationally aligned aspect of shared leadership has never been empirically demonstrated or linked to the other aspects despite its nature as essential to shared leadership development and effectiveness (Contractor et al., 2012). Therefore, a comprehensive examination of shared leadership, particularly the interrelationship between its aspects, is necessary to best align theory with methodology and fully understand how shared leadership can develop in teams.

To resolve these issues, we propose and test a dynamic temporal model of how leadership density, decentralization, and SAL logically emerge in teams and build upon one another, ultimately impacting team performance. For this investigation we draw upon adaptive leadership theory (DeRue 2011; DeRue & Ashford, 2010), which proposes that team members assume short-term leader or follower roles based on factors such as expertise and credibility as the team adapts to dynamic situations. This perspective suggests that TMS, or the *meta*-knowledge of team members' expertise and a transactive process of utilizing the distributed expertise (Moreland, 1999), may serve as a key factor impacting the emergence of shared leadership processes. Using a time-lagged multi-wave study design built in a team task simulation, we decompose the temporal process of leadership structure emergence by modeling how the three aspects of shared leadership develop over time and eventually affect performance. We propose and find evidence that team TMS sparks a team's SAL and contributes to a more decentralized leadership network, which, in turn, has a positive effect on team leadership density. We also find that leadership density and SAL predict team performance.

The main purpose and contribution of this research is to comprehensively examine the shared leadership development process, through its eventual impact on team performance, by examining all three of its aspects in a temporal process model. Whereas previous research has built substantial knowledge on how each individual aspect of shared leadership might precipitate team performance, we answer calls to examine the more nuanced nature of shared leadership (D'Innocenzo et al., 2016) by modeling how all three of its aspects develop and interact over time, culminating in their impact on team effectiveness. In this manner, our model serves as the first to simultaneously model multiple aspects of shared leadership networks and their connections with each other, while accounting for the essential dynamics of leadership transition across team members (Contractor et al., 2012). We explicitly unpack the process of shared leadership emergence by applying adaptive leadership theory to build and test an overarching leadership network growth process. Echoing the original conceptualization of shared leadership that emphasized its time-varying nature (Pearce & Conger, 2003), our findings detail distinct roles of the three shared leadership aspects in different phases of its development and explain their contributions to team performance. As such, our study provides a more nuanced understanding of shared leadership emergence and development.

Theory and hypotheses

There has been growing interest in studying leadership as a relational phenomenon, specifically through a social network approach, as it provides a more comprehensive perspective on relationships among individuals in a social context such as in teams (Balkundi & Kilduff, 2006). For instance, previous research has demonstrated that a formal team leader's centrality in the team advice network impacts how leader-like (Chiu et al., 2017) or charismatic (Balkundi et al., 2011) he or she may be perceived. A formal team leader's informal relationships outside their team also have substantial effects on team performance (e.g., Mehra et al., 2006). As these examples indicate, research on social network approaches to leadership emphasizes the impact of various types of social networks (e.g., avoidance and friendship networks) on the emergence and effectiveness of formally appointed leaders (e.g., Balkundi & Harrison, 2006; Balkundi et al., 2011; Chiu et al., 2017; Mehra et al., 2006).

Building on this work, another way to apply a network approach to leadership is to conceptualize leadership itself as an influence network, wherein each person on the team can be a source of leadership influence and participate in team leadership. This approach offers a more comprehensive conceptualization of shared leadership as social networks capture leadership ties that exist within a team (Carson et al., 2007; D'Innocenzo et al., 2016) without being limited to the assumption that leadership influence can only emanate from individuals with formal managerial titles (DeRue, 2011; DeRue & Ashford, 2010).

Although theory on shared leadership can be traced back decades (e.g., Follett, 1973; Gibb, 1954; Katz & Kahn, 1978), it has only recently been formally defined as "a dynamic, interactive influence process among individuals in groups for which the objective is to lead one another to the achievement of group or organizational goals" (Pearce & Conger, 2003, p. 1). Traditional leadership conceptualizations describe a top-down influence process originating from a single formal team leader (Day & Harrison, 2007). In contrast, shared leadership emphasizes that multiple team members, even without formal managerial titles, can step up, assume influence, and help the team progress towards its goals (Pearce & Sims, 2002; Carson et al., 2007). Rather than viewing leadership as a role tied to formal positions (Turner, 2001), the shared leadership literature conceptualizes it as a functional role, such that informal leaders can emerge spontaneously as they acquire situational leadership identities during sustained interactions in a group setting (DeRue & Ashford, 2010). Broader leadership participation manifested in behaviors such as planning team tasks, providing support, and influencing decision making, can allow members with knowledge, skills, and abilities uniquely suited to the team's current challenges to leverage their expertise and guide the team to greater performance (Burke et al., 2003; Conger & Pearce, 2003). As such, a leadership role can be assumed by anyone regardless of their position roles in a team or organization. Overall, the accumulated empirical evidence indicates that shared leadership is a useful phenomenon for teams in that it boosts desirable outcomes such as team performance (D'Innocenzo et al., 2016; Wang et al., 2014).

Adaptive leadership theory (DeRue, 2011; DeRue & Ashford, 2010) provides a framework to develop a model for the emergence of shared leadership. This theory posits that the construction of shared leadership is based on the leadership relationships that develop among team members as they claim and grant leadership roles from and to each other. These claims are accepted and recognized based upon, among other factors, their clarity and credibility. To the extent that teammates recognize behaviors as leader-like and accept their legitimacy, new leaders can emerge as they are granted these roles. Leadership claims are more likely to be initiated when the risk of rejection is low, and they are more likely to be granted by others when the claims are perceived as credible, arising from competent teammates (DeRue & Ashford, 2010). This perspective proposes that leadership will most strongly emerge when the team's environment (a) supports the credibility and clarity of leadership claims and (b) minimizes the risk of rejection.

Constructing leadership roles is not the final stage of shared leadership. Adaptive leadership theory suggests that shared leadership networks develop over time and take on different patterns via repeated dyadic leading-following interactions, or leadership ties. Depending on how much leadership is displayed and where the leadership roles reside, shared leadership networks can vary in overall magnitude and dispersion (DeRue, 2011). The magnitude of leadership exhibited in teams can be represented by network density – the proportion of actual to possible links (e.g., leadership ties) present in the network (Wasserman & Faust, 1994). Network density indicates the total amount of leadership emerging within a team, taking into account how strongly each member evidences leadership to all other group members. The dispersion of leadership throughout the team can also be demonstrated by network decentralization – a team-level index representing the extent to which leadership influence is distributed across the overall network (D'Innocenzo et al., 2016; Wasserman & Faust, 1994). Thus, shared leadership is a team property, featuring a network structure with different density and decentralization patterns, which emerge and evolve as team members influence each other.

Scholars in social networks (e.g., Wasserman & Faust, 1994), leadership (e.g., Sparrowe et al., 2001) and shared leadership in particular (e.g., DeRue et al., 2015) have long recognized that these two network concepts are theoretically and empirically distinct. As noted by Lemoine and colleagues (2020) concerning shared leadership: "Density and decentralization represent different and not necessarily correlated aspects of a network…." (p. 435). At extremely high levels of density, decentralization must also mathematically be fairly high (Butts, 2006), but decentralization cannot be mathematically concluded from other levels of density, nor can density be inferred from any level of decentralization (Freeman, 1978; Lemoine et al., 2020). For instance, if a leadership network becomes more dense, it might be because more members are engaging in leadership (indicating more decentralization) or because a few members are engaging in relatively more leadership (indicating less decentralization). Team leadership researchers are increasingly recognizing that neither density nor decentralization alone can provide a full picture of the constellation of shared leadership within a team (e.g., DeRue et al., 2015; D'Innocenzo et al., 2016; Lemoine et al., 2020). Thus, it is essential to understand how the two aspects function differentially in the development process of shared leadership.

It is plausible that relatively early leader role interactions establish norms within the team such that granted leader claims enhance the credibility of future claims, whereas rejected leader claims increase the perceived riskiness of future claims. Patterns of influence arise organically as team members first interact and establish norm perceptions. As such, instead of shared leadership existing as a static state, team leadership emergence is a process during which specific network structures may unfold, develop, and evolve (DeRue, 2011). The limited work on antecedents of shared leadership supports this view. A qualitative study of repeated delegation and leadership development (Klein et al., 2006) and research on cross-functional team power transition during changing tasks (Aime et al., 2014) provide evidence that leadership networks grow and develop dynamically over time, and an understanding of the differentiated expertise within the team may significantly shape the development of shared leadership. Thus, given that shared leadership networks generally feature an absence of hierarchy or notable status differences based on formal titles or legitimate bases of power (Pearce & Conger, 2003; Yukl et al., 1996), leadership roles are often most dependent upon the perceived competence of the individuals attempting to claim influence, originating from their possessed expertise (Bunderson, 2003; Yukl & Falbe, 1991).

Altogether, this logic indicates that transactive memory systems (TMS) within teams, defined as the division of knowledge and members' active use of each other's knowledge to perform a joint task (Lewis, 2003), may play an essential part in creating conditions within which team members would be most likely to claim and grant leadership roles. A TMS is a team state which entails not only a shared understanding of who knows what, but also a set of knowledge-relevant transactive processes by which team members encode, store, and retrieve knowledge from holders to use towards achieving the team's goals (Lewis, 2003; Lewis & Herndon, 2011).

The original conceptualization of TMS described an implicit division of cognitive labor in intimate couples, developed over time, to impact what couples can remember and utilize in various situations (Wegner, 1986). Subsequent research moved the study of TMS from personal relationships to organizational teams and examined how TMS could also develop in newly formed teams (e.g., Hollingshead, 2000; Moreland et al., 1996; Stasser et al., 1995). This evolution in the study of TMS argued that while common relationship history and time might help make TMS more efficient, substitute processes may foster TMS development and make it possible for newly formed teams to develop a meaningful TMS in a short time. For example, when a clear division of expertise is communicated to a newly formed team, individuals are more likely to view each other as individuals with unique skills (Liang et al., 1995; Moreland, 1999). Such perceptions motivate each person to focus on learning information in their own area of expertise, expecting others to do the same and reducing cognitive labor for each member (Hollingshead, 1998a; 2000). Strasser et al. (1995), for instance, found that when impromptu groups were told explicitly about each member's area of expertise, they were more likely to spend time discussing uniquely held information, enabling them to make better decisions. The explicit communication of how expertise is distributed in a newly formed team enables encoding, storing, and retrieving knowledge to happen more quickly, helping teams develop valuable TMS. Confirming this view, past research suggests communication regarding member expertise happens at the early stages of team development (Hollingshead, 1998b; Pearsall et al., 2010), allowing the team to gain significantly in TMS early on.

Within a TMS, the specialized knowledge and meta-cognition of 'who knows what' allows and encourages members to seek requisite information from team members with relevant expertise. Such coordinated actions, in turn, facilitate repeated knowledge- and influence-sharing interactions throughout the network. When team members learn about each other's strengths and areas of expertise, this understanding and respect for teammate competence enhances the credibility of leadership claims and increases the odds that others will grant those claims. Similarly, if a member knows that others view them as competent and capable, they will perceive lower risks for stepping up in leadership roles. The unique expertise held by team members helps them to be regarded as experts and influential in their specialized area (French et al., 1959), providing them with credible, low-risk bases for influence and leadership claims while demonstrating their competence. Especially for the complex and interdependent team tasks for which shared leadership is most useful (Wang et al., 2014), specialized knowledge and expertise are likely to be required from multiple individuals (Aime et al., 2014; Austin, 2003). Team members might even seek leadership from those with specialized knowledge and perceived credibility by directly granting a leadership role to them without a claim beforehand (DeRue & Ashford, 2010). Thus, it is likely that TMS is an important factor for shared leadership development.

We propose that TMS enhances overall team shared leadership by first impacting network decentralization, understood as the degree to which leadership influence is dispersed across team members rather than being concentrated on a select few (Mayo et al., 2003). Again, decentralization is likely *not* best considered as an omnibus measure of the amount of shared leadership in a network; instead, it measures the relative *leadership status equality* across a team network (Lemoine et al., 2020). More decentralized networks are more equal, but they may entail much, little, or no actual leadership exhibited (D'Innocenzo et al., 2016; Lemoine et al., 2020).

As argued above, a strong team TMS facilitates the credibility of leadership claims while reducing interpersonal risk, thus creating conditions for more individuals to emerge as leaders (DeRue & Ashford, 2010; DeRue et al., 2015). This does not necessarily indicate strong or overbearing leadership claims or grants, as it is instead plausible that a new team with enhanced TMS will at first make tentative and minor leadership claims and grants among themselves, creating a group norm and culture of mutual influence and status equality over time. That is, members may initially 'test the waters' with relatively weak leadership claims, based on their confidence and perception of minimized risk due to TMS, until a group norm of leadership-sharing more firmly develops. Therefore, developing networks may be decentralized, with many leaders engaging in tentative and relatively minor initial leadership roles. Alternatively, in a team with low TMS, a lack of knowledge of member strengths may cast doubt on member competence and credibility, making members more hesitant to claim or grant leadership roles. Altogether, this logic suggests that TMS's effects on perceived claim credibility and risk should increase the extent to which multiple team members engage in leadership role construction, resulting in more decentralized leadership networks. At the team's early stages, dense networks with high degrees of shared leadership may not yet have time to develop, but a more equal, decentralized network is more likely. As such, we propose:

Hypothesis 1: A transactive memory system in a team will be positively related to the extent to which leadership is distributed (vs. centralized) in the team.

Because decentralization alone does not address how much leadership as a whole arises in a group, it is essential to also consider other aspects of shared leadership, such as density. We propose that the conditions extant in a more equal and decentralized network, regardless of leadership quantity, should subsequently drive greater group engagement in leadership behaviors, represented by a high level of shared leadership density. Early on in the team process, weak leadership claims and grants may be marked by mild influence, idea-sharing, and offers of help. This might represent the development of a safe climate wherein team members feel comfortable exerting influence and being open to influence from others in the team (Bradley et al., 2012; Edmondson, 1999). With each successfully claimed and granted leadership role and influence relationship that is developed consequently, however weak, the group's norms of leadership sharing are strengthened. This reduces team members' perceived risks of claiming leadership roles and, importantly, substantially increases the credibility of future leadership ties team members attempt to establish (DeRue & Ashford, 2010). With enhanced credibility and reduced risk, team members become more confident to claim stronger leadership roles. Enhanced confidence, in turn, motivates members to engage in additional leadership and helps them be perceived as more leader-like in the eyes of their team members (Anderson et al., 2008). As members engage in more leadership behaviors and grant members' subsequent stronger claims of leadership, they create a robust and dense leadership network, resulting in a higher overall amount of leadership exhibited in the team.

In this way, leadership decentralization can contribute to the development of more dense leadership networks over time. This rationale would not operate in the opposite direction, such that leadership density might precipitate decentralization. Consider, for instance, a traditional vertical leadership network, which would suggest some magnitude of leadership but no decentralization. Role theory suggests that members of such a group would 'settle' into their allotted roles and leave leadership to the extant leaders (Dansereau et al., 1975). Because of this, the existence of one or a few influential leaders, as might be present in situations of moderate density, may create norms for rigid leadership structures centralized on one or a few individuals (Taggar & Ellis, 2007). Initial increases in density, then, might not necessarily drive decentralization. However, decentralization should create team norms that enable more substantial leadership claims and grants.

Hypothesis 2: Leadership decentralization in previous stages of shared leadership development will be positively related to leadership density in subsequent stages.

Hypothesis 3: A transactive memory system in a team will have an indirect effect on leadership density via a decentralized leadership structure, such that TMS will promote a decentralized leadership structure, which will impact leadership density in a subsequent stage.

Density and decentralization are the two most commonly studied aspects of shared leadership (D'Innocenzo et al., 2016). However, we propose a third network aspect of importance, which we refer to as situationally-aligned leadership (SAL). Much of the foundational theory of shared leadership indicates an assumption that shared leadership predicts performance because the appropriate members – credible subject-matter experts – step up as leaders in the appropriate situations (Conger & Pearce, 2003; Contractor et al., 2012). If leadership emerges more arbitrarily, such that individuals lacking essential skills or appropriate competencies emerge to become leaders, there might be less reason to believe that their leadership would drive performance. "Situationally-aligned" emergent leaders may be essential for efficient and effective problem solving (Aime et al., 2014; Conger & Pearce, 2003). The idea of SAL is similar to that posed in Fiedler's (1978) contingency theory of leadership, but whereas Fiedler argued that the situation moderates the effects of a single hierarchical leader's behaviors (either task-oriented or relation-oriented) on group performance, shared leadership theory indicates that specific individuals may be more suited to lead based on situational needs – that is, the *team* adjusts its *leader* for a particular situation. Given our interest in understanding the emergence of shared leadership, which emphasizes the match between the situational requirements and competencies of individual team members from whom leadership influence originates, examining SAL is essential to our theoretical model.

A well-developed TMS creates team knowledge regarding unique resources held by each member of the team, without which those members would lack credibility to make leadership claims or have them granted (DeRue & Ashford, 2010). A TMS entails a knowledge division and coordination system, where team members know where to find and retrieve key knowledge and expertise and are able to coordinate information for joint tasks. When team members with knowledge, skills, or abilities particularly relevant to a team's unique situation know that the group recognizes and values their expertise, they feel more confident in stepping up. Similarly, team members are more likely to grant such claims of influence based on their awareness of that expertise (Mayer et al., 1995). Alternatively, when team members know who holds relevant knowledge and expertise, they might nominate that individual as their leader by granting the leadership role to them. Over time, changing situations cause changes in roles held by team members (Mead, 1934) – a team member who takes on a follower role in one situation, might assume a leadership role in another. Unique expertise can serve as a cue to the team that certain members are particularly well-suited to serve in a leadership role. This effect would logically be most potent when there is a developed TMS among team members. In this manner, the credibility of leadership claiming and granting interactions for team members with particularly situationally-relevant expertise is substantially enhanced, thereby creating more favorable conditions for SAL.

Hypothesis 4: A transactive memory system in a team will be positively related to the emergence of situationally-aligned leaders.

Finally, in line with an abundance of empirical work, we expect that multiple aspects of shared leadership will positively relate to team performance. As demonstrated by previous meta-analytic studies (e.g., D'Innocenzo et al., 2016), when the team features high levels of leadership influence, reflected in high leadership density, knowledge exchange among members is improved, and team coordination and efficiency are enhanced. In addition, the utilization of team members' knowledge and expertise also improves teams' social capital, which in turn enhances team performance (Day et al., 2004). We also propose that when situationally-aligned team members engage in high levels of leadership, task performance should likewise improve. Aligned with earlier work on power transitions (Aime et al., 2014; Burke et al., 2003; Pearce & Conger, 2003), members with uniquely relevant resources for the team's context may be best suited to coordinate activities and guide the team to maximum effectiveness. Such team members may possess a superior understanding of problems, awareness of solutions, and access to the appropriate tools and mechanisms to efficiently guide the group. A position of leadership is an ideal one from which such situationally-aligned members can influence teams to achieve high performance.

In contrast, more decentralized leadership alone is not likely to directly influence team performance because status-equality (i.e., completely decentralized leadership) on its own does not indicate whether meaningful leadership influence is being exercised within the team. Indeed, a highly decentralized structure might indicate that everyone is at an equal but relatively *low* level of influence, thus engaging in little to no leadership (Lemoine et al., 2020). Although performance boosts might be realized due to status equality in some contexts, stronger team leadership is more likely to have a consistent effect on performance. Thus, we suggest that leadership network density, or the total amount of leadership, will predict overall team performance (e.g., Carson et al., 2007), as will the emergence of situationally-aligned leadership.

Hypothesis 5: Leadership density will be positively related to team performance.

Hypothesis 6: Situationally-aligned leadership will be positively related to team performance.

Methods

We tested these hypotheses in the context of the Mount Everest Leadership and Teamwork Simulation (Roberto & Edmondson, 2008) with 90 teams worked on a multi-part collaborative task. We used a teamwork simulation rather than field design in order to sample newly formed teams, to ensure that member expertise would be distributed such that leadership transitions would be desirable, and so that we could precisely monitor changes in networks over time. To maximize variation in TMS, we conducted an intervention as described below.

Participants

Participants were 450 undergraduate students from a large university in the northeastern United States who received course credit in exchange for their participation in this study. Our sample was 40% female, 21.3 years (SD = 1.99) old on average, 53.8% Caucasian, 33.8% Asian, 5.7% African American, and 3.8% Hispanic.

Procedure

Upon their arrival at the research lab, students were randomly assigned to teams of five members for a total of 90 teams. We then randomly assigned the five roles of the Mount Everest Simulation to members of each team. Previously used in team process research (e.g., Pearsall & Venkataramani, 2015; Tost et al., 2013), the Mount Everest simulation provides an appropriate context for analyzing the emergence of shared leadership as it simulates a complex, interdependent, and relatively ambiguous expedition for the team. Roles assigned to individuals included a designated expedition leader, a photographer, a physician, an environmentalist, and a marathoner, each with unique knowledge and resources, some of which are critical at various phases of the simulation.

Before starting the simulation, students completed a questionnaire assessing their demographics and personality traits. After this questionnaire, we performed a TMS intervention for half of the teams in an effort to generate TMS variance during the teamwork. Although early conceptualization of TMS described its development in natural settings (e.g., Wegner, 1986), the literature on TMS suggests that it can also be fostered in newly formed teams in a lab setting (e.g., Hollingshead, 1998a; Liang et al., 1995; Moreland & Myaskovsky, 2000). In particular, several lab studies have either manipulated TMS (Gupta & Hollingshead, 2010; Mell et al., 2014) or created a group training/intervention for group members to develop TMS and work towards team tasks (Liang et al., 1995; Moreland & Myaskovsky, 2000). Building on this body of research, we gave team members four minutes to study the detailed information about their assigned roles, and then allowed them to spend six minutes discussing and sharing their role information with each other in the team. The purpose of this group discussion was to make sure participants were aware of the specialized knowledge and expertise across members. Following that, the experimenter reminded participants that each one was an expert in their specific area to strengthen each role's credibility and emphasized that effective coordination across team members was critical to the team's success. By so doing, we emphasized the knowledge specialization, credibility of knowledge sources, and the importance of coordination (Lewis, 2003; Liang et al., 1995), expecting to create TMS variance. In contrast, the other half of the teams that did not receive a TMS intervention spent the first six minutes introducing themselves to their teammates, and another four minutes reading their role profiles alone. The detail of TMS intervention is provided in Appendix A1.

After that, teams began the simulation, which involved a group climbing effort to reach the summit of Mount Everest. The simulation included three critical challenges regarding the allocation of medical supplies, assessment of weather conditions, and distribution of oxygen canisters. We measured shared leadership networks after each challenge scenario during which teams needed to make important strategic decisions. In the first and the second challenge, a specific member of the team was particularly suited to influence the team, and coordinate to pool the information and choose the correct strategy, based on the unique background role provided to him or her. For the medical challenge, the team physician was situationally appropriate to gather information and step up to lead and influence the team to make the right decision. For the weather challenge, during which the team faced communication issues with their base camp, the member playing the part of the marathoner was best positioned to take the lead, and coordinate and influence others on the team to be able to solve the challenge. During the oxygen challenge, no specific member was uniquely well-suited to take the lead. In total, it took about 90 minutes to complete the simulation and the surveys. In addition, only the experimenter could allow the simulation to proceed after all teams finished each round and took its accompanying survey. Team members received no performance feedback between the rounds, and only learned their performance after the study's conclusion.

The uniqueness of the Mount Everest simulation is that it allows us to examine the transitions of leadership roles, regardless of participants' assigned positions in the team. The right person to lead in each challenge must go beyond merely playing their position roles, such as a team physician making a diagnosis. They need to act as a leader by clarifying the big picture for the team, communicating effectively, emphasizing team goals, and seeking cooperation and commitment to the team's decisions (Kotter, 1990). Thus, it provides an opportunity to measure leadership that goes beyond just fulfilling their in-role behaviors by engaging in extra-role leadership influence.

Measures

Unless otherwise noted, we used scales ranging from 1 = *strongly disagree* to 7 = *strongly agree*.

TMS was assessed using the 6-item TMS scale from Choi et al.'s (2010), which was adapted from Lewis's (2003) 15-item scale of transactive memory systems. We measured TMS after the medical challenge (Time 1), with the expectation that team members would further develop TMS through a few rounds of team tasks before the medical challenge and after the TMS intervention (Liang et al. 1995; Moreland & Myaskovsky, 2000). Sample items for this scale include, "Our team members have specialized knowledge of some aspects of our task," "Our team members trust that other members' knowledge about the project is credible," and "Our team members know each other and have the ability to work together in a well-coordinated fashion." The Cronbach's alpha coefficient for TMS was 0.92. The full list of TMS items is provided in Appendix A2.

Following Carson and colleagues (2007), the *leadership network* was measured by asking each participant to indicate to what extent their team relied on each team member for leadership during the round they just completed. Responding to this question, each individual assessed the other four team members on a Likert-type scale ranging from 1 = *not at all* to 7 = *to a very great extent.* We measured team leadership networks at multiple time points –Time 1 after the medical challenge, Time 2 after the weather challenge, and Time 3 after the oxygen challenge. Consistent with how others have measured leadership in teams (e.g., Carson et al., 2007; Mehra et al., 2006), this approach captures global leadership perceptions each member forms about his or her teammates and their contribution to team leadership, at different stages of team tasks.

The three aspects of shared leadership – decentralization, density, and SAL were calculated based on the leadership networks we obtained[1]. First, at Time 2, we calculated team leadership centralization values according to Freeman's (1978) centralization formula adapted for valued ties (Lemoine et al., 2020). This resulted in centralization scores for the team leadership networks ranging from zero to one, with 1 indicating the most centralized leadership network (i.e., leadership originating only from a single team member). We reverse-coded the output of this procedure to obtain decentralization scores. A score of 1 indicated a fully decentralized leadership network, and a score of 0 indicated a fully centralized one, so as to make higher scores indicative of more dispersed leadership in the team.

We calculated *team leadership density* at Time 3 by summing team members' ratings of teammates' leadership (as described above) and dividing the sum by the maximum possible amount of leadership within the team. Teams whose members report more leadership from teammates will have a higher level of density (Carson et al., 2007).

We calculated *team situationally-aligned leadership* at Time 2 by dividing the amount of leadership manifested by the situationally-aligned role (i.e., the leadership in-degree value for the marathoner, who uniquely possessed information and resources useful to the weather challenge) by the total amount of leadership existing in the team during that challenge (i.e., the sum of in-degree values for the five roles). This resulted in the proportion of overall team leadership displayed by the individual with the most appropriate resources for the current situation. We chose this ratio rather than the marathoner's simple in-degree leadership, or total raw leadership displayed, as such a value would be a linear component of our density measure and thus create potential confounding effects. We chose to use the marathoner/weather challenge at Time 2 rather than the physician/medical challenge at Time 1 to measure SAL for two reasons. First, by using the weather challenge, we tested a potential leadership transition: the physician, who might play a major role during the medical challenge, would need to step back in favor of the marathoner during the weather challenge. Relying on the weather challenge would allow us to test the transition to the marathoner from the physician. Second, since our theoretical model centers on network growth, we used shared leadership during the medical challenge as the baseline to more restrictively test our hypotheses.

Team performance was the objective performance scores provided by the simulation program (Tost et al., 2013). We modeled this in two different ways relevant to our independent variables. For SAL, we measured performance as the team's performance on the weather challenge. Challenge performance was a 0–1 binary variable that represented failure or success on the challenge. Since we measured SAL during the weather challenge, capturing challenge performance right after the weather challenge was the most appropriate option. For the overall effects of shared leadership density, we used the cumulative goal achievement score (i.e., overall team performance) provided by the simulation at the end for the entire array of challenges, which ranged from 0% to 100% (at Time 4). This score is calculated by taking into account individual and team goal achievements. Teams received points for resolving each challenge. They also received points when individual team members met their role goals (e.g., for the role of the leader, two goals included reaching the summit personally and making sure team members get to the summit). A team could receive a 100% if it resolved all challenges successfully and all team members achieved all individual goals.

Control variables. In predicting leadership decentralization (Time 2) and SAL (Time 2) we controlled for the baseline leadership network decentralization (Time 1). We also controlled for the baseline leadership network density (Time 1) when predicting leadership density (Time 3). Further, we included a series of additional exogenous control variables to rule out alternative explanations for the relationships tested. The additional control variables included team average Big 5 personality traits (measured by using the 20-item Mini-IPIP scale; Donnellan et al., 2006), gender and racial-ethnicity diversity (operationalized using Blau's index of heterogeneity; Blau, 1977), and team TMS intervention conditions[2]. However, the additional control variables did not predict the mediators or the final outcomes significantly. A joint Wald test of them also showed they were not necessary. Therefore, since the pattern of the results remained the same when they were excluded from the analysis, we followed the recommendations of Carlson and Wu (2012) and omitted them from our final analysis. We have presented the results with the additional control variables included in Appendix B.

Data aggregation

Although social network statistics such as density and decentralization do not require within-group agreement as they represent team network patterns rather than shared cognitions, TMS, as a team-level variable, is fundamentally team referent and therefore required checks for interrater agreement. We checked for differences across teams with analysis of variance (ANOVA) tests, which indicated statistically meaningful between-team differences for TMS (F (89, 360) = 1.86,

[1] Importance-weighted density (IWD: Lemoine et al., 2020) has been proposed as the most appropriate measure to operationalize the full shared leadership construct. However, as Lemoine et al. (2020) noted, it is less appropriate when researchers are interested specifically in shared leadership's component aspects and their interrelationships. As such, we model the specific aspects rather than the overall shared leadership construct using IWD.

[2] We also measured team cohesion (using the scale developed by Barrick et al., 2007) as a covariate of team performance but did not include it in the analyses. Post-hoc analyses did not show any changes in the findings with team cohesion included.

$p < .001$). In addition, we calculated the mean within-group inter-rater reliability ($r_{wg(j)}$; James et al., 1984) with slightly skewed distributions, a more conservative test than the uniform distribution (Biemann et al., 2012), as well as intraclass correlations (ICC_1 and ICC_2) to provide further support. Results revealed high inter-rater reliability for TMS (r_{wg} = 0.89) and adequate distribution of within/between-team variance (ICC_1 = 0.15 and ICC_2 = 0.46). The ICC_1 value met the recommended cut-off of 0.12 (James, 1982). ICC_2 values were lower than the cut-off of 0.70 (Klein & Kozlowski, 2000), but this may have been due to the sensitivity of ICC_2 to the small size of teams in our sample (Klein & Kozlowski, 2000; Liao et al., 2009). Overall, this evidence, combined with our theoretical model, justifies the aggregation of TMS.

Analytic strategy

In testing our hypotheses, we used path analyses (with Mplus 7) to estimate all the hypothesized relationships simultaneously. We used a path model with manifest variables and utilized maximum likelihood estimation to calculate coefficient estimates. We also used bootstrapping to calculate confidence intervals (for technical details, see Muthén & Muthén, 2012). In testing the effect from SAL to team challenge performance, we conducted a logit regression due to the categorical nature of challenge performance.

Although we administered a TMS intervention, we did not consider it appropriate to frame this study as a conditional experiment. The TMS literature indicates that it would be difficult for a manipulation to replicate the full spectrum of this construct as TMS develops over time as team members engage in team activities and develop cognitive representations of differentiated knowledge and the interdependence of expertise for task accomplishment (Hollingshead, 1998a, 1998b; Wegner, 1986; Wegner et al., 1991). Thus, we conducted an intervention with the objective of maximizing variance in TMS across teams. Although the intervention did produce a significant difference between the two TMS conditions ($M_{intervention}$ = 5.74 (s.d. = 0.48), $M_{No\ intervention}$ = 5.48 (s.d. = 0.50); F (1, 88) = 5.98, p = .016), this difference was small (0.26; approximately half of a standard deviation of TMS). Because there was more variance in the true TMS scores (with the standard deviation of 0.50), this indicated that there were meaningful differences in measured TMS scores beyond those caused by the intervention. Therefore, we used the direct measures in TMS in testing our hypotheses. Previous research has also used interventions for variance generation and measured scores for hypothesis testing, especially for psychological or cognitive states that may develop in participants in real-life situations but are difficult to replicate in lab settings (e.g., anxiety; Hauser et al., 2018; Schachter, 1959; Stangor, 2004; Wilson et al., 1989).

Results

We first tested the fit of the model, which showed the model fit the data well (Chi-square value = 12.57, df = 7, p = .08)[3]. Table 1 presents the means, standard deviations, and correlations of the study variables. The results of direct effect tests are presented in Fig. 1 and Table 2. Our first hypothesis argued that TMS positively predicts the decentralization aspect of shared leadership. In testing this hypothesis, we controlled for the team's initial level of decentralization to accurately capture the growth of this network property. This hypothesis was supported as we found a significant effect from TMS to leadership decentralization (H1: β = 0.20, p = .01).

Hypothesis 2 predicted that more equally distributed and decentralized leadership networks at Time 2 would precipitate more dense leadership networks at Time 3. For this hypothesis, we again controlled for the team's initial level of the dependent variable (density) to capture the growth. This hypothesis received support in our model (β = 0.35, $p < .001$), suggesting that more decentralized team leadership networks contribute to the subsequent density of leadership in the team.

Integrating the two previous hypotheses, Hypothesis 3 posited an indirect effect of TMS on leadership density through leadership decentralization. Supporting this hypothesis, the indirect effect of TMS on leadership density at Time 3 through leadership decentralization at Time 2 was significant as bootstrapped confidence intervals for the indirect effect excluded zero (*effect* = 0.07, CI_{95} = [0.01, 0.14]).

Our next hypothesis (H4) involved the effect from TMS to situationally-aligned leadership emergence. Supporting this hypothesis (H4: β = 0.22, p = .002), we found that TMS at Time 1 precipitated SAL at Time 2. In teams with more extensive transactive memory systems, marathoners (the situationally-aligned leadership role) engaged in significantly greater leadership relative to their teammates[4]. Further evidence for SAL transition is provided by results for the team physicians. If TMS indeed facilitated SAL transitions, then we could expect the physicians to exhibit relatively less leadership, whereas the marathoners would exhibit relatively more. This is exactly what our results indicated: TMS negatively predicted the relative leadership of team members in the physician role (β = -0.32, $p < .001$), indicating that the physicians were stepping back as the more situationally relevant marathoners assumed leadership roles, as shown by the significant coefficient reported above. Altogether, this supports the logic for TMS as a predictor of situational leadership transition, as presented in Hypothesis 4.

Our final hypotheses involved positive impacts of leadership density and SAL on team performance (H5 and H6, respectively). Leadership density at Time 3 significantly predicted team overall performance at Time 4 (β = 0.35, p = .005), aligned with the extant shared leadership literature. We also found support for H6, in which team performance was measured as effectiveness on the specific team task for which SAL might emerge (β = 0.24, p = .048).

To check our model's overall robustness, we also used the Mplus 'model indirect' command to estimate confidence intervals for the serially mediated indirect effect of transactive memory systems, through the shared leadership network variables, on performance. The bootstrapped confidence interval for this indirect effect excluded zero ($CI_{95\%}$ = [0.01,0.15]), supporting the overall hypothesized model presented here and providing additional evidence for the beneficial role of TMS for shared leadership and performance.

Post-hoc analysis and results

The support of Hypothesis 2, showing that more decentralized leadership networks would precipitate more dense leadership networks, was encouraging, especially given that this held while controlling for the team's initial levels of leadership density. However, to check the specificity of our results for this hypothesis, we also examined whether the opposite effect would hold across these time points: would network density contribute to more decentralized networks over time? Examining this allows us to test the robustness of our results further and have more confidence in our conclusion.

We tested this possibility in two ways. First, we reversed the order of decentralization and density in our path model and examined the new model. However, in this alternative model (i.e., TMS at Time 1 to Density at Time 2 to Decentralization at Time 3), leadership density

[3] Mplus cannot perform chi-square tests of model fit with the ML estimator when any outcomes are categorical. Therefore, we excluded the relationship from SAL to challenge performance to obtain the fit for the resulting model. An additional test of the entire model (including the relationship from SAL to challenge performance) using the WLS estimator also showed that the model fit the data well (Chi-square value = 20.59, df=12, p = .06).

[4] H4 still receives support if the SAL is measured using in-degree leadership nominations instead of the ratio of in-degree leadership nominations to total amount of leadership existing in the team.

Table 1
Team-level descriptive statistics and correlations.

Variables	Mean	SD	1	2	3	4	5	6	7	8	9
1. Leadership decentralization (T1)	0.79	0.11									
2. Leadership density (T1)	0.67	0.09	0.54								
3. TMS intervention	0.58	0.50	-0.11	0.09							
4. TMS (T1)	5.63	0.50	0.07	0.33	0.25	(0.91)					
5. Leadership decentralization (T2)	0.81	0.10	0.61	0.47	-0.10	0.24					
6. Leadership density (T2)	0.70	0.09	0.47	0.75	0.15	0.44	0.62				
7. Situationally-aligned leadership (T2)	0.19	0.03	0.21	0.35	0.02	0.24	0.29	0.27			
8. Leadership density (T3)	0.71	0.10	0.47	0.65	0.03	0.44	0.60	0.76	0.20		
9. Team challenge performance (T2)	0.35	0.48	0.17	0.11	-0.02	0.05	0.05	0.07	0.19	0.13	
10. Team overall performance (T4)	50.91	13.92	0.14	0.13	0.19	0.15	0.09	0.04	0.11	0.28	0.43

Note. n = 90. Correlations greater than |0.20| are significant at $p < .05$. Those greater than |0.26| are significant at $p < .01$. Two-tailed tests. Coefficient alphas appear in parentheses along the diagonal when available. TMS = Transactive Memory Systems. T1 = Time 1 (after the medical challenge), T2 = Time 2 (after the weather challenge), T3 = Time 3 (after the oxygen challenge), T4 = Time 4.

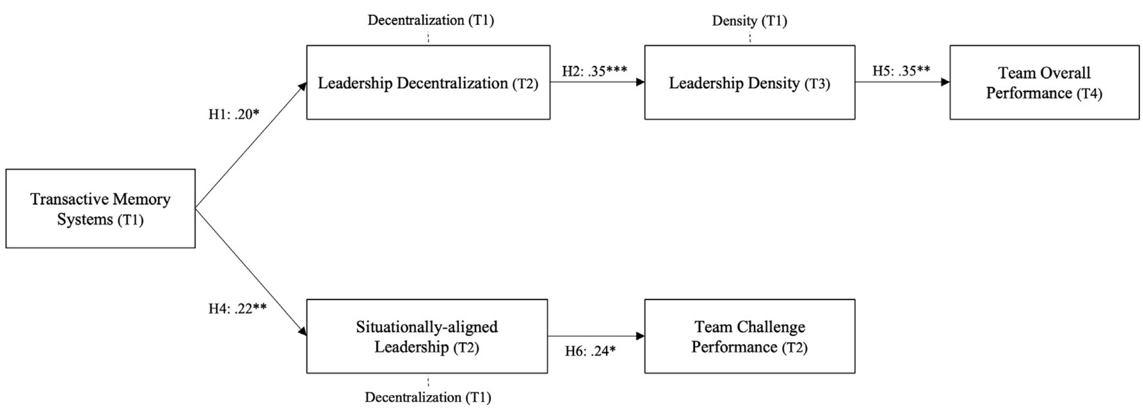

Fig. 1. Hypothesized path model. *Note:* Standardized parameter estimates for the structural model examining the relationships between transactive memory system (TMS), leadership decentralization, leadership density, situationally-aligned leadership, team challenge performance, and team overall performance. Solid lines represent the hypothesized model; dotted lines indicate the control variables for each stage. T1 = Time 1 (after the medical challenge), T2 = Time 2 (after the weather challenge), T3 = Time 3 (after the oxygen challenge), T4 = Time 4. * $p < .05$. ** $p < .01$. *** $p < .001$.

Table 2
Regression coefficients of the path analysis.

Predictors	Leadership decentralization (T2)				Leadership density (T3)				Team overall performance (T4)				SAL (T2)				Team challenge performance (T2)			
	Model 1				Model 2				Model 3				Model 4				Model 5			
	Est.	*SE*	*t*	*p*	*Est.*	*SE*	*t*	*p*	*Est.*	*SE*	*t*	*p*	*Est.*	*SE*	*t*	*p*	*Est.*	*SE*	*t*	*p*
DEC(T1)	0.60	0.07	7.95	<0.001									0.19	0.12	1.67	0.095				
DEN(T1)					0.42	0.09	4.77	<0.001												
TMS(T1)	0.20	0.08	2.56	0.010	0.22	0.07	3.22	0.001	0.02	0.11	0.20	0.839	0.22	0.07	3.12	0.002	0.00	0.14	0.02	0.982
DEC(T2)					0.35	0.08	4.61	<0.001	-0.12	0.12	−1.02	0.307								
DEN(T3)									0.35	0.12	2.78	0.005								
SAL(T2)																	0.24	0.12	1.98	0.048

Note. n = 90. Standardized parameter estimates are shown in the table.
DEC = Leadership decentralization, DEN = Leadership density, TMS = Transactive memory systems, SAL = Situationally aligned leadership.
T1 = Time 1 (after the medical challenge), T2 = Time 2 (after the weather challenge), T3 = Time 3 (after the oxygen challenge), T4 = Time 4.

failed to predict leadership decentralization in the subsequent period ($\beta = 0.20, p = .106$). We also conducted a cross-lagged panel analysis (Zyphur et al., 2020) between density and decentralization at Time 2 and Time 3. As presented in Fig. 2, we found that after including the auto-relationship of leadership density at Time 2 to leadership density at Time 3, the effect from leadership decentralization at Time 2 to leadership density at Time 3 was still significant ($\beta = 0.20$, $p = .019$). The other diagonal relationship, however, was not significant. That is, leadership density at Time 2 did not significantly predict leadership decentralization at Time 3 ($\beta = -0.06, p = .565$). Overall, we consistently found that decentralization predicted density, but the opposite order did not hold, providing further support for the validity and direction of Hypothesis 2.

Finally, we proposed that density rather than decentralization would directly predict performance. We found support for this expectation (H5), but as a post-hoc analysis, we also checked the direct effect of decentralization on performance in our alternative model described above. Confirming our expectations, the effect of decentralization on team performance in this alternative model was not significant ($\beta = 0.07, p = .487$).

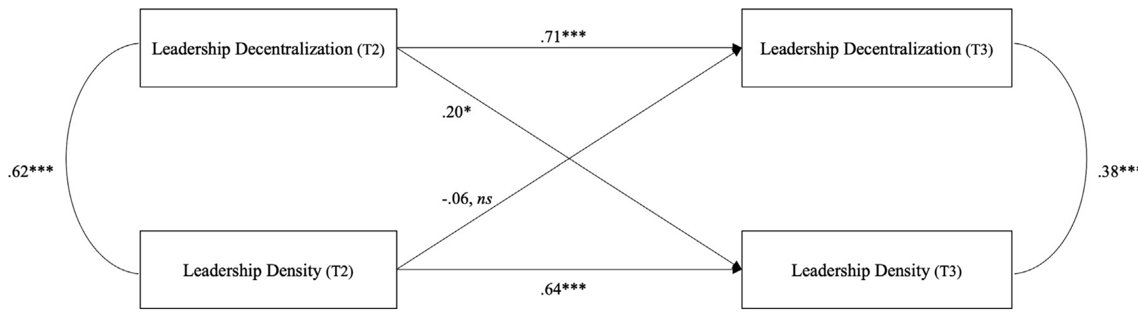

Fig. 2. Post-hoc cross-lagged panel analysis. *Note:* Standardized parameter estimates are provided. T2 = Time 2 (after the weather challenge), T3 = Time 3 (after the oxygen challenge). * $p < .05$. ** $p < .01$. *** $p < .001$.

Discussion

Drawing on the tenets of adaptive leadership theory (DeRue, 2011; DeRue & Ashford, 2010), the goal of this study was to propose and test a model exploring how the three aspects of shared leadership emerge and contribute to performance over time. We examined the structural development of shared leadership through a longitudinal design and tested our hypothesized model against an alternative temporal sequence. Our findings suggest that the three aspects of shared leadership – leadership density, leadership decentralization, and SAL – emerge and function differentially at different phases of shared leadership emergence. Teams with more extensive transactive memory systems enable members whose expertise aligns with situational demands to emerge in leadership roles. TMS also fosters a more decentralized leadership network within the team in the early stages of team processes. This decentralization of leadership, in turn, serves to increase the magnitude of leadership shown by team members over time. The high level of leadership density eventually enhances team performance, and SAL improves explicitly performance in the task aligned with the expertise of a situationally-aligned leader. Collectively, these findings contribute to research on shared leadership by clarifying both its dynamic development process and the necessity of examining the full spectrum of shared leadership, responding to previous calls for the examination of these issues (e.g., Contractor et al., 2012; D'Innocenzo et al., 2016; Wang et al., 2014; Zhu et al., 2018).

Theoretical implications

Shared leadership scholars have suggested that decentralization and density represent distinct aspects of shared leadership networks (DeRue, 2011; Lemoine et al., 2020; Mayo et al., 2003), but most empirical research uses one or the other, rather than integrating them into a developmental model that examines shared leadership from a more comprehensive standpoint (D'Innocenzo et al., 2016; Engel Small & Rentsch, 2010). To our knowledge, our research represents the first time these two aspects of shared leadership have been integrated within a developmental model. As such, this study contributes to the literature by identifying how and when leadership network density and decentralization function developmentally in the emergence of shared leadership and its relationship to team performance.

Specifically, when leadership influence emanates across multiple team members (forming a more decentralized leadership network), this serves as a key foundation for the growth of leadership magnitude (i.e., greater leadership density) in the team. However, leadership density does not appear to influence the distribution of leadership in the team. This suggests that having a greater amount of leadership in a team does not necessarily lead to more equality and more people taking the lead, a finding foreshadowed by role theory (Dansereau et al., 1975). When only a few team members engage in substantial leadership influence and establish strong leadership roles, the rest of the team would feel an increased risk of claiming leadership roles in the future and eventually assume follower roles instead. Significantly, if one of such team members possesses critical knowledge and expertise to address particular situational problems and potentially enhance team performance from a leadership role, a highly centralized leadership structure might prevent them from doing so, and eventually harm the team as a whole.

Our study suggests, however, that decentralization of leadership alone is not sufficient to enhance team performance, a result which differs from at least some previous research on shared leadership (as summarized by D'Innocenzo et al., 2016). The non-significant findings reported here may be the result of accounting for both density and decentralization within the model, which has rarely been done in other studies; it is plausible that other findings may have tapped decentralization's indirect effect through density. Our results suggest that rather than directly impacting performance, leadership decentralization is a more important aspect of shared leadership in the earlier phases of the shared leadership emergence process. This is consistent with adaptive leadership theory (DeRue, 2011; DeRue & Ashford, 2010), which suggests that at the micro-level, leader identity development is a process that starts with individuals testing the waters and determining their standing in different dyadic leadership relationships in the team. Only then should these networks gradually evolve into a relatively mature leadership network within which there is a common understanding of roles in alignment with team needs and goals. Early in this process, decentralization should inevitability be more salient as individuals are in the trial, role-taking stage.

In this manner, leadership decentralization emerges as crucial to the overall development of shared leadership networks early in a team's life. Later in the process, however, once dyadic leadership relationships are established, density assumes a more prominent role in reflecting the sharedness of team leadership and facilitating performance. By fleshing out these two stages of leadership structure emergence, we further provide empirical evidence that there is merit to modeling both leadership decentralization and density as separate aspects of shared leadership. Since density and decentralization play distinct roles in different phases of shared leadership development, it is also plausible that each of them has its unique implications to different types of outcomes, such that density might predict performance more whereas decentralization maybe more important for effective information exchange or justice.

This study also advances research on shared leadership by explicitly modeling a less studied aspect of shared leadership – the adaptive emergence of SAL. Although leadership density and decentralization provide valuable information about shared leadership at a structural level, looking solely at the overall team structure overshadows the leadership dynamism between team members. As an important component of shared leadership (Contractor et al., 2012), SAL may deserve as much attention as the magnitude and dispersion of leadership in the team. The dynamic leadership transitions depicted by SAL represents a team's capacity to adapt to changing situations. The team's adaptability is critical to team success (Burke et al., 2003; Burke et al., 2006). Examining SAL alongside leadership density and decentralization enables us to understand better the effectiveness of shared leadership in responding to the dynamic conditions that may necessitate different sources and forms of leadership at different points in time or under changing circumstances. Future research on shared leadership should consider the impact of context and dynamic situations further to advance our understanding of shared leadership and its contribution to team adaptability.

We further found support for and extended some of the adaptive leadership theory's key propositions in identifying TMS as a critical factor facilitating the emergence of shared leadership networks. TMS prepares team members to engage in a dynamic series of leadership claiming and granting. TMS appears to provide credibility to leadership claims and encourages team members to step up when appropriate and be open to others' influence based on their expertise and experience. In this manner, TMS serves to clarify where and when individuals might best be suited for follower or leader roles, and prevents the centralization of leadership responsibilities on only a few members. A team TMS also provides signals as to which members are most suited to lead depending on the team's context, based on their unique resources. In the simulation used in this research, there was a designated leader in every team, indicating a possible existing power hierarchy in teams. However, our findings suggest that a well-developed TMS might override the existence of power hierarchy and help teams to engage in wider power-sharing in order to cooperate better and access informational resources. Thus, shared leadership appears to follow a functional model (Morgeson et al., 2010; Zaccaro et al., 2001), wherein team needs and goals can play a stronger role than politics inside the team in determining who should lead and when.

Practical implications

Since various studies have pointed to the positive impact of shared leadership on team outcomes, it is vital to propose ways that managers and practitioners can develop shared leadership. Organizational managers should consider intentionally distributing even relatively minor leadership responsibilities widely to many team members to grow robust shared leadership networks. Whereas organizations might typically focus on just a few members as potential leaders who might be strongly extraverted or match implicit prototypes of leadership (Judge et al., 2002; Lord et al., 1984), our results indicate that widely distributed influence is the most effective path to both widespread involvement and engagement, and eventual better team performance. Distributed and decentralized influence across all team members creates perceptions of status equality, which increase influence claim credibility while reducing risk, resulting in increased volumes and magnitudes of leadership interactions and, subsequently, enhanced performance. Empowering only one or a few leaders in teams might eventually backfire by creating a centralized leadership structure that discourages other team members' involvement.

The relationship between SAL and performance may also hold important meaning for organizational team management. Personal or contextual characteristics might suppress leadership emergence from team members with unique situationally-aligned resources; for instance, such individuals might be introverts (Judge et al., 2002), or generally have less dominant personalities (Anderson & Kilduff, 2009), or have low motivation to lead (Chan & Drasgow, 2001). Our findings regarding SAL, however, underscore the importance of individuals with the right expertise and skills stepping up and helping their team cope with the situational uncertainties. Thus, organizations might attempt to encourage and support such individuals into considering leadership roles to realize the benefits of their resources. Providing team-building opportunities that promote safe and cohesive team climates might foster this.

This study also suggests that TMS can play a crucial role in facilitating the development of shared leadership in teams and helping those situationally-aligned leaders emerge. Practices that foster TMS in a team can range from diversifying team composition based on demographics or competence to group training, and even changing the team's contextual elements (Ren & Argote, 2011; Peltokorpi, 2012). While we caution against assuming that all of these practices can facilitate shared leadership, we provide empirical support for the idea that building member credibility and competence should aid in developing shared leadership. Thus, organizations seeking more robust team leadership networks would be well-served by helping team members identify, acknowledge, and leverage one another's relevant strengths.

Limitations

The present study is not without limitations. First, we recognize that using a student laboratory sample potentially limits our findings' generalizability. However, the level of control provided in our simulated design may be most appropriate to test our temporal model rigorously. Additionally, meta-analytic tests of shared leadership reveal that student laboratory samples provide conservative and appropriate tests of this construct (D'Innocenzo et al., 2016). Nonetheless, future research might test the proposed relationships in field settings before firm conclusions can be made about the generalizability of the results. Such future studies might also provide an opportunity to recruit a larger number of teams as our sample of 90 teams might be considered somewhat small.

Second, while we measured our study variables across multiple time points and the results did not change with and without exogenous control variables such as team average personality traits, our use of measured TMS limits our ability to draw causal conclusions. The use of measured TMS instead of exogenous TMS intervention raises the concern of whether omitted variables influenced the theorized relationships. Therefore, future research with a more robust experimental design is needed to draw causal inferences.

Relatedly, we also acknowledge the limitation of our TMS intervention as a means to produce TMS variance in teams. The participants in the no-intervention condition spent the same amount of time introducing themselves to their teammates before studying their role profiles. This was necessary to prevent them from sharing their role information after studying their role profiles. However, the sequence was the opposite in the TMS intervention (i.e., participants first learned their profiles and then talked to each other). This raises the possibility that the communication order might potentially have a confounding effect on the relationships tested. In addition, we employed a boost for the TMS intervention groups, which was not present in no-intervention groups. Although our focus in this study was not TMS in teams, future research can help address these limitations by exploring more robust TMS interventions in lab settings.

Third, one feature of the Mount Everest simulation is that players can go beyond their in-role behaviors and engage in leadership influence, manifested in behaviors such as coordinating information exchange and motivating team members. We acknowledge that both in-role and extra-role behaviors can help an individual be perceived as a leader. However, due to the conceptual emphasis of shared leadership on the influence process and the reliance on perceptual measures, neither theory nor empiricism currently breaks down the sources of influence in the shared leadership research. However, we encourage researchers to develop a fine-grained measurement for shared leadership that could differentiate various influence sources contributing to shared leadership.

Finally, by using simulated teamwork as part of our study design, we created a situation with a clear division of expertise, and participants could learn about their teammates' expertise. However, in real organizations, the possessed knowledge and skills can sometimes be considered employees' deep-level characteristics, which may not be detected or understood immediately by others. Individuals tend to infer each other's deep-level characteristics, such as knowledge, skills, or values from salient attributes, such as personality (Anderson & Kilduff, 2009; Harrison et al., 2002). For instance, individuals with a dominant personality, who are assertive and talkative, are more likely to be perceived as competent and seen as leaders, regardless of whether they actually have the expertise (Anderson & Kilduff, 2009). This might impact the transition of the leadership role to a member who is perceived as competent, rather than the one who has the required expertise relevant to the context. Thus, future research might focus on how this ineffective leadership transference might impact shared leadership network dynamics and team performance.

Conclusion

Despite the well-established beneficial impact on team performance, the theoretical conceptualization and empirical examination of shared leadership have not yet well-aligned in shared leadership research. Our study strives to provide a comprehensive view of shared leadership by bringing together its three aspects – leadership density, leadership decentralization, and SAL – in a dynamic temporal model. The results of our study provide new insights regarding shared leadership emergence and development and suggest that each of the three aspects plays distinct roles and affects each other in the process of shared leadership emergence. Overall, our research offers a more nuanced understanding of the shared leadership process. Future research should build on these findings to further explore the dynamics of shared leadership emergence in teams.

Appendix A

A1. TMS intervention:

1) To the participants in TMS intervention groups, we provided the following discussion guide for their group discussion:

"As you review your role profile with the rest of your team, please make sure you pay attention to critical information about your role, and exchange this information with your teammates to ensure that each member of the team has an idea of everyone's strengths and weaknesses. As you discuss and exchange information about your role, make sure you touch on the following items: 1) please share the critical information about your role, and your common and individual goals during the ascent to the summit of Mt. Everest; 2) How can you help your teammates based on your role's background, experience, and expertise?"

We also highlighted the following critical information appeared in role profiles to ensure participants pay attention to and share them with their teammates during the group discussion.

Leader:

- You are a far more experienced high-attitude mountaineer than anyone on your team. No one else on your team has been on the top more than once. No one else has climbed more than four 8,000-meter peaks.

Team physician:

- You are a tenured professor at a major medical school and a world-renowned physician.
- As a physician, it is extremely important for your career that you don't get frostbite in your hands or fingers.
- As the Physician you will be allocating medical treatment to your teammates. Please note that you can only allocate assistance to one team member per round.

Photographer:

- To do a good job, you would like to spend one extra day at Camps 1 and 2.

Marathoner:

- You are in top physical condition.
- You would like very much to get to the summit, so as to become the first world-class marathoner to reach the peak of Everest.
- As a marathon runner, it is extremely important for your career that you don't get frostbite in your feet or toes. Therefore, you'll be sure to predict the weather at each camp before deciding to hike ahead.

Environmentalist:

- You are Italy's most accomplished mountaineer, who began your career as a teenager scaling mountains in the Alps.
- You have been to the summit twice before in your career.

2) To the participants in no-intervention groups, we provided the following discussion guide for the group discussion:

"During the group discussion, in order for your teammates to know you better, please ensure that you briefly discuss the following: 1) please share some background information of you to your teammates, such as your age, your hometown and your family; 2) as you are all students in an organizational behavior class, please share your thoughts on the class (like or dislike, favorite parts, etc.); 3) share a little about your major, your career plan, and your future plans beyond the colleague."

Besides the discussion guide, we did not highlight anything in their role profiles.

A2. The items we used to measure TMS were previously used by Choi, Lee, and Yoo (2010). The scale includes the following six items:

1) Our team members have specialized knowledge of some aspects of our task.
2) Our team members are comfortable accepting procedural suggestions from other team members.
3) Our team members trust that other members' knowledge about the project is credible.
4) Our team members are confident of relying on the information that other team members bring to the discussion.
5) Our team members know each other and have the ability to work together in a well-coordinated fashion.
6) Our team members have the capability to respond to the task-related problems smoothly and efficiently.

Appendix B

Table B1 presents the results of path analysis with all control variables included in all relationships. A post-hoc Monte Carlo power analysis revealed that this analysis was severely underpowered, which may explain the non-significance of the effect of SAL on team challenge performance.

Table B2 presents another alternative wherein the additional control variables are included only when predicting the proximal dependent variables (i.e., Leadership decentralization and SAL).

Table B1
Regression coefficients of path analysis with control variables in every path.

Predictors	Leadership decentralization (T2)				Leadership density (T3)				Team overall performance (T4)				SAL (T2)				Team challenge performance (T2)			
	Model 1				Model 2				Model 3				Model 4				Model 5			
	Est.	*SE*	*t*	*p*	*Est.*	*SE*	*t*	*p*	*Est.*	*SE*	*t*	*p*	*Est.*	*SE*	*t*	*p*	*Est.*	*SE*	*t*	*p*
EXT	-0.04	0.10	-0.43	0.664	-0.09	0.08	−1.11	0.266	-0.11	0.11	−1.00	0.315	-0.27	0.11	−2.37	0.018	-0.14	0.14	−1.01	0.314
AGR	-0.08	0.09	-0.87	0.386	-0.02	0.07	-0.25	0.804	-0.02	0.13	-0.13	0.895	-0.03	0.10	-0.29	0.771	0.21	0.15	1.40	0.161
CON	-0.02	0.09	-0.22	0.823	-0.03	0.09	-0.29	0.770	0.03	0.12	0.22	0.827	0.01	0.12	0.04	0.967	-0.03	0.13	-0.23	0.815
NER	-0.11	0.08	−1.32	0.186	-0.08	0.07	−1.07	0.283	0.13	0.10	1.29	0.197	0.07	0.10	0.71	0.479	0.32	0.13	2.48	0.013
OPN	-0.14	0.09	−1.62	0.104	0.04	0.08	0.52	0.606	0.04	0.12	0.30	0.763	-0.00	0.11	-0.03	0.977	-0.21	0.15	−1.37	0.171
GDIV	-0.09	0.09	-0.97	0.330	-0.10	0.07	−1.33	0.182	0.09	0.12	0.76	0.447	0.14	0.10	1.45	0.147	0.11	0.14	0.78	0.438
RDIV	0.10	0.09	1.12	0.262	0.01	0.08	0.14	0.892	-0.13	0.10	−1.27	0.204	0.03	0.10	0.26	0.798	0.06	0.17	0.33	0.740
TMSINT	-0.10	0.08	−1.21	0.226	-0.05	0.08	-0.55	0.579	0.18	0.10	1.88	0.061	-0.04	0.10	-0.36	0.721	-0.01	0.13	-0.04	0.969
DEC(T1)	0.55	0.08	6.47	<0.001									0.17	0.12	1.36	0.174				
DEN(T1)					0.43	0.10	4.48	<0.001												
TMS(T1)	0.22	0.09	2.54	0.011	0.25	0.08	2.96	0.003	-0.05	0.12	-0.44	0.658	0.21	0.08	2.54	0.011	-0.02	0.15	-0.12	0.907
DEC(T2)					0.31	0.08	3.86	<0.001	-0.08	0.14	-0.58	0.562								
DEN(T3)									0.36	0.14	2.56	0.011								
SAL(T2)																	0.11	0.14	0.79	0.428

Note. n = 90. Standardized parameter estimates are shown in the table.
EXT = Extraversion, AGR = Agreeableness, CON = Conscientiousness, NER = Neuroticism, OPN = Openness to experience, GDIV = Gender diversity, RDIV = Racial diversity, TMSINT = TMS intervention, DEC = Leadership decentralization, DEN = Leadership density, TMS = Transactive memory systems, SAL = Situationally aligned leadership.
T1 = Time 1 (after the medical challenge), T2 = Time 2 (after the weather challenge), T3 = Time 3 (after the oxygen challenge), T4 = Time 4.

Table B2
Regression coefficients of path analysis with control variables in the first two paths.

Predictors	Leadership decentralization (T2)				Leadership density (T3)				Team overall performance (T4)				SAL (T2)				Team challenge performance (T2)			
	Model 1				Model 2				Model 3				Model 4				Model 5			
	Est.	*SE*	*t*	*p*	*Est.*	*SE*	*t*	*p*	*Est.*	*SE*	*t*	*p*	*Est.*	*SE*	*t*	*p*	*Est.*	*SE*	*t*	*p*
EXT	-0.04	0.10	-0.43	0.664									-0.27	0.11	−2.37	0.018				
AGR	-0.08	0.09	-0.87	0.386									-0.03	0.10	-0.29	0.771				
CON	-0.02	0.09	-0.22	0.823									0.01	0.12	0.04	0.967				
NER	-0.11	0.08	−1.32	0.186									0.07	0.10	0.71	0.479				
OPN	-0.14	0.09	−1.62	0.104									-0.00	0.11	-0.03	0.977				
GDIV	-0.09	0.09	-0.97	0.330									0.14	0.10	1.45	0.147				
RDIV	0.10	0.09	1.12	0.262									0.03	0.10	0.26	0.798				
TMSINT	-0.10	0.08	−1.21	0.226									-0.04	0.10	-0.36	0.721				
DEC(T1)	0.55	0.08	6.47	<0.001									0.17	0.12	1.36	0.174				
DEN(T1)					0.42	0.09	4.78	<0.001												
TMS(T1)	0.22	0.09	2.54	0.011	0.22	0.07	3.21	0.001	0.02	0.11	0.20	0.839	0.21	0.08	2.54	0.011	0.00	0.14	0.02	0.982
DEC(T2)					0.35	0.07	4.63	<0.001	-0.12	0.12	−1.02	0.307								
DEN(T3)									0.34	0.12	2.78	0.006								
SAL(T2)																	0.24	0.12	1.98	0.048

Note. n = 90. Standardized parameter estimates are shown in the table.
EXT = Extraversion, AGR = Agreeableness, CON = Conscientiousness, NER = Neuroticism, OPN = Openness to experience, GDIV = Gender diversity, RDIV = Racial diversity, TMSINT = TMS intervention, DEC = Leadership decentralization, DEN = Leadership density, TMS = Transactive memory systems, SAL = Situationally aligned leadership.
T1 = Time 1 (after the medical challenge), T2 = Time 2 (after the weather challenge), T3 = Time 3 (after the oxygen challenge), T4 = Time 4.

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