Fostering team innovation and learning by means of team-centric transformational leadership: The role of teamwork quality

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Please cite as: Klaic, A., Burtscher, M. J., & Jonas, K. (2020). Fostering team innovation and learning by means of team-centric transformational leadership: The role of teamwork quality. *Journal of Occupational and Organizational Psychology*. Advance online publication. doi:10.1111/joop.12316

Abstract:

Team innovation is an important factor for organizational effectiveness. However, fostering innovation in teams remains a major challenge for team leaders. In particular, we still have an incomplete understanding of a) the effects of team-centric leadership and b) the role of teamwork for the relationship between leadership and innovation and learning. Integrating team-centric transformational leadership and the teamwork quality model with frameworks for team innovation, the current study addresses this issue. Specifically, we investigated teamwork quality as a team-level mediator of the relationship between team-centric transformational leadership, team innovation, and individual members' learning. We tested our hypotheses using lagged, multi-source data from a sample of 79 scientific teams. Our findings show that team-centric transformational leadership is positively related to both team innovation and individual members' learning. Furthermore, the positive relationship between team-centric transformational leadership and learning is mediated by specific aspects of teamwork quality. Our study helps to clarify the processes underlying the effects of team-centric leadership on innovation and learning.

Keywords:

team-centric transformational leadership; teamwork quality; team innovation; individual members' learning; scientific teams

Funding statement:

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Acknowledgements:

The authors thank Laura Tophinke for her help with the data collection.

Practitioner Points:

- Innovation and learning are crucial drivers of success in organizations in knowledge-intensive industries such as science. Transformational leadership is a key factor for enhancing innovation and learning in scientific teams.
- By engaging in team-centric transformational leadership behaviours including emphasizing group identity, communicating a group vision, and fostering team-building, scientific team leaders can improve innovation and learning
- However, leaders of scientific teams should also be aware of potential negative effects of high team cohesion on team innovation, because it may undermine divergent thinking and critical discussions in teams.

Nowadays, organizations have to foster innovation to ensure their competitive advantage in the marketplace (Anderson, Potočnik, & Zhou, 2014; van Knippenberg, 2017; Zhou & Hoever, 2014). Most of the innovative work in organizations is performed by teams, in particular in knowledge-intensive industries (Anderson et al., 2014; Choi & Thompson, 2006; West, 2002). Among these industries, science arguably represents the occupation where innovation is most essential. Consequently, we state a need to specify the factors that foster innovation in scientific teams. Our analysis focuses on leadership and team processes because both have been shown to be key factors for innovation in other team contexts (Dong, Bartol, Zhang, & Li, 2017; X.-H. Wang, Fang, Qureshi, & Janssen, 2015).

Most teams in science have a formal leader (e.g., principal investigator). Not surprisingly, transformational leadership has been identified as a central factor for innovation in these teams (Dong et al., 2017; Eisenbeiss, van Knippenberg, & Boerner, 2008; Y. Jiang & Chen, 2018). Leadership, however, is usually conceptualized as leadership behaviours directed towards *individual* employees. Thus, calls for more research on the effects of *team-centric* leadership – i.e., leadership directed towards a team as a whole – have been made (Kozlowski, Mak, & Chao, 2016). Similarly, a recent review suggests that further research on the effects of leadership on innovation at the team-level is needed (Hughes, Lee, Tian, Newman, & Legood, 2018).

Besides considering team-centric leadership, more studies about the team processes and emergent states that mediate the effects of leadership are needed (Hughes et al., 2018). The majority of studies on innovation have focused on a single team process, for example, team knowledge sharing (Dong et al., 2017; Y. Jiang & Chen, 2018) or psychological safety (Hu, Erdogan, Jiang, Bauer, & Liu, 2018; Wong, Chow, Lau, & Gong, 2018). While these studies have provided many valuable insights

(Hülsheger, Anderson, & Salgado, 2009), we believe that a more holistic approach considering multiple team processes and emergent states at the same time would be worthwhile. Our argument is based on common frameworks of team effectiveness that propose that teamwork consists of several simultaneously occurring team processes (Hoegl & Gemuenden, 2001; Salas, Shuffler, Thayer, Bedwell, & Lazzara, 2015). This is also reflected in the literature on team innovation, which suggests that multiple team processes are responsible for transforming individual members' knowledge and skills into innovative ideas and products (Gebert, Boerner, & Kearney, 2010; West, 2002; West & Anderson, 1996). Accordingly, we investigated a more comprehensive construct as a potential mediator – teamwork quality (Hoegl & Gemuenden, 2001), which integrates multiple team processes and emergent states to capture teamwork in a more holistic manner.

The current study aims to address these two issues – more research on team-centric leadership and the need to investigate teamwork in a more holistic manner. To that end, we integrate the constructs team-level transformational leadership (X.-H. Wang & Howell, 2010) and teamwork quality (TWQ; Hoegl & Gemuenden, 2001) into frameworks for team innovation (Gebert et al., 2010; van Knippenberg, 2017; West, 2002; West & Anderson, 1996). Specifically, we propose that teamwork quality, which comprises multiple team processes (e.g., communication) and emergent states (e.g., cohesion), mediates the relationship between team-centric transformational leadership and team innovation. We were also interested in the effect of these factors on individual members' learning, which constitutes another important outcome for teams in knowledge-intensive industries (Hoegl & Gemuenden, 2001; Yoon & Kayes, 2016).

We see several contributions of the current study: First, we investigate how team-centric transformational leadership affects team innovation and individual members' learning. This is important because – despite the plethora of insights generated by individual-centric leadership research – fostering innovation in teams remains a major challenge for team leaders (Anderson et al., 2014). Against this background, the current study aims to complement individual-centric research, thereby providing novel insights into the factors that drive team innovation and learning. Secondly, we increase our knowledge of the team processes that foster innovation and learning. Specifically, we suggest that teamwork should be investigated in a more holistic manner by considering teamwork as consisting of several team processes and emergent states. This in line with the current team innovation literature, which emphasizes the importance of clearly delineating the factors that affect the integration of individual members' knowledge (van Knippenberg, 2017). Finally, as a theoretical contribution, we integrate different conceptual frameworks to develop a more complete model regarding the team processes through which leaders of scientific teams can affect both team innovation and individual learning.

Theory and hypotheses

Teams in science

The current study focuses on scientific teams as an example of teams in knowledge-intensive industries. Scientific teams need to demonstrate a particularly high degree of innovation and learning because generating knowledge is the essence of scientific endeavours. Furthermore, there has been a shift from individual-based to team-based work structures in the scientific work context (Cooke & Hilton, 2015; Vabø, Alvsvåg, Kyvik, & Reymert, 2016), which makes scientific teams a particularly relevant setting for studying team innovation.

Outcomes for teams in science: innovation and learning

Team innovation is defined as an outcome or product "of attempts to develop and introduce new and improved ways of doing things." (Anderson et al., 2014; p. 1298), which implies that team innovation includes both idea generation as well as their implementation (Rosing et al., 2018). These two processes are particularly relevant for scientific teams (Cooke & Hilton, 2015; Vabø et al., 2016). Members of scientific teams need to be creative and innovative to formulate theories, develop new methods, and find solutions for emerging problems.

Besides team innovation, individual members' learning is another important outcome in science (Hoegl & Gemuenden, 2001). Individual members' learning is defined as the extent to which employees perceive that they have acquired knowledge, skills, and abilities conducive to their professional practice and career development (D. Liu & Fu, 2011; Yoon & Kayes, 2016). Generating novel ideas and discussing their implementation in a team stimulates learning processes, as team members benefit from exchanging knowledge, skills, and expertise (Gong, Kim, Lee, & Zhu, 2013; Y.-N. Lee, Walsh, & Wang, 2014; Y. Liu, Keller, & Shih, 2011). These newly acquired knowledge and skills can in turn be put to use in future team projects (Hoegl & Gemuenden, 2001; Yoon & Kayes, 2016).

Importantly, we choose to focus on *individual* learning instead of team or cooperative learning. Team learning has been conceptualized as mediator linking input factors to team outcomes such as performance and innovation (Edmondson, 1999; Post, 2012). This is in line with the conceptualizing of team learning as a behavioural process (Edmondson, 1999; Sole & Edmondson, 2002). By contrast, individual learning describes to the extent to which employees have acquired new knowledge, skills, and competencies, and therefore rather represents an outcome variable (e.g., Yoon & Kayes, 2016). This distinction is crucial in science. Here, it is not only important that teams complete their current project successfully by demonstrating high levels of innovation.

Rather, team members –particularly junior scientist such as PhD students and post-doctoral researchers – are also expected to learn new knowledge and skills that qualify them for the next steps in their career. In other words, individual member's need to transfer knowledge to other teams and projects. Consequently, we consider both team innovation as well as individual members' learning as central work outcomes in science.

Leadership as a means for fostering innovation and learning

In science, team leaders – usually professors or principal investigators – face significant challenges when trying to promote innovation and learning within their teams (Anderson et al., 2014). Consequently, a number of studies have investigated the effects of (transformational) leadership (see for example Banks, McCauley, Gardner, & Guler, 2016; Hoch, Bommer, Dulebohn, & Wu, 2018; G. Wang, Oh, Courtright, & Colbert, 2011). While these studies generated many important insights, they mostly focused on leadership behaviours directed towards *individual* employees thereby neglecting specific characteristics of the team context.

Against this background, it has been criticized that "much of what is known about team leadership has been adapted from individual leadership theory" (Salas, Sims, & Burke, 2005, p. 572). Even more, recent research often uses aggregates of individual-level leadership scales, as opposed to specific team-level measures, to operationalize leadership at the team-level. This is a problem because team-centric leadership has been shown to have unique and differential effects on a number of team outcomes (Y. Jiang & Chen, 2018; Klaic, Burtscher, & Jonas, 2018; Li, Mitchell, & Boyle, 2016). As a consequence, scholars have called for more team-centric leadership research (Kozlowski et al., 2016), particularly in the context of innovation (Hughes et al., 2018).

In response to these calls, the current study employs a genuine team-level approach to investigate the effects of leadership on innovation and learning. In line with the conceptualization of Morgeson, DeRue, and Karam (2009), we identified the specific source of leadership in scientific teams: In most cases it is internal and formal leadership, that is, scientific team leaders are senior members of the team who have a higher position in the organizational hierarchy (i.e., top-down). Given this situation, we believe that team-centric transformational leadership offers a fruitful approach to studying team leadership in science. This is not to say that other leadership concepts such as team coaching or shared leadership (e.g., Scott-Young, Georgy, & Grisinger, 2019) might not play a role in scientific teams. However, due to the characteristics of this work context, we think that team-centric transformational leadership has greater relevance.

Team-centric transformational leadership

Addressing the above-mentioned concerns, X.-H. Wang and Howell (2010) proposed a multilevel framework of transformational leadership. This framework distinguishes between leadership behaviours directed towards individual team members and leadership behaviours directed to a team as a whole (i.e., team-centric leadership). Crucially for the current study, the authors define team-centric transformational leadership as a type of behaviour that aims to communicate the importance of a shared consensus regarding team goals, to develop shared values and standards within the team, and to foster collaboration among team members (X.-H. Wang & Howell, 2010, p. 1135). The reasoning behind this distinction is that leading a team requires different leadership behaviours than leading individual employees (X.-H. Wang & Howell, 2010). Team-centric transformational leadership consists of three group-specific subdimensions: emphasizing group identity, communicating a group vision, and team-building (X.-H. Wang & Howell, 2010).

Transformational leadership as a concept has been subject to recent criticism (van Knippenberg & Sitkin, 2013). Most of this criticism has been known for some time, which is why X.-H. Wang and Howell (2010) have already addressed some of these points by developing a more valid method for assessing transformational leadership. For example, they clearly delineated which behaviours represent transformational leadership directed towards individual employees (e.g., help an employee developing professional skills) and which behaviours have the team as a whole as the target and thus focus on improving team dynamics.

Transformational leadership in the team context has been the focus on increased attention (Cai, Jia, & Li, 2017; Chun, Cho, & Sosik, 2016; Dong et al., 2017; Feng, Huang, & Zhang, 2016; W. Jiang, Gu, & Wang, 2015; E. K. Lee, Avgar, Park, & Choi, 2019; Lorinkova & Perry, 2019). Most of these studies rely on the conceptualizations and measures either by Pearce and Sims (2002) or Podsakoff, MacKenzie, Moorman, and Fetter (1990) and mostly aggregate individual-centric scales of transformational leadership, as opposed to using genuine team-centric measures. Thus, we believe that team-centric transformational leadership (X.-H. Wang & Howell, 2010) offers a promising alternative for studying leadership at the team-level.

Initial studies suggest that team-centric leadership has unique effects on team outcomes in knowledge-intensive industries. For example, in research and development teams, team-centric transformational leadership was positively related to team performance, helping behaviour (X.-H. Wang & Howell, 2010), collective efficacy (X.-H. Wang & Howell, 2012), and knowledge sharing and team creativity (Dong et al., 2017). In scientific teams, team-centric transformational leadership was positively related to job satisfaction and negatively related to work-related strain (Klaic et al., 2018). However, the empirical evidence about effects of team-centric leadership on team innovation and individual members' learning is scarce (Hughes et al., 2018). As innovation and learning constitute central work outcomes in scientific teams, we aim to clarify how team-centric leadership affects these work outcomes.

Integrating conceptual frameworks from the leadership and team innovation literature, we propose that team-centric transformational leadership fosters team innovation. Team-centric transformational leadership implies that team leaders emphasize identification with the team, communicate a vision for the team, and resolve conflicts among team members (X.-H. Wang & Howell, 2010). Importantly, these aspects of team-centric transformational leadership are considered key variables in several frameworks of team innovation. For example, Gebert et al. (2010) propose that fostering collective team identification is crucial for innovation in teams. Furthermore, van Knippenberg (2017) provides a thorough synthesis of the team innovation literature and argues for a model whereby informational resources facilitate team innovation through information elaboration and integration. Leadership plays a key role in helping teams elaborate and integrate these informational resources. Additionally, the team climate for innovation framework by Anderson and West (1998) highlights the importance of a common vision. West (2002) emphasizes the need to manage conflicts in teams effectively, and proposes that for fostering team innovation, teams need to develop integration skills, which include the skill to communicate openly and supportively. In line with these frameworks, we consider team-centric transformational leadership as a key factor for team innovation. Accordingly, we hypothesize the following:

Hypothesis 1. Team-centric transformational leadership is positively related to team innovation.

Furthermore, we propose that team-centric transformational leadership promotes individual members' learning. Specifically, we argue that team-centric transformational leadership has a positive effect on learning by creating a safe learning environment, for example through managing conflicts and promoting team-building activities (cf. Anderson & West, 1998). A psychologically safe environment is crucial for individual members' learning because in such an environment, team members believe that making mistakes is part of the learning process, and that other team members will offer help and feedback instead of punishment or resentment (Edmondson, 2003; Edmondson & Roloff, 2009; Nembhard & Edmondson, 2006). Moreover, we argue that by fostering team identification, leaders can also facilitate learning processes in their teams (cf. van der Vegt & Bunderson, 2005). In sum, we hypothesize the following:

Hypothesis 2. Team-centric transformational leadership is positively related to individual members' learning.

Teamwork quality as mediator

Besides establishing a relationship between team-centric leadership and team innovation, research needs to investigate the underlying mechanisms of this relationship. In particular, more studies are needed that investigate teamwork as a potential mediator in a more holistic way (i.e., by considering multiple team processes and emergent states; Anderson et al., 2014). The team processes leading to enhanced team innovation have been receiving increased attention in the literature (Hughes et al., 2018). As already mentioned, van Knippenberg (2017) argues that information elaboration and integration are key process factors for team innovation. In addition to these task-related team processes, other models of innovation stress the importance of relationship-related emergent states such as team cohesion and psychological safety. To consider both aspects, we chose the teamwork quality framework by Hoegl and

Gemuenden (2001) as a underlying theoretical rationale. Teamwork quality is based on the assumption that team success depends on the correct execution of tasks on the one hand and on the quality of teamwork on the other hand, because teams need both task and social behaviours to function effectively (Hertel & Hüffmeier, 2011; Levi, 2017). In line with this argumentation, we propose that both task-related and relationship-related team processes matter for team innovation and individual member's learning.

Most studies investigating mediators focused on a single team process such as team knowledge sharing or team communication quality (Dong et al., 2017; Y. Jiang & Chen, 2018; Valls, González-Romá, & Tomás, 2016). Effective teamwork, however, does not consists of a single team process: Team researchers have emphasized that multiple team processes and emergent states shape the quality of teamwork and affect team effectiveness (Marks, Mathieu, & Zaccaro, 2001; Salas et al., 2015). Accordingly, team innovation research should consider teamwork in a more holistic way.

Against this background, the framework teamwork quality by Hoegl and Gemuenden (2001) offers a promising approach to further our understanding of the team processes that mediate the effects of leadership on innovation and learning. Teamwork quality aims to define what constitutes high quality interactions in teams, and how teamwork quality affects both team and individual success. Of these factors, the following four are particularly relevant for innovation and learning[1]: communication quality, balance of member contributions, mutual support, and cohesion. According to Hoegl and Gemuenden (2001), these four variables are defined as follows: High communication quality in teams can be achieved when sufficient time is spent communicating and when informal communication (e.g., spontaneously initiated contacts) prevails over formal communication (e.g., scheduled meetings). Moreover, high communication quality in teams can be achieved when team members are able to communicate directly with all other team members and when team members share their information openly with each other. In terms of balance of member contributions, it is important that every team member is able to contribute his/her task-relevant knowledge and experience to the team. Regarding mutual support, it is crucial that team members hold a cooperative frame of mind instead of a competitive one, so that team members support each other. In terms of cohesion, team members need to have an adequate level of desire to remain in the team and engage in collaborative work.

Teamwork quality has been linked to positive outcomes in a number of studies. For example, teamwork quality was positively related to team performance and individual members' learning in a study of Hoegl and Gemuenden (2001) and Lindsjørn, Sjøberg, Dingsøyr, Bergersen, and Dybå (2016). Furthermore, in a study of Cha, Kim, Lee, and Bachrach (2015), teamwork quality mediated the positive relationship between transformational leadership and inter-team collaboration.

Building on this framework, we propose that teamwork quality transmits the hypothesized effects of team-centric transformational leadership on team innovation and individual members' learning in scientific teams. Scientific teamwork requires exchange of knowledge between the members of a team (Y.-N. Lee et al., 2014; Y. Liu et al., 2011; Wuchty, Jones, & Uzzi, 2007) and thus – in particular – effective communication patterns (Hirst & Mann, 2004), balance of member contributions, mutual support, and commitment to team goals through cohesion (Hoegl & Gemuenden, 2001). As these processes constitute key elements of teamwork quality, we argue that teamwork quality is particularly relevant for scientific teams. In line with the argumentation by van Knippenberg (2017), we tried to elaborate which team processes constitute key factors transmitting the effects of team-centric transformational leadership to team innovation and individual member's learning. We believe that information integration can best be achieved if teams express high levels of communication quality, balance team members' contributions in discussion, support each other, and work for achieving team goals.

Teamwork quality can be affected by team-centric transformational leadership behaviours, which includes emphasizing group identity, communicating a group vision, and team-building. By emphasizing group identity and by communicating a group vision, leaders foster mutual support (Braun, Peus, Weisweiler, & Frey, 2013; Eisenbeiss et al., 2008) and cohesion (Raes et al., 2013; Y.-S. Wang & Huang, 2009). Furthermore, by carrying out team-building activities, leaders can solve problems regarding communication and balance of member contributions, and foster mutual support and cohesion (Aga, Noorderhaven, & Vallejo, 2016; García-Morales, Jiménez-Barrionuevo, & Gutiérrez-Gutiérrez, 2012).

Teamwork quality in turn can affect team innovation: Open communication and balance of member contributions promotes creative and innovative processes in scientific teams because – similar to hidden-profile situations – task-relevant information needs to be shared (Dong et al., 2017). Mutual support and cohesion are important for team innovation performance because team members need to support each other when they face difficulties during task completion, particularly in the context of long-term projects. West (2002) and Gebert et al. (2010) propose that these processes are important for knowledge generation and integration in teams. For example, in one team, new ideas may be routinely ignored, whereas in another team, they may be verbally and behaviourally supported (West, 2002). This has likely both immediate as well indirect effects on team innovation. If new ideas are supported by other team members, they are more likely to be developed into innovations. Moreover, in the long-run, team members might feel more comfortable sharing their thoughts. In sum, we propose that teamwork quality mediates the relationship between team-centric transformational leadership and team innovation.

Hypothesis 3 Teamwork quality mediates the positive relationship between team-centric transformational leadership and team innovation.

In addition, teamwork quality positively affects individual members' learning (Hoegl & Gemuenden, 2001). Open communication and balance of member contributions maximize individual members' learning because these processes ensure that knowledge is openly shared within the team (Anderson & West, 1998). Mutual support and cohesion also contribute to individual members' learning, as they increase members' willingness to share knowledge, skills and abilities with their teammates (Gebert et al., 2010; West, 2002). In addition, these team processes and emergent states potentially affect the climate the team is operating in (i.e., higher participative safety; Edmondson & Roloff, 2009). Thus, we propose that teamwork quality mediates the relationship between team-centric transformational leadership and individual members' learning in teams.

Hypothesis 4. Teamwork quality mediates the positive relationship between team-centric transformational leadership and individual members' learning.

In sum, we propose a multilevel model of team leadership in scientific teams (Figure 1), which integrates team-level transformational leadership (X.-H. Wang & Howell, 2010), the teamwork quality model (Hoegl & Gemuenden, 2001), and the team innovation literature (Anderson & West, 1998; Gebert et al., 2010; West, 2002). Our model aims to clarify the role of teamwork as a holistic construct, which comprises different team processes and emergent states, as a mediator of the relationships between team-centric transformational leadership and innovation and learning in teams.

Figure 1 about here

Method

Participants and procedure

In total, 79 teams from different universities in Switzerland and Germany participated in this study. To ensure that our sample consists of actual teams, we checked a) if team members worked interdependently and b) if they identified as a team[2]. Teams that did not match these criteria were excluded. The data for this study comprises ratings of 235 team members and 64 team leaders[3]. Team members were part of the scientific staff (e.g., junior and senior researchers). Members working under the supervision of the same team leader were considered a team. The average number of respondents per team was 7.9 (*SD* = 4.3) ranging from 2 to 9 members per team, whereby not all team members were able or willing to participate in the study (i.e., at least two members per team excluding the team leader participated at both measurement time points). Average team tenure was 40 months (*SD* = 26.7) and team members were on average 36 years old (*SD* = 8.3). 54% of the members were women. Team leaders were mainly professors or principal investigators of a research project. They were on average 51 years old (*SD* = 9.3), and 20% of the leaders were female.

Data collection from team members and team leaders took place at two measurement time points (T1, T2), separated by approximately four to six weeks in 2016 (i.e., temporally lagged survey design; see Venkataramani, Le Zhou, Wang, Liao, & Shi, 2016). The predictor variable team-centric transformational leadership was assessed at T1. The mediator variable teamwork quality and the criterion variables team innovation and individual members' learning were assessed at T2. Surveys were administered online.

Measures

Survey items were drawn from existing literature to ensure construct validity. Questionnaires were available in English and in German. As some of the survey items and scales were available in English only, items had to be translated and back-translated by two bilinguals. Furthermore, we edited some of the scales by changing the tense from past to present, because our sample included teams in which team members were still working together, whereas in other studies team members have been surveyed after project completion (e.g., Hoegl & Gemuenden, 2001). We included the adapted version of the scales for teamwork quality and individual team members' learning in the appendix. Accounting for other potential influences on team innovation and learning, we controlled for team size, team duration, task interdependence, age and gender.[4] Team size and gender have been found to influence team performance and employees' learning (Bernerth & Aguinis, 2016).

Team-centric transformational leadership. We used the group-focused transformational leadership subscale (α = .94) from the Dual-Level Transformational Leadership Scale (X.-H. Wang & Howell, 2010) to measure team-centric transformational leadership. Participants rated their team leader on a 5-point scale (16 items), with responses ranging from 1 (not at all) to 5 (frequently, if not always). A sample item is "My direct supervisor encourages team members to take pride in our team". Only a slight modification has been done to this scale: we changed the wording from "my leader" to "my direct supervisor", because participants from a preliminary survey reported back that "supervisor" is the better term for this specific work context. We did not include this scale in the appendix because of copyright issues[5].

Teamwork quality. Teamwork quality was measured by adapting the Teamwork Quality (TWQ) scale by Hoegl and Gemuenden (2001). As mentioned earlier, we focused on the four subscales (α = .93) most relevant for innovation and learning: communication quality, balance of member contributions, mutual support, and cohesion. Regarding scale modifications, we left out three items from the cohesion subscale because in a preliminary survey, participants reported back that they had some difficulties answering these items. Team members rated teamwork quality on a 5-point scale (26 items), with responses ranging from 1 (strongly disagree) to 5 (strongly agree). A sample item for mutual support as a subcomponent of teamwork quality is "The team members help and support each other as best they can".

Team innovation. Team leaders rated team innovation using the scale (α = .92) by Zhou and George (2001). They rated their team's innovation performance on a 5-point scale (13 items), with responses ranging from 1 (strongly disagree) to 5 (strongly agree). A sample item is "The members of my team develop adequate plans and schedules for the implementation of new ideas.".

Individual team members' learning. Individual team members' learning was measured by adapting the scale (α = .80) from Yoon and Kayes (2016), who used the team-level learning scale from Hoegl and Gemuenden (2001) and slightly adapted this scale to measure learning on the individual-level by following the referent-shift consensus model approach (Chan, 1998). Team members rated their learning on a 5-point scale (5 items), with responses ranging from 1 (strongly disagree) to 5 (strongly agree). A sample item for individual members' learning is "I am able to acquire important know-how through my project(s)".

Data aggregation, analytic strategy, and level of analysis

We tested the main effects hypotheses by applying multiple linear regression analysis (H1) and multilevel modelling (H2) with the lme4 package version 1.1-21 (Bates, Mächler, Bolker, & Walker, 2015) of the statistical software R version 3.6.1 (R Core Team, 2016). We specified random intercept models and compared them to random intercepts and slopes models with chi-square tests, whereby the random intercept models fitted best. We tested the mediation hypotheses (H3 and H4) using two different approaches: the traditional approach by Baron & Kenny (1986) and the mediation package version 4.5.0 in R (Tingley, Yamamoto, Hirose, Keele, & Imai, 2014). In the latter approach, the total effect of the independent variable is de-composed into a causal mediation (=ACME) and direct effect (ADE; Imai, Keele, & Tingley, 2010), whereby the ACME represents the effect of the independent variable on the outcome through the mediating variable.

We calculated $r_{WG(J)}$ as a measure of agreement within teams, interclass correlation (ICC1), and F-tests (Bliese, 2000), to test if the multilevel approach and the aggregation of variables to the team level were appropriate for further analysis. As the ICC1 value for individual members' learning (.12) was significant ($F(78,156) = 1.41$, $p < .05$), we proceeded with the mixed methods approach as the primary analytic strategy. For team-centric transformational leadership, $r_{WG(J)}$ was .86, ICC1 was .21, $F(78,156) = 1.78$, $p < .01$. For teamwork quality, $r_{WG(J)}$ was .98, ICC1 was .30, $F(78,156) = 2.27$, $p < .01$. These results indicate that team membership explained considerable variance in individual ratings of learning, team-centric transformational leadership, and teamwork quality. Moreover, $r_{WG(J)}$ -values justify the aggregation of the individual-level measures of team-centric transformational leadership and teamwork quality.

To account for potential problems regarding common method variance (CMV), we applied both procedural remedies before data collection and statistical remedies after data collection (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). First, we separated the measurement of the predictor and criterion variables (a) temporally by assessing the variables at two time points and (b) by surveying team members as well as team leaders. Second, we performed partial correlation procedures to test for CMV by partialling out a marker variable (Lindell & Whitney, 2001; Podsakoff et al., 2003). We chose post hoc the variable "external collaboration" as marker variable, as it is theoretically unrelated to the variables in our model. Team members rated their amount of collaboration with researchers outside the team (1 item, "Myself and/or other team members collaborate with external researchers") on a 5-point scale, with responses ranging from 1 (strongly disagree) to 5 (strongly agree). The analyses indicated that CMV was not an issue.[6]

Scale evaluation

We used confirmatory factor analysis (CFA) to establish discriminant validity of the three self-report scales (i.e., team-centric transformational leadership, teamwork quality, and individual members' learning). For this purpose, we employed the lavaan package version 0.6-5 (Rosseel, 2012) of the R software (R Core Team, 2016) and used MLM estimation – a maximum likelihood estimation with robust standard errors and a Satorra-Bentler scaled tests statistic. We performed the CFAs using the item parceling approach, as our dataset did not provide ideal conditions (i.e., relatively small sample size in combination with a large number of parameters to be estimated) for assessing CFA (Little, Rhemtulla, Gibson, & Am Schoemann, 2013; Marsh, Hau, & Wen, 2004).. We are aware of the concerns and criticism regarding the item parceling approach (Little et al., 2013; Marsh, Lüdtke, Nagengast, Morin, & Davier, 2013; Matsunaga, 2008; Sterba, 2019). Therefore, to validate our findings, we also ran the CFAs without parceling the items and compared them with the results from the CFAs with item parcelling.[7]

We created 9 parcels for the constructs used in this study to increase the power of latent variable models: three parcels for team-centric transformational leadership, four parcels for teamwork quality, and two parcels for individual members' learning. Item parceling was based on theoretical considerations as well as on item content. For example, team-centric transformational leadership is composed of three sub-dimensions (X.-H. Wang & Howell, 2010), which is why we created three parcels for team-centric transformational leadership.

The results from the CFA revealed that a three-factor model, in which items associated with each construct loaded onto distinct factors, had an acceptable fit, (χ^2 = 48.96, *df* = 24; RMSEA = .06, SRMR = .04; CFI = .98). In this model, all item loadings from the items to their latent factors were significant at $p < .05$. To further establish discriminant validity, we compared the three-factor model to different alternative models. For each comparison, the original three-factor model provided superior fit (see Table 1). These results offer evidence of discriminant validity between the latent constructs.

Table 1 about here

Results

The means, standard deviations, and correlations of predictor and dependent criterion are reported in Table 2. Of note, the correlations between teamwork quality and team innovation are unexpectedly low and not significant.

Table 2 about here

Hypothesis testing

The results of the linear regression and multilevel modelling analyses predicting team innovation and individual members' learning are reported in Table 3. Hypothesis 1 predicted a significant relationship between members' ratings of team-centric transformational leadership and leaders' ratings of team innovation. As expected, team-centric transformational leadership was positively related team innovation (*b* = .18, *SE* = .06, *t*(178) = 2.84, 95% CI = [0.06; 0.31], $p < .01$). The percentage of explained variance in team innovation was $R^2 = 0.12$. Thus, Hypothesis 1 was fully supported.

Hypothesis 2 predicted a significant cross-level relationship between team perceptions of leaders' team-centric transformational leadership and individual members' learning. As expected, team-centric transformational leadership was positively related to individual members' learning (*b* = .23, *SE* = .06, *t*(228) = 3.53, 95% CI = [0.10; 0.35], $p < .01$). The overall variance explanation (i.e., pseudo-R2) of the random-intercept model was 0.09 (Nakagawa & Schielzeth, 2013). Thus, Hypothesis 2 was also supported.

Table 3 about here

Hypothesis 3 predicted that teamwork quality mediates the relationship between members' ratings of team-centric transformational leadership and leaders' ratings of team innovation. Following the approach by (Baron & Kenny, 1986), we predicted the mediator teamwork quality from the mean-centred antecedent team-centric transformational leadership. The relationship between team-centric transformational leadership and teamwork quality was significant (*b* = .36, *SE* = .03, *t*(228) = 10.59, 95% CI = [0.30; 0.43], $p < .01$). To establish the mediation effect, we regressed the outcome team innovation from the mean-centred antecedent team-centric transformational leadership, while controlling for the mediator teamwork quality. Contrary to our prediction, the relationship between teamwork quality and team innovation was not significant (*b* = .004, *SE* = .12, *t*(175) = 0.03, 95% CI = [-0.23; 0.24], $p > .05$,). To explicitly test the mediation effect, we used the mediate-package in R (Tingley et al., 2014). This analysis did not reveal a mediation effect (i.e., ACME) of teamwork quality either (ACME = 0.002, 95% CI [-0.07; 0.08], $p > .05$). Thus, Hypothesis 3 was not supported.

Hypothesis 4 predicted that teamwork quality mediates the relationship between members' ratings of leaders' team-centric transformational leadership and individual members' learning (i.e., a Level-2 to Level-1 mediation effect). Again, we predicted the mediator teamwork quality from the mean-centred antecedent team-centric transformational leadership. The relationship between team-centric transformational leadership and teamwork quality was significant ($b = .29$, $SE = .04$, $t(228) = 7.88$, 95% CI [.21; .34], $p < .01$). Next, we regressed the outcome individual members' learning from the antecedent team-centric transformational leadership, while controlling for the mediator teamwork quality. We found that the relationship between teamwork quality and individual members' learning was significant ($b = .37$, $SE = .12$, $t(227) = 3.11$, 95% CI [.14; .59], $p < .01$), while the direct effect of team-centric transformational leadership on individual members' learning became non-significant ($b = .09$, $SE = .08$, $t(227) = 1.21$, 95% CI [-.05; .23], $p > .05$). This pattern suggests that teamwork quality mediates the effect of team-centric transformational leadership on individual members' learning. By applying the mediate function in R, we found support for the mediation effect of teamwork quality (ACME = 0.11, 95% CI [0.04, 0.19], $p < .01$). Again, we estimated the overall variance explanation with the pseudo-R-squared (Nakagawa & Schielzeth, 2013), this time by including the mediator variable teamwork quality, pseudo-R^2_m= 0.14. Thus, Hypothesis 4 was fully supported.

Supplementary post-hoc analyses

As teamwork quality did not mediate the relationship between team-centric transformational leadership and team innovation (Hypothesis 3), we performed additional post-hoc analyses. We decomposed the construct teamwork quality into its four dimensions (i.e., communication quality, balance of member contributions, mutual support, and cohesion)[8]. Our goal was to investigate potential indirect effects of the four teamwork quality dimensions separately by testing a multiple-mediator model. First, we calculated $r_{WG(J)}$ and ICC1 to test, if the aggregation of the four teamwork quality dimensions was appropriate for further analysis. For communication quality, $r_{WG(J)}$ was .95 and ICC1 was .22, $F(78,156) = 1.85$, $p < .01$. For balance of member contributions, $r_{WG(J)}$ was .82 and ICC1 was .14, $F(78,156) = 1.47$, $p < .05$. For mutual support, $r_{WG(J)}$ was .93 and ICC1 was .25, $F(78,156) = 2.01$, $p < .01$. For cohesion, $r_{WG(J)}$ was .91 and ICC1 was .35, $F(78,156) = 2.58$, $p < .01$. We concluded, that aggregation of the individual-level measures of the four teamwork quality dimensions was appropriate.

Second, using the INDIRECT macro version 3.4 (Preacher and Hayes (2008), we calculated a multiple-mediator model. We predicted the mediators (a) communication quality, (b) balance of member contributions, (c) mutual support, and (d) cohesion from the antecedent team-centric transformational leadership. The relationships between team-centric transformational leadership and (a) communication quality ($b = .37$, $SE = .04$, $t(5,177) = 9.95$, $p = .01$), (b) balance of member contributions ($b = .33$, $SE = .06$, $t(5,177) = 5.83$, $p = .01$), (c) mutual support ($b = .29$, $SE = .04$, $t(5,177) = 7.12$, $p = .01$), and (d) cohesion ($b = .43$, $SE = .05$, $t(5,177) = 8.38$, $p = .01$) were significant. To establish the mediation effects of the four teamwork quality dimensions, we regressed the outcome team innovation from the antecedent team-centric transformational leadership, while introducing the mediators (a) communication quality, (b) balance of member contributions, (c) mutual support, and (d) cohesion. The relationship between (b) balance of member contributions and team innovation was significantly positive ($b = .39$, $SE = .10$, $t(5,177) = 3.72$, $p = .01$). In contrast, the relationship between (d) cohesion and team innovation was significantly negative (b = -

.34, *SE* = .14, *t*(5,177) = -2.41, *p* = .02). However, neither the relationship between (a) communication quality and team innovation (*b* = -.08, *SE* = .18, *t*(5,177) = -0.42, *p* = .67) nor the relationship between (c) mutual support and team innovation were significant (*b* = .11, *SE* = .17, *t*(5,177) = 0.68, *p* = .50). Bootstrap analysis of indirect effects supported the mediation effects of (b) balance of member contributions (*ab* = .13, BCa CI [.04, .27]) and (d) cohesion (*ab* = -.16, BCa CI [-.31, -.03]). Notably, it seems that balance of member contributions with its positive relation and cohesion with its negative relation to team innovation cancel each other statistically out when combined as one construct (i.e., teamwork quality).

Discussion

The results of our analyses support three of our four hypotheses. The relationships between team-centric transformational leadership and both team innovation as well as individual members' learning were positive and significant as predicted. Whereas the relationship with learning was mediated by teamwork quality, this was not the case for team innovation. Our supplementary analysis suggests that the latter is the case because the effects of different aspect of teamwork quality – namely balance of member contributions and cohesion – cancel each other out.

Our study contributes to the literature on leadership and innovation in multiple ways. First, we answer recent calls for more team-centric leadership studies (Hughes et al., 2018; Kozlowski et al., 2016) and provide results on the effects of team-centric leadership on innovation and learning in scientific teams. Our findings show that team-centric transformational leadership has positive effects on team- and individual-level outcomes in teams from knowledge-intensive industries. This constitutes an important supplement of the existing literature on leadership and team innovation, which has mainly focussed on individual-level leadership behaviour.

Second, our study investigates multiple mediating processes simultaneously (Salas et al., 2015). By considering multiple team processes and emergent states simultaneously, this study increases our understanding of the processes underlying innovation and learning in teams. For one, our results show that central aspects of teamwork quality mediated the relationship between team-centric transformational leadership and individual members' learning. When team leaders support members to communicate effectively with each other, try to balance member contributions during discussions, encourage them to support each other during task completion, and foster high levels of cohesion, they promote individual members' learning through sharing knowledge and skills (Hoegl & Gemuenden, 2001; Yoon & Kayes, 2016).

Notably, teamwork quality did not mediate the relationship between team-centric transformational leadership and team innovation. Supplementary post-hoc analyses showed that balance of member contributions was positively related to team innovation, whereas cohesion was negatively related to team innovation. A likely interpretation is that these two aspects of teamwork quality cancel each other out statistically when combined into a single construct. It makes sense that balance of member contributions is positively related to team innovation: Balance of member contributions is an important determinant of team innovation because every team member has to have the chance to share information to optimize team decision making (Dong et al., 2017; Hoegl & Gemuenden, 2001).

Although team cohesion is generally considered a positive factor for team innovation (Hülsheger et al., 2009), it could be argued that – under certain conditions – high levels of cohesion might have negative effects. For one, team innovation requires divergent thinking of team members, which may be difficult to achieve when a team is too cohesive and team members do not want to criticize each other (Brodbeck, Kerschreiter, Mojzisch, & Schulz-Hardt, 2007). For example, a high level of cohesion may lead to groupthink (Bernthal & Insko, 1993; Janis, 1982; Zaccaro & Lowe, 1988). Hülsheger et al. (2009) posit that a high degree of cohesion fosters psychological safety in teams, which in turn enables high innovation performance. However, Bradley, Postlethwaite, Klotz, Hamdani, and Brown (2012) argue that psychological safety "differs from cohesion in that it facilitates, rather than discourages, constructive disagreements among members" (p. 152). Thus, teams may have a high degree of cohesion without necessarily having a high degree of psychological safety. As a result, future research should investigate both cohesion and psychological safety in order to specify their unique effects on innovation.

Altogether, our findings point towards the importance of investigating multiple team processes and emergent states simultaneously. In particular, some factors may have adverse effects on specific outcomes. For example, high levels of cohesion within a team may neutralize the positive effects of having balanced discussions regarding team performance. Therefore, one needs to be aware of the possibility of such counteracting effects and investigate multiple team processes within a more holistic way. Thus, we provide novel insights for the current discussion on team innovation, which emphasizes the importance of developing a more comprehensive model of teamwork and innovation (van Knippenberg, 2017). This is what we were aiming for by applying the teamwork quality framework (Hoegl & Gemuenden, 2001) to scientific teams. To conclude, we integrate different conceptual frameworks to develop a more complete model for the research field on leadership, teamwork and innovation.

Practical implications

The current study confirms previous studies that transformational leadership is a key factor for enhancing work outcomes in scientific teams (Braun et al., 2013; Braun, Peus, Frey, & Knipfer, 2016; Klaic et al., 2018). Particularly, leaders of scientific teams need to be aware of these positive effects of team-centric transformational leadership on team functioning and performance. As such, leaders of scientific teams should be trained to show team-centric transformational leadership behaviours such as (a) emphasizing group identity, (b) communicating a group vision, and (c) fostering team-building activities. For example, team leaders may emphasize group identity by encouraging team members to place the interests of the team ahead of their own interests.

Additionally, our results stress the importance of management strategies to enhance teamwork quality. Leaders of scientific teams should try to improve the quality of teamwork by adopting team-centric transformational leadership behaviours. For example, by fostering team-building activities, leaders can improve communication quality and balance of member contributions besides mutual support and cohesion (Aga et al., 2016; García-Morales et al., 2012). However, team leaders need to be aware of the negative effect of cohesion on team innovation and should perhaps rather promote psychological safety to ensure constructive discussions (Hu et al., 2018).

Limitations and future research

We assessed mediator and criterion variables at the same measurement points However, at least for team innovation, we tried to minimize potential CMV by using two different sources (members vs. leaders' ratings). Moreover, the correlational design of the current study does not allow the establishment of causal relationships between team-centric transformational leadership and innovation and learning. Hughes et al. (2018) propose that research on the effects of leadership on creativity and innovation should apply experimental designs to estimate causal models appropriately. This issue could be addressed in an intervention study, in which randomly chosen groups of leaders receive team-centric transformational leadership training prior to data collection.

Furthermore, it could be of interest to assess how daily levels of team-centric transformational leadership are related to work outcomes, as recent studies suggest that the levels of transformational leadership a leader shows may vary from day to day (Breevaart et al., 2014; Diebig, Bormann, & Rowold, 2016; Tepper et al., 2018) or week to week (Breevaart, Bakker, Demerouti, & Derks, 2016). It is usually assumed that team-centric transformational leadership is a stable construct, which is modifiable through leadership training, but does not vary on a daily or weekly basis. However, this may not be the case for newly-installed team leaders who still have to find out how they can optimally use transformational leadership behaviours during their daily routine.

Lastly, we assessed team innovation through supervisory ratings. In the scientific work context, team innovation may be operationalized through “hard” outcome measures such as teams’ publication performance (see for example Braun et al., 2013). However, there are some serious issues in regard of defining team innovation as team publication performance and measuring it through indicators such as number of publications and journal impact factors (see for example Popova, Romanov, Drozdov, & Gerashchenko, 2017). In our sample we included scientific teams from various disciplines which makes it even harder to find appropriate indicators of team publication performance to account for differences in the publication process between disciplines (e.g., citation speed). Thus, we decided to measure team innovation through leader-evaluations.

Conclusion

Our study makes several contributions to the literature on leadership and team innovation. Combining different theoretical approaches and focussing on team-centric leadership, we were able to further clarify the factors that contribute to higher innovation and learning in scientific teams. Specifically, our results show that team-centric transformational leadership is positively related to team innovation and individual members' learning via different aspect of teamwork quality. Supplementary analyses show that two aspects of teamwork quality, namely balance of member contributions and cohesion, have unique and contrasting effects on team innovation. In sum, this study highlights the importance of considering both team-centric leadership as well as multiple team processes to achieve more comprehensive understanding of factors driving innovation and learning in knowledge-intensive industries.

Footnotes

1. We excluded the two dimensions coordination and effort, as they did not seem to be significant team processes in the work context of scientific teams. In line with this notion, a preliminary survey with 20 scientific team members revealed that participants had difficulties answering the coordination and effort items.

2. Task interdependence was measured with a scale from van der Vegt, van de Vliert, and Oosterhof (2003). Team members rated the degree of task interdependence within their teams (3 items) on a 5-point scale, with responses ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). A sample item is "In order to complete our work, my colleagues and I have to exchange information and advice." (Cronbach's α = .80). Furthermore, we asked team members to indicate if they viewed themselves as operating in a team (i.e., through the item: "In our project team / competence centre we perceive ourselves as a team").

3. We need to mention that not all leaders of the 79 teams could participate in this study, which is why we were able to analyse the hypotheses with team innovation as the outcome variable only with a reduced sample of 64 teams.

4. The results remain stable if these control variables are not included.

5. X.-H. Wang and Howell (2010) developed the Dual-Level Transformational Leadership Scale by adapting some items from the Multifactor Leadership Questionnaire (MLQ) Form 5X-Short (Avolio & Bass, 2004). Especially in the dimension of communicating a group vision, 5 items have been adapted from the MLQ Form 5X-Short, whereby we are not allowed to show all the items due to copyright issues (for further information see X.-H. Wang & Howell, 2010).

6. Results from these analyses can be obtained from the corresponding author.

7. We noticed that for the three-factor model especially the CFI values were much improved in the "with item parceling" solution (χ^2 = 48.96, *df* = 24; RMSEA = .06, SRMR = .04; CFI = .98) compared to the "witouth item parceling" solution (χ^2 = 2536.47, *df* = 986; RMSEA = .07, SRMR = .08; CFI = .77).

8. The reliability coefficients for the four dimensions of teamwork quality are: Communication quality (Cronbach's α = .80), balance of member contributions (Cronbach's α = .63), mutual support (Cronbach's α = .82), and cohesion (Cronbach's α = .85).

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(Appendix follows)

Appendix

Adapted version of the teamwork quality scale (Hoegl & Gemuenden, 2001)

Communication quality

1. There is frequent communication within the team.
2. The team members communicate often in spontaneous meetings, phone conversations, etc.
3. The team members communicate mostly directly and personally with each other.
4. There are mediators through whom much communication is conducted.
5. Project-relevant information is shared openly by all team members.
6. Important information is kept away from other team members in certain situations.
7. In our team there are conflicts regarding the openness of the information flow.
8. The team members are happy with the timeliness in which they receive information from other team members.
9. The team members are happy with the precision of the information received from other team members.
10. The team members are happy with the usefulness of the information received from other team members.

Balance of member contributions

1. The team recognizes the specific potentials (strengths and weaknesses) of individual team members.
2. The team members are contributing to the achievement of the team's goals in accordance with their specific potential.

3. Imbalance of member contributions causes conflicts in our team.

Mutual support

1. The team members help and support each other as much as they can.
2. If conflicts come up, they are easily and quickly resolved.
3. Discussions and controversies are conducted constructively.
4. Suggestions and contributions of team members are respected.
5. Suggestions and contributions of team members are discussed and further developed.
6. Our team is able to reach consensus regarding important issues.

Cohesion

1. It is important to the members of our team to be part of the project(s).
2. All members are fully integrated in our team.
3. There are many personal conflicts in our team.
4. There is personal attraction between the members of our team.
5. Our team is sticking together.
6. The members of our team feel proud to be part of the team.
7. Every team member feels responsible for maintaining and protecting the team.

Adapted version of the individual learning scale (Yoon & Kayes, 2016)

1. I am able to acquire important know-how through my project(s).
2. I see my project(s) as a success.
3. I am learning important lessons from my project(s).
4. Teamwork promotes one personally.
5. Teamwork promotes one professionally.

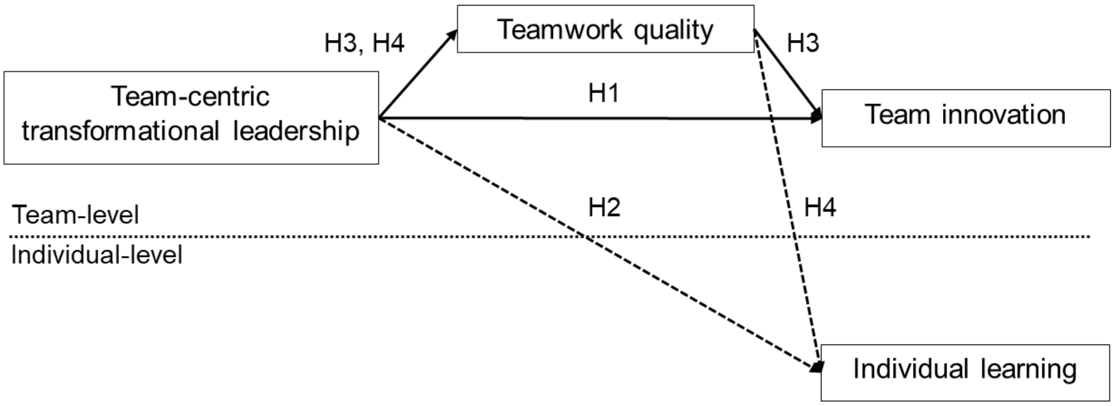

Figure 1. Multilevel model of team-centric transformational leadership, teamwork quality, team innovation and individual members' learning. H = Hypothesis. Dashed lines indicate cross-level relations.

Table 1

Comparison of measurement models for study variables

Model description	χ^2	*df*	$\Delta\chi^2$	RMSEA [90% CI]	SRMR	CFI
Three-factor model	48.96	24	-	.063 [.033, .092]	.035	.979
Two-factor model: TTFL and TWQ as one factor, and Lear as one factor	276.17	26	227.2***	.200 [.177, .224]	.085	.774
One-factor model	302.68	27	253.7***	.206 [.184, .230]	.093	.752

Note. TTFL = team-centric transformational leadership; TWQ = teamwork quality; Lear = individual members' learning; $\Delta_{\chi}{}^2$ = Satorra-Bentler scaled differences; RMSEA = root mean square error of approximation; CI = confidence interval; SRMR = standardized root mean square residual; CFI = comparative fit index. $N = 235$;

* $p < .05$, ** $p < .01$, *** $p < .001$.

Table 2

Means, standard deviations, and correlations of study variables (all on Level 1).

	M	*SD*	1	2	3
1. TTFL[a]	3.24	.83			
2. TWQ[a]	3.89	.49	.56**		
3. Team innovation[b]	3.97	.51	.16*	.09	
4. Learning[a]	4.11	.51	.33**	.43**	.11

Note. TTFL = team-centric transformational leadership, TWQ = teamwork quality, Learning = individual members' learning. *N* = 235[a]; *N* = 183[b]; * p < .05, ** p < .01 (two-tailed).

Table 3

Results of analyses predicting team innovation and individual learning.

	team innovation		individual learning	
	b^1	*SE*	b^2	*SE*
(Intercept)	3.15**	0.31	3.80**	0.21
Level 1				
Age			0.00	0.00
gender (male)			-0.10	0.06
Level 2				
team size	0.03	0.01	-0.00	0.01
team duration	0.00	0.00	0.00	0.00
task interdep.	-0.02	0.04	0.07	0.04
TTFL	0.18**	0.06	0.23**	0.07
TWQ	0.00	0.12	0.37**	0.12

Note. task interdep. = task interdependence; TTFL = team-centric transformational leadership; TWQ = teamwork quality; b^1 = estimate for multiple regression; b^2 = estimate for linear mixed model; *SE* = standard errors;

Please note that team innovation is a level 2 outcome variable, whereas individual learning is a level 1 outcome variable.

Level 1: N=235; Level 2: N=64.

* $p < .05$, ** $p < .01$ (two-tailed).