RUNNING HEAD: LEADERSHIP DYNAMICS

The emergence of shared leadership in newly-formed teams with an initial structure of vertical leadership: A longitudinal analysis.

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Abstract

The importance of high-quality leadership for team effectiveness is widely recognized, with recent viewpoints arguing shared leadership to be a more powerful predictor than vertical leadership. To identify changes in leadership structures over time, we longitudinally tracked the leadership structure of 27 newly-formed teams (N = 195), all having an initial structure of vertical leadership. Our findings demonstrated that the average team leadership strengthened over the course of the 24-week project and leadership tended to become more distributed among team members. Regarding the antecedents of these changes, we found evidence that the more team members are perceived as warm or competent, the higher their perceived influence. Finally, examining the consequences of these changes, the leadership structure was found to be related with team performance in that teams with higher average leadership perceptions performed better. These findings underpin the importance of shared leadership, thereby suggesting leaders to empower their team members.

Keywords: shared leadership, longitudinal approach, social network analysis, informal leadership, organizational leadership, leadership emergence

Introduction

The importance of high-quality leadership to human activity is widely recognized in a variety of domains. Effective political leadership is an important element in a well-organized society. Also in a competitive business environment, good managers are essential to achieve the targets and make organizations successful. Furthermore, the leadership quality of parents and teachers provides the ideal environment for children to grow, develop, and become healthy and productive adults. Given the importance of high-quality leadership for our society, it is not surprising that throughout history leadership processes have been a key research topic for academics.

Traditionally, scholars and practitioners adopted the model of vertical leadership (Pearce & Conger, 2003). This model is characterized by the influence and behavior of one single team leader, usually a manager external to the team. This leader is then designated with authority for all other group members, who are being considered as followers. The last decade in leadership research, however, has been characterized by a shift towards shared leadership. Shared leadership contrasts with the conventional paradigm of 'vertical leadership' (Pearce & Sims, 2002) by asserting that leadership is distributed among multiple group members. In recent years, scholars have provided extensive evidence for the idea that shared leadership is a better predictor of team effectiveness than vertical leadership (for meta-analyses, see Nicolaides et al., 2014; Wang, Waldman, & Zhang, 2014). In this regard, it was demonstrated that teams with shared leadership experienced less conflict, greater consensus, and higher intra-group trust and cohesion than teams without shared leadership, and therefore ultimately performed better (Bergman, Rentsch, Small, Davenport, & Bergman, 2012).

As most of these findings are based on cross-sectional research, important information on the change of leadership structures (i.e., how leadership is structured in a team) over time remains concealed; do leadership structures change over time, for instance from a vertical leadership structure towards a more shared leadership structure? And if they do, what are the

antecedents and the consequences of these changes in leadership structure? In other words, which factors underpin these changes and how do these changes in leadership structure impact the team effectiveness? These are the three research questions that the present research study aims to address.

Important insights in these change processes can be found in the literature on leaderless groups, also termed self-managing teams. First, several studies in this context have indeed supported the fact that leadership structures can change over time (Small & Rentsch, 2010). More specifically, the authors revealed that leaderless teams show a tendency to embrace more shared leadership over time. However, Carte, Chidambaram, and Becker (2006) illustrated that while this is true for some leadership behaviors (e.g., monitoring behaviors), this tendency towards shared leadership does not hold for others behaviors (e.g., performance-focused behaviors). Instead, the latter behaviors tend to become more concentrated over time (Carte et al., 2006). Second, with respect to the factors that underpinned changes in a person's leadership (and therefore also changes in the leadership structure of the team), authors emphasized the role of perceptions of competence, warmth, and empathy (DeRue, Nahrgang, & Ashford, 2015; Kellett, Humphrey, & Sleeth, 2006; Sutanto, Tan, Battistini, & Phang, 2011). In other words, the more persons are seen as competent, warm, and empathic, the more their leadership tends to strengthen over time. Third, looking at the impact of these leadership changes, research revealed that the trend towards more shared leadership in leaderless teams was related with an improved performance (Small & Rentsch, 2010).

When interpreting these findings, it is important to note that such leaderless or self-managing teams have no formal leadership structure; no appointed leaders. Along the same lines, leaderless group exercises (i.e., observing self-composed groups without a formal leader to assess personal leadership behavior, such as taking initiative) have even become a staple in

assessment centers for leadership identification (Guastello, 2007). Nevertheless, it is important to keep in mind that most organizational teams are not leaderless, but instead are led by a formal leader. In particular in the case of newly-formed teams, managers often hinge on the vertical leadership model. This view stems from the need for clear goals and guidelines during the initial stages of the group processes (Ensley, Hmieleski, & Pearce, 2006). Therefore, newly-formed teams are often complemented by a more experienced leader who has the required know-how to help the team in accomplishing their goals (Sarin & McDermott, 2003).

In contrast to the well-understood leadership emergence in leaderless teams, as outlined above, the emergence of leadership in teams with a formal leader is far less understood. Therefore, the present study aims to address this need by examining the emergence of shared leadership in newly-formed teams with an initial structure of vertical leadership, thereby aiming to provide more insight in three spearheads: (1) the longitudinal evolution of leadership structures; (2) the antecedents underpinning the fluctuations in the leadership structures; and (3) the consequences of fluctuations in the leadership structures (i.e., in particular the relationship with team performance). We will outline each of these aims in more detail.

Aim 1 – Longitudinal Evolution of Leadership Structure

Traditionally, leadership was conceptualized as a relatively stable construct that served as a static input to dynamic group processes such as job satisfaction, organizational commitment, innovation, and performance (Mathieu, Maynard, Rapp, & Gilson, 2008). This static interpretation neglected unique influences of the dynamic processes by which team members − over time – develop, meld, and synchronize their knowledge, skills, efforts, and leadership capacities to become effective as a team (Kozlowski, Watola, Nowakowski, Kim, & Botero, 2008). More recently, scholars have demonstrated that leadership structures are not

as stable as initially assumed. Instead, leadership relations within a team can shift over time (Aime, Humphrey, DeRue, & Paul, 2014; DeRue et al., 2015; Klein, Ziegert, Knight, & Xiao, 2006; Pearce & Conger, 2003). In this respect, several scholars have explicitly emphasized the need for longitudinal designs to understand how leadership structures emerge and develop over time (Carson, Tesluk, & Marrone, 2007, p. 1229; Mehra, Smith, Dixon, & Robertson, 2006).

To address these shortcomings, our study will investigate the leadership emergence of newly-formed teams over time by using a longitudinal social network approach. More specifically, we will focus on the fluctuations of two standard team-level features of leadership structures (or in network terms; leadership networks), namely the amount of leadership exhibited (assessed by the density of the leadership network, or in short leadership density) and the degree to which the leadership structure is centralized or shared (assessed by the centralization of the leadership network, or in short leadership centralization) (Borgatti, Everett, & Johnson, 2013; Gockel & Werth, 2010).

Only few studies exist that have used a longitudinal approach to examine changes in leadership structure over time. With regard to leadership density, Mathieu, Kukenberger, D'Innocenzo, and Reilly (2015) demonstrated that leadership density in student teams increased significantly over time, a finding that could not be corroborated within newly-formed consulting teams (DeRue et al., 2015). With regard to leadership centralization (i.e., the extent to which leadership is shared), Perry, Pearce, and Sims (1999, p. 43) noted that "shared leadership is a group process that requires time to develop, and its display is more likely in mature teams." As team members require time to gain understanding of each other's skills and knowledge, along the stages of team development, the ability and willingness of teams to engage in shared leadership will increase, characterized by a decrease in leadership centralization (Small & Rentsch, 2010). Although several researchers indeed found that

shared leadership was lower when the team initiated the task than in later stages in the team's development (Berdahl & Anderson, 2005; Small & Rentsch, 2010), DeRue et al. (2015) could not collaborate these findings and found no difference in leadership centralization over time.

It should be noted, though, that an important shortcoming of most previous work is that scholars focused on either the leadership density, without considering centralization (e.g., Carson et al., 2007) or focused exclusively on centralization (e.g., Berdahl & Anderson, 2005; Small & Rentsch, 2010). Furthermore, as DeRue et al. (2015) accurately noted, this one-sided view is particularly problematic given that the conclusions drawn from prior studies often conflate the amount of leadership (i.e., density) with the extent to which it is shared (i.e., centralization).

In the present study we will therefore assess changes in both leadership density and leadership centralization. Although most of this previous work focused on leaderless teams (Berdahl & Anderson, 2005; Mathieu et al., 2015; Small & Rentsch, 2010), we assume that the same conclusions will hold for newly-formed teams with an initial structure of vertical leadership. More specifically, based on the above-mentioned research suggesting that the longer teams are working together, the higher their ability and willingness to take up leadership responsibility (Mathieu et al., 2015) and engage in shared leadership (Berdahl & Anderson, 2005; Small & Rentsch, 2010), we expect that:

H1a: Over the course of the project, team members will demonstrate more leadership over time, reflected in an increase in the density of the leadership networks.

H1b: Over the course of the project, the teams' leadership structure will shift from a centralized leadership structure at the start (with one formal leader) to a more shared leadership structure at the end (due to an increase in informal leadership), reflected in a decrease of the centralization of the leadership networks.

Aim 2 – Antecedents of Leadership Emergence

After identifying the change processes of leadership structures over time, we will unpack the individual level processes that underpin the observed changes. More specifically, we will address the question of which attributes or behaviors of a group member at one point in time predict an increase in his/her leader status at the next point in time.

Throughout history, researchers have distinguished between two important leadership functions, namely a task-related function and a relationship-oriented function (Bales, 1950; Kogler Hill, 2001; Stogdill, 1950). The task-related function (also termed instrumental function or initiating structure) focuses on the accomplishment of the group tasks; getting the job done, making decisions, solving problems, adapting to changes, making plans, and achieving goals. The social-related function (also referred to as expressive function, maintenance, or consideration), on the other hand, focuses on the improvement of interpersonal relationships, for example, by developing a positive climate, by solving interpersonal problems, by satisfying members' needs, and by developing cohesion among team members. It should be noted that these two functions are not mutually exclusive. In other words, group members can simultaneously engage in both task-related and social-related leadership functions (Rees & Segal, 1984).

To provide more insight in the relative importance of both leadership functions, Judge, Piccolo, and Ilies (2004) conducted a meta-analysis, including approximately 160 independent correlations between both leadership functions and team effectiveness. Their results revealed that both leadership functions seem to be important for the team's effectiveness, with the social-related leadership function having a higher average correlation with team effectiveness ($\rho = .48$) than the task-related leadership function ($\rho = .29$). Furthermore, the authors highlighted a different impact on the included outcome variables; while the social-related leadership function was more strongly related to team

members' satisfaction, their motivation, and their effectiveness as a leader, the task-related function was more strongly related to criteria reflecting leader performance.

Along the same lines, the Stereotype Content Model (Fiske, Cuddy, & Glick, 2007) asserts that impressions of leader attributes reflect two universal dimensions of social perception, namely competence and warmth. The competence dimension includes attributes that reflect perceived ability (e.g., skill, intelligence, and creativity), while the warmth dimension includes attributes that refer to perceived intent (e.g., trustworthiness, helpfulness, and friendliness). These leader attributes closely align with the previous distinction between task- and relationship-oriented leadership functions.

Earlier research on the American elections in 1980 and the Polish elections in 1994 demonstrated indeed that the impressions of presidential candidates were characterized by both competence-oriented and warmth-oriented traits (e.g., Kinder, Peters, Abelson, & Fiske, 1980; Wojciszke & Klusek, 1996). Not only in politics, but also in organizational teams (Burke et al., 2006; DeRue et al., 2015) and in sport teams (Loughead, Fransen, Van Puyenbroeck, Hoffmann, & Boen, 2016; Price & Weiss, 2011), it has been shown that leaders are perceived as effective based on their competence, but also based on the quality of their relations with other team members.

Given that most previous research relied on a cross-sectional data collection to support their hypotheses, we aim to replicate these findings within a longitudinal design based on three measurement points (T1, T2, T3). More specifically, we will investigate at the individual level whether the extent to which a team member is perceived as competent and/or warm will predict the extent to which that team member is perceived as a leader at a later point in time. Based on previous research indicating the importance of competence and warmth as antecedents of leadership perceptions (Burke et al., 2006; Loughead et al., 2016), we expect that:

H2a: The extent to which a team member is perceived as competent at T1 (T2) will predict that team member's perceived leadership at T2 (T3).

H2b: The extent to which a team member is perceived as warm at T1 (T2) will predict that team member's perceived leadership at T2 (T3).

Aim 3 – Consequences of Leadership Emergence

The last aim of our article addresses how changes in leadership structures impacts team performance. The latest evolutions in the field reflect the idea that shared leadership is a more powerful predictor of team effectiveness than vertical leadership (Nicolaides et al., 2014; Wang et al., 2014). This argument is based on the fact that when team members engage in leadership, they bring more resources to the task, share more information, and demonstrate a higher commitment with the team (Katz & Kahn, 1978). Collectively, these consequences lead to higher levels of team performance (D'Innocenzo, Mathieu, & Kukenberger, 2016). A number of studies have corroborated these claims by demonstrating an overall positive relationship between shared leadership and team performance (e.g., Carson et al., 2007; Pearce & Sims, 2002).

A closer examination of the literature, however, reveals important inconsistencies in how shared leadership is conceptualized, operationalized, and measured (D'Innocenzo et al., 2016). More precisely, previous research has often allegedly measured the concept of *shared* leadership by assessing the average leadership in the team (i.e., the density of the leadership network). In contrast, in the strict sense of the word, shared leadership refers to the extent to which the leadership is shared throughout the team, and therefore should also take into account the centralization of the leadership network.

If we review the existing literature more systematically based on how the construct is measured, we find that with respect to leadership density, most studies revealed a positive relationship with team performance, with effect sizes varying between .21 and .65 (Carson et

al., 2007; D'Innocenzo et al., 2016; Nicolaides et al., 2014; Wang et al., 2014). In other words, the higher the average leadership perceptions in the group, the better the performance. With regard to the distribution of leadership, studies pointed to a positive relation between a higher extent of shared leadership (i.e., lower network centralization) and an improved performance, with effect sizes ranging between .22 and .29 (D'Innocenzo et al., 2016; Small & Rentsch, 2010). D'Innocenzo et al. (2016) contrasted the relative effect sizes of the density approaches (effect size = .35; *SD* = .14) and centralization approaches (effect size = .29; *SD* = .16) and did not find a significant difference between both. Based on these findings, the most effective leadership structure is thus a leadership network having a high density (i.e., high leadership quality in the team) and a low centralization (i.e., leadership distributed amongst the team members).

Several reasons might underpin these observed positive relationships (D'Innocenzo et al., 2016). For example, Pearce and Manz (2005, p. 132) noted that shared leadership is often advantageous as it is "ever more difficult for any leader from above to have all of the knowledge, skills and abilities necessary to lead all aspects of knowledge work." Instead, when multiple team members offer leadership, they bring more resources to the task, share more information, and are more committed to their team, all together leading to an improved performance (Katz & Kahn, 1978). Furthermore, being open to the influence of others, a precedent of effective shared leadership, can generated higher levels of respect and trust, which in turn fosters the team's functioning and its performance (Day, Gronn, & Salas, 2004; Marks, Mathieu, & Zaccaro, 2001).

Based on these arguments, we hypothesize that teams who moved away from their initial vertical leadership structure towards a leadership structure characterized by a high network density (i.e., high leadership quality) and low centralization (i.e., leadership spread throughout the team) will be most effective. More specifically, we hypothesize that …

H3a: The density of the leadership networks will be positively associated with team performance.

H3b: The centralization of the leadership networks will be negatively associated with team performance.

Methods

Participants

Thirty-three task groups, consisting of engineering students at a French university in Belgium, participated in the study. Each of these task groups comprises five to seven group members, who collaborated on a project under the guidance of a group leader. The group members were first-year engineering students (N = 206; M_{Age} = 18.5 years old; SD = 1.13), while the group leader was a fourth-year engineering student (N = 33; M_{Age} = 22.0 years old; SD = 1.90). Mainly male students participated in the experiment (79% of the first-year students and 70% of the fourth-year students), which reflected the male majority in engineering studies. Participants took part in the study voluntarily. After the completion of the study, we rewarded participants of two groups with a cinema ticket via a lottery. Six groups were excluded from the final analyses, because these groups had missing data for more than two participants on one or more moments in time, and as such compromising the reliability of the network analyses. The final sample thus consisted of 168 group members, nested in 27 teams and their respective team leaders.

Procedure

In the current research, we followed groups of engineering students during their 24-week collaboration on a project. Working with student teams, instead of real organizational teams, facilitated the extent to which we could control our study design. For example, we were able to measure multiple teams, who all followed exactly the same procedure (i.e., the same task, the same measurement tasks, and the same evaluation criteria). More specifically,

in this project, first-year engineering students had to design and build a technical device that could heat water by means of physical activity (e.g., pedaling or rowing). Furthermore, we ensured that each team was complemented by a formal leader, more specifically a fourth-year engineering student, having prior knowledge on the task, who guided the project and gave his team members feedback throughout the project. After finalizing the project, students presented their work for an external jury. This jury encompassed two engineers and one pedagogue to ensure a sound evaluation of both the task-specific performance and the group processes. More specifically, the jury judged the quality of their work based on a written report, on a presentation of the prototype, and on the process of collaboration. While the common criterion for leadership effectiveness is individual members' perceptions of the effectiveness of their leader, we followed the suggestions of Kozlowski and Ilgen (2006) to use the team's performance as more direct indicator of leadership effectiveness.

We administered questionnaires at three moments during the collaboration. To allow group members to get to know each other and work together, we only administered the first questionnaire after seven weeks (Time 1). The second questionnaire was filled out after 21 weeks (Time 2). The large time gap between the first and second measurement was due to a period of exams and a semester break for six weeks. At Time 2, the students were used to work together again. The third questionnaire was handed out after 24 weeks (Time 3) when the groups had presented their work for the jury, and thus just before the group's dissolution.

Measures

The questionnaires were administered in French. Our variables were measured with a sociometric approach: group members rated every other member of their group in terms of their leadership, competence, and warmth at three points in time.

Leadership. In the present study, we asked participants to rate group members' influence on a Likert scale ranging from 1 (*not at all*) to 5 (*very much*). More specifically,

participants rated each of their group members on the question: "(Since last measurement), to what extent did this person have influence in the group?" This method is consistent with leadership being defined as "a process whereby an individual *influences* a group of individuals to achieve a common goal" (Northouse, 2010) and follows earlier approaches to construct leadership networks (Lusher, Robins, & Kremer, 2010). If we refer to the concept of leadership in this article, we thus refer to the assessed influence perceptions.

For each team, the procedure resulted in one directed and valued $N \times N$ leadership network for each of the time points (with N being the number of team members). The network is *directed* because how person A perceives person B's influence does not have to equal how person B perceives person A's influence, and the network is *valued*, because the strength of the ties ranges from 1 to 5. In the table representation of the network, the rows refer to the outgoing ties of the team members (i.e., the extent to which team members perceive other members as being influential), whereas the columns refer to the incoming ties of team members (i.e., the extent to which team members are perceived by other members as influential). By convention, the diagonal entries are forced to be missing values, meaning that team members do not rate their own influence.

Competence. In line with previous suggestions (Cuddy, Fiske, & Glick, 2007), participants were asked to rate the competence of every other team member with one item: "(Since last measurement), how competent was this person for the tasks you have to perform for the project?" Group members rated every other group member on this item on a Likert scale ranging from 1 (*not at all*) to 5 (*very much*). For each group member, we calculated a competence score by averaging the competence ratings of all other group members for that member (i.e., the indegree centrality of the competence network).

Warmth. Group members' warmth was measured with three items: "(Since last measurement), to what extent (1) do you and this same person are on the same wavelength,

(2) do you like this person in the group, and (3) do you and this person are attuned to each other?" Group members were asked to rate every other group member on each of these items on a Likert scale ranging from 1 (*not at all*) to 5 (*very much*). The average of the three items represents the overall rating of team member's warmth. The internal consistency of this warmth scale proved to be excellent (Cronbach's α = .92 at Time 1; .95 at Time 2; and .96 at time 3). For each group member, we calculated a warmth score by averaging the warmth ratings of all other group members for that member (i.e., the indegree centrality of the warmth network).

Team Performance. After finishing the project, an external jury judged the quality of their work based on a written report, on an oral presentation, and on the process of collaboration. Each of these facets equally contributed to an overall performance score for each group, ranging between 0 (*very poor*) and 20 (*very good*).

Data Analysis

Network parameters. In the present study, we will use three network-specific measures; one measure at the individual level (i.e., indegree centrality), and two measures at the group level, or in other words, the network level (i.e., network density and network centralization). First, the indegree centrality is a measure at the individual level that refers to the average strength of the incoming ties for that particular individual (Borgatti et al., 2013). In other words, the team members with a high indegree centrality in the leadership network are, on average, perceived as influential by their peers.

Second, network density is a measure at the group level that describes the overall strength of interconnections between group members (i.e., whether many group members perceive many other group members as (very) influential) and can be computed by the average strength of all ties in the network. The stronger ties each group member has with other group members, the greater the density of the network. For each of the task groups at the

three time points, the density was computed for the leadership network, using the procedure for valued networks as described by Sparrowe, Liden, Wayne, and Kraimer (2001). As a result, high density scores refer to teams with on average strong influence perceptions, while low density scores characterize teams with on average low influence perceptions.

Third, network centralization is another group-level measure that reflects the extent to which a network is dominated by a single individual (Borgatti et al., 2013). With regard to the leadership network, we can thus conclude that the lower the network centralization, the more leadership is shared among the team members (Mayo, Meindl, & Pastor, 2003; Small & Rentsch, 2010). In the present study we assessed in particular the indegree centralization of leadership networks, which is based on the incoming ties (i.e., how team members are perceived by others), rather than on the outgoing ties (i.e., how a particular team member perceives other members). A maximally centralized network would thus look like a star, with the node at the center of the network (i.e., the leader) receiving all the strongest ties, while no other ties exist (i.e., all other team members perceive each other as very poor leaders). A measure of centralization, then, is a measure of the extent to which a network resembles a star (Borgatti et al., 2013). More specifically, we used the definition suggested by Freeman (1979, p. 228), which has become standard over the years:

$$Indegree\ centralization = 100 \times \frac{\sum_{i=1}^{n}(C^{*}-C_i)}{Max\ \sum_{i=1}^{n}(C^{*}-C_i)},$$

with C^{*} the indegree centrality of the most central node (i.e., team member with the highest indegree centrality) and C_i the indegree centrality of each of the other team members. More specifically, to calculate indegree centralization, we thus sum the difference between each node's indegree centrality and the indegree centrality of the most central node (i.e., the leader). We then divide this by the maximum possible, which is the score that the star graph would get. For a more detailed explanation, we refer to Borgatti et al. (2013).

A highly centralized network (i.e., with a maximum score of 100) is thus characterized by a low degree of shared leadership: one single team member is perceived by all other team members as highly influential, while the other team members are considered as not influential at all. In contrast, a decentralized network (i.e., with a minimum score of 0) is characterized by an equal distribution of leadership perceptions across the team (all team members received high (or low) influence perceptions). Teams with a high degree of shared leadership are thus characterized by high network density (i.e., strong overall leadership perceptions) together with low network centralization (i.e., leadership is spread throughout the team) (D'Innocenzo et al., 2016; Mayo et al., 2003).

Longitudinal network analysis. In order to investigate whether, over time, the competence and warmth of group members predict how influential they are to the group, we performed longitudinal social network analysis with RSIENA (R Development Core Team, 2013; Ripley, Snijders, & Preciado, 2013; Snijders, van de Bunt, & Steglich, 2010). SIENA (i.e., Simulation Investigation for Empirical Network Analysis) is a program to model network and behavior dynamics (i.e., longitudinal analysis of change in networks, change in behavior, and their co-evolution). The R in RSIENA refers to the implementation of this program into the statistical program R. RSIENA makes use of stochastic actor-based models. These are "models for network dynamics that can represent a wide variety of influences on network change and allow to estimate parameters expressing such influences, and test corresponding hypotheses" (Snijders et al., 2010, p. 44). It is assumed that social actors (i.e., nodes in the network) drive changes in the ties with others. These changes may be partly explained by factors related to the network structure and partly by factors related to stable or changing characteristics of the social actors or their relationship with others (Snijders et al., 2010). One of the key assumptions of RSIENA is that networks can be regarded as states, instead of brief discrete events. Furthermore, networks are expected to follow a Markov

process, which means that the current state of the networks probabilistically determines the future state of the networks (Snijders et al., 2010). Modeling with RSIENA thus allows "to assess the effect of a given mechanism, while controlling for the possible simultaneous operation of other mechanisms or tendencies" (Snijders et al., 2010, p. 45).

Applied to our data, RSIENA uses the overall dynamics in the data to estimate, simultaneously, changes in leadership ties (i.e., changes in the network structure), changes in the levels of competence and warmth, and associations between changes in leadership ties and changes in the levels of competence and warmth over time. In this way, we can model whether changes in competence (warmth) predict changes in leadership ties (i.e., whether, over time, group members with higher scores on competence (warmth) are perceived as more influential to the group), while at the same time controlling for several other, possibly confounding, effects (Snijders et al., 2010). More specifically, we control for the reverse effect that changes in leadership ties predict changes in competence/warmth (i.e., whether, over time, group members who are perceived as influential have higher ratings of competence/warmth). In addition, and as suggested by Snijders et al. (2010), we control for changes in the network structure, for example, whether group members reciprocate influence ties, whether there is agreement among group members about which group members are most influential (i.e., indegree popularity), or whether group members that rate many other members as influential are perceived as influential as well (i.e., outdegree popularity).

Furthermore, we also control for other effects that may influence the leadership network, thereby confounding our results (Snijders et al., 2010). For instance, it may be that group members with equal levels of competence or warmth perceive each other as influential (i.e., competence or warmth similarity). In addition, we also control for potential effects on the leadership network, caused by the covariates formal leadership and sex. Formal leaders, for instance, are usually seen as competent, and this relationship may account for the effect of

competence on the leadership network. We also control for a sex similarity effect, which tests whether members of the same sex perceive each other as more influential. This may be due to a similarity-attraction effect, described by Byrne and Griffitt (1973). By including all these covariates, we control for their effects on the leadership network. An overview including all the effects that we accounted for can be found in Appendix A. In sum, RSIENA is able to estimate the longitudinal association between members' competence and warmth on the one hand and the leadership network structure on the other hand, while simultaneously controlling for other effects that could not be controlled for by more traditional analyses.

The use of RSIENA requires binary networks (Ripley et al., 2013). Therefore, we dichotomized the leadership ratings in a way that the values at the midpoint and at the lower end of the scale (1-3) represent the absence of leadership (0 = *no tie*), whereas the values at the higher end of the scale (4-5) represent the presence of leadership (1 = *tie*). Because RSIENA requires one network (i.e., leadership network) and one behavior variable (i.e., warmth or competence), we calculated each individual's indegree centrality as a measure for warmth and competence. The indegree centrality is a node-specific measure that refers to the average strength of the incoming ties for that particular node (Borgatti et al., 2013). A high indegree centrality in the competence (warmth) network thus characterized the team members who are perceived as competent (warm) by their peers.

Results

Aim 1 – Longitudinal Evolution of the Leadership Structure

Table 1 presents the means, standard deviations, and correlations between all the included variables for the three time points at the individual level, whereas Table 2 provides the same information at the team level. The evolution of leadership networks across time can be characterized by three parameters: (1) the extent to which the average leadership in the

team changes; (2) the extent to which leadership is shared within the team; and (3) the extent to which formal or informal leaders influence their team members.

Table 1

Means, standard deviations, and correlations between all the included variables at the individual level for the three time points.

	M	*SD*	1A.	1B.	1C.	2A.	2B.	2C.	3A.	3B.	3C.
1. Team members' warmth											
A. Time 1	3.72	.57	-								
B. Time 2	3.70	.58	.64***	-							
C. Time 3	3.89	.55	.64***	.84***	-						
2. Team members' competence											
A. Time 1	3.62	.66	.78***	.54***	.47***	-					
B. Time 2	3.60	.67	.53***	.77***	.66***	.66***	-				
C. Time 3	3.77	.64	.53***	.73***	.80***	.62***	.80***	-			
3. Team members' leadership											
A. Time 1	3.41	.72	.76***	.53***	.46***	.86***	.64***	.57***	-		
B. Time 2	3.35	.80	.58***	.73***	.63***	.65***	.87***	.78***	.73***	-	
C. Time 3	3.62	.70	.56***	.69***	.74***	.63***	.80***	.88***	.68***	.85***	-

***$p < .001$.

Average leadership across time. The average leadership in the team at a specific time was measured by the network density of the leadership network. In this case, the network density could hypothetically vary between 1 (*no team members are perceived as influential*) and 5 (*all team members are considered as very influential*). However, in our sample, the density of the leadership network varied between 2.44 and 4.20 across the different teams and across the different time points. The means and standard deviations of the leadership density across the three time points are presented in Table 2.

Table 2

Means, standard deviations, and correlations between all the included variables at the team level for the three time points.

	M	*SD*	1A.	1B.	1C.	2A.	2B.	2C.	3A.	3B.	3C.	4A.	4B.	4C.
1. Team warmth														
A. Time 1	3.73	.30	-											
B. Time 2	3.71	.34	.47*	-										
C. Time 3	3.90	.34	.41*	.86***	-									
2. Team competence														
A. Time 1	3.63	.28	.84***	.32	.26	-								
B. Time 2	3.60	.30	.43*	.85***	.73***	.41*	-							
C. Time 3	3.78	.30	.32	.73***	.87***	.32	.70***	-						
3. Team leadership (density)														
A. Time 1	3.42	.30	.80***	.32	.30	.88***	.41***	.33	-					
B. Time 2	3.37	.37	.49**	.79***	.77***	.48*	.92***	.76***	.52**	-				
C. Time 3	3.63	.33	.29	.65***	.84***	.28	.68***	.89***	.37	.78***	-			
4. Team leadership (centralization)														
A. Time 1	19.77	6.28	-.20	-.37	-.24	-.30	-.33	-.11	-.26	-.37	-.19	-		
B. Time 2	19.21	6.38	-.40*	-.36	-.45*	-.31	-.22	-.33	-.25	-.32	-.23	.48*	-	
C. Time 3	18.03	6.67	-.40*	-.27	-.39*	-.17	-.15	-.37	-.18	-.27	-.31	.17	.54**	-
5. Team performance														
Time 3	14.63	2.13	.17	.53**	.40*	.15	.53**	.43*	.17	.42*	.44*	-.24	.10	.13

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

A repeated-measures ANOVA indicated a significant difference between the leadership density over time ($F(2, 52) = 10.84$, $p < .001$). Post-hoc pairwise comparisons using the Bonferroni correction revealed no significant differences between the average leadership densities between Time 1 and Time 2. However, the average leadership density appeared to be significantly higher at Time 3, when compared with Time 1 ($p < .05$) and Time 2 ($p < .001$). We can thus conclude that, in line with H1a, the average leadership perceptions in the team increased towards the end of the project.

Leadership distribution across time. The distribution of leadership in the team, or in other words, the extent to which leadership is shared among the team members, can be assessed by the centralization of the leadership network (Mayo et al., 2003; Small & Rentsch, 2010). In the present study, the centralization of the leadership networks varied between 5.60 and 33.89 across time and across the different teams. Given that centralization scores can hypothetically vary between 0 and 100, with 0 being a completely decentralized network (i.e., shared leadership) and 100 being a completely centralized network (i.e., vertical leadership), the results reveal that all the observed work teams are characterized by low centralization, and thus by a high degree of shared leadership. The means and standard deviations of leadership centralization over time are presented in Table 2. Although a trend towards higher degrees of sharing the lead can be observed, a repeated-measures ANOVA revealed no significant differences between the network centralizations at different time points ($F(2,52) = .86$, $p = .43$), which contrasts H1b.

Although at the team level, no significant differences in network centralization emerged, more insight might be gained at the individual level by examining the potential shift in influence from formal leaders to informal leaders. The balance between formal and informal leadership can be examined in two ways: (1) by comparing the indegree centralities of the formal leaders and the other team members across the three time points; and (2) by

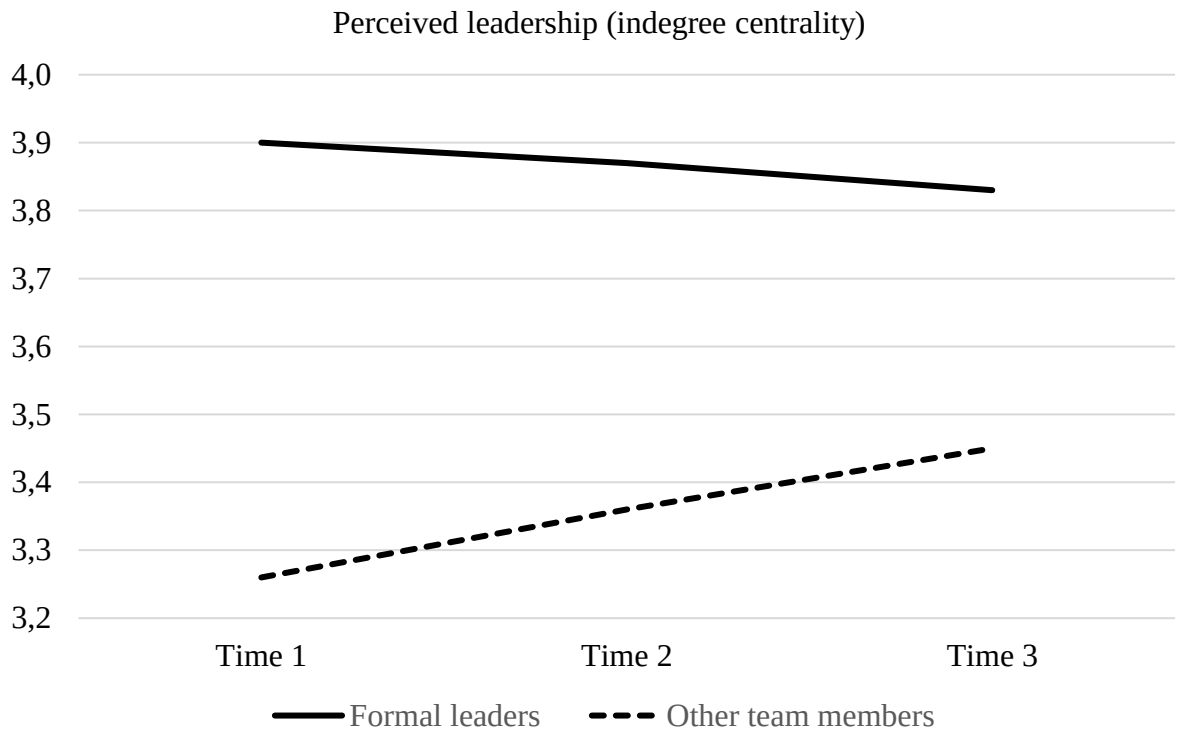
comparing the leadership rankings of both the formal leaders and the other team members. First, the indegree centrality, computed by the average strength of the incoming ties, is an individual-level SNA-measure that identifies a team members' importance in the team and the extent to which that team member influences other members (e.g., Hoppe & Reinelt, 2010). Our findings revealed that the average indegree centrality of the formal leaders varied between 3.93 (*SD* = .49) at Time 1, over 3.84 (*SD* = .61) at Time 2, to 3.85 (*SD* = .64) at Time 3, while the average indegree centrality of the other team members ranged from 3.39 (*SD* = .65) at Time 1, over 3.31 (*SD* = .77) at Time 2, to 3.58 (*SD* = .71) at Time 3.

To compare the perceived influence of formal leaders with the perceived influence of the other team members over time, we constructed a multilevel regression model with time as within-subjects variable (Level 1), formal leader status as between-subjects variable (Level 2) (i.e., formal leader = 1; other team members = 0), and the perceived influence scores (i.e., indegree centrality) as dependent variable. Also gender was included as a control at Level 2 and cross-level interactions between time and the Level 2-variables were tested. Furthermore, a random intercept was included at Level 3 to control for the nesting of individuals within teams. The addition of this random intercept allows to infer relations that are not influenced by the clustered nature of our data but are solely due to differences within and between individuals (Hox, 2002).

First, the results revealed that formal leadership status was a significant predictor (*B* =.67, $p < .001$). On average the formal leaders were perceived as stronger leaders than the other team members were. Furthermore, time was a significant predictor at Level 1, indicating that team members' indegree centrality increased over time (*B* = .08, $p < .001$). However, this effect was conditioned by a significant cross-level interaction between time and formal leader status (B = -0.13, $p = .02$).

To further examine the nature of this interaction effect, Simple Slope Analyses were conducted. These analyses revealed that while the leadership perceptions (i.e., indegree centralities) did not significantly change over time for the formal leaders (B = -.05, p = .38), a significant increase in leadership did emerge over time for the other team members (B = .08, p <.001). The interaction effect was thus caused by the stability of the perceived influence of the formal leaders, while the perceived influence of the other team members increased. This finding suggests a trend towards more shared leadership the longer the team works together. These change patterns are illustrated in Figure 1. Finally, neither gender (B = .09, p = .46) nor the interaction between time and gender (B = .03, p = .51) were significant.

Figure 1. The interaction between participants' change in perceived leadership (indegree centrality) over time and formal leadership status. Change patterns are depicted separately for formal leaders and the other team members.



More in-depth investigation on the average leadership ranking of the formal leader demonstrates that the formal leader was, on average, perceived as second most influential

leader of the group at Time 1 (i.e., average ranking = 2.19). However, at the end of the project (i.e., Time 3), the leadership status of the formal leader decreased and, on average, two other team members were perceived as exerting more influence than the formal leader (i.e., average ranking = 3.03). We can conclude that, although at the team level no difference in leadership centralization emerged, at the individual level, a transfer from formal to informal leadership can be observed.

Aim 2 – Antecedents of Leadership Emergence

Table 3 summarizes the results for the RSIENA models of competence and warmth predicting members' influence across time. The table provides estimates of the effects and their standard error. Dividing the value of the estimate by the value of the standard error results in a t-ratio, which denotes the significance of the effect (Snijders, 2001). A full overview of all analyses can be found in the Appendix A. We will elaborate on the most important relationships.

Over time, significant changes are observed in the leadership networks (see Table 3, Effects 2-3). This result is in line with our previous findings that leadership networks are dynamic and change over time. On the other hand, also the competence and warmth networks appear to be liable to fluctuations over time (see Table 3, Effects 4-5). In other words, the degree in which individuals perceive their team members to be competent or warm varies over time. As predicted, the observed changes in the competence and warmth network can be linked to the observed changes in the leadership networks. In other words, consistent with H3a and H3b, both group members' competence and their warmth measured at one time predicted their influence in the group at the next time (see Table 3, Effect 1), controlling for several other effects (for more details, we refer to the Method section on longitudinal network analysis and to Appendix A).

Table 3

Unstandardized parameter estimations for the network models of competence and warmth, including the standard error between parentheses and the t-value as measure of the effect size.

Effects	Competence		Warmth	
	Estimate (SE)	*t*-value	Estimate (SE)	*t*-value
Effect of interest				
1. Tendency of members with higher levels of competence [warmth] to be evaluated as influential by more team members	.98** (.35)	2.78	.70*** (.18)	3.94
Controls (for the full list of control variables, see Appendix A)				
2. Change in influence ties between Time 1 and Time 2	4.90*** (.59)	8.27	4.56*** (.49)	9.32
3. Change in influence ties between Time 2 and Time 3	3.33*** (.39)	8.44	3.16*** (.32)	9.83
4. Change in the levels of competence [warmth] between Time 1 and Time 2	1.64*** (.35)	4.65	1.26** (.29)	4.27
5. Change in the levels of competence [warmth] between Time 2 and Time 3	.97*** (.19)	5.10	.89*** (.15)	6.05

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

Aim 3 – Consequences of Leadership Emergence

All correlations between the team-level indicators of the leadership networks (i.e., density and centralization) and the team performance are presented in Table 2. Although the power at team level is very limited ($N = 27$), we found a significant correlation between leadership density and team performance ($r = .44$; $p < .05$), in line with H3a. In other words, the better the average leadership in the team, the better their performance ratings by the external jury. In contrast with H3b, no significant relationship emerged between the

centralization of the leadership network (i.e., the degree in which leadership is shared) and the team performance.

Discussion

The current study investigated how leadership structures change over time in newly-formed teams with an initial structure of vertical leadership. By doing so, our work challenged the conventional image of stable, hierarchical leadership structures and revealed that leadership can fluctuate over time and, more specifically, tends to become more shared throughout the team. Furthermore, we extended previous work by articulating how the extent to which a team member is perceived as warm or competent underpinned the changes in his/her perceived leadership. Finally, we demonstrated that the more team members exhibited leadership at the end of the project (i.e., the more teams moved away from a hierarchical leadership structure towards a shared leadership structure), the better their team performed.

Longitudinal Evolution of the Leadership Structure

Although recent leadership research tends to embody the notion that leadership structures change over time (e.g., Aime et al., 2014; Carson et al., 2007; Drescher, Korsgaard, Welpe, Picot, & Wigand, 2014), these studies did not provide concrete evidence on the nature of leadership transitions in terms of density or centralization of the leadership networks. Regarding the dynamics of leadership structures over time, we found evidence that the average leadership perceptions in the team (i.e., leadership density) increased towards the end of the project, thereby confirming H1a. These findings are in line with previous work of Mathieu et al. (2015), who found a similar increase in leadership density when examining self-managing teams. We can thus conclude that previous findings in self-managing or leaderless teams also apply to newly-formed teams with an initial hierarchical leadership structure.

Furthermore, if we look at the extent to which leadership is shared, our findings revealed a trend towards more shared leadership (i.e., decreasing centralization) over time. The longer the team worked together, the more leadership was shared throughout the team and no longer dominated by solely the formal leader. Although the observed trend is in line with H1b, it should be noted that a ceiling effect (i.e., all participating teams were characterized by a relatively large degree of shared leadership) potentially concealed the significance of this trend.

To provide more insight in the nature of these leadership transitions, we examined at the individual level whether a flow of leadership occurred between formal and informal leadership. Although no differences emerged in the influence perceptions of the formal leaders over time, the other team members became significantly stronger leaders towards the end of the project. This growth in informal leadership also triggered the slight increase in shared leadership towards the end of the project.

Furthermore, analysis of the leadership rankings of the formal leaders revealed that at the end of the project, on average, two other team members were perceived as more influential than the formal leader. These findings are in line with previous work that found a significant decrease of leadership centralization over time (Berdahl & Anderson, 2005; Small & Rentsch, 2010). Given that shared leadership is a process that requires time to develop and therefore more often occurs in mature teams (Perry et al., 1999; Small & Rentsch, 2010), it might be possible that the duration of the project was not long enough or the intensity of cooperation (i.e., hours per week) was too small to find significant effects at the team level.

Knowing that leadership structures significantly change throughout time, we consequently investigated both the antecedents and the consequences of these leadership changes (Aim 2 and Aim 3, respectively).

Antecedents of Leadership Emergence

Our second aim was to unpack the micro-level processes that underpinned the observed leadership changes. We focused thereby on competence and warmth in particular, given that these factors reflect two universal dimensions of social perception, driving human's emotions and behaviors and determining their social interactions (Fiske et al., 2007). Furthermore, these attributes are closely linked with two essential leadership functions that have been researched throughout decades of leadership research, namely a task-related function and a relationship-oriented function (Bales, 1950; Kogler Hill, 2001; Stogdill, 1950).

Noteworthy is that, according to our results, not only leadership networks fluctuate over time but also networks of competence and warmth are susceptible to changes over time. These findings further corroborate the work of Cuddy, Fiske, and Glick (2004), showing that warmth and competence perceptions are susceptible to change. More specifically, the authors revealed that, when working women became mothers, their perceived warmth increased, at the expense of a drop in their perceived competence. For our specific sample of newly-formed teams, we found that both competence and warmth perceptions tended to increase over the course of the project. With regard to competence, it is conceivable that as team members require time to gain understanding of each other's skills and knowledge, perceptions of each other's competence increased along the stages of team development. The same holds for warmth given that team members needed time to get to know each other and to establish warm relationships. This finding could also be explained by the exposure effect, indicating that mere exposure to particular individuals causes higher perceptions of attractiveness to these individuals (Moreland & Beach, 1992). As such, by providing insight in the dynamics of competence and warmth, our findings move beyond the work of DeRue et al. (2015) who measured competence and warmth only at a single time point.

Furthermore, consistent with H2a and H2b, we found that higher perceptions of competence and warmth of group members at one time predicted their perceived influence in the group at the next time, while controlling for alternate effects. In other words, the more a person is perceived as warm and competent at one time, the more he/she will be perceived as influential at the next time. This finding corroborates previous cross-sectional research revealing that warmth and competence are important predictors of leadership perceptions (e.g., Burke et al., 2006; Ho, Shih, & Walters, 2012; Judge et al., 2004; Kinder et al., 1980; Wojciszke & Klusek, 1996).

Consequences of Leadership Emergence

After identifying the factors underpinning the observed leadership changes, we examined the consequences of the observed changes in leadership structure. More specifically, we investigated the relationship between key indicators of the leadership networks (i.e., density and centralization) and the performance evaluation by the external jury. Our findings indicated that the leadership density in the team was significantly associated with the team performance. In other words, having, on average, better leadership perceptions in the team led to an improved team performance. This finding collaborated previous research demonstrating a positive relationship between team leadership and team performance (for reviews, see D'Innocenzo et al., 2016; Nicolaides et al., 2014; Wang et al., 2014).

Although most previous studies used network density as measure for shared leadership, network centralization better reflects the extent to which leadership perceptions are shared throughout the team. In our study, the centralization of the leadership networks (i.e., the extent to which leadership is spread throughout the team) was not related to team performance, which contrasts previous findings (D'Innocenzo et al., 2016; Small & Rentsch, 2010). This non-significant relationship between leadership network centralization and performance suggests that a fully shared leadership structure, in which all team members take

the lead on equal bases, might not be the most effective. This could be explained by the fact that not all individuals have the skills required to lead, nor the motivation to take up a leadership role. More importantly, when all team members want to take the lead, this can prove to be problematic since inconsistent messages may lead to confusion and miscommunication (Fransen et al., 2017). As Gockel and Werth (2010) nicely phrased it: "It might be good to share the burden of leading, but too many cooks might spoil the broth." We should note, however, that the lack of a significant effect could also have been caused by the limited variation in network centralization across teams. The maximum centralization of the teams' leadership networks was only 35% (on a scale from 0 to 100%), indicating that all teams showed a relatively high degree of shared leadership.

More research is needed to obtain more insight in the ideal number of leaders within the team. Along these lines, additional analyses in the present study demonstrated a strong relationship between the average leadership quality of the three best leaders in the team and the team's performance ($r = .53$; $p < .01$). This finding provides preliminary evidence for the fact that the relationship between shared leadership and team outcomes might not be linear, but rather curvilinear, thereby suggesting that a leadership team with a limited number of leaders (in contrast to having only one leader or everyone taking up a leadership role) seems to be most effective (Gockel & Werth, 2010).

Practical Implications

The observed findings in the present study suggest that, in order to optimize team effectiveness, teams might thus opt for a hybrid approach, combining the strengths of both shared leadership (e.g., shared responsibility) and vertical leadership (e.g., consistent communication). This leadership structure would yield a network that is characterized by high network density but only intermediate network centralization (Fransen et al., 2017).

In order to implement such a hybrid shared leadership structure, it is important to identify the best leaders in the team. The perceptions of team members are essential in driving this process, rather than only relying on the perceptions of the formal leader (Fransen et al., 2017). Indeed, when team members do not recognize or accept the leadership of appointed leaders, they will also be unlikely to follow the leaders' guidance, undermining the leader's capacity to lead (Platow, Haslam, Reicher, & Steffens, 2015). After identifying those team members who are perceived consensually as the best leaders in the team, it is also important to formally appoint these leaders in their leadership role. As such these leaders will be more eager to take on responsibility, especially in difficult times (Cotterill & Fransen, 2016).

After implementing an effective structure of shared leadership, the leadership potential in the team can be maximized by further developing the quality of the appointed leaders in the team. The findings of the present study identified warmth and competence as important drivers of a person's perceived leadership. These results suggest that future research leadership programs should not only focus on leaders' competence, but also emphasize their social leadership function. In other words, leaders should be taught on how to provide a good atmosphere in the team, nurture interpersonal relationships, and handle intra-team conflicts. In the future research section below, we highlight additional research avenues that would be highly relevant in helping managers on the floor to create the most favorable circumstances under which shared leadership can flourish.

Strengths and Limitations

When interpreting the present findings, it is worth considering the strengths and limitations of our study approach. A major strength of this study is its longitudinal design. Despite the fact that the traditional idea of a stable leadership structure have paved the way for a more dynamic view on shared leadership, most studies on shared leadership to date have still adopted a cross-sectional design (Carson et al., 2007; Casciaro & Lobo, 2005; Loughead

et al., 2016). Our study addressed the clear need for longitudinal designs, as previously highlighted by Carson et al. (2007). Indeed, this design allowed us to obtain more insight in the dynamical nature of leadership by exploring the changes in leadership networks over time, or more specifically, over stages of team development. Furthermore, this design allowed us to investigate the impact of warmth and competence perceptions on leadership transitions in a more dynamic way.

Second, we adopted a novel methodology to answer our research questions. Because shared leadership is inherently a relational phenomenon, it is well captured by an approach such as network analysis whose unit of analysis is the leadership perception between team members (Nicolaides et al., 2014).

Third, past empirical research has operationalized the construct of shared leadership often as the overall quantity of leadership in the team, neglecting the essence of the conceptual definition – the distribution of leadership (e.g., Small & Rentsch, 2010). In the present study, however, we examined the dynamics of the leadership networks both in terms of average team leadership (i.e., network density) and in terms of leadership distribution (i.e., network centralization). As such, we obtained a comprehensive insight in the dynamics of leadership structures over time.

Despite the strengths, we should also acknowledge some limitations that are inherent to this study. For example, the present study relied on the assumptions of the Stereotype Content Model (Fiske et al., 2007), asserting that impressions of leader attributes reflect two universal dimensions of social perception, namely competence and warmth. Although our study findings revealed that both dimensions were indeed related to leader effectiveness, and therefore indirectly also related to performance, other organizational models might relate more directly to performance. For example, the classic notion that performance is a function of both ability and motivation (Anderson & Butzin, 1974) highlights the importance of team

members' motivation, a facet that was not controlled for in this study. Another framework that could shed more light on how networks can impact the team's functioning is the Dynamic Network Theory Perspective (Westaby, Pfaff, & Redding, 2014), which provides more insight in how social networks impact upon goal pursuits in organizational systems. More specifically, this perspective outlines eight role behaviors that are essential in explaining how social networks evolve to be more oriented towards goal pursuit or resistance. In line with these insights and the work of Mehra et al. (2006), future research could identify specific leadership network attributes that are crucial for a team's success.

Besides this theoretical limitation, there are also a few limitations with respect to our study design that could inspire future research. A first limitation concerns the nature of our sample (i.e., university students). While student groups are often used as participants in empirical studies because of their easy access, well-defined task, and controllable team composition, they might not reflect the realities that are experienced in organizations. In this view, the observed relationships in this study might even be an underestimating of the ones in real organizations, as D'Innocenzo et al. (2016) revealed lower average effect sizes for the relationship between shared leadership and performance in educational settings compared to the organizational field. Future studies should thus examine a wider range of work groups to test the generalizability of our findings.

Second, we studied ad hoc task teams, which worked together for 24 weeks on a well-defined project. Although half of organizational teams work together for less than one year, and many of these teams work together for only two or three months (DeRue et al., 2015), our findings may not generalize to teams who work together for longer periods of time.

Third, we assessed leadership by asking participants to what extent they perceived other team members as influential. This measure is consistent with leadership being defined as "a process whereby an individual *influences* a group of individuals to achieve a common

goal" (Northouse, 2010) and follows earlier approaches to construct leadership networks (Lusher et al., 2010). Nevertheless, some researchers argue that leadership is more than having influence. Future research could use measures that are more directly tapping into leadership quality (Fransen et al., 2017; Fransen et al., 2015) or leadership effectiveness (e.g., Atwater, Dionne, Avolio, Camobreco, & Lau, 1999) to verify the generalizability of our results.

Fourth, we opted for a longitudinal design in order to detect evolutions in leadership networks across time. Although our findings suggested that competence and warmth were two important predictors of influence relations, our design does not allow us to claim causality. Future experimental studies, in which the warmth and competence of a team member is experimentally manipulated, could corroborate the causality of their relationship with leadership. The downside of such designs is then the limited external validity.

Finally, in the present study a relatively large time gap distinguished the different measurement points. In addition, the adopted time gap was not consistent throughout the experiment, as a result of exams and a semester break. For example, the shorter break between T2 and T3 could have underpinned the fact that the correlations between T2 and T3 were overall higher than the correlations between T1 and T2. On the other hand, this difference could also be explained by the fact that these team attributes became more stable the longer the team worked together. Future research, including more frequent measures of the different variables, could offer a more in-depth insight in the both the short-term leadership dynamics and the emergence of shared leadership structures over time.

Promising Avenues for Future Research

In addition to the suggestions raised above, we highlight some additional opportunities for future research. The present research examined the dynamics of general leadership networks over time. Future research could go more into detail and explore the dynamics of

role-specific leadership networks. More specifically, previous research distinguished between different leadership roles that team members can occupy. For example, the role differentiation theory (Bales, 1950) distinguishes between leaders with a task-oriented function and leaders with a socially-oriented function. Similar leadership categorizations are found across different domains, ranging from organizational settings (e.g., Denison, Hooijberg, & Quinn, 1995; Sheard & Kakabadse, 2007) to sports settings (e.g., Fransen et al., 2017; Fransen et al., 2015; Loughead, Hardy, & Eys, 2006).

Besides the task-oriented leadership behaviors (e.g., planning and organizing, development and mentoring of team members) and relation-oriented leadership behaviors (e.g., support and consideration), alternate behaviors include for instance change leadership behaviors such as questioning each others' strategies or encouraging rethinking of ideas (Grille, Schulte, & Kauffeld, 2015; Hiller, Day, & Vance, 2006; Small & Rentsch, 2010). Interesting in this regard is the study of Carte et al. (2006), who observed differences in the role-specific leadership networks of self-managed virtual teams. More specifically, the participating teams displayed a centralized leadership structure with respect to performance-oriented leadership behavior, while showing a shared leadership structure with respect to monitoring leadership behaviors (i.e., keeping track of group work). This study thus provides evidence that different leadership behaviors can embody different network structures. Future research could provide more insight in the dynamics of these role-specific leadership networks over time.

A second interesting future research line could look at the *quality* of leadership, rather than the extent to which leadership is demonstrated. In other words, while the present study delved into the amount of influence that team members demonstrated, this measure does not give information on the quality of this influence, or in other words, on whether this influence was positive or negative. In line with earlier recommendations, future could thus examine to

what extent the quality of the provided leadership is predicted by perceptions of warmth or competence.

Another promising avenue for future research is to identify other factors than warmth and competence that predict, or potentially moderate, the transitions in leadership networks over time. An example study in this regard is the work of Hong, Catano, and Liao (2011), who demonstrated that the motivation to lead was an important predictor for leaders to stand up from the crowd. In our study participants' motivation to lead could have served as an important moderator for the emergence of shared leadership. The cohesion within a team might be an alternate factor that predicts the emergence of shared leadership. Indeed, it has been shown that team members in highly cohesive teams are more likely to exchange advice and share perspectives with each other (van Woerkom & Sanders, 2010). Along the same lines, it was found that more cohesive teams demonstrated higher levels of shared leadership (Bergman et al., 2012; Mathieu et al., 2015). Having a profound insight in all factors that predict and moderate fluctuations in leadership emergence over time would help organizations to modify and optimize the leadership structure in their teams.

Furthermore, research investigating the processes underlying the leadership transitions would provide more insight in the nature of leadership dynamics. For example, DeRue et al. (2015) did not only demonstrate that individuals' perceptions of the group's warmth predicted leadership emergence, but also that this effect could be explained by an increased identification of the members with their group. In other words, members who perceived their group as warm identified more strongly with the group, and, as a result, contributed more informal leadership over time. Similarly, future research could provide more insight in why being perceived as competent or warm by one's group members increases one's leadership perceptions over time.

A final avenue for future research relates to the relationship between shared leadership and performance. As our study did not succeed in revealing a clear significant relationship between the centralization of leadership structures and the team performance, it is possible that underlying moderators are at play. More specifically, the effectiveness of shared leadership may depend to a large part on the existence of important boundary conditions and moderating mechanisms. Moderators that have been emphasized in organizational theorizing as critical antecedents for optimal group functioning in a shared leadership structure are, amongst others, leader acceptance (Burke, Fiore, & Salas, 2003), role differentiation (e.g., Burke et al., 2003; Seers, Keller, & Wilkerson, 2003), and team identification (Small & Rentsch, 2010). Also the task complexity might constitute an import moderator explaining the effectiveness of shared leadership, although previous literature is characterized by inconsistency in its findings. On the one hand, authors argue that the more complex the work is that is being performed, the more likely it is that shared leadership will be needed for optimal performance (Pearce & Manz, 2005). In contrast, others observed that while this may be the case in some situations, shared leadership did not appear to be beneficial for team performance in teams with high levels of complexity (D'Innocenzo et al., 2016). Unfortunately, not only with respect to task complexity, but also with respect to the other mentioned moderators, a thorough understanding of the factors explaining when and why shared leadership fosters (or undermines) team effectiveness is still lacking. Experimental studies that support the validity of these moderators would enhance our understanding of the mechanisms and processes underlying the effectiveness of shared leadership.

Conclusion

The present work provided more insight in the dynamics of leadership networks over time by demonstrating that the average team leadership increases over time and leadership tends to become more distributed among team members. This shift towards more shared

leadership over time could be attributed to a flow from formal to informal leadership, and importantly, was associated with a better team performance. Furthermore, this study combined network-based perceptions on leadership structure with insights of the social-psychological literature on interpersonal perceptions. Bringing together these different domains revealed that competence and warmth are part of the social foundation through which leadership structures emerge in groups.

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Appendix A

Description of the effects tested in the network model, including the unstandardized parameter estimations and standard errors tested in the network model for competence and warmth.

Nr.	Effect	Network parameter	Description	Competence	Warmth
Effect of interest:					
1	Others' influence ratings of competent [warm] members	Competence [warmth] alter	Tendency of members with higher levels of competence [warmth] to be evaluated as influential by more team members	**.98** ** **(.35)**	**.70** *** **(.18)**
Controls:					
2	Influence tie change (period 1)	Constant tie rate (period 1)	Change in influence ties between Time 1 and Time 2	**4.90** *** **(.59)**	**4.56** *** **(.49)**
3	Influence tie change (period 2)	Constant tie rate (period 2)	Change in influence ties between Time 2 and Time 3	**3.33** *** **(.39)**	**3.16** *** **(.32)**
4	Competence [warmth] change (period 1)	Rate competence [warmth] (period 1)	Change in the levels of competence [warmth] between Time 1 and Time 2	**1.64** *** **(.35)**	**1.26** *** **(.29)**
5	Competence [warmth] change (period 2)	Rate competence [warmth] (period 2)	Change in the levels of competence [warmth] between Time 2 and Time 3	**.97** *** **(.19)**	**.89** *** **(.15)**
6	Competence [warmth] when rated as influential by many others	Behavior competence indegree	Tendency of members who are evaluated as influential by more team members to have higher levels of competence [warmth]	**.63 (.21)** **	**.45** ** **(.14)**
7	Influence rating intercept	Outdegree	Basic tendency to form influence ties	-.66 (.65)	**-1.61** ** **(.61)**
8	Influence rating reciprocity	Reciprocity	Tendency to reciprocate influence ties	.41 (.28)	.41† (.25)
9	Transitive triplets	Transitive triplets	Tendency of member B to evaluate member C as influential when member A evaluates member B as	**.35** *** **(.05)**	**.33 (.05)** ***

			influential and member A evaluates member C as influential		
10	3-cycles	3-cycles	Tendency of member A to evaluate member C as influential when member A evaluates member B as influential and member B evaluates member C as influential	-.32 (.10)	**-.35** (.12)**
11	Agreement in influence ratings	Indegree popularity (sqrt)	Tendency to evaluate those members as influential who are evaluated as influential by many others as well	.22 (.34)	**.66*** (.19)**
12	Influence when rating others as influential	Outdegree popularity (sqrt)	Tendency to evaluate those members as influential who evaluate more other members as influential	-.23 (.36)	-.08 (.46)
13	Competent [warm] member's ratings of others' influence	Competence [warmth] ego	Tendency of members with higher levels of competence [warmth] to evaluate more other members as influential	-.01 (.18)	-.09 (.16)
14	Seeing members with similar levels of competence [warmth] as influential	Competence [warmth] similarity	Tendency of members to evaluate members with similar levels of competence [warmth] as more influential	-.36 (.79)	-.27 (.79)
15	Competence [warmth] when rating many others as influential	Behavior competence [warmth] outdegree	Tendency of members who evaluate more other members as influential to have higher levels of competence [warmth]	.16 (.11)	.08 (.11)
16	Linear change in competence [warmth]	Behavior competence [warmth] linear shape	General tendency of linear change in the levels of competence [warmth] in the overall network	**-2.29** (.81)**	**-1.37*** (.51)**
17	General convergence or divergence in competence [warmth]	Behavior competence	General tendency of quadratic change in the levels of competence [warmth] in the overall network	**-1.34*** (.30)**	**-1.13*** (.20)**

		[warmth] quadratic shape			
18	Leader's higher influence	Leader alter	Tendency of leaders to be evaluated as more influential	.15 (.14)	.25 (.15) †
19	Leaders perceiving more others as influential	Leader ego	Tendency of leaders to evaluate more other members as influential	.14 (.13)	.15 (.14)
20	Different competence [warmth] changes for leaders	Behavior competence [warmth] effect from leader	General tendency of change in the levels of competence [warmth] for leaders as compared to other group members	-.17 (.34)	-.53 (.36)
21	Women's higher influence	Gender alter	Tendency of women to be evaluated as more influential	.13 (.14)	.05 (.12)
22	Women perceiving more others as influential	Gender ego	Tendency of women to evaluate more other members as influential	.13 (.13)	.09 (.12)
23	Seeing members with similar gender as influential	Gender similarity	Tendency to evaluate members of the same gender as influential	-.36 (.79)	.15 (.13)
24	Different competence [warmth] changes for women	Behavior competence [warmth] effect from women	General tendency of change in the levels of competence [warmth] for women as compared to men	.09 (.28)	.16 (.28)

† $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$.

Note. This table displays the final RSIENA model that was tested with the central hypothesis that members' level of competence or warmth at one time point would predict how influential they are in the group at the next point in time (Effect 1). At the same time, this model controls for several other effects, effects of the leadership network structure, effects of warmth and competence, other types of associations between both, and associations with the covariates gender and formal leadership. We also tested the model without the controls that were not significant in the model shown above, and found that the effect of competence/warmth on the influence network remained.

The numbers in the table represent unstandardized parameter estimates and their standard errors (between brackets). A t-ratio is obtained by dividing the parameter estimate by its standard error.