Journal of Science and Medicine in Sport

Will the Real Leaders Please Stand Up? The Emergence of Shared Leadership in Semi-Professional Soccer Teams

--Manuscript Draft--

Manuscript Number:	JSAMS_2020_341R1
Article Type:	Original article
Section/Category:	Sport Science
Keywords:	Shared leadership; Athlete leadership; Peer leadership; Leadership emergence; Team functioning; Social network analysis
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Abstract:	Objectives. High-quality leadership is often regarded as one of the main sources of competitive advantage. Especially within sport teams, a team's leadership structure has historically been considered to be stable across the season, with the coach and team captain as the formal, and often sole, leaders. In line with recent organizational research, the present study aims to broaden this perspective by also taking informal leaders into account and exploring how leadership structures among athletes within sport teams evolve over the course of a season. Design. Using social network analysis, we analyzed the leadership structure of 20 semi-professional soccer teams (Mage = 23.50 years; SD = 4.55) at the start of the season and then again halfway through the season. More specifically, for each team we constructed a leadership network for four leadership roles (task, motivational, social, and external leadership) at these two time points. Results. Findings suggest that leadership structures in sport teams can change considerably over the course of the competitive season, thereby challenging the classic view of stable, vertical leadership structures. The transition to more shared forms of leadership can be attributed to the emergence of informal leaders over time as players engage more strongly in leadership roles. Furthermore, our results suggest that as teams evolve towards shared leadership their functioning and performance benefits from these changes. Conclusions. Based on these findings, we recommend that coaches actively implement a structure of shared leadership and seek to develop the leadership qualities of formal and informal athlete leaders
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Response to Reviewers:	We would like to thank the reviewers for their positive and constructive comments. We are grateful for the time they invested in reviewing our paper and for providing us with detailed suggestions on how we can further improve our manuscript. We have outlined our adaptations and responses in the document "response to the comments of the

	reviewers". A point-by-point explication on how we addressed each of the comments of both reviewers is presented in the aforementioned document. Furthermore, the changes we made are highlighted in red in the main manuscript. The line numbers in this response refer to the line numbers in the revised manuscript.

Dear Prof. Dr. Waddington, Editor-In-Chief of Journal of Science and Medicine in Sports,

Enclosed you find our revised research article that we would like to submit to the editorial team of Journal of Science and Medicine in Sports. This manuscript falls under the subdiscipline 'sport and exercise psychology', and is entitled "Will the Real Leaders Please Stand Up? The Emergence of Shared Leadership in Semi-Professional Soccer Teams". The manuscript is formatted to conform to the journal's guidelines. Furthermore, it has not yet been published and is not under simultaneous consideration elsewhere. My co-authors and I do not have any interests that might be interpreted as influencing the research. APA ethical standards were followed in the conduct of the study and the study design was approved by the ethical committee of KU Leuven. The manuscript (including title page and abstract) is 22 pages long, excluding references. Three tables were added to enhance the clarity of the text, four appendices are provided as supplementary material.

In this revised manuscript, we have implemented the suggestions of the expert reviewers and have addressed each of their comments. We have outlined our adaptations and responses in the document "response to the comments of the reviewers". A point-by-point explication on how we addressed each of the comments of both reviewers is presented in the aforementioned document. Furthermore, we highlighted all changes in the main manuscript by using red colored font.

I will be serving as the corresponding author for this manuscript. All authors listed in the byline have agreed to the byline order and to submission of the manuscript in this form. I have assumed responsibility for keeping my co-authors informed of our progress through the editorial review process, the content of the reviews, and any revisions made.

We hope that our manuscript lives up to the standards applied by your journal.

Sincerely,

Drs. Niels Mertens,

Also on behalf of the co-authors Prof. Dr. Filip Boen, Prof. Dr. Niklas Steffens, Prof. Dr. S. Alexander Haslam, and Prof. Dr. Katrien Fransen

Response to the comments of the reviewers

Manuscript: Will the Real Leaders Please Stand Up? The Emergence of Shared Leadership in Semi-Professional Soccer Teams.

Journal: Journal of Science and Medicine in Sport.

Reviewers' comments	Response
Reviewer 1: The manuscript under consideration (JSAMS_2020_341) examined the development of leadership quality and leadership structure among semi-professional soccer teams. The study found interesting changes in leadership quality and structure from beginning to middle of a sport season, and subsequent associations with team-level variables (e.g., identity). The study had strong ecological validity given that 20 intact teams were longitudinally sampled. The results provide a novel and important advancement to the literature on sport team leadership. To be transparent, I have limited expertise in sport leadership but do have expertise in similar areas of sport group dynamics and was able to provide feedback on the methodology and analyses employed in this study, so this review primarily pertains to the methods. Overall, this paper has potential to make an important contribution to the sport psychology literature. _Reviewer 2:_ This manuscript is very well written and very well argued. To begin, the author(s) nicely set the scene, offering a strong motivation for the study. In particular, the discussion and conclusion provide a very strong analysis and synthesis of the findings of the study in relation to extant literature.	We would like to thank the reviewers for their positive and constructive comments. We are grateful for the time they invested in reviewing our paper and for providing us with detailed suggestions on how we can further improve our manuscript. The changes we made are highlighted in red in the main manuscript. The line numbers in this response refer to the line numbers in the revised manuscript.
Reviewer 1	
Introduction---	We agree with Reviewer 1 that this information is important and was missing in the original manuscript. In the revised manuscript, we have provided more detail in introducing the four leadership roles as follows:

1. 1. Line 54-62: This paragraph describes previous literature on the informal roles that athletes can take. The authors cite a study by Fransen and colleagues that identifies 4 discrete forms of leadership and, although they point the reader towards a previous study, I think that this is a critical point which warrants additional details. Notably, how were these 4 discrete types of leadership identified?; Can athletes assume multiple leadership roles?; are leadership positions across these 4 sub-types often held by the same people?	lines 53-67: Besides this distinction based on formal (vs. informal) status, athlete leaders can be categorized according to the different roles that they occupy [1]. Building on a line of previous research investigating athlete leader roles [2-4], Fransen et al. [5] surveyed 3,193 players and 1,258 coaches, and extended the athlete leadership role classification established by Loughead et al. [3] from three to four distinct leadership roles — two that are primarily performed on the field and two that are primarily performed off the field. The two on-field leadership roles encompass the task leader (who provides technical and tactical instructions) and the motivational leader (who motivates team members on the field); the two off-field roles include the social leader (who promotes good relations in the team and seeks to create a positive team atmosphere) and the external leader (who represents the team towards other stakeholders such as media, fans, club management, and sponsors; for detailed descriptions of these roles, see Fransen et al. [5]). While the four leadership roles can be occupied by different people, it is also possible for a single player to occupy multiple leadership roles within a team [3, 6]. However, based on previous work [5, 6], the odds of one player perceived as occupy multiple roles are relatively low, as only 19% of players are seen to fulfill two leadership roles in the same team, and only 2% of teams is perceived as having one player who is seen to fulfil all four leadership roles.
1. 2. The term 'shared leadership' needs to be further unpacked for readers who are less familiar with the recent advances in leadership research. For instance, I was left wondering whether shared leadership means that multiple athletes take the same leadership roles within a team (e.g., task leader) by distributing the related duties, or if this means that each type of leadership positions is held by a different team member (one role per member).	We agree with Reviewer 1 that the manuscript should provide more in-depth information about the concept of shared leadership. Therefore, in line with suggestions from Reviewer 2, we have included this in the revised manuscript as follows. lines 75-115: Over the course of the last decade, the importance of athlete leaders has inspired a shift in sport leadership research such that the traditional focus on models of vertical leadership (in which the coach is typically seen as the only leader) has given way to an approach which recognizes the value of shared leadership. This approach of shared leadership proposes that leadership is most effective when it is performed not by one individual alone but instead is shared among various members of the team [7]. This shift also accords with findings from research in organizational contexts, which indicates that shared leadership tends to be a better predictor of team effectiveness than vertical leadership [8, 9]. Furthermore, in the context of sport management, an emerging body of work has explored the nature of shared leadership. Consistent with the idea that shared leadership structures distribute leadership responsibilities across an organization [10], previous research shows that shared leadership allows leaders to emerge on different levels in a sport organization (e.g., athletes, coaches, governance,

fans). Specifically, Peachey et al. [11] encourage the implementation shared leadership to resolve problems associated with 'top-heavy and heroic leadership' in sport management, thereby filling the gap in the extant sport management literature by capturing entire leadership structures, including the network of relationships between team members rather than focusing only on the traits of individual leaders [12, 13]. Building on this growing body of work, in the present research, we examine sport leadership through the lens of shared leadership as provided by both coaches and athletes within a team.

As noted above, previous research indicates that leadership is likely to be more effective if it is shared across different leadership roles so that different people occupy the roles of task, motivational, social, and external leader. Beyond this, there is also evidence that leadership is more likely to be effective when it is shared, not only across, but also within the different leadership roles so that more than one person has responsibility for a particular leadership role [14, 15]. Here, it is important to note that shared leadership can encompass a range of leadership structures that vary in their form and degree of sharedness. Shared leadership refers to shared leadership across individuals (e.g., where two or more team members perform a given leadership role) or across roles (e.g., where team members perform different leadership roles), or a combination of these two. The extent of shared leadership can also vary. For example, while in a maximal case shared leadership involves the equal distribution of leadership across all team members, in a minimal case it involves leadership being shared by just two team members (e.g., the coach and the captain). Previous research has argued that neither one of these (i.e., maximal or minimal sharedness) is optimal. On the one hand, it is likely that not all team members will have the requisite skills and/or the motivation to lead [16]. More importantly, if all team members assume leadership roles, then the difficulty of coordinating their messages increases the likelihood of miscommunication [2, 17, 18]. As Gockel and Werth [19] observe "it might be good to share the burden of leading, but too many cooks might spoil the broth". On the other hand, minimal shared leadership structures that involve only two team members (e.g., coach and team captain) do little to address problems associated with leadership role overload [20]. Here, then, individuals will tend to have more roles than they have the time, energy, or resources to perform, and this is likely to put them under considerable strain [5]. Consistent with these assumptions, there is evidence that the relationship between the number of appointed leaders in a shared leadership structure and team outcomes is curvilinear [2, 18, 19]. Together, these studies suggest that optimal leadership sharedness can be found somewhere between the minimal and maximal extremes.

	We thank Reviewer 1 for this suggestion. We have dialed back the strong language (and cut the reference to "abundant evidence") and now refer the reader to a sports-focused review that surveys the empirical evidence supporting our argument.
1. 3. Line 77: The paper states that there is abundant evidence that shared leadership is beneficial. Abundant is a strong word for how few references were given and that the extant evidence was not sport related. If there really is an abundance of evidence, then I encourage a richer review of this literature. Otherwise, the language could be dialed back and even presented as rationale for why we need to learn more about shared leadership in sport groups.	
	lines 116-118:
	Yet, while the benefits of shared leadership are well documented for sport teams (e.g., see Cotterill & Fransen, 2016, for a review [21]), little is known about how these leadership structures evolve over time.
	We understand Reviewer 1's concern, and in line with other comments, we have clarified the operationalization of leadership structures in the Introduction.
1. 4. Line 88-99: This Fransen study on student work groups is presented as key evidence and preliminary rationale for the current study. However, it still feels unclear at this point in the manuscript what is meant by statements like "overall leadership increased" and "leadership became more shared". What do these shifts look like practically? Being clear on the operationalization of leadership in terms of empirically observable or quantifiable phenomena would really help the reader digest this key rationale. This is especially the case given that the current study examined leadership quality rather than the presence of, or quantity of, leadership traits.	lines 118-131:
	As Brass and Krackhardt [22] have highlighted, leadership research has largely overlooked the importance of the structure of interpersonal relationships relevant to leadership. Nevertheless, in recent years, sport leadership research has started to pursue a social network approach which captures a team's leadership structure as a whole as well as the relations between team members [6]. This approach involves measuring interpersonal concepts, phenomena, and experiences that people are able to form ideas about (e.g., closeness or liking) [23] and this provides an ideal way of assessing leadership within teams in a way that captures people's experiences of others' leadership qualities. Specifically, the analysis estimates two team-level variables that are important features of leadership structures: network density and network centralization [23]. Leadership network density reflects the average leadership quality in the team, while leadership network centralization captures the distribution of leadership ranging from a maximally centralized network in which one team member is at the center of the network and no other team members are perceived as a high-quality leader, to a minimally centralized network, in which the leadership quality is equally distributed between all team members (i.e., all team members are, on average, perceived as equally good or bad athlete leaders).
	lines 148-158:
	Second, Fransen et al. [18] investigated the natural evolution of leadership structures in 27 newly formed university student project teams — each of which had a formal leader — over the course of a 24-week project. Initially, these

groups had a vertical leadership structure in which one (fourth-year) student was assigned to be the leader of a group of four to six (first-year) students. Findings indicated that the vertical leadership structure of the teams paved the way for increasing levels of shared leadership throughout the project. More specifically, the overall level of leadership within the team increased over time and more team members tended to become better leaders over time (i.e., a there was a combination of an increasing leadership network density and a decreasing leadership network centralization). Interestingly too, those teams that reported higher average perceptions of leadership quality across team members performed best, suggesting that the evolution of a shared leadership structure is associated with better team performance.

Reviewer 1: 1. 5.　Line 127: H2 should be described in greater detail. Changes in what, specifically?	We recognize that our earlier description was unclear, and so we have revised both H1 and H2 to clarify the specific aims of the manuscript as follows. lines 181-189: Leadership structures for each of the four leadership roles (i.e., task, motivational, social, and external leadership) will change substantially over time. More specifically, the average leadership quality in each of the four roles will increase (i.e., an increase in leadership network density; H1a), while leadership will become more distributed over time (i.e., a decrease in leadership network centralization; H1b). H2. Changes in leadership structures at the network level (i.e., density and centralization; as described in H1) can be accounted for by an increase in the perceived leadership quality of informal leaders (i.e., so that players within the team other than the captain step up and take the lead).
Reviewer 1: 1. 6.　Line 129: H3 seems to lack rationale within the introduction. Especially considering the large number of possible outcomes being tested, the authors may want to concede that, although there is rationale for anticipating leadership to facilitate positive sport experiences, these potential associations are exploratory. I also encourage the authors to consider conceptual differences between individual-level outcomes and group-level outcomes. At this point in the manuscript is still unclear what level are these constructs being studied – so additional	We concede that H3 was largely exploratory, examining the relationship between the evolution of shared leadership and team outcomes. We have adapted the manuscript in line with Reviewer 1's input. In particular, in the Introduction we have highlighted the existing link between high-quality athlete leadership and team outcomes, as well as introducing H3 in more detail. lines 68-74: Previous research suggests that in teams where these four leadership roles are enacted, team members identify more strongly with their team, are more

clarification earlier in the manuscript would help the reader understand the purpose and hypotheses.

motivated, and have more confidence in their team's abilities, in ways that ultimately lead to better performance [5, 6, 21]. Furthermore, it has been shown that teams with high-quality athlete leaders on and off the field are characterized by a stronger task-involving climate (in which athletes cooperate to master the task at hand) and a weaker ego-involving climate (in which athletes try to outperform other team members), in ways that ultimately contribute to better team performance [17, 24].

lines 190-195:

Furthermore, in light of evidence that teams with shared forms of leadership are seen to function and perform better [9, 21, 25], we also explore the relationship between leadership structures (as measured in terms of leadership network density and centralization) and team functioning and performance. As the leadership structure in a team is a team-level construct, we will explore this relationship at the team level, aggregating the outcome variables that were all measured at the individual level.

Furthermore, we have emphasized in the Results and Discussion sections that there was prior evidence speaking to the relationships captured in H3 and we now acknowledge that the present data provides only initial (descriptive) answers to the nature of these relationships. We have also dialed back the language used to interpret these results.

lines 388-389:

The next step was to explore how changes in leadership networks relate to team-level outcomes (i.e., Hypothesis 3).

lines 415-418:

We should note that on the team level our data do not have sufficient power to perform a meaningful inferential test (e.g., a moderated regression model). Accordingly, we will provide a descriptive analysis that explores how different leadership structures are related to team outcomes.

lines 421-422:

This exploration revealed that *high density* and *moderate centralization* were positively associated with more favorable outcomes.

lines 431-433:

Our data exploration thus suggests that moderate levels of motivational, social, and external leadership centralization are (at least descriptively) associated with better team outcomes.

lines 458-460:

To explore the optimal leadership structure for the four leadership roles, we categorized the leadership structures in terms of their leadership network density (high – low) and in terms of their leadership network centralization (high – moderate – low).

lines 471-481:

Their recommendation aligns with what our data suggest — namely that having a limited number of task leaders is more beneficial than having either the coach as the only leader or a larger number of athletes taking the lead. Furthermore, with respect to motivational, social, and external leadership, our data suggest that teams with *high density* and *moderate centralization* (i.e., a larger group of leaders having high leadership qualities) tended to have the most favorable outcomes (i.e., the highest team identification, the strongest confidence in their team, the highest level of intrinsic motivation, displaying a task-involving climate over an ego-involving climate, and the highest satisfaction with their team's performance). Furthermore, it is worth noting that teams with a limited number of leaders (i.e., a small leadership team) appeared to be more effective than teams in which everyone takes on a leadership role, (reflected by a low centralization) [18, 26].

lines 483-487:

In conclusion, our results seem to suggest that, at least for motivational, social, and external leadership tasks, teams benefit from having multiple leaders taking the lead in these roles. However, there comes a point at which there are diminishing returns for sharing leadership further (as indicated by less favorable outcomes for teams with low centralization).

Reviewer 1: Method---	We appreciate Reviewer 1's insight into the relevance of team tenure when considering athlete leadership. However, we would argue that it is precisely because tenure is such an integral part of athlete leadership that we would not want to 'correct' our analysis to

1. 7. It is stated that participants had been with their team for an average of 3.4 years, but the analyses otherwise fail to integrate potentially important effects of tenure with team. With most players having been on the team for quite some time, it's unclear whether we should expect to see substantial shifts across the 5-month study period. Moreover, if someone just joined the team (rookie), it is hard to imagine that they would immediately be viewed as having high-quality leadership skills. I think that tenure must be included as a covariate, where possible. Notably, the multilevel model predicting indegree centrality should account for tenure, and potentially include an interaction effect of time*tenure.

take account of this. As previous research has demonstrated [3, 27], players believe that it is more important for more tenured players to display leadership behaviors than for less tenured players. Indeed, given how strongly interwoven tenure is with athlete leadership and how tenure shapes athletes' expectations of teammates' leadership, we explicitly chose not to correct for this factor. Put slightly differently, as we want to identify the real athlete leaders in the team, it is important to collect the true perceptions of the athletes, and if team tenure if one of the attributes that shapes this perceived quality, it is important not to control for it.

However, we agree with Reviewer 1 that the evolution of leadership structures at the team level might have been affected by team tenure, in that the leadership structure of teams that play longer together would be more stable across the season, relative to teams that include many newcomers.

To investigate this assumption, we have performed paired sample t-tests for our team level leadership network constructs, separated in two categories. The ten teams with the 'lower' overall tenure (i.e., ranging from 1.79 to 3.09 years) are contrasted against the ten teams with the 'higher' overall tenure (i.e., ranging from 3.25 to 5.91 years). We have provided the results of this analysis in Appendix C, and included team tenure as a topic in the Results. Specifically, here we state the following:

lines 326-337:

> One could wonder, though, whether these changes would be similar for newly-formed teams and teams that already play for a long time together. To investigate this in more detail, we performed an exploratory post-hoc analysis concerning the influence of a team's overall team tenure on team-level leadership network constructs. Specifically, we first separated our data in two categories using a median split for the average team tenure of all players on the team ('high team tenure' ranged from 3.25 to 5.91 years, 'low team tenure' ranged from 1.79 to 3.09 years). Next, paired sample t-tests comparing T1 and T2 values of both categories indicated that in teams with a relatively higher team tenure, the evolution to shared leadership structure across the season is more prevalent than in teams with lower team tenure (i.e., a there is a larger decrease in leadership network centralization; see Appendix C). These findings are in line with previous research on athlete leadership and tenure [3, 27], as our

results show that in teams with relatively higher overall tenure, during the course of the season, more athletes tend to be seen as better leaders.

For your convenience, the table for Appendix C is reproduced below:

	High tenure teams					Low tenure teams				
	M_{T1}	SD_{T1}	M_{T2}	SD_{T2}	t	M_{T1}	SD_{T1}	M_{T2}	SD_{T2}	t
Task leadership network density	5.26	.52	5.45	.61	1.80	5.34	.49	5.32	.58	-.177
Motivational leadership network density	5.56	.52	5.71	.64	1.77	5.61	.49	5.64	.59	.214
Social leadership network density	5.91	.56	6.00	.66	.87	5.83	.45	5.83	.61	.02
External leadership network density	5.01	.67	5.31	.70	3.58[**]	4.94	.78	5.21	.82	1.77
Task leadership network centralization	.33	.10	.25	.08	-2.77[*]	.31	.07	.28	.10	-1.51
Motivational leadership network centralization	.31	.27	.22	.04	-9.59[***]	.22	.10	.24	.09	.45
Social leadership network centralization	.26	.03	.20	.04	-4.99[**]	.22	.08	.24	.04	.95
External leadership network centralization	.38	.03	.28	.03	-6.82[***]	.31	.09	.28	.07	-1.76

In the Discussion, under the present research's limitations, we also indicated how the present research did not seek to address the question of the kind of attributes that contribute to an athlete's perceived leadership quality (potential antecedents).

lines 503-513:

> First, while our findings show that the leadership structure in sport teams changes over time as informal leaders assume leadership status, the present research provides no insight in the underpinning mechanisms that cause players to accrue leadership status. For example, in organizational contexts, Fransen et al. [18] showed that team members who were perceived as competent and warm were likely to gain leadership status. Similarly, in a sport context, future research could identify the predictors underpinning athletes' acquisition of leadership status. Here the selection of potential predictors to investigate should be informed by previous research on the characteristics of good leaders [21]. These predictors might also differ according to the specific leadership role under investigation and could include both individual characteristics (e.g., competence, experience, team tenure, and age) and specific behaviors (e.g., expressing confidence in teammates, encouraging them, etc.).

Reviewer 1:

Relatedly, I think that team size must be accounted for – or if it was, this was not made clear. Were network-derived indices standardized to control for team size? Line 185 describes an approach to computing indegree centrality that is unfamiliar – Typically, I have seen raw indegree centrality scores standardized to account for varying team sizes (i.e., normalized centrality).

We understand Reviewer 1's concern about controlling for team size using network-derived indices. To clarify, all network-derived indices used in the present study are standardized to an identical scale amongst different teams which effectively controls for team size. Below, we clarify three aspects of the analysis.

First, for network density, we used the procedure for valued networks suggested by Sparrowe et al. [28], that involved computing the average strength of all leadership perceptions in the network. Because this is an average, every team's network density is interpretable on a scale from 0 to 10 (and thus not dependable on team size).

Second, for network centralization, using the definition of Freeman [29] and the suggestion of Borgatti et al. [23], we computed a percentage for each team representing the extent to which a team is similar to a 'perfect' leader with maximum centralization (i.e., one individual receiving only 10's from all team members, with all other ties being 0's). These percentages are thus also comparable between teams (irrespective of team size).
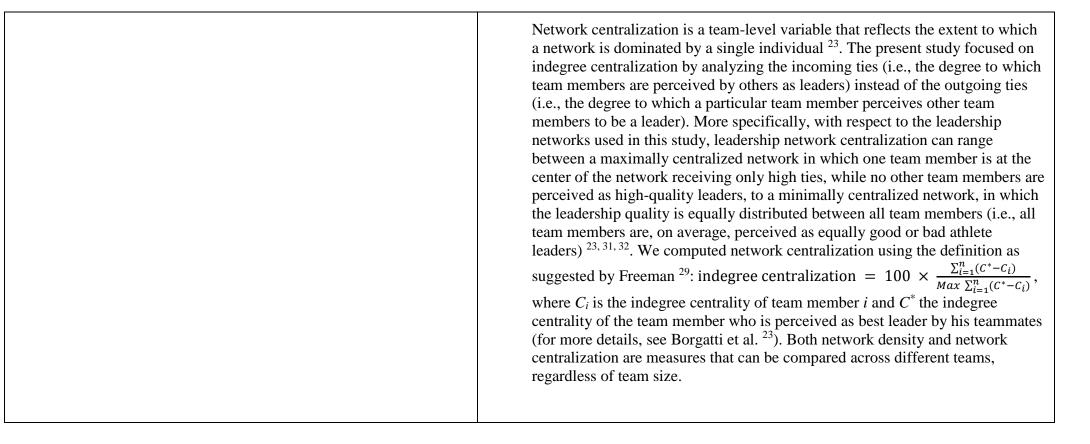
Third, and Reviewer 1's main concern, for indegree centrality, we followed the guidelines of Borgatti et al. [23] for valued and directed networks. This procedure involves averaging all incoming ties for one team member, resulting in an indegree centrality score on a scale from 0 to 10 for every individual, regardless of team size. Reviewer 1's reference to normalized centrality is typically only used for binary data, as indicated by UCINET's user manual [30]. Specifically, binary networks can (and should) use the sum of incoming ties as measure for indegree centrality, thus emphasizing the need of standardizing these values when comparing different teams. However, as Borgatti et al. [23] indicate, for valued, directed networks one should compute the average incoming tie for a team member's indegree centrality. This average is immediately usable for comparison amongst teams. Furthermore, this calculation ensures that the indegree centrality value is interpretable on the same scale as used to measure the valued network, instead of resulting in a sum of valued ties, which is difficult to interpret and still has to be standardized afterwards.

We hope that the current explanations for these calculations are sufficient to clarify this issue for a potential reader.

lines 245-273:

> At the individual level, the indegree centrality of each team member reflects the extent to which that individual is perceived to be a good leader in a specific leadership role. Indegree centrality therefore constitutes an appropriate measure of a leader's influence on other members of their team [6, 29]. In line with the guidelines of Borgatti et al. [23], we computed the indegree centrality of each team member by averaging the strength of all incoming ties for that specific team member (i.e., the average leadership quality as perceived by other team members). This calculation results in a measure that can be compared across different teams, regardless of their team size.
> The density of a network is a team-level variable and describes the overall strength of connections between team members. In leadership networks, the density reflects the average leadership quality in the team; high density scores for a particular leadership role characterize teams with, on average, high-quality leadership, while low density scores characterize teams with, on average, low-quality leadership in that specific role [23, 26]. Following the procedure for valued networks suggested by Sparrowe et al. [28], we calculated the density of all teams for all four leadership networks at both time points by computing the average strength of all leadership perceptions in the network.

Network centralization is a team-level variable that reflects the extent to which a network is dominated by a single individual [23]. The present study focused on indegree centralization by analyzing the incoming ties (i.e., the degree to which team members are perceived by others as leaders) instead of the outgoing ties (i.e., the degree to which a particular team member perceives other team members to be a leader). More specifically, with respect to the leadership networks used in this study, leadership network centralization can range between a maximally centralized network in which one team member is at the center of the network receiving only high ties, while no other team members are perceived as high-quality leaders, to a minimally centralized network, in which the leadership quality is equally distributed between all team members (i.e., all team members are, on average, perceived as equally good or bad athlete leaders) [23, 31, 32]. We computed network centralization using the definition as suggested by Freeman [29]: indegree centralization $= 100 \times \frac{\sum_{i=1}^{n}(C^* - C_i)}{Max \sum_{i=1}^{n}(C^* - C_i)}$,

where C_i is the indegree centrality of team member i and C^* the indegree centrality of the team member who is perceived as best leader by his teammates (for more details, see Borgatti et al. [23]). Both network density and network centralization are measures that can be compared across different teams, regardless of team size.

1. 8.   Measurement of peer-nominated leadership quality: I do not find it accurate to describe leadership nominations as a social 'tie'. Especially considering the operationalization of leadership quality ranging from very bad leader to very good leader. With this operationalization, a weighted-ties approach is assumed, so the only way that a lack of a 'tie' is possible is if the participants nominate a teammate as being a very bad leader (scored as 0). Pertaining to this measurement approach, there is an important distinction between not being a leader vs. being a bad leader. These are two distinct constructs. Related to comment #4, I have serious concerns that the measurement of peer-nominated leadership quality has been misconstrued throughout the manuscript as leadership quantity (often described in terms of leaders vs. non-leaders).

We understand Reviewer 1's concern, and we acknowledge that our description of measuring leadership quality could have been clearer throughout the manuscript. Furthermore, we agree that this method, like any other, has some unique strengths and limitations. That is, while there are numerous advantages to using a social network approach with directed valued networks (which we will outline below), we agree that there are some disadvantages to this approach as well (such as the incapacity to capture a lack of leadership). In the revised manuscript, we now acknowledge these limitations and elaborate further on the disadvantage that you mentioned in the limitations section in the discussion.

Nevertheless, our sense is that the various advantages outweigh the disadvantages and that social network analysis is the best method to capture the team's leadership structure, for reasons we outline further below.

Looking back at the first studies on athlete leadership research, the categorical distinction has often been made between leaders and non-leaders (i.e., "Do athletes show leadership?"). The main problem here was that these studies did not provide any insight into the quality of the leadership that was provided. Specifically, labeling someone as a leader does not necessarily imply that the appointed leader also fulfils his/her leadership function well. For example, we might label a person a leader because of the position this person occupies, but that does not necessarily go hand in hand with this person's ability to shape the behavior of team members (i.e., to actually do leadership)? Building upon the review by Cotterill and Fransen [21], it seems that the quality with which a leadership role is fulfilled might be more decisive for the leader's effectiveness than that person's leadership status in itself. For this reason, there is value in providing a more nuanced picture of athletes' leadership quality that assesses this quantitatively (in terms of degree) rather than categorically (in terms of absence vs. presence), and this was at the heart of our decision to use social network analysis.

Furthermore, we would emphasize that social network analysis has been used to capture all types of ties to assess a range of different structures, including communication networks [33], advice networks [34, 35], assessment of animal disease spread [36], structuring knowledge flows [37], etc. Furthermore, Borgatti et al. [38] outlined a topology of 'ties' which are studies in the social siences using social network analysis, differentiating between social relationships, similarities (e.g., location, membership, attribute), interactions (e.g., talked to, adviced, helped, harmed), and flows (e.g., information, beliefs, resources). Because athlete leaders lead in a web of interpersonal

relationships with their team [6], the use social network analysis allows us to measure the actual influence of this leadership on the team more accurately, consistent with previous research that has used social network analysis to capture a team's leadership structure [39-42].

However, we agree with the reviewer that while focusing on the quality of an athlete's leadership, we did not take into account the amount of leadership provided. Although this would be interesting, there is no previous literature on how to combine both the quantity and quality of a person's leadership into one construct. Furthermore, as we also indicate in our revised discussion, we would also point out the practical difficulties to collect this type of data. In this case, we would have needed to have collected data for another network for each of the four leadership roles (i.e., task, motivational, social, external). This would have resulted in 8 networks each containing 23 items (given an average team size of 23 players). Consequently, players would have had to complete, on average, 184 items without including any of the outcome variables. Considering that asking athletes to maintain their focus throughout such an extensive questionnaire is not realistic, we chose to assess the leadership variable that recent literature indicates is most strongly linked to team effectiveness.

In line with Reviewer 1's issue concerning the easily confused leadership presence and leadership quality, we have adapted the manuscript to reflect our assessment of leadership quality more accurately.

lines 118-139:

> As Brass and Krackhardt [22] have highlighted, leadership research has largely overlooked the importance of the structure of interpersonal relationships relevant to leadership. Nevertheless, in recent years, sport leadership research has started to pursue a social network approach which captures a team's leadership structure as a whole as well as the relations between team members [6]. This approach involves measuring interpersonal concepts, phenomena, and experiences that people are able to form ideas about (e.g., closeness or liking) [23] and this provides an ideal way of assessing leadership within teams in a way that captures people's experiences of others' leadership qualities. Specifically, the analysis estimates two team-level variables that are important features of leadership structures: network density and network centralization [23]. Leadership network density reflects the average leadership quality in the team, while leadership network centralization captures the distribution of leadership ranging

from a maximally centralized network in which one team member is at the center of the network and no other team members are perceived as a high-quality leader, to a minimally centralized network, in which the leadership quality is equally distributed between all team members (i.e., all team members are, on average, perceived as equally good or bad athlete leaders). Furthermore, social network analysis also addresses some of the limitations of more traditional peer-nominations approaches which can severely restrict the number of other team members that a person can identify as a leader. While this method might be helpful when appointing leaders, it fails to provide insight in the team's overall leadership structure (as shared vs hierarchical), and provides no information about the leadership quality of individuals who are not formally nominated as leaders.

While social network analysis has been used to provide insight in the current state of leadership structures [6], previous research provides little insight into how (or whether) these structures change over time.

lines 259-268:

Network centralization is a team-level variable that reflects the extent to which a network is dominated by a single individual [23]. The present study focused on indegree centralization by analyzing the incoming ties (i.e., the degree to which team members are perceived by others as leaders) instead of the outgoing ties (i.e., the degree to which a particular team member perceives other team members to be a leader). More specifically, with respect to the leadership networks used in this study, leadership network centralization can range between a maximally centralized network in which one team member is at the center of the network receiving only high ties, while no other team members are perceived as high-quality leaders, to a minimally centralized network, in which the leadership quality is equally distributed between all team members (i.e., all team members are, on average, perceived as equally good or bad athlete leaders) [23, 31, 32].

We have also addressed Reviewer 1's issue of only measuring leadership quality, (instead of also looking at leadership quantity, say).

lines 532-542:

Fourth, the present research focused on the assessment of players' perceived leadership quality. Doing this using social network analysis (SNA) had its advantages, as this allowed us to look beyond the categorical distinction

between leaders and non-leaders (i.e., "Do athletes show leadership?"). Nevertheless, while SNA is an ideal tool for investigating key aspects of leadership structures, leadership quality is clearly only one aspect of leadership. The present research did not, for example, take the *quantity* of team members' leadership into account, nor the expectations for someone to take up one or more leadership roles. While investigating these constructs would be possible, we opted to focus on perceived leadership quality because it has been found to be a good predictor of leadership effectiveness [21], and because we were mindful of questionnaire length. Nevertheless, an expanded analysis that encompassed other dimensions of leadership would provide an interesting focus for future research.

Reviewer 1:

1. 9.   I think the authors should provide justification for using social network analysis as opposed to a parsimonious peer-nomination approach within a multilevel modeling framework. Social network analyses are designed to examine social ties between members (e.g., friendship ties) that are usually binary but can be weighted as well to indicate the strength of a social tie. However, just as the lack of a friendship tie does not equate to being unfriendly (or enemies) the lack of taking on leadership roles does not equate to being a bad leader. Note that, although I am aware researchers have used SNA to study perceived leadership in sport teams (Dr. Fransen's recent work comes to mind), I am not convinced that this is the most appropriate approach. As such, I believe that the paper needs to present a stronger rationale for employing this methodology. Rather than indegree centrality and network density, simpler peer-nominated leadership constructs could be considered as within-group lv1 and between-group lv2 variables within a multilevel model. Please provide rationale for the benefits of this operationalization over a parsimonious MLM approach.

We understand Reviewer 1's concern. While we are aware that our social network approach has its limitations (e.g., the incapacity to capture a lack of leadership), we are convinced that the benefits outweigh these disadvantages. In line with Reviewer 1's previous comment and the disadvantages mentioned here, we have adapted the manuscript to acknowledge and discuss these limitations in the Discussion. However, compared to SNA, peer-nomination typically severely restricts the number of others someone can choose, and generally results in the nomination of individuals with whom someone has a rather close relationship. While this could potentially be a valid method for selecting the 'best' leaders in a team, by its very nature, peer-nomination categorically distinguishes between leaders and non-leaders. Thus, this method lacks a lot of information required for the research questions posed by the present study. A peer-nomination approach does not provide any insight in the team's overall leadership structure (shared vs hierarchical), nor does it provide any information about the leadership quality of individuals beyond the nominated leaders. Moreover, nominating someone as a leader is no indication of the extent to which the appointed leader fulfils his/her leadership function well. Social network analysis resolves these issues by obtaining information from every team member, and captures all the intricacies that exist between all possible individuals. Through SNA, we can obtain information on the overall leadership structure present in the team (i.e., in the form of leadership network density and centralization, which combined to provide insight in how leadership is shaped within a team), and it allows for capturing the perceived leadership quality of every team member. Indeed, given that the present research aimed to track potential changes in overall leadership structures, and investigate if the perceived leadership

quality of players within the team other than typical leaders such as the coach or captain would change over time, we believe that SNA's methodology was perfectly aligned with our research questions.

Furthermore, in line with Reviewer 1's previous comment, while leadership might not be a 'social tie', we want to reiterate that social network analysis allows for the assessment of a team's structure across different constructs (e.g., communication networks [33], advice networks [34, 35], assessment of animal disease spread [36], structuring knowledge flows [37]). Because athlete leaders lead in a web of interpersonal relationships with their team [6], the use social network analysis allows us to measure the actual influence of this leadership on the team more accurately. Previous research has often used social network analysis to capture the team's leadership structure [39-42].

As noted in our response to the previous point (1.8), these are issues that we now expand upon in some detail in the Discussion.

Reviewer 1:	We appreciate the reviewer's suggestions to clarify the operationalization of leadership networks. As s/he notes, the present research did not ask participants to indicate who *is* a leader in a given domain, but rather asked them to indicate their perceptions of the leadership *quality* of every team member in a given domain. In the example offered by Reviewer 1, an individual who performs poor leadership actions (e.g., leading practice activities poorly), would likely receive a low score from other team members. Thus, if most/all of the team members perceive an individual as doing a poor job as a leader in a given domain (regardless of the amount of leadership actions performed), that individual will end up with a lower indegree centrality score. Furthermore, the review by Cotterill and Fransen [21] suggests that perceived leadership quality might be more decisive for leadership effectiveness than leadership quantity. In the words of Shaver [43]: "an individual's perception of a situation is more important than the objective situation in determining one's feelings and actions." Building upon this previous work, we chose to ask participants to indicate the leadership quality of every team member, instead of leadership nominations. Nevertheless, in line with our response to point 1.8 above, we have addressed this limitation in the Discussion.
1. 10. The description of network centralization is unclear. This description on line 198-200 implies that only one member has reached a threshold to be considered a leader, and that no other member has met this threshold. What would be the arbitrary threshold for being considered a leader – and is this variable centered within groups? For example, one member could be higher nominated than the rest, but still practically/descriptively considered to be low on the range between very bad leader and very good leader. It should also be made clear that this is a group-level variable. Ultimately, I think that network centralization could be a useful group-level variable, but I remain concerned by the operationalization of leadership nominations (ties) as ranging from very bad to very good. For example, if someone has a clear leadership role on the team in terms of quantity of their contributions (e.g., always leads practice activities), but is perceived to be doing a poor job (e.g., practice activities run poorly), it is unclear how this member's leadership score is interpreted. They would be a bad leader but a leader none the less.	
	Furthermore, as Reviewer 1 notes, a 'low' centralized leadership network, could still mean that team members are all perceived as bad leaders, or all perceived as good leaders. This is exactly the reason why it is important to always interpret the combination of density and centralization to get the full picture of a team's leadership

structure. We have adapted the manuscript to explicate the importance of investigating the combination of density and centralization.

lines 390-398:

> However, it can be argued that only the combination of both measures provides adequate insight into the team's leadership structure [9, 31]. For example, when a team with a high network density also has a high network centralization, this team's leadership will be centered on a few very good leaders, and thus does not reflect more distributed forms of shared leadership. Along the same lines, a team with a low network centralization and with a low network density is likely to have no good leaders at all. Again, this is not a structure that represents high-quality shared leadership. Instead, we would argue that only networks with a combination of a high density and a low/medium centralization are characteristic of structures of shared leadership.

<u>*Reviewer 1:*</u>

1. 11. Regarding measurement of collective efficacy and intrinsic motivation, there were adaptations made to scales that lacked justification e.g., why were only two items used for intrinsic motivation? Confirmatory factor analysis (or similar) should be provided to justify decisions on which items to include. For instance, were factor loading cutoffs used when deciding which items should be included for a given construct?

We understand Reviewer 1's concern. However, the length of the questionnaire was a concern when designing the study, as we already included four network measures per team (one network per leadership role). Each network then contains as many items as there are individuals in a team, meaning that on average, each participant had to complete 92 items for the leadership networks alone. Thus, to avoid survey fatigue we aimed to keep the length of the survey to as short as possible, while following examples from previous researchers. We also checked the internal consistencies of all included measurements to double-check our implemented measurements. However, it was not our goal to create or validate new, shortened measurements of these constructs, as indicated by the exploratory nature of the research question in which these items are used. This is a point we now clarify in the Method section:

lines 279-291:

> We used a shortened form of the Collective Efficacy Questionnaire for Sports (CEQS), to assess team confidence (following Fransen et al. [44] and Mertens et al. [45]), including the five highest loading items on each of the subscales: ability, effort, unity, persistence, and preparation [46] (e.g., "My team has the ability to demonstrate a strong work ethic"). Participants indicated their agreement with these items on scales ranging from 1 (*completely disagree*) to 7 (*completely agree*). This measure showed high internal consistency at both data collection points (α_{T1}= .88, α_{T2}= .88).

With respect to intrinsic motivation, we included the two highest loading items of the relevant subscale of the Behavioral Regulation in Sport Questionnaire [47], in line with previous research [45]. We chose to include only this subscale because intrinsic motivation is the hallmark of volitional functioning [48] and to ensure that the questionnaire would not become too long for athletes to remain focused. The subscale items that we included were: "I play soccer because it is fun" and "I play soccer because I like it" (1 = *completely disagree*, 7 = *completely agree*). This measure had high internal consistency at both data collection points (α_{T1}= .78, α_{T2}= .81).

Reviewer 1:

1. 12. The decision to include coaches within the networks should be justified. This seems to conflate very concrete formal leadership with informal peer-perceived leadership in a way that would bias the network centralization analyses. Especially considering that teammate perceptions of coach leadership quality decreased in 3 of the 4 leadership domains, it's unclear whether changes in network centralization reflect more players developing high-quality leadership vs. coaches just being nominated as having poorer leadership across time.

The decision to include coaches within the networks was taken to ensure that we obtained a complete view of a typical sports team's leadership structure. The goal of the present research was not just to obtain an isolated perspective of peer-perceived leadership in teams, but instead to observe perceived leadership by all members of the team including formal (e.g., coach and captain) and informal leaders (e.g., other players). With this goal in mind, we would consider the inclusion of coaches in the network not as a bias but a necessity. More specifically, we aimed to observe leadership networks in their natural state and habitat. If a leadership structure was vertical such that team members look primarily towards their coach for guidance, then network centralization values *should* increase. As formal leadership positions (a coach, a captain) are inherently part of the leadership structure of a sports teams, it was critical that the analysis included them as a part of these networks.

With respect to Reviewer 1's second point, our data does actually provide us with insight into why changes in network centralization reflect more players developing high-quality leaders, instead of coaches just being perceived as displaying poorer leadership over time. More specifically, in addition to our analyses on the team level (i.e., changes in leadership network density and leadership network centralization), we also conducted analyses on the individual level. In these we analyzed whether changes in leadership network centralization and density reflect more players developing high-quality leadership vs. coaches just being nominated as having poorer leadership across time.

More specifically, as part of our second aim (H2), we compared any changes occurring in perceived leadership quality for coaches and players. These analyses indicated how the increase in players' perceived leadership quality was significantly larger than the

observed changes in coaches' perceived leadership quality. Because of this, we can conclude that any changes to leadership network centralization are largely due to changes occurring in players developing better quality leadership. We would like to point out, however, that this does not indicate that coaches are worse leaders than informal leaders, or vice-versa. The aim of the present research was not to directly compare who were 'better' or 'more suited' leaders amongst coaches, captains, or informal athlete leaders, nor do our analyses allow for such an interpretation. Instead, the aim, and conclusions, of the present study focused on observing potential changes in overall leadership structure based on the distribution of perceived leadership quality of all members of the team. Furthermore, we should note that the comparison of a player's perceived leadership quality by either their team members or by the coach was not the scope of the present research. This was already investigated in a larger sample of athletes in previous work [49].

Reviewer 1:
 	
Results----
 	
  1. 13. The correlations described in Appendix B appear to conflate within-group and between-group associations. Many of these constructs should be considered at each level and disaggregated to provide a better understanding of these associations, but it is unclear how lv1 variables and lv2 variables are related. As such, a better description of the level of analysis in these correlations shown in Appendix A and Appendix B is needed.
	We thank Reviewer 1 for these suggestions. Appendix A displays means, standard deviations, etc. at the team level for all 20 teams and we have clarified in the manuscript that Appendix A displays the measurements that were used for any analysis at the team level. More specifically, the constructs leadership network density and leadership network centralization are by nature team-level constructs. We also included aggregated measures for all outcomes measured through questionnaires in each individual participant. These were all constructs used for Hypothesis 3.
	
	Appendix A
	
	      Means, standard deviations, and correlations between all the included variables at the team level ($n = 20$). For aggregated measures, we also included ICC1 and ICC2 values on the diagonal in the following manner: *ICC1 / ICC2*.
	
	Appendix B displays means, standard deviations, etc. at the individual level for all 370 participants. No aggregated measures thus appear here, as network centralization is an individual network-derived measure by nature, and all outcomes were obtained from individual questionnaires. We have clarified this in the description of Appendix B.
	
	Appendix B
	
	      Means, standard deviations, and correlations between all the included variables at the individual level ($n = 370$).

Reviewer 1: 1. 14. Line 252-253: The conclusion that external leadership became more distributed as the season progressed is difficult to interpret in light of the operationalization of leadership quality rather than quantity. Perhaps a better description of how centralization is practically interpreted would help the reader understand this finding. Rather than leadership becoming more shared, these findings seem to indicate that more members became better leaders across time (quality), which is conceptually different from more members taking on leadership roles over time or distributing leadership tasks among more members. I have to again emphasize that measurement of leadership quality ranging from very bad to very good seems to muddle the interpretation of these findings.	We agree with Reviewer 1 that our method of analysis investigated leadership quality, and not leadership quantity. We also thank Reviewer 1 for suggesting how to more clearly describe changes in leadership network centralization for potential readers. In line with Reviewer 1's suggestion and our earlier comments, we have adapted the manuscript to reflect this operationalization (as per 1.8 above).

Reviewer 1:
 	
1. 15. Line 318: The dichotomization of network density needs additional information and rationale. What were the cutoff scores used? Were some of the teams categorized as low density still relatively high in density from a practical standpoint?
	In response to the reviewer's first question, we have clarified that we aimed to create groups of equal size. To provide readers with more information about the absolute values, we have also included the averages, as well as the total range (i.e., minima and maxima) for each category in the manuscript, both for network density and network centralization.
	
	lines 400-404:
	
	    First, with respect to density, we created two equal groups by assigning the 10 teams with the lowest network density at T2 to a 'low density' group (average overall density = 4.80; with values ranging between 3.98 and 5.23 on a scale from 1 to 10), and the 10 teams with the highest network density at T2 to a 'high density' group (average overall density = 6.04; with values ranging between 5.34 and 7.09 on a scale from 1 to 10).
	
	lines 407-413:
	
	    Second, with respect to centralization, previous studies have suggested that the relationship between centralization and team outcomes might be curvilinear, rather than linear [18, 26]. Accordingly, we aimed to create three equal centralization groups: a 'low centralization' group consisting of seven teams (average overall centralization = .13; ranging from .05 to .17 on a scale from 0 to 1), an 'average centralization' group consisting of six teams (average overall

centralization = .24; ranging from .19 to .29 on a scale from 0 to 1), and a 'high centralization' group consisting of seven teams (average overall centralization = .35; ranging from .31 to 45 on a scale from 0 to 1).

To answer the reviewer's second question, as SNA analyses for leadership networks are relatively new in sports teams (especially directed and valued leadership networks), there are no 'expected' values for either leadership network density or categorization to compare against. Thus, in light of previous literature indicating that density has a linear relation with team outcomes [8, 9, 50], we opted to create two equal groups in our data comparing those with low and high values in the sample (i.e., below and above the sample median). With respect to network centralization, previous studies hinted at a curvilinear relationship between centralization and team [26, 50], thus, we ended up creating three categories of nearly equal size (seven teams, six teams, seven teams). We chose to create categories of similar sizes in this stage, to maximize the odds that when we combined categories from density and centralization, we would have at least two teams in each of the six categories (see Table 3). However, we are aware that the maximum centralization value in this study was .45 (on a scale of 0 to 1), which we also highlighted in the discussion.

lines 464-468:

It should be noted that the maximum centralization value in this study was .45 (on a scale of 0 to 1), indicating that even the highly centralized structures in our study do not represent vertical leadership structures (with the coach as single high-quality leader), but rather structures in which a limited number of athletes are perceived as high-quality athlete leaders.

Reviewer 1: 1. 16. Line 324-235: The manuscripts states that 3 groups of centralization were calculated by splitting the teams into three categories with 7 teams each. This implies that there are 21 teams?	We thank Reviewer 1 for spotting this mistake. We have corrected this error, in line with Reviewer 1's suggestion on providing more detail on the categorization. lines 407-413: Second, with respect to centralization, previous studies have suggested that the relationship between centralization and team outcomes might be curvilinear, rather than linear [18, 26]. Accordingly, we aimed to create three equal centralization groups: a 'low centralization' group consisting of seven teams (average overall centralization = .13; ranging from .05 to .17 on a scale from 0 to 1), an 'average centralization' group consisting of six teams (average overall

centralization = .24; ranging from .19 to .29 on a scale from 0 to 1), and a 'high centralization' group consisting of seven teams (average overall centralization = .35; ranging from .31 to 45 on a scale from 0 to 1).

Reviewer 1:

1. 17. The inability to determine direction of effects should also be discussed as a limitation. For example, those athletes with higher confidence in their team may be more willing to nominate teammates as being high quality leaders. Were the outcome variables also assessed at T1? If so, then the authors may consider calculating latent or residualized change scores in these constructs from T1 to T2 to enhance interpretation of the findings.

We agree with Reviewer 1 about the limitations for the exploratory aim posed by the present research (H3). Our decision to provide a descriptive overview of this data was guided by the fact that not all outcome variables were assessed at T1 (e.g., it was not possible to assess the teams' ranking at the start of the season), and our power at team level ($n = 20$) was too low to perform any meaningful inferential tests. Nevertheless, we have followed Reviewer 1's suggestion, and now provide an overview of the residualized change scores for team outcomes for each of the six combinations of density and centralization for each leadership role in Appendix D. Furthermore, we have discussed this limitation in the manuscript, as suggested.

lines 514-521:

> Second, we acknowledge that while we provided a transparent comprehensive exploration of how leadership structures relate to team outcomes, our design lacked the power to perform meaningful inferential tests (e.g., a moderated regression model). Furthermore, the present design is not able to determine the direction of effect (e.g., does high quality leadership result in higher team confidence, or does higher team confidence inspire stronger perceptions of leadership quality?). To address these issues, there would be value in future research that examines the present relationship with a larger sample, preferably in an experimental setting, with a view to establishing the generalizability and direction of the patterns observed above.

line 433, footnote [a]

> [a] Besides our initial descriptive overview, we have included an overview of the residualized change scores of team outcomes for each of the six combinations of density and centralization for each leadership role in Appendix D. This overview generally aligns with the descriptive overview provided by Table 3. More specifically, for task leadership, our data suggests that teams with _high density_ and _high centralization_ generally displayed the highest residualized change scores. With respect to motivational, social, and external leadership, our data suggests that teams with _high density_ and _moderate centralization_ tended to have the most favorable residualized change scores. Appendix D provides a

	full overview of all residualized change scores, formatted similarly to Table 3 for an easy comparison.
Reviewer 1: Line 56: delete 'to' Line 77: delete 'answers'	We thank Reviewer 1 for spotting these mistakes. These errors have been corrected in the manuscript.

Reviewer 2

| *Reviewer 2:*

  2. 1. However, there is also a growing interest in shared leadership within the organization of sport (off field). By the way, this is also sometimes referred to as sport leadership. So, my first suggestion is that when you do refer to "sport leadership" (just the first time – albeit it is relatively obvious) – you establish explicitly that you are referring to "onfield/athlete". | We thank Reviewer 2 for this suggestion, and have adapted the manuscript to more clearly establish the exact context of leadership investigated in the present research at the start of the manuscript. Here we now say:

lines 39-44:

"The strength of the group is the strength of the leaders."
This statement by the legendary NFL coach Vince Lombardi captures the perceived importance of leadership for optimal team sport performance. Zooming in on leadership dynamics between coaches and athletes, most of the research on leadership in field sport has investigated the impact of the coach [21]. In this regard, the leadership styles and behaviors of coaches have been linked to a range of key outcomes including athletes' motivation, self-esteem, and performance [e.g., 51]. |

Reviewer 2:

2. 2. Next, I think it would strengthen the manuscript if you were also able to loop in the small but emerging body of work on shared leadership within sport management (there is also some emerging work on collective leadership in sport management). Some suggested key articles include:

Welty Peachey, J., Damon, Z. J., Zhou, Y., & Burton, L. J. (2015). Forty years of leadership research in sport management: A review, synthesis, and conceptual framework. Journal of Sport Management, 29, 570–587.

Ferkins, L., Skinner, J., & Swanson. (2018). Sport leadership: A new generation of thinking. Journal of Sport Management, 32, 77-81. DOI: https://doi.org/10.1123/jsm.2018-0054 <https://doi.org/10.1123/jsm.2018-0054>

Jones, G., Wegner, C., Bunds, K., Edwards, M., & Bocarro, J. (2018). Examining the environmental characteristics of shared leadership in a sport-for-development organization.

Journal of Sport Management, 32, 82-95.

We appreciate the opportunity to expand the manuscript's discussion on the emergence of shared leadership research. To this end, we have included a discussion of the literature proposed by Reviewer 2, and now recognize the added value of this work for shared leadership sports research.

lines 80-91:

This shift also accords with findings from research in organizational contexts, which indicates that shared leadership tends to be a better predictor of team effectiveness than vertical leadership [8, 9]. Furthermore, in the context of sport management, an emerging body of work has explored the nature of shared leadership. Consistent with the idea that shared leadership structures distribute leadership responsibilities across an organization [10], previous research shows that shared leadership allows leaders to emerge on different levels in a sport organization (e.g., athletes, coaches, governance, fans). Specifically, Peachey et al. [11] encourage the implementation shared leadership to resolve problems associated with 'top-heavy and heroic leadership' in sport management, thereby filling the gap in the extant sport management literature by capturing entire leadership structures, including the network of relationships between team members rather than focusing only on the traits of individual leaders [12, 13]. Building on this growing body of work, in the present research, we examine sport leadership through the lens of shared leadership as provided by both coaches and athletes within a team.

Reviewer 2:

2. 3. Related to the above, on page 5, line 101, the author(s) state: "To date, most research into sport leadership has been cross-sectional in nature, even though leadership relations within a team might change over time 13.
In the reference list, 13 is: Aime F, Humphrey S, DeRue DS, Paul JB. The riddle of heterarchy: Power transitions in cross-functional teams. Acad. Manage. J. 2014; 57(2):327-352.

I'm wondering how you can use this citation in relation to sport leadership? Please consider and correct. Second, if you are talking

We thank Reviewer 2 for noticing this mistake, and we have adapted the sentence to reflect the intended meaning. We also addressed their second point as follows:

lines 159-161:

To date, most research on athlete leadership has also been cross-sectional in nature, limiting our understanding of potential changes over time. To our knowledge, the only exception is a study by Duguay et al. [27], which investigated the evolution of leadership in a youth ice hockey team.

organizational sport leadership then the above statement is incorrect (please refer to the above references).	
Reviewer 2: 2. 4. In sum, I think it an omission in the front end of the paper to not recognise the emerging shared leadership in sport management literature. Furthermore, in drawing on shared leadership within sport management literature, how might this strengthen your findings and conclusions, including your direction setting for future research?	In line with Reviewer 2's previous comments, we have enriched the present manuscript with literature on the emerging shared leadership body of work in the sport management literature. A key section is: lines 550-554: As a final remark, even though the scope of the present study is limited to leadership interactions between coaches and athletes, we hope that the present study will serve to encourage future research in different settings to investigate shared leadership structures over time. Here, research could also examine changes in leadership structures at a higher managerial level within sport organizations (e.g., among the coaching staff or in club management; see also Jones et al. [13])
Reviewer 2: Minor: Page 3, Line 57 – remove "to" from the following, "Cuyper, et al. 4 to identified four …". Page 4, Line 82, - remove "answers" from the following, "In sport teams, such questions answers …"	We thank Reviewer 2 for spotting these errors. The manuscript has been corrected.

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6.   Fransen K, Van Puyenbroeck S, Loughead TM, et al. Who takes the lead? Social network analysis as pioneering tool to investigate shared leadership within sports teams. *Soc. Networks.* 2015; 43:28-38.

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Full title: Will the Real Leaders Please Stand Up? The Emergence of Shared Leadership in Semi-

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3

4   **Word Count:** 6295

5   **Abstract Word Count:** 250

6   **Number of Tables:** 3

7   **Number of Figures:** 0

8   **Abstract**

9   **Objectives.** High-quality leadership is often regarded as one of the main sources of

10   competitive advantage. Especially within sport teams, a team's leadership structure has historically

11   been considered to be stable across the season, with the coach and team captain as the formal, and

12   often sole, leaders. In line with recent organizational research, the present study aims to broaden this

13   perspective by also taking informal leaders into account and exploring how leadership structures

14   among athletes within sport teams evolve over the course of a season.

15   **Design.** Using social network analysis, we analyzed the leadership structure of 20 semi-

16   professional soccer teams (M_{age} = 23.50 years; SD = 4.55) at the start of the season and then again

17   halfway through the season. More specifically, for each team we constructed a leadership network for

18   four leadership roles (task, motivational, social, and external leadership) at these two time points.

19   **Results.** Findings suggest that leadership structures in sport teams can change considerably

20   over the course of the competitive season, thereby challenging the classic view of stable, vertical

21   leadership structures. The transition to more shared forms of leadership can be attributed to the

22   emergence of informal leaders over time as players engage more strongly in leadership roles.

23   Furthermore, our results suggest that as teams evolve towards shared leadership their functioning and

24   performance benefits from these changes.

25   **Conclusions.** Based on these findings, we recommend that coaches actively implement a

26   structure of shared leadership and seek to develop the leadership qualities of formal and informal

27   athlete leaders.

28   *Keywords:* Shared leadership; Athlete leadership; Peer leadership; Leadership emergence;

29   Team functioning; Social network analysis

30   **Practical Implications**

31   • Leadership structures in sport teams are not stable, but tend to evolve towards more shared

32   leadership structures due to the emergence of informal leaders over time.

33   • A growth in shared leadership appears to be positively associated with increases in both team

34   functioning and team performance.

35   • Based on our findings, we would advise coaches to actively implement a structure of shared

36   leadership by encouraging players to take on leadership roles.

37

38   **Introduction**

39   *"The strength of the group is the strength of the leaders."*

40   This statement by the legendary NFL coach Vince Lombardi captures the perceived

41   importance of leadership for optimal team sport performance. Zeroing in on leadership dynamics

42   between coaches and athletes, most of the research on leadership in field sport has investigated the

43   impact of the coach [1]. In this regard, the leadership styles and behaviors of coaches have been linked

44   to a range of key outcomes including athletes' motivation, self-esteem, and performance [e.g., 2].

45   Yet in recent years, research has shown that leadership can also emanate from sources other

46   than the coach. In particular, athletes within sport teams have been observed to take on leadership

47   roles in ways that make a significant contribution to team success [1]. Loughead et al. [3, p. 144] defined an

48   athlete leader as an "athlete occupying a formal or informal leadership role influencing team members

49   toward a common goal." Formal athlete leaders are those players who are officially appointed in their

50   leadership role (e.g., the team captain), while informal athlete leaders are players who emerge as

51   leaders through interactions with their teammates, even though their leadership status is not formally

52   recognized.

53   Besides this distinction based on formal (vs. informal) status, athlete leaders can be

54   categorized according to the different roles that they occupy [4]. Building on a line of previous research

55   investigating athlete leader roles [5-7], Fransen et al. [8] surveyed 3,193 players and 1,258 coaches, and

56   extended the athlete leadership role classification established by Loughead et al. [6] from three to four

57   distinct leadership roles — two that are primarily performed on the field and two that are primarily

58   performed off the field. The two on-field leadership roles encompass the task leader (who provides

59   technical and tactical instructions) and the motivational leader (who motivates team members on the

60   field); the two off-field roles include the social leader (who promotes good relations in the team and

61   seeks to create a positive team atmosphere) and the external leader (who represents the team towards

62   other stakeholders such as media, fans, club management, and sponsors; for detailed descriptions of

63   these roles, see Fransen et al. [8]). While the four leadership roles can be occupied by different people, it

64   is also possible for a single player to occupy multiple leadership roles within a team [6, 9]. However,

65   based on previous work [8, 9], the odds of one player perceived as occupy multiple roles are relatively

66   low, as only 19% of players are seen to fulfill two leadership roles in the same team, and only 2% of

67   teams is perceived as having one player who is seen to fulfil all four leadership roles.

68   Previous research suggests that in teams where these four leadership roles are enacted, team

69   members identify more strongly with their team, are more motivated, and have more confidence in

70   their team's abilities, in ways that ultimately lead to better performance [1, 8, 9]. Furthermore, it has been

71   shown that teams with high-quality athlete leaders on and off the field are characterized by a stronger

72   task-involving climate (in which athletes cooperate to master the task at hand) and a weaker ego-

73   involving climate (in which athletes try to outperform other team members), in ways that ultimately

74   contribute to better team performance [10, 11].

75   Over the course of the last decade, the importance of athlete leaders has inspired a shift in

76   sport leadership research such that the traditional focus on models of vertical leadership (in which the

77   coach is typically seen as the only leader) has given way to an approach which recognizes the value of

78   shared leadership. This approach of shared leadership proposes that leadership is most effective when

79   it is performed not by one individual alone but instead is shared among various members of the team

80   [12]. This shift also accords with findings from research in organizational contexts, which indicates that

81   shared leadership tends to be a better predictor of team effectiveness than vertical leadership [13, 14].

82   Furthermore, in the context of sport management, an emerging body of work has explored the nature

83   of shared leadership. Consistent with the idea that shared leadership structures distribute leadership

84   responsibilities across an organization [15], previous research shows that shared leadership allows

85   leaders to emerge on different levels in a sport organization (e.g., athletes, coaches, governance, fans).

86   Specifically, Peachey et al. [16] encourage the implementation shared leadership to resolve problems

87   associated with 'top-heavy and heroic leadership' in sport management, thereby filling the gap in the

88   extant sport management literature by capturing entire leadership structures, including the network of

89   relationships between team members rather than focusing only on the traits of individual leaders [17, 18].

90   Building on this growing body of work, in the present research, we examine sport leadership through

91   the lens of shared leadership as provided by both coaches and athletes within a team.

92   As noted above, previous research indicates that leadership is likely to be more effective if it is

93   shared across different leadership roles so that different people occupy the roles of task, motivational,

94   social, and external leader. Beyond this, there is also evidence that leadership is more likely to be

95   effective when it is shared, not only across, but also within the different leadership roles so that more

96   than one person has responsibility for a particular leadership role [19, 20]. Here, it is important to note

97   that shared leadership can encompass a range of leadership structures that vary in their form and

98   degree of sharedness. Shared leadership refers to shared leadership across individuals (e.g., where two

99   or more team members perform a given leadership role) or across roles (e.g., where team members

100   perform different leadership roles), or a combination of these two. The extent of shared leadership can

101   also vary. For example, while in a maximal case shared leadership involves the equal distribution of

102   leadership across all team members, in a minimal case it involves leadership being shared by just two

103   team members (e.g., the coach and the captain). Previous research has argued that neither one of these

104   (i.e., maximal or minimal sharedness) is optimal. On the one hand, it is likely that not all team

105   members will have the requisite skills and/or the motivation to lead [21]. More importantly, if all team

106   members assume leadership roles, then the difficulty of coordinating their messages increases the

107   likelihood of miscommunication [5, 11, 22]. As Gockel and Werth [23] observe "it might be good to share the

108   burden of leading, but too many cooks might spoil the broth". On the other hand, minimal shared

109   leadership structures that involve only two team members (e.g., coach and team captain) do little to

110   address problems associated with leadership role overload [24]. Here, then, individuals will tend to have

111   more roles than they have the time, energy, or resources to perform, and this is likely to put them

112   under considerable strain [8]. Consistent with these assumptions, there is evidence that the relationship

113   between the number of appointed leaders in a shared leadership structure and team outcomes is

114   curvilinear [5, 22, 23]. Together, these studies suggest that optimal leadership sharedness can be found

115   somewhere between the minimal and maximal extremes.

116   Yet, while the benefits of shared leadership are well documented for sport teams (e.g., see

117   Cotterill & Fransen, 2016, for a review [1]), little is known about how these leadership structures evolve

118   over time. As Brass and Krackhardt [25] have highlighted, leadership research has largely overlooked the

119   importance of the structure of interpersonal relationships relevant to leadership. Nevertheless, in recent

120   years, sport leadership research has started to pursue a social network approach which captures a

121   team's leadership structure as a whole as well as the relations between team members [9]. This approach

122   involves measuring interpersonal concepts, phenomena, and experiences that people are able to form

123   ideas about (e.g., closeness or liking) [26] and this provides an ideal way of assessing leadership within

124   teams in a way that captures people's experiences of others' leadership qualities. Specifically, the

125   analysis estimates two team-level variables that are important features of leadership structures:

126   network density and network centralization [26]. Leadership network density reflects the average

127   leadership quality in the team, while leadership network centralization captures the distribution of

128   leadership ranging from a maximally centralized network in which one team member is at the center

129   of the network and no other team members are perceived as a high-quality leader, to a minimally

130   centralized network, in which the leadership quality is equally distributed between all team members

131   (i.e., all team members are, on average, perceived as equally good or bad athlete leaders).

132   Furthermore, social network analysis also addresses some of the limitations of more traditional

133   peer-nominations approaches which can severely restrict the number of other team members that a

134   person can identify as a leader. While this method might be helpful when appointing leaders, it fails to

135   provide insight in the team's overall leadership structure (as shared vs hierarchical), and provides no

136   information about the leadership quality of individuals who are not formally nominated as leaders.

137   While social network analysis has been used to provide insight in the current state of

138   leadership structures [9], previous research provides little insight into how (or whether) these structures

139   change over time. Is the leadership structure in a sport team stable over the course of a season? Do

140   dominant leaders lose their leadership status as the season progresses? Do new leaders come to the

141   fore? In sport teams, such questions have gone largely unanswered, but research in other domains

142   provides some clues as to how leadership structures may transition over time. First, Small and Rentsch

143   [27] and Smith et al. [28] examined the stability of leadership structures in self-managing teams (i.e.,

144   leaderless groups) and found that these tended to change substantially over time. More specifically,

145   these authors observed a tendency for leadership to become more shared and less hierarchical.

146   However, the applicability of research findings in leaderless groups to team sport can be questioned as

147   sport teams typically identify a coach and a team captain as formal leaders.

148   Second, Fransen et al. [22] investigated the natural evolution of leadership structures in 27 newly

149   formed university student project teams — each of which had a formal leader — over the course of a

150   24-week project. Initially, these groups had a vertical leadership structure in which one (fourth-year)

151   student was assigned to be the leader of a group of four to six (first-year) students. Findings indicated

152   that the vertical leadership structure of the teams paved the way for increasing levels of shared

153   leadership throughout the project. More specifically, the overall level of leadership within the team

154   increased over time and more team members tended to become better leaders over time (i.e., a there

155   was a combination of an increasing leadership network density and a decreasing leadership network

156   centralization). Interestingly too, those teams that reported higher average perceptions of leadership

157   quality across team members performed best, suggesting that the evolution of a shared leadership

158   structure is associated with better team performance.

159   To date, most research on athlete leadership has also been cross-sectional in nature, limiting

160   our understanding of potential changes over time. To our knowledge, the only exception is a study by

161   Duguay et al. [29], which investigated the evolution of leadership in a youth ice hockey team. The

162   findings here revealed that the overall level of task leadership in that specific ice hockey team

163   increased, while the extent to which task leadership was shared among the team members did not

164   change. For social leadership, however, the researchers observed that the average social leadership

165   qualities in the team not only increased over time, but also became more shared among the team

166   members. But unlike previous studies in organizational contexts [22, 27], in this study these changes in

167   leadership structures were not related to team effectiveness or performance.

168   Yet given the observed fluctuations in a team's leadership, there is a clear need to gain more

169   insight into the evolution of leadership over time [30]. In the present study, we seek to address this

170   lacuna by building on the case study by Duguay et al. [29]. More specifically, we test the validity of the

171   study's findings in a broader sample of 20 semi-professional teams (rather than just one youth team)

172   and we examine the longitudinal evolution of the four leadership roles defined by Fransen et al. [8]

173   (rather than just the task and social leadership roles). In addition to providing insight in the evolution

174   of the leadership structures throughout the season, our goal is also to garner deeper insight into the

175   nature of these changes by identifying the underlying mechanisms responsible for them. Moreover, we

176   will also investigate the implications of these changes for team functioning, in ways that build upon

177   the previous research of Fransen et al. [22]

178   In line with previous research from organizational domains, we expect that leadership

179   structures in sport teams will not be stable, but rather prone to changes over time [22, 27, 31]. More

180   specifically, we hypothesize that:

181   H1. Leadership structures for each of the four leadership roles (i.e., task, motivational, social,

182   and external leadership) will change substantially over time. More specifically, the average

183   leadership quality in each of the four roles will increase (i.e., an increase in leadership

184   network density; H1a), while leadership will become more distributed over time (i.e., a

185   decrease in leadership network centralization; H1b).

186   H2. Changes in leadership structures at the network level (i.e., density and centralization; as

187   described in H1) can be accounted for by an increase in the perceived leadership quality of

188   informal leaders (i.e., so that players within the team other than the captain step up and take

189   the lead).

190   Furthermore, in light of evidence that teams with shared forms of leadership are seen to function

191   and perform better [1, 14, 32], we also explore the relationship between leadership structures (as measured

192   in terms of leadership network density and centralization) and team functioning and performance. As

193   the leadership structure in a team is a team-level construct, we will explore this relationship at the

194   team level, aggregating the outcome variables that were all measured at the individual level. Here we

195   hypothesize:

196   H3: The evolution towards more shared forms of leadership (as anticipated by H1) will be

197   positively related to (a) increased team identification (H3a), (b) increased team confidence

198   (H3b), (c) increased intrinsic motivation (H3c), and (d) increased task-involving climate

199   (H3d), as well as (e) a weakened ego-involving climate (H3e), and (f) improved

200   performance (H3f), as observed at the team level.

Methods

202   Twenty-three semi-professional male Belgian soccer teams were contacted to participate in the

203   study and 20 agreed to do so (response rate = 87%). The main reason for non-participation of the

204   remaining three teams was the reluctance of the respective head coach to have the team complete the

205   required questionnaires due to the investment of time this would require. The participating teams

206   competed in the third-, fourth- and fifth-highest divisions of the Belgian soccer league and trained

207   between 8 and 16 hours each week. Nineteen teams were semi-professional (i.e., at least one player

208   played as their main occupation), while one team was a fully professional club.

209   Team sizes varied between 18 and 28 players ($M = 23$, $SD = 2.66$). In total, 460 individual

210   players participated. These players were on average 23.5 years old ($SD = 4.55$) and had played for 3.4

211   years for their current team ($SD = 3.96$). Full data sets were obtained from 415 players at T1 (response

212   rate = 91%), 384 players at T2 (response rate = 84%), and 370 players completed both surveys

213   (response rate = 81%). Thirty-one players dropped out during the study with the main reason being

214   that they were injured, sick, or not present at the moment of the second assessment. In addition to the

215   players, the head coach of each team was also surveyed ($N = 20$; $M_{age} = 46.8$; $SD = 8.20$). On average,

216   these coaches had been working for 4.1 years for their current club ($SD = 8.20$).

217   We gathered data by administering questionnaires at two time points. The first round of data

218   collection (T1) took place in July, when the teams had started their preparation for the competitive

219   season (i.e., the teams had already played multiple practice and cup games, but had not yet started the

220   regular competitive season). Data were collected a second time (T2) in November just before the mid-

221   season and the beginning of the 'transfer window'. In soccer, this window is a period in which players

222   are able to change clubs. In Belgian soccer, this can be a turbulent phase, as many teams change their

223   composition at this point. Given that we were interested in the evolution of leadership networks, a

224   period during which players frequently change teams would disrupt this process and distort our

225   findings. Accordingly, we focused on the evolution of leadership during the first half of the season.

226   All players participated voluntarily in the study and were assured that their data would be treated

227   confidentially. The research design was approved by the ethical committee of the first author's

228   university (G-201711996). Upon termination of the study, we provided the head coach of each team

229   with a detailed report on the leadership analysis of their own team.

230   The questionnaires, containing all measurements described below, were available in Dutch,

231   French, and English to ensure that every participant had the opportunity to complete the questionnaire

232   in their preferred language.

233   We assessed players' leadership quality in the four leadership roles (i.e., task, motivational,

234 social, and external leader), instead of focusing on players' general leadership quality. After carefully

235 reading the definitions of each role (as defined by Fransen et al. [8]), we asked participants to rate the

236 leadership quality of each of their team members (including the head coach) on an 11-point Likert

237 scale ranging between 0 (*very bad leader*) and 10 (*very good leader*) in each of the four roles. Using

238 this approach, we were able to construct four leadership networks for each team, one for each

239 leadership role. These networks are evaluative because the strength of the ties between team members

240 ranges from 0 to 10. Furthermore, the networks are directional because team member A's perception

241 of team member B's leadership qualities is not necessarily the same as team member B's perception

242 on team member A's leadership qualities. Social network analyses resulted in three specific network

243 parameters for each of the leadership roles — one parameter at the individual level (i.e., indegree

244 centrality) and two parameters at the team level (i.e., network density and network centrality) [26].

245   At the individual level, the indegree centrality of each team member reflects the extent to

246 which that individual is perceived to be a good leader in a specific leadership role. Indegree centrality

247 therefore constitutes an appropriate measure of a leader's influence on other members of their team [9,

248 33]. In line with the guidelines of Borgatti et al. [26], we computed the indegree centrality of each team

249 member by averaging the strength of all incoming ties for that specific team member (i.e., the average

250 leadership quality as perceived by other team members). This calculation results in a measure that can

251 be compared across different teams, regardless of their team size.

252   The density of a network is a team-level variable and describes the overall strength of

253 connections between team members. In leadership networks, the density reflects the average

254 leadership quality in the team; high density scores for a particular leadership role characterize teams

255 with, on average, high-quality leadership, while low density scores characterize teams with, on

256 average, low-quality leadership in that specific role [26, 34]. Following the procedure for valued networks

257 suggested by Sparrowe et al. [35], we calculated the density of all teams for all four leadership networks

258 at both time points by computing the average strength of all leadership perceptions in the network.

259   Network centralization is a team-level variable that reflects the extent to which a network is

260 dominated by a single individual [26]. The present study focused on indegree centralization by analyzing

261   the incoming ties (i.e., the degree to which team members are perceived by others as leaders) instead

262   of the outgoing ties (i.e., the degree to which a particular team member perceives other team members

263   to be a leader). More specifically, with respect to the leadership networks used in this study, leadership

264   network centralization can range between a maximally centralized network in which one team member

265   is at the center of the network receiving only high ties, while no other team members are perceived as

266   high-quality leaders, to a minimally centralized network, in which the leadership quality is equally

267   distributed between all team members (i.e., all team members are, on average, perceived as equally

268   good or bad athlete leaders) [26, 27, 36]. We computed network centralization using the definition as

269   suggested by Freeman [33]: indegree centralization $= 100 \times \frac{\sum_{i=1}^{n}(C^*-C_i)}{Max \sum_{i=1}^{n}(C^*-C_i)}$, where C_i is the

270   indegree centrality of team member i and C^* the indegree centrality of the team member who is

271   perceived as best leader by his teammates (for more details, see Borgatti et al. [26]). Both network

272   density and network centralization are measures that can be compared across different teams,

273   regardless of team size.

274   With respect to team identification, we used a five-item measure, following Doosje et al. [37]

275   (e.g., "Being a member of the team is very important for me"). This scale has previously been shown

276   to have a high internal consistency in sport settings e.g., [38]. Participants rated each team member on a

277   scale from 1 (*completely disagree*) to 7 (*completely agree*). In line with previous research the scale

278   showed high internal consistency at both data collection points ($\alpha_{T1}= .88$, $\alpha_{T2}= .90$).

279   We used a shortened form of the Collective Efficacy Questionnaire for Sports (CEQS), to

280   assess team confidence (following Fransen et al. [39] and Mertens et al. [40]), including the five highest

281   loading items on each of the subscales: ability, effort, unity, persistence, and preparation [41] (e.g., "My

282   team has the ability to demonstrate a strong work ethic"). Participants indicated their agreement with

283   these items on scales ranging from 1 (*completely disagree*) to 7 (*completely agree*). This measure

284   showed high internal consistency at both data collection points ($\alpha_{T1}= .88$, $\alpha_{T2}= .88$).

285   With respect to intrinsic motivation, we included the two highest loading items of the relevant

286   subscale of the Behavioral Regulation in Sport Questionnaire [42], in line with previous research [40]. We

287   chose to include only this subscale because intrinsic motivation is the hallmark of volitional

288   functioning [43] and to ensure that the questionnaire would not become too long for athletes to remain

289   focused. The subscale items that we included were: "I play soccer because it is fun" and "I play soccer

290   because I like it" (1 = *completely disagree*, 7 = *completely agree*). This measure had high internal

291   consistency at both data collection points (α_{T1}= .78, α_{T2}= .81).

292   We used the Peer Motivational Climate in Youth Sport Questionnaire, a 21-item measure to

293   assess participants' perceptions of the team's motivational climate [44]. This scale encompassed two

294   types of motivational climates. The measure of task climate included 12 items (e.g., "Most players of

295   my team help each other improve"), while the measure on ego climate included nine items (e.g., "Most

296   players of my team encourage each other to outplay their teammates"). Participants rated their

297   agreement on scales ranging from 1 (*completely disagree*) to 7 (*completely agree*). The internal

298   consistency of the task climate scale was good (α_{T1}= .93, α_{T2}= .94), while that of the ego climate scale

299   was lower but still acceptable (α_{T1}= .67, α_{T2}= .64).

300   As a subjective measure of performance, we asked both players and coaches to rate their

301   team's performance since the start of the season on an 11-point Likert scale ranging from 0 (*very poor*)

302   to 10 (*very good*) at both T1 and T2. As an objective measure of team performance, we used the

303   position of each team in their league at T2. Because we collected the data at T1 before the start of the

304   season, we did not have the team's ranking at this point.

Results

306   Means, standard deviations, and correlations between all variables at the team level are

307   presented in Appendix A. Appendix B presents the same information at the individual level.

308   In order to test Hypothesis 1 (i.e., the evolution of leadership networks over time), we

309   conducted paired samples *t*-tests to compare both the density and centralization of all leadership

310   networks (across all four leadership roles) at both T1 and T2 at the team level. In contrast with H1a,

311   we observed no significant changes in leadership networks' densities for task leadership (T1: M =

312   5.30, SD = .49; T2: M = 5.39, SD = .58; t = -1.07, p = .30), motivational leadership (T1: M = 5.58, SD

313   = .49; T2: M = 5.67, SD = .60; t = -1.19, p = .25), and social leadership (T1: M = 5.87, SD = .50; T2:

314   M = 5.91, SD = .63; t = -.60, p = .56). For external leadership, however, a significant increase was

315   observed in the *density* of the leadership networks between T1 (*M* = 4.98, *SD* = .71) and T2 (*M* = 5.26,

316   *SD* = .70; *t* = -3.38, *p* = .003). These results suggest that, in line with H1a, the overall external

317   leadership quality in the team increased throughout the first half of the season.

318   Furthermore, there was a significant drop in the *centralization* of the task leadership networks

319   between T1 (*M* = .32, *SD* = .08) and T2 (*M* = .26, *SD* = .09; *t* = 3.06, *p* = .006). A similar decrease in

320   centralization was observed in the external leadership networks (T1: *M* = .29, *SD* = .08; T2: *M* = .25,

321   *SD* = .05; *t* = 4.79, *p* < .001). We can conclude that, in line with H1b, both for task and external

322   leadership more team members became better leaders. In contrast with H1b, no significant changes

323   were observed in the centralizations of the teams' motivational (T1: *M* = .27, *SD* = .09; T2: *M* = .23,

324   *SD* = .07; *t* = 1.34, *p* = .20) and social leadership networks (T1: *M* = .24, *SD* = .06; T2: *M* = .22, *SD* =

325   .04; *t* = .98, *p* = .34).

326   One might wonder, though, whether these changes would be similar for newly-formed teams

327   and teams that have already played together for a long time. To investigate this, we performed an

328   exploratory post-hoc analysis of the influence of a team's overall player tenure on team-level

329   leadership network constructs. Specifically, we first separated our data in two categories using a

330   median split for the average team tenure of all players on the team ('high team tenure' ranged from

331   3.25 to 5.91 years, 'low team tenure' ranged from 1.79 to 3.09 years). Next, paired sample *t*-tests

332   comparing T1 and T2 values of both categories indicated that in teams with a relatively higher team

333   tenure, the evolution to shared leadership structure across the season is more prevalent than in teams

334   with lower team tenure (i.e., a there is a larger decrease in leadership network centralization; see

335   Appendix C). These findings are in line with previous research on athlete leadership and tenure [6, 29], as

336   our results show that in teams with relatively high overall tenure more athletes tend to be seen as good

337   leaders over the course of the season.

338   To obtain more insight into the processes underpinning the above changes in network density

339   and centralization, we analyzed the changes in the perceived leadership quality (i.e., indegree

340   centrality) of coaches, team captains, and players over time (i.e., Hypothesis 2). An important remark

341   is that players are nested within different teams, in contrast to coaches and team captains, of which

342   there is only one of each for every team. Therefore, we needed a differentiated approach for these

343   groups. First, starting with the non-nested data (i.e., coach and team captain), we used a Wilcoxon

344   Signed-Rank test. This revealed a significant decrease over time in *coaches'* perceived leadership

345   quality for task, motivational, and social leadership (task: $M_{T1} = 8.63$, $SD_{T1} = .58$, $M_{T2} = 8.03$, $SD_{T2} =$

346   .78; $Z = -3.33$, $r = -.75$, $p = .001$; motivational: $M_{T1} = 8.24$, $SD_{T1} = .44$, $M_{T2} = 7.68$, $SD_{T2} = .85$; $Z = -$

347   2.85, $r = -.64$, $p = .004$; social: $M_{T1} = 7.53$, $SD_{T1} = .64$, $M_{T2} = 7.22$, $SD_{T2} = .65$; $Z = -2.59$, $r = -.58$, $p =$

348   .01). However, for external leadership, coaches were perceived as better external leaders as the season

349   progressed ($M_{T1} = 7.70$, $SD_{T1} = 1.80$, $M_{T2} = 7.73$, $SD_{T2} = .80$; $Z = -2.29$, $r = -.51$, $p = .022$). For the

350   indegree centrality scores of the *captains*, we found no significant changes for the four leadership roles

351   over time. Second, to account for the clustered data of the players, we used a multilevel regression

352   model using indegree centrality as our outcome measure, while including time as a level-1 predictor

353   (T1= 0, T2 = 1). To control for team differences, we included a level-2 random intercept, resulting in

354   the subtraction of variance that is due to differences between teams. These results and the relevant ICC

355   calculations are presented in Table 1. In contrast to coaches and captains, for *players*, their indegree

356   centrality scores increased significantly over time for all four leadership roles (task: $\beta = .10$, $p = .001$;

357   motivational: $\beta = .16$, $p < .001$; social: $\beta = .10$, $p = .001$; external: $\beta = .34$, $p < .001$). In other words,

358   players were, on average, perceived as better leaders at T2 than at T1.

359   In the next phase of analysis, we examined whether the observed changes in indegree

360   centrality over time (i.e., T1 vs. T2) were different for coaches, captains, and players. To account for

361   the clustered nature of our data, we used a multilevel regression model, presented in Table 2. Using

362   indegree centrality as our outcome measure, we included time as a level-1 predictor (T1= 0, T2 = 1)

363   and the individual's category (i.e., coach, captain, or player) as a level-2 predictor. Our aim was to

364   investigate the cross-level interaction effects between a level-1 predictor and a level-2 predictor (time

365   X category). As our player data (level 2) is also nested within teams, we included a level-3 random

366   intercept to control for team differences. More specifically, this third level in our multilevel model

367   ensures that our result is corrected for the potential variance that is due to the differences between

368   teams. Furthermore, we included all ICC calculations in Table 2.

369   When comparing the coaches' and captains' changes in indegree centrality scores, the

370   analyses revealed no significant cross-level interaction effect for any leadership role. However, after

371   comparing players' and coaches' indegree centrality scores, our results showed a significant cross-

372   level interaction effect for all leadership roles (task: β = -.65, p < .001; motivational: β = -.75, p <

373   .001; social: β = -.45, p = .001; external: β = -.45, p = .03). Simple slope analyses revealed that the

374   increase in players' indegree centrality scores was significantly larger than the observed changes in

375   coaches' indegree centrality scores (task; players: β = .75, p < .001; coaches: β = .10, p = .003 |

376   motivational; players: β = .91, p < .001; coaches: β = .15, p < .001 | social; players: β = .55, p < .001;

377   coaches: β = .01, p < .001 | external; players: β = .79, p < .001; coaches: β = .33, p < .001).

378   Furthermore, when comparing players' and captains' indegree centrality scores, significant cross-level

379   interaction effects were found for athletes in task, motivational, and social leadership roles (task: β = -

380   .36, p = .031; motivational: β = -.35, p = .012; social: β = -.28, p = .03). Simple slope analyses

381   revealed that the increase in players' indegree centrality scores was also significantly larger than the

382   observed changes in captains' indegree centrality scores (task; players: β = .33, p = .011; captains: β =

383   .10, p = .003 | motivational; players: β = .50, p < .001; captains: β = .15, p = .029 | social; players: β =

384   .38, p < .001; captains: β = .10, p < .001). For external leadership, no significant differences between

385   the players' and the captains' indegree centrality scores were found. On this basis we can conclude

386   that informal leaders gained leadership status throughout the season in all leadership roles, while

387   coaches' perceived leadership quality only increased with respect to external leadership.

388   The next step was to explore how changes in leadership networks relate to team-level

389   outcomes (i.e., Hypothesis 3). Previous research has used either high network density or low network

390   centralization as a measure of effective shared leadership. However, it can be argued that only the

391   combination of both measures provides adequate insight into the team's leadership structure [14, 36]. For

392   example, when a team with a high network density also has a high network centralization, this team's

393   leadership will be centered on a few very good leaders, and thus does not reflect more distributed

394   forms of shared leadership. Along the same lines, a team with a low network centralization and with a

395   low network density is likely to have no good leaders at all. Again, this is not a structure that

396   represents high-quality shared leadership. Instead, we would argue that only networks with a

397   combination of a high density and a low/medium centralization are characteristic of structures of

398   shared leadership.

399   To allow for an adequate comparison across all combinations of density and centralization, we

400   dichotomized both variables. First, with respect to density, we created two equal groups by assigning

401   the 10 teams with the lowest network density at T2 to a 'low density' group (average overall density =

402   4.80; with values ranging between 3.98 and 5.23 on a scale from 1 to 10), and the 10 teams with the

403   highest network density at T2 to a 'high density' group (average overall density = 6.04; with values

404   ranging between 5.34 and 7.09 on a scale from 1 to 10). We did not create an intermediate group in

405   light of previous literature indicating that density has a linear relation with team outcomes, which

406   implies that a higher density relates to more beneficial outcomes [13, 14, 22].

407   Second, with respect to centralization, previous studies have suggested that the relationship

408   between centralization and team outcomes might be curvilinear, rather than linear [22, 34]. Accordingly,

409   we aimed to create three equal centralization groups: a 'low centralization' group consisting of seven

410   teams (average overall centralization = .13; ranging from .05 to .17 on a scale from 0 to 1), an

411   'average centralization' group consisting of six teams (average overall centralization = .24; ranging

412   from .19 to .29 on a scale from 0 to 1), and a 'high centralization' group consisting of seven teams

413   (average overall centralization = .35; ranging from .31 to 45 on a scale from 0 to 1).

414   By combining the different categories, we obtained six combinations of density and

415   centralization for each leadership role. We should note that on the team level our data do not have

416   sufficient power to perform a meaningful inferential test (e.g., a moderated regression model).

417   Accordingly, we will provide a descriptive analysis that explores how different leadership structures

418   are related to team outcomes. More specifically, for each leadership role, we will examine which

419   combination of density and centralization is associated with the most favorable outcomes (i.e., the

420   highest observable means). Table 3 depicts the average team outcomes at T2 for each of these

421   combinations. This exploration revealed that *high density* and *moderate centralization* were positively

422   associated with more favorable outcomes. More specifically, these teams had the highest team

423   identification, the strongest confidence in their team, were most intrinsically motivated, displayed a

424   task-involving climate over an ego-involving climate, and felt best about their team's performance.

425   With respect to objective performance, these same teams (i.e., those with leadership networks

426   characterized by high density and moderate centralization) obtained the second highest performance,

427   while teams with high network density and high network centralization were observed to display the

428   highest performance. These findings held for motivational leadership, social leadership, and external

429   leadership. For task leadership, however, teams with high density and high centralization surpassed

430   teams with high density and moderate centralization in team identification, team confidence, and both

431   players' and coaches' ratings of the team's performance. Our data exploration thus suggests that

432   moderate levels of motivational, social, and external leadership centralization are (at least

433   descriptively) associated with better team outcomes [a]. However, this curvilinear relationship was not

434   observed for task leadership. More specifically, teams in which the task leadership was centered in a

435   limited group of leaders performed better than teams in which the leadership was spread throughout

436   the team.

437   **Discussion**

438   To our knowledge, the present study is the first to track the development of leadership

439   structures within multiple high-level sport teams longitudinally over the course of a season. Our

440   findings align with recent research in organizational psychology which challenges traditional models

441   of leadership by moving beyond the notion of stable, vertical leadership structures [45]. More

442   specifically, we provide evidence that leadership in sport teams changes over the competitive season,

443   with informal leaders emerging from the team to form an important source of leadership, in addition to

444   the coach and the team captain. This growth in informal leadership was observed to be the key driver

445   behind the transition of leadership structures in sport teams towards shared leadership. Overall, these

446   findings are in line with previous work in newly formed student groups [22], where an evolution of

447   initially vertical leadership structures toward shared leadership structures has been observed over time.

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[a] Besides our initial descriptive overview, we have included an overview of the residualized change
scores of team outcomes for each of the six combinations of density and centralization for each
leadership role in Appendix D. This overview generally aligns with the descriptive overview
provided by Table 3. More specifically, for task leadership, our data suggest that teams with *high
density* and *high centralization* generally displayed the highest residualized change scores. With
respect to motivational, social, and external leadership, our data suggest that teams with *high density*
and *moderate centralization* tended to have the most favorable residualized change scores. Appendix
D provides a full overview of all residualized change scores, formatted similarly to Table 3 for an
easy comparison.

448   It should be noted that the patterns for external leadership differed to those for task,

449   motivational, and social leadership. More specifically, whereas the perceived task, motivational, and

450   social leadership quality of coaches decreased throughout the season, their perceived external

451   leadership qualities increased over time. This discrepancy suggests that, while task, motivational, and

452   social leadership can be easily extended to the player group (as reflected by the increase in players'

453   perceived leadership quality on these roles), coaches hold on more tightly to their role as external

454   leader. One possible explanation for this is that coaches inevitably have a stronger link with the world

455   around the team. For example, as the competitive season progresses, coaches often become the main

456   link between a team and the club's management. Furthermore, they are often the key individuals who

457   are interviewed after competitive games, which in turn reinforces their status as external leader.

458   To explore the optimal leadership structure for the four leadership roles, we categorized the

459   leadership structures in terms of their leadership network density (high – low) and in terms of their

460   leadership network centralization (high – moderate – low). For task leadership, teams with high

461   density and high centralization (i.e., a few leaders having high leadership qualities) scored best on

462   team identification, team confidence, and both players' and coaches' ratings of the team's

463   performance. The second-best scoring teams were the ones with high density and moderate

464   centralization scores (i.e., a larger group of leaders having high leadership qualities). It should be

465   noted that the maximum centralization value in this study was .45 (on a scale of 0 to 1), indicating that

466   even the highly centralized structures in our study do not represent vertical leadership structures (with

467   the coach as single high-quality leader), but rather structures in which a limited number of athletes are

468   perceived as high-quality athlete leaders. Leo et al.[20] recently provided more information on the exact

469   number of athlete leaders that would be most optimal for the team's functioning. They specified this to

470   be two task leaders, which was the maximum number of leaders observed in their study for male

471   soccer teams. Their recommendation aligns with what our data suggest — namely that having a

472   limited number of task leaders is more beneficial than having either the coach as the only leader or a

473   larger number of athletes taking the lead.

474   Furthermore, with respect to motivational, social, and external leadership, our data suggest

475   that teams with *high density* and *moderate centralization* (i.e., a larger group of leaders having high

476   leadership qualities) tended to have the most favorable outcomes (i.e., the highest team identification,

477   the strongest confidence in their team, the highest level of intrinsic motivation, displaying a task-

478   involving climate over an ego-involving climate, and the highest satisfaction with their team's

479   performance). Furthermore, it is worth noting that teams with a limited number of leaders (i.e., a small

480   leadership team) appeared to be more effective than teams in which everyone takes on a leadership

481   role, (reflected by a low centralization) [22, 34]. This accords with Gockel and Werth's [34] observation that

482   too many cooks can spoil the broth. This may be because, when all team members take the lead,

483   regardless of their leadership skills or motivation to lead, miscommunication is likely to occur [11]. In

484   conclusion, our results seem to suggest that, at least for motivational, social, and external leadership

485   tasks, teams benefit from having multiple leaders taking the lead in these roles. However, there comes

486   a point at which there are diminishing returns for sharing leadership further (as indicated by less

487   favorable outcomes for teams with low centralization).

488   Reflecting on the strengths of the present research, this study was the first to track the natural

489   evolution of four different leadership structures in sub-elite soccer teams. Importantly, this design

490   allowed us to obtain insight into the dynamic nature of leadership structures in team sport, thereby

491   advancing on previously obtained cross-sectional evidence in this setting [9, 11] and on the longitudinal

492   single-case study of Duguay et al. [29]. Furthermore, differentiating between the four different leadership

493   roles in ways suggested by Fransen et al. [8] allowed us to richer insight into the texture of leadership

494   activity. This nuanced view is important as our findings indicate that different types of leadership

495   change in different ways over time. In addition, the nature of the most beneficial leadership structure

496   differed between the leadership roles.

497   Another strength of this study is that we used evaluative and directional social network

498   analysis to capture leadership structures, thereby allowing us to track the leadership quality not only of

499   the coach and the captain, but of all team members [9]. Furthermore, in contrast to previous studies that

500   have focused exclusively on network density [30] or on network centralization [27], we combined measures

501   of both overall leadership quality (i.e., density) and measures of the distribution of leadership (i.e.,

502   centralization) to obtain more comprehensive insights in the leadership structures.

503   Despite these strengths, the study also had some limitations. First, while our findings show

504   that the leadership structure in sport teams changes over time as informal leaders assume leadership

505   status, the present research provides no insight in the underpinning mechanisms that cause players to

506   accrue leadership status. For example, in organizational contexts, Fransen et al. [22] showed that team

507   members who were perceived as competent and warm were likely to gain leadership status. Similarly,

508   in a sport context, future research could identify the predictors underpinning athletes' acquisition of

509   leadership status. Here the selection of potential predictors to investigate should be informed by

510   previous research on the characteristics of good leaders [1]. These predictors might also differ according

511   to the specific leadership role under investigation and could include both individual characteristics

512   (e.g., competence, experience, team tenure, and age) and specific behaviors (e.g., expressing

513   confidence in teammates, encouraging them, etc.).

514   Second, we acknowledge that while we provided a transparent comprehensive exploration of

515   how leadership structures relate to team outcomes, our design lacked the power to perform meaningful

516   inferential tests (e.g., a moderated regression model). Furthermore, the present design is not able to

517   determine the direction of effect (e.g., does high quality leadership result in higher team confidence, or

518   does higher team confidence inspire stronger perceptions of leadership quality?). To address these

519   issues, there would be value in future research that examines the present relationship with a larger

520   sample, preferably in an experimental setting, with a view to establishing the generalizability and

521   direction of the patterns observed above.

522   Third, this study was conducted only with male soccer teams. Further research should explore

523   the generalizability of these study findings in other sports and in female teams. Leo et al. [20] recently

524   showed that the optimal leadership structure can indeed differ between male and female teams. More

525   specifically, their research showed that both male and female teams benefited from having multiple

526   task leaders in their teams. However, for social and external leadership, the most optimal leadership

527   structure differed (motivational leadership was not assessed in this study); whereas male teams

528   performed best in a structure that had few social but multiple external leaders, female teams performed

529   best when there were more social leaders, but a single external leader. Future studies should examine

530   whether such changes between male and female teams also emerge with respect to the evolution of

531   leadership structure over time.

532   Fourth, the present research focused on the assessment of players' perceived leadership

533   quality. Doing this using social network analysis (SNA) had its advantages, as this allowed us to look

534   beyond the categorical distinction between leaders and non-leaders (i.e., "Do athletes show

535   leadership?"). Nevertheless, while SNA is an ideal tool for investigating key aspects of leadership

536   structures, leadership quality is clearly only one aspect of leadership. The present research did not, for

537   example, take the *quantity* of team members' leadership into account, nor the expectations for

538   someone to take up one or more leadership roles. While investigating these constructs would be

539   possible, we opted to focus on perceived leadership quality because it has been found to be a good

540   predictor of leadership effectiveness [1], and because we were mindful of questionnaire length.

541   Nevertheless, an expanded analysis that encompassed other dimensions of leadership would provide

542   an interesting focus for future research.

543   Fifth, in the present research we made a conscious decision to administer our first

544   measurements at the end of the preparation phase (once the teams had already played multiple practice

545   and cup games, but had not yet started the regular competitive season), in order to obviate against the

546   likelihood of team members not knowing everyone in their team. While a requirement of SNA is that

547   every team member has some knowledge of all others, future research should still establish the

548   generalizability of our findings when taking the actual beginning of the season as starting point, as

549   well as potential differences in the second half of the season.

550   As a final remark, even though the scope of the present study is limited to leadership

551   interactions between coaches and athletes, we hope that the present study will serve to encourage

552   future research in different settings to investigate shared leadership structures over time. Here,

553   research could also examine changes in leadership structures at a higher managerial level within sport

554   organizations (e.g., among the coaching staff or in club management; see also Jones et al. [18]).

555   **Conclusion**

556   The present work provides evidence that semi-professional soccer teams tend to develop more

557   shared leadership structures over the course of a season. This trend towards shared leadership can be

558   attributed to the emergence of informal leaders over time as players take on leadership roles.

559   Furthermore, this growth in shared leadership appears to be positively associated with increases in

560   both team functioning and team performance. On this basis we would recommend that coaches

561   encourage players to take on leadership roles of this form. Moreover, coaches can formally implement

562   a structure of shared leadership by identifying the best leaders in every leadership role (i.e., the leaders

563   with a broad support base in the team [9]); and then formally appointing them as part of the leadership

564   team. By further developing the leadership potential of these appointed leaders, the coach can then

565   maximize the team's functioning.

566   In conclusion, then, as noted in the quotation from Vince Lombardi at the beginning of this

567   paper, it appears that the strength of a team is indeed closely tied to the strength of its leaders. At the

568   same time, though, it needs to be recognized that this strength does not necessarily reside solely in

569   those team members who are assigned formal leader roles. Instead, leadership can change over time,

570   and can be enacted by multiple members of the team. Moreover, it appears that the development of

571   shared leadership is itself an important pathway to team strength and success. The key lesson from

572   Lombardi's quote is thus not that a team needs a strong coach but that it needs to have a coach who is

573   interested in cultivating the leadership of the athletes within their team.

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