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Who takes the lead?

Social network analysis as a pioneering tool to investigate shared leadership within sports teams.

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41 **Abstract**

42 Leaders do not operate in social vacuums, but are imbedded in a web of interpersonal
43 relationships with their teammates and coach. The present manuscript is the first to use social
44 network analysis to provide more insight in the leadership structure within sports teams. Two
45 studies were conducted, including respectively 25 teams ($N = 308$; $M_{age} = 24.9$ years old) and
46 21 teams ($N = 267$; $M_{age} = 24.3$ years old). The reliability of a fourfold athlete leadership
47 categorization (task, motivational, social, external leader) was established by analyzing
48 leadership networks, which mapped the complete leadership structure within a team. The
49 study findings highlight the existence of shared leadership in sports teams. More specifically,
50 regarding the task and external leadership roles, no significant differences were observed
51 between the leadership quality of coaches and athlete leaders. However, athlete leaders were
52 perceived as better motivational and social leaders than their coaches. Furthermore, both the
53 team captain and informal athlete leaders shared the lead on the different leadership roles.
54 Social network analysis was found to be a pioneering but valuable tool for obtaining a deeper
55 insight in the leadership structure within sports teams.

56 *Keywords:* athlete leadership, informal leadership, team captain, peer leaders,
57 leadership roles, coaching

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59 **Highlights:**

- 60 ➤ We used SNA to examine the complete leadership structure within 59 sports teams.
- 61 ➤ Sports teams are characterized by shared leadership.
- 62 ➤ Athlete leaders are perceived as better motivational and social leaders than their coach.
- 63 ➤ The formal and informal athlete leaders shared the lead on the different roles.
- 64 ➤ SNA is a novel but pioneering tool to obtain a better insight in sports leadership.

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Introduction

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High-quality leadership has been considered as a decisive factor in the successes of governments, political movements, educational institutions, business enterprises, and sports teams (Chelladurai, 2012). The majority of the research on team leadership has focused narrowly on the influence and behavior of one single team leader (usually a manager external to the team), thereby largely ignoring the leadership provided by team members. Only since the last decade, the concept of shared leadership was introduced in organizational settings and has been defined as “leadership that emanates from the members of teams and not simply from the appointed team leader” (Pearce & Sims, 2002, p. 172). The idea that “shared leadership is a more useful predictor of team effectiveness than vertical leadership” (Pearce & Sims, 2002, p. 183) seems to be at the heart of the growing interest in shared forms of organizational leadership (Pearce & Conger, 2003).

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The structure of a sports team is similar to the structure of a business team. Both teams are characterized by a hierarchical structure in which there is one person formally appointed as *the* leader of the team (i.e., respectively the manager or the coach). Furthermore, both types of teams strive for visible performance outcomes, for instance, taking the form of sale increases or a sports victory. Therefore, it should not be surprising that there are also similarities between the leadership styles of business managers and sport coaches (Weinberg & McDermott, 2002). In line with organizational leadership research, the vast majority of the research on leadership in sports settings has concentrated on the role of the coach. In this regard, a wide range of outcomes has been linked to coaches’ leadership styles and behaviors, ranging from athletes’ motivation to athletes’ performance (for reviews see Amorose, 2007; Chelladurai, 2007; Gould & Wright, 2012; Horn, 2008; Langan, Blake, & Lonsdale, 2013).

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While coaches are vital to their teams, another source of leadership within teams has recently garnered research attention; namely athlete leadership. Athlete leaders have been

90 characterized by more central positions on the field compared with their teammates, a longer
91 playing time, a higher task competence, a longer team tenure, and a stronger social
92 connectedness with teammates (Fransen, Van Puyenbroeck, et al., 2015; Loughead, Hardy, &
93 Eys, 2006; Moran & Weiss, 2006; Price & Weiss, 2011; Rees & Segal, 1984; Yukelson,
94 Weinberg, Richardson, & Jackson, 1983). Furthermore, a positive relationship was
95 demonstrated between the presence of athlete leaders and team outcomes, such as athletes'
96 satisfaction, athletes' team confidence, the team's cohesion, and the team's performance
97 (Crozier, Loughead, & Munroe-Chandler, 2013; Fransen, Haslam, et al., 2015; Fransen,
98 Vanbeselaere, De Cuyper, Vande Broek, & Boen, 2015; Fransen et al., 2012; Price & Weiss,
99 2011; Vincer & Loughead, 2010). These findings highlight the crucial role of having high-
100 quality athlete leaders and necessitate further research efforts to obtain a deeper insight in
101 athlete leadership.

102 Loughead et al. (2006, p. 144) defined an athlete leader as “an athlete occupying a
103 formal or informal leadership role influencing team members towards a common goal.”
104 Contained within this definition are two types of leaders. Athletes who are formally appointed
105 to be a leader, such as the team captain, are termed formal leaders. Informal leaders on the
106 other hand are not formally recognized as a leader but acquire their leadership role through
107 group member interactions. Previous studies on athlete leadership have mainly focused on the
108 team captain as formal leader (e.g., Dupuis, Bloom, & Loughead, 2006; Grandzol, Perlis, &
109 Draina, 2010; Kent & Todd, 2004; Voelker, Gould, & Crawford, 2011). Nevertheless, several
110 researchers have argued that, besides the team captain as formal leader of the team, informal
111 leadership should also be taken into consideration (Cope, Eys, Beauchamp, Schinke, &
112 Bosselut, 2011). For example, Loughead et al. (2006) revealed that, although most athlete
113 leaders occupy a formal leadership position (i.e., captain or assistant captain), also other
114 players within the team are perceived as leaders by their teammates. In a different study, the

115 majority of athletes (65.1%) pointed out that both the team captain and other players occupied
116 a leadership function in their team (Loughead & Hardy, 2005).

117 In addition to the formal-informal leadership distinction, Fransen et al. (2014) recently
118 identified the presence of four different athlete leadership roles. This new athlete leadership
119 categorization encompasses two on-field leadership roles (task and motivational leader) and
120 two off-field leadership roles (social and external leader). A detailed description of these four
121 different leadership roles, as outlined in previous research (Fransen et al., 2014), can be found
122 in Table 1. Using this new categorization of athlete leadership roles, Fransen et al. (2014)
123 focused on the players who were perceived as the best leader with respect to these four
124 leadership roles. Interestingly, the results indicated that there was some overlap between the
125 task and motivational leadership role. More specifically, 18.8% of the best task leaders were
126 also perceived as the best motivational leaders in their team. Furthermore, 11.5% of the best
127 motivational leaders were also seen as the best social leaders. However, these overlapping
128 percentages were relatively low, supporting the fact that the four leadership roles are clearly
129 distinct and, more importantly, showing that different players within the team are perceived as
130 best leader on the four leadership roles.

131 Furthermore, Fransen et al. (2014) examined the formal and informal athlete leaders
132 with respect to the four leadership roles (i.e., task, motivational, social, and external) within
133 nine different team sports in Flanders ($N = 4451$). The results demonstrated that only 1% of
134 the participants perceived their team captain (i.e., a formal leader) as the best leader in all four
135 roles. Even more remarkable was that almost half of the participants (44%) did not perceive
136 their captain as the best leader on any of the four roles, neither on the field, nor off the field.
137 On average over the four leadership roles, 29.5% of the participants indicated their captain as
138 the best leader on a specific leadership role, whereas 70.5% of the participants indicated an
139 informal leader. These results show that athlete leadership is shared among different team

140 members, thereby contradicting the general notion of players and coaches that the team
141 captain is the only leader of the team. As a consequence, there is a clear need for a better
142 understanding how widespread athlete leadership is within teams.

143 One limitation emerging from Fransen et al. (2014) was that participants were only
144 asked to evaluate the *best* leader on their team. As such, the authors obtained important
145 information concerning the *best* leader on the team, concerning the overlap between the *best*
146 leaders in the different leadership roles, and concerning whether the team captain is perceived
147 as *best* leader. However, information on the leadership provided by other team members, who
148 may not be the best but still influential leaders, is missing. Furthermore, because perceived
149 leadership of the coach was not measured, it was not possible to compare the athlete leaders
150 and the coach in this respect. As such, the leadership structure within the complete team
151 remains concealed. Consequently, it cannot be ruled out that the captain, not often perceived
152 as the best leader in the Fransen et al. (2014) study, was neither perceived as second or third
153 best leader. Likewise, it could be that, although the captain was not perceived as best leader in
154 any of the given roles, he/she might have been perceived as best all-round leader (i.e., scoring
155 second or third best on all four leadership roles).

156 In order to gain a deeper insight into the leadership structure of sports teams, the
157 present study will measure the leadership quality of the coach and of every player on the team
158 with respect to the four different leadership roles. Moreover, it is important to realize that
159 athlete leaders do not lead in a social vacuum, but instead, are imbedded in a web of
160 interpersonal relationships with their teammates and coach. Nevertheless, previous research
161 has typically focused on individual perceptions when examining athlete leadership, thereby
162 ignoring the surrounding team context. The present study will extend previous research by
163 using social network analysis to obtain a greater insight in the complete leadership structure
164 within sports teams.

165 **Social Network Analysis**

166 Social network analysis is a set of methodological tools for understanding the
167 relationships and structures within a network. This approach views social relationships in
168 terms of network theory, consisting of nodes, representing the individual actors within the
169 network, and ties, representing the relationships between the individuals (Wasserman &
170 Faust, 1994). Over the past decade, the theory of networks yielded explanations for social
171 phenomena in a wide variety of areas, ranging from organizational networks and information
172 sharing, over the use of social media, to politics and terrorist networks (Borgatti, Mehra,
173 Brass, & Labianca, 2009).

174 Recently, social network analysis has also been established as a well-suited technique
175 to study leadership in organizational settings for three reasons: (1) it can model patterns of
176 relationships among interconnected individuals; (2) it can represent how leadership is
177 distributed among group members; and (3) it can identify the emergence of multiple leaders
178 (Emery, Calvard, & Pierce, 2013). In this regard, Emery et al. (2013) used social network
179 analysis to investigate the emergence of leaders in a newly-formed leaderless group. Also
180 Hoppe and Reinelt (2010) postulated different leadership networks as a useful framework to
181 identify important outcomes such as collaboration and information sharing. It is important to
182 note that the ties in such an organizational leadership network are often informal and exist
183 outside the formal organizational structure, such as when an employee seeks advice from a
184 colleague other than the manager to solve a problem more quickly. This informal leadership
185 closely aligns with the informal athlete leadership in sports settings.

186 Although social network analysis has emerged as a useful technique in other research
187 disciplines, this network approach has hardly found its way into sports research (Lusher,
188 Robins, & Kremer, 2010). That is unfortunate because, as Lusher et al. (2010) noted, sports
189 teams are ideally suited for a social network investigation because they are composed of a

190 well-defined group of interdependent individuals (or stated in social network terms ‘a full
191 network’). Furthermore, a sports team has clear and measurable performance outcomes, and
192 the effectiveness of the relationships between the players has a direct impact on those
193 outcomes.

194 Although Nixon (1993) argued that social network analysis could provide important
195 insights in the leadership structure of sports teams, the few studies that used social network
196 analysis in sports settings only focused on the cognitive or actual interaction between the
197 players during the game (Bourbousson, Poizat, Saury, & Seve, 2010; Cotta, Mora, Merelo, &
198 Merelo-Molina, 2013; Passos et al., 2011). To our knowledge, there is only one study that
199 took a first step in the direction proposed by Nixon. More specifically, Lusher et al. (2010)
200 constructed an influence network of an Australian football team by asking each of the players
201 which teammate they considered as influential. Unfortunately, the network used in this study
202 did not provide any information on the strength of these influence perceptions. The results
203 simply revealed that most players rated the best players in their team as influential, but these
204 findings did not reveal any information on the degree of influence these players were
205 perceived to have.

206 **The Present Study**

207 The present manuscript, which includes two studies, aims to extend the current athlete
208 leadership literature by demonstrating that social network analysis is a useful tool to examine
209 leadership in sports teams. Therefore, the present studies used networks of leadership
210 perceptions in which the nodes represent the team members and the ties are determined by the
211 strength of the perceived leadership quality. This network approach constitutes a novel
212 approach to examine leadership in sports teams. Although social network analysis has already
213 been used to study leadership in education and work team settings (Emery et al., 2013; Mehra,
214 Smith, Dixon, & Robertson, 2006), the specific network approach that is used in the current

215 manuscript extends these studies in two ways. First, the present research does not use binary
216 networks (relations represented by 0 ‘no leader’ or 1 ‘a leader’), but instead valued networks,
217 in which the strength of the ties represents the athlete leadership quality, ranging from 0 (*very*
218 *poor leader*) to 4 (*very good leader*). As such, high-quality leaders can be identified as the
219 persons who receive the strongest ties. In addition, we do not only examine the general athlete
220 leadership of team members (Study 1), as was the case in previous research. Instead, Study 2
221 goes more in depth and investigates the leadership structure within each team for the four
222 different roles (i.e., task, motivational, social, and external leadership role). This role-based
223 leadership approach is suggested to provide a more comprehensive view on the complete
224 leadership network. Consequently, two aims can be distinguished in the present manuscript.

225 **Aim 1 – The reliability of the fourfold athlete leadership categorization for**
226 **networks.** To compare the leadership roles of the coach, the team captain, and the informal
227 athlete leaders, we rely on the fourfold leadership classification developed by Fransen et al.
228 (2014). As we noted above, this classification was based on perceptions of the *best* leader on
229 each leadership role. Because social network analysis takes into account the leadership
230 structure of all players in the team, we should establish in a first step whether the previous
231 classification still holds for the leadership network structure. Performing social network
232 analysis on the data of Study 2 (role-specific leadership quality) allows us to examine the
233 correlations between all four leadership networks for all players within the team. In other
234 words, not only the *best* leaders will be compared, as was the case in the study of Fransen et
235 al. (2014), but also the moderate leaders and the players who do not occupy a leadership
236 function at all. With a network approach, it can then be established whether a person with
237 high or low athlete leadership quality on one leadership role, also scores respectively high or
238 low on another leadership role. It is only in this way that we can examine whether the four
239 roles are really distinct leadership roles or whether leadership qualities can be generalized

240 over different roles. In line with previous research, we expect only moderate correlations
241 between the different leadership networks, indicating that the roles are clearly distinct roles
242 and mainly fulfilled by different players within the team (H1).

243 **Aim 2 – Comparing coach leadership with formal and informal athlete leadership.**

244 In a second step, the main purpose of the study can then be realized, namely establishing the
245 usefulness of social network analysis as a novel approach to better understand the leadership
246 structure in sports teams. Previous research only focused on a part of the leadership structure
247 in sports teams, for example, on the difference between the coach and athlete leaders (e.g.,
248 Loughead & Hardy, 2005; Price & Weiss, 2013), on the difference between the team captain
249 as formal leader and the informal athlete leaders (e.g., Fransen et al., 2014; Holmes, McNeil,
250 & Adorna, 2010), or on the different types of informal athlete leaders (e.g., Eys, Loughead, &
251 Hardy, 2007; Fransen et al., 2014; Loughead et al., 2006). In the present study, we compare
252 the leadership quality of the coach with the leadership quality of both formal and informal
253 athlete leaders within the team, in general (Study 1) and on the four leadership roles (Study
254 2).

255 In line with previous studies (Fransen et al., 2014; Loughead & Hardy, 2005; Loughead
256 et al., 2006), we expect that in at least half of the teams, the team captain will not be perceived
257 as best athlete leader. As such, we expect that the average captain's leadership quality, as
258 rated by their teammates, will be lower than the perceived quality of the best athlete leader in
259 the team (H2a), both in general (Study 1) and on the four leadership roles (Study 2).
260 Nevertheless, even though the team captain might not be perceived as the best leader, we do
261 expect that the leadership quality of the team captain will be rated higher in general (Study 1)
262 and on all four different leadership roles (Study 2) than the average leadership quality of all
263 the players in the team (H2b).

264 Furthermore, this network approach allows us to compare the leadership quality of
265 athlete leaders and coaches. Because most coaches have completed a coach education
266 program, and given the hierarchical structure in sports teams characterized by the coach as
267 formal leader, we expect that the coaches will be perceived as the best leaders in the team,
268 with respect to general leadership quality (H3a; data of Study 1). With regard to the different
269 roles, previous research that compared coach and athlete leadership in sports teams showed
270 that athlete leadership was more strongly related to social cohesion than coach leadership
271 (Price & Weiss, 2013). Moreover, both coach and athlete leadership were found to be equally
272 important for task cohesion. Furthermore, coaches displayed behaviors aimed at training and
273 instruction (i.e., characteristic behavior for task leaders) more frequently than athlete leaders.
274 By contrast, athlete leaders exhibited more positive feedback and social support than their
275 coaches, which are characteristic behaviors for motivational and social leaders (Loughead &
276 Hardy, 2005). Therefore, we expect that the coach will be perceived as a better leader than
277 athlete leaders on the task leadership role (H3b; data of Study 2). On the other hand, we
278 expect that athlete leaders will outperform the coach on the motivational and social leadership
279 roles (H3c; data of Study 2).

280 **Method**

281 **Procedure**

282 In total, 71 coaches were invited via email to participate in our study. The 59 coaches
283 who agreed to participate (yielding a response rate of 83%) were asked to send us the player
284 list for the current season. We adopted a stratified sampling technique with respect to sport,
285 gender, and playing level to constitute our sample in both studies. As such, an equal number
286 of teams of the different sports were selected (i.e., soccer, volleyball, basketball, and handball
287 in Study 1; soccer, volleyball, and basketball in Study 2). Within each sport, an equal number
288 of male and female teams participated. Moreover, within each subgroup, half of the teams

289 played at high level (i.e., national level) and half of the teams played at low level (i.e.,
290 provincial or regional level).

291 At the end of a training session, a research assistant was present to inform the players
292 about the nature of the study and to answer any questions participants may have had during
293 the completion of the questionnaire. The APA ethical standards were followed in the conduct
294 of the study and players could withhold their participation at any time. Informed consent was
295 obtained from all participants and confidentiality was guaranteed. No rewards were given for
296 participation in the study.

297 **Participants**

298 **Study 1.** In total, 35 sports teams participated in Study 1 (eight volleyball teams, eight
299 soccer teams, eight basketball teams, and 11 handball teams). To conduct reliable social
300 network analyses, a high response rate within each participating team is required (Sparrowe,
301 Liden, Wayne, & Kraimer, 2001; Wasserman & Faust, 1994). In 10 teams several players did
302 not attend the training session in which this research study was conducted, and as a
303 consequence, the minimum required response rate of 75% was not attained in these teams
304 (Smith & Moody, 2013). Therefore, these 10 teams were removed from our dataset. The 25
305 remaining teams included 15 male teams and 10 female teams. The participants were on
306 average 24.9 years old and had 15.7 years of experience in their sport. More detailed
307 information on the participants can be found in Table 2.

308 **Study 2.** In total, 24 sports teams participated in Study 2 (eight soccer teams, eight
309 volleyball teams, and eight basketball teams). There was no overlap between the samples of
310 Study 1 and Study 2. Based on the cut-off of 75% for the response rate per team, three teams
311 were removed from our dataset. The 21 remaining teams included 11 male teams and 10
312 female teams. The participants were on average 24.3 years old and had 14.9 years of

313 experience in their sport. More detailed information on the participants is presented in Table
314 2.

315 **Measurements**

316 **Study 1 – General leadership quality.** Each participant had to indicate “to what
317 extent they considered each player as having good general leadership qualities” on a 5-point
318 Likert scale, ranging from 0 (*very poor leader*) to 4 (*very good leader*). Based on the player
319 list, all the names of the players on the team were listed in advance, as was suggested by
320 Lusher et al. (2010). For each team, this resulted in an $N \times N$ adjacency matrix (with N being
321 the number of team members). The first row indicates the outgoing ties of the first team
322 member (i.e., the leadership quality of every team member as perceived by the first team
323 member), while the second row indicates the second team member’s leadership quality
324 perceptions, and so on. The columns reflect the incoming ties to team members, with the first
325 column being the ratings of all team members with regard to the leadership quality of the first
326 player. This means that the AB entry not necessarily equals the BA entry. In other words,
327 person A can perceive person B as a good leader, but person B does not necessarily perceive
328 person A as a good leader. This adjacency matrix thus refers to a non-symmetric, finite $N \times N$
329 social network with directed relations that refer to the rating of general leadership quality that
330 team members gave each other. By convention, the diagonal entries are forced to be missing
331 values, representing that players do not rate their own leadership quality. In addition, each
332 player rated the general leadership quality of their coach, also on a 5-point Likert scale,
333 ranging from 0 (*very poor leader*) to 4 (*very good leader*).

334 **Study 2 – Role-specific leadership quality.** To construct role-specific leadership
335 quality networks, each of the participants had to rate the leadership quality of each of their
336 teammates and their coach on four different leadership roles: task leader, motivational leader,
337 social leader, and external leader. The same procedure was used as to construct the general

338 leadership network in Study 1. For example for the task leadership network, the definition of a
339 task leader, as outlined in Table 1, was presented to the participants. Subsequently, each
340 participant had to rate the quality of the task leadership of each of his/her teammates, whose
341 names were listed in advance. Players had to indicate for each of their teammates “how well
342 they perceived their teammates’ task leadership qualities” on a 5-point Likert scale, ranging
343 from 0 (*very poor task leader*) to 4 (*very good task leader*). This procedure resulted in a finite
344 $N \times N$ task leadership quality network for each team. This network had directed relations,
345 referring to the rating of task leadership quality that team members gave each other. In
346 addition, each player rated the task leadership quality of their coach on the same response
347 scale. The same procedure was adopted for the other leadership roles, so that for every team
348 four role-specific leadership networks were created: a task leadership network, a motivational
349 leadership network, a social leadership network, and an external leadership network.

350 **Data Analysis**

351 Degree centrality is an often used social network measure to study leadership in teams
352 (Carson, Tesluk, & Marrone, 2007). In our study, we used a valued network approach, in
353 which the ratings vary within a given range (in our study between ‘0’ and ‘4’). The degree
354 centrality thereby refers to the strength of a node’s ties. In directed networks, like the
355 networks in our study, centrality can be further differentiated into indegree centrality (i.e., the
356 strength of the incoming ties) and outdegree centrality (i.e., the strength of the outgoing ties).
357 For the examination of leadership networks, it has been recommended to use indegree
358 centrality: an athlete’s leadership quality as perceived by his/her teammates. This measure
359 assesses a leader’s importance in the network and his/her influence on the other team
360 members (Freeman, 1979; Hoppe & Reinelt, 2010; Sutanto, Tan, Battistini, & Phang, 2011).
361 In our leadership networks, a node with a high indegree centrality refers to a player that is, on
362 average, seen as a good leader by his/her teammates.

363 To examine the relation between the different types of networks, we performed the
364 social network-specific Quadratic Assignment Procedure (QAP) hypothesis tests (Krackhardt,
365 1988). The autocorrelated structure of network data (Wasserman & Faust, 1994) can lead to
366 severe biases when classical hypothesis tests are performed (Krackhardt, 1987). Therefore,
367 QAP-tests use restricted permutation tests, which makes them robust against the problem of
368 autocorrelation (Dekker, Krackhardt, & Snijders, 2007). More specifically, QAP-correlations
369 were calculated between the different leadership quality networks for each team separately.
370 The goal of this analysis was to examine the degree in which the ties in the different
371 leadership quality networks are related with each other. For example, a high QAP-correlation
372 between the task leadership quality network and the motivational leadership quality network
373 in a certain team means that the athletes who are perceived as high-quality task leaders are
374 also perceived as high-quality motivational leaders. Moreover, the low-quality task leaders are
375 also perceived as low-quality motivational leaders.

376 **Results**

377 **The Different Leadership Networks**

378 To test the reliability of the existing athlete leadership classification (Fransen et al.,
379 2014) for the use of network analysis, we created a separate leadership quality network for
380 each of the four leadership roles (task, motivational, social, and external leadership role). As
381 an illustration, Figure 1 presents the task leadership quality network of one of the participating
382 teams: a male volleyball team. Figure 2 presents the social leadership quality network within
383 the same team. To maintain clarity of the figures, we decided to visualize only the strongest
384 leadership perceptions or, in other words, the perceptions of very good leadership (i.e., score
385 of 4). The size of each node corresponds to the player's leadership quality in fulfilling that
386 particular leadership role (i.e., the player's indegree centrality). The node size does take into
387 account all the arrows, also the ones with scores lower than 4 that are not visualized in the

388 picture. The more a player is perceived as a good leader by his/her teammates, the larger the
389 corresponding node size, and the more central the node is positioned in the network. Because
390 we did not ask the coach to rate the players' leadership quality, there are no out-going arrows
391 from the coach's node.

392 For instance, Figure 1 reveals that in this particular volleyball team player 7 is
393 perceived as the best task leader. Both coach and team captain are also perceived as relatively
394 important task leaders, indicated by their central position in the network and their relatively
395 large node size. In Figure 2, both player 4 and player 11 have the same indegree centrality
396 scores and thus share the lead as the two individuals who provide the highest quality of social
397 leadership. In this figure, the formal leaders (i.e., the coach and the team captain) are both
398 positioned on the outside of the network, meaning that the social leadership role is clearly
399 fulfilled by the informal leaders on this team.

400 Figure 3 represents the all-round leadership quality network of the same team as in
401 Figure 1 and Figure 2. The perceived all-round leadership quality is the average of the
402 perceived leadership quality scores on the four leadership roles (task, motivational, social, and
403 external). The visualization in Figure 3 only includes the arrows indicating an average score
404 of 3 or higher (i.e., perception of a good or very good all-round leader). In this network, the
405 node size (and the position centrality in the network) corresponds to players' indegree
406 centrality of all-round leadership quality. The nodes of both formal and informal leaders are
407 filled. In this team, the informal leaders (player 7 and player 11) are positioned most central in
408 the network, and thus are perceived as the best all-round leaders. However, it should be noted
409 that the coach and team captain also occupy relatively central positions.

410 **Aim 1 – The Reliability of the Fourfold Athlete Leadership Categorization for Networks**

411 First, we used the data of Study 2 to test the reliability of the leadership categorization
412 (i.e., task, motivational, social, and external leadership role) with respect to our network

413 approach, because the categorization was originally developed based on perceptions of only
414 the *best* leader in each role (Fransen et al., 2014). We thus examined the overlap between the
415 different networks to establish whether the roles are also distinct if we included the complete
416 leadership structure of the team, instead of only the best leader. To determine this network
417 overlap, QAP-correlations between the different leadership networks were calculated for each
418 team. This social network measure determines the correlation between two networks, thereby
419 examining whether a player, scoring high (or low) on one leadership network (e.g., task
420 leadership), also scores high (or low) on another leadership network (e.g., motivational
421 leadership). In Table 3, the QAP-correlations, averaged over all teams, are indicated.

422 The results revealed only moderate correlations, suggesting that the four different
423 leadership roles, although correlated, are clearly distinct leadership roles, which confirms H1.
424 Furthermore, the highest correlation was found between the two on-field leadership networks,
425 namely the task and the motivational leadership quality networks. This finding holds for both
426 male and female teams, in all sports, regardless of the competition level. In other words, team
427 members who perceive a player as a good task leader were more likely to perceive this player
428 also as a good motivational leader, regardless of their gender, sport, or competition level. In
429 addition, the second highest correlation was found between the motivational and the social
430 leadership quality network. Also this finding held for both male and female teams, regardless
431 of competition level, in soccer, basketball, and volleyball.

432 One-way Anova's revealed no significant differences between the strength of the
433 correlations between all four networks with regard to sport, team gender, and level. The only
434 difference that was (marginally) significant was the correlation between task and external
435 leader as a function of playing level ($F = 4.55$; $p = .046$). More specifically, the task
436 leadership quality network correlated significantly more strongly with the external leadership
437 quality network in high level teams ($r = .51$) than in low level teams ($r = .34$).

438 These findings verified the reliability of the existing leadership categorization when
439 taking into account the complete leadership structure within the team, thereby confirming H1.
440 As a result, we can proceed to the main purpose of the present study: examining the complete
441 leadership structure within teams, thereby comparing the leadership quality of the coach and
442 the athlete leaders, in general, and with respect to the four different leadership roles.

443 **Aim 2 – Comparing Coach Leadership with Formal and Informal Athlete Leadership**

444 We calculated the indegree centrality as a measure of the average leadership rating
445 received from all other players in the team (see Table 4). The node size and the position
446 centrality of the players in the networks in Figures 1, 2, and 3 are based on the players’
447 indegree centrality. Table 4 presents the indegree centrality scores for the coach and the
448 players, averaged over all teams. Furthermore, we examined the captain, as formal leader of
449 the team, and the actual ‘athlete leader’ on each role. This athlete leader refers to the player
450 that was perceived as best leader on that specific role. This person can be the team captain,
451 but can also be an informal leader scoring the highest on leadership quality.

452 To obtain more insight in the leadership status of the team captain, we computed a
453 ranking for all players in the team, based on their indegree centrality scores. This ranking thus
454 ranged from 1 (*player who is perceived as best leader by the other team members*) to n
455 (*player who is perceived as worst athlete leader by the other team members*), with n being the
456 total number of players in the team. The averaged ranking of the team captain over all teams,
457 as presented in Table 4, reveals whether formal or informal leaders are perceived as providing
458 the highest-quality leadership on a specific role. If the team captain is not the highest ranked,
459 this means that in most teams informal leaders are perceived as better leaders on that role than
460 the captain.

461 For both Study 1 (general leadership) and Study 2 (role-specific leadership) we will
462 follow the same approach to present the results. First, we investigated athlete leadership

463 within the team by comparing the team captain with the best athlete leader (H2a) and with the
464 average of all players in the team (H2b). Next, we compared the leadership quality of the
465 coach with the leadership quality of the best athlete leader, in general (H3a), and on the
466 different leadership roles (H3b and H3c).

467 In Study 1, the team captain had an average rank of 2.3 regarding his/her general
468 leadership qualities. The general leadership quality of the team captain (i.e., indegree
469 centrality) was, on average, perceived as significantly lower than the general leadership
470 quality of the best athlete leader ($t = 4.37; p < .001$). More specifically, in 14 of the 25 teams,
471 other players than the team captain were perceived as better leaders. The finding that the
472 formal leader is not always the best leader in the team confirms H2a. However, it should be
473 noted that the team captain is still perceived as a relatively important leader. In fact, in 21 of
474 the 25 teams, the captain was placed in the top 3 ranking of general leadership quality.
475 Furthermore, the team captain is perceived as a significantly better leader than the average
476 player in the team ($t = 11.22; p < .001$), which is in line with H2b. In contrast with H3a,
477 findings revealed that the best athlete leader was perceived as a significantly better leader than
478 the coach ($t = 2.41; p = .02$). More specifically, in only 8 of the 25 teams, the coach was
479 perceived as a better leader in general than the best athlete leader.

480 One-way Anova's did not reveal any significant differences with respect to the
481 average athlete leadership quality (i.e., indegree centrality at team level) between high and
482 low level teams ($p = .21$), male and female teams ($p = .17$), or between the different sports (p
483 $= .97$). Furthermore, independent-samples Kruskal-Wallis tests revealed no significant
484 differences in the leadership ranking of the team captain between high and low level teams (p
485 $= .86$), male and female teams ($p = .75$), or between the different sports ($p = .54$).

486 In Study 2, we compared the leadership qualities of the best athlete leader with the
487 leadership quality of the team captain and the coach on each of the four leadership roles. First,

488 looking at the leadership within the team, the results revealed that the best athlete leaders on
489 each role are perceived as significant better leaders than the team captain ($t = 2.90$; $p = .009$
490 for task leadership; $t = 3.00$; $p = .007$ for motivational leadership; $t = 4.43$; $p < .001$ for social
491 leadership; $t = 2.18$; $p = .04$ for external leadership; $t = 2.52$; $p = .02$ for all-round leadership).
492 More specifically, in respectively 9, 12, 15, and 6 teams of the 21 teams, other leaders than
493 the captain take the lead on the task, motivational, social, and external leadership roles. In
494 addition, the best athlete leader was perceived as a significantly better all-round leader than
495 the captain ($t = 2.52$; $p = .02$), thereby confirming H2a.

496 However, in line with Study 1, Study 2 corroborated that the team captain is not only a
497 formal leader, but that he/she does indeed occupy an important leadership role. More
498 specifically, in respectively 12, 6, 9, and 15 teams of the 21 teams, the team captain is
499 perceived as best leader on the task, motivational, social, and external leadership roles.
500 Furthermore, in half of the teams (12 teams) the captain was perceived as the best all-round
501 leader, and in five teams the captain was still perceived as second or third best all-round
502 leader. Independent-samples Kruskal-Wallis tests revealed no significant differences for the
503 leadership ranking of the captain with respect to each of the four roles between high and low
504 level teams, between male and female teams, or between the different sports. Only one
505 exception emerged; the captain was ranked significantly higher on social leadership in soccer
506 and basketball teams than in volleyball teams ($p < .05$).

507 In addition, the perceived athlete leadership quality of the team captain was
508 significantly higher than the team's average on respectively task leadership ($t = 7.33$; $p <$
509 $.001$), motivational leadership ($t = 5.72$; $p < .001$), social leadership ($t = 3.95$; $p = .001$),
510 external leadership ($t = 5.69$; $p < .001$), and all-round leadership ($t = 6.08$; $p < .001$). It can
511 therefore be concluded that, although the team captain is not always perceived as the most

512 important leader, he/she does occupy an important leadership function, thereby confirming
513 H2b.

514 Finally, we compared the leadership quality of the coach and the best athlete leader in
515 the team. No significant difference emerged between the all-round leadership quality of the
516 coach and the best athlete leader ($t = 1.24; p = .23$), which contradicts H3a. Also with regard
517 to the task and external leadership role, no significant difference was observed between the
518 leadership quality of the coach and the leadership quality of the best athlete leader
519 (respectively $t = .96; p = .35$ and $t = .56; p = .58$), thereby contradicting H3b. More
520 specifically, the coach was perceived as best task leader in 11 of the 21 teams, and as best
521 external leader in 13 of the 21 teams. For the motivational and social leadership quality, a
522 significant difference emerged in line with H3c: the athlete leader is perceived as a significant
523 better leader than the coach on both motivational ($t = 2.31; p = .03$) and social leadership ($t =$
524 $5.28; p < .001$). More specifically, in only 6 and 2 teams of the 21 teams, the coach was
525 perceived as best motivational and social leader respectively.

526 Discussion

527 Athletes are imbedded in webs of interpersonal relationships with their teammates and
528 coach. Nevertheless, most sport psychology research has typically relied on individual level
529 measures to assess team level constructs such as leadership. Brass and Krackhardt (1999, p.
530 181) highlighted this research gap by stating: “Largely ignored in leadership research is an
531 approach that focuses on the structure of interpersonal relationships: a social network theory
532 of leadership.” The present study was, to our knowledge, the first to use social network
533 analysis to obtain a greater insight in the leadership structure within sports teams. In contrast
534 to previous studies, we did not restrict the analysis to the best leader or to the formally
535 appointed leaders, but instead, we covered the full range of leadership relations within the
536 team, thereby providing evidence for shared leadership. This network approach allowed us to

537 compare the leadership quality (as perceived by all team members) of the coach, the team
538 captain, and the informal athlete leaders within the team.

539 **Aim 1 – The Reliability of the Fourfold Athlete Leadership Categorization for Networks**

540 We first verified the reliability of the recently developed athlete leadership
541 categorization, including the roles of task, motivational, social, and external leader, when
542 using leadership networks. Very similar findings emerged as in the original manuscript that
543 developed this classification based on only the best leader in each of the four leadership roles
544 (Fransen et al., 2014). In particular, in line with H1, moderate positive correlations were
545 observed between the different leadership networks. To a certain degree, general leadership
546 capacities are thus transferable between the different roles; a good leader in one leadership
547 role is more likely to be perceived as a good leader in another leadership role. However, the
548 fact that only moderate correlations emerged, corroborates previous research, demonstrating
549 that the four roles are clearly distinct leadership roles, which require specific leadership
550 qualities (Fransen et al., 2014).

551 Our results revealed the highest correlation between the task and the motivational
552 leadership quality networks, regardless of team gender, sport, and competition level. This
553 finding extends previous research that observed the highest overlap between the *best* task
554 leader and the *best* motivational leader (Fransen et al., 2014). Three possible explanations
555 may explain this relationship. First, playing time was demonstrated to be an attribute of both
556 high-quality task leaders and high-quality motivational leaders (Fransen, Van Puyenbroeck, et
557 al., 2015). In other words, the field players, rather than the bench players, were perceived as
558 good task and motivational leaders by their teammates, which may have caused the relatively
559 high overlap between these two on-field leadership quality networks. Second, the tactical
560 advice that is provided by the task leader might also serve as a good strategy to cope with
561 competition-specific stressors (Anshel, Williams, & Williams, 2000). For example, for a

562 stressed or discouraged player, it may be beneficial to focus on the task at hand, rather than on
563 his/her own negative emotions. Therefore, the tactical advice provided by the task leader
564 might help to steer the emotions in the right direction, thereby motivating the player. Third,
565 tactical communication was demonstrated to be an important indicator of players' confidence
566 in their team (Fransen, Vanbeselaere, et al., 2015; Fransen et al., 2012). By giving tactical
567 advice, the task leader is perceived as being confident in his/her team. Because expressing
568 confidence by the leader has a motivational impact on the other players (Fransen, Haslam, et
569 al., 2015; Fransen, Steffens, et al., 2015; Fransen et al., 2012; Moll, Jordet, & Pepping, 2010),
570 it can be inferred that the task leadership quality of a player is positively correlated with
571 his/her motivational leadership quality.

572 The second highest overlap was found between the motivational and social leadership
573 quality networks, regardless of team gender, sport, and competition level. Because these
574 leadership roles refer to interpersonal relations, respectively on and off the field, it can be
575 assumed that interpersonal leadership qualities are characteristic for both roles. Our data thus
576 demonstrate that previous findings on the correlations between the different leadership roles,
577 which only took the best leader into account (Fransen et al., 2014), can be transferred to
578 complete leadership networks, thereby confirming H1.

579 **Aim 2 – Comparing Coach Leadership with Formal and Informal Athlete Leadership**

580 After establishing the reliability of our theoretical framework including the four
581 leadership roles, we proceeded to the main aim of our study, namely to provide a deeper
582 understanding of the leadership structure within sports teams, thereby comparing the
583 perceived leadership quality of the coach and both formal and informal athlete leaders. Three
584 major conclusions can be drawn in this regard.

585 First, with regard to athlete leadership, both Study 1 and Study 2 revealed that in half
586 of the teams an informal leader, rather than the team captain, was perceived as the best all-

587 round leader. Furthermore, Study 2 added that especially on the motivational and social
588 leadership role mainly informal leaders were perceived as best leaders. These findings
589 corroborate earlier research (Loughead & Hardy, 2005; Loughead et al., 2006) that besides
590 the team captain, other players (i.e., informal leaders) take the lead within sports teams,
591 thereby confirming H2a.

592 Second, it should be noted that, although the team captain is not always perceived as
593 best leader, he/she does fulfill an important leadership function in most teams. More
594 specifically, in 83% of the investigated teams, the captain is seen as one of the top three
595 leaders (i.e., with respect to general or all-round leadership), which confirms H2b. Study 2
596 provided more insight in the role-specific leadership function of the captain and revealed that
597 captains were often rated higher by their teammates on external leadership quality, followed
598 by task leadership quality. With respect to the motivational and social role, other players than
599 the captain were generally perceived as best leader. These results align with the findings of
600 Loughead et al. (2006) who observed that the majority of external leaders (79%) occupied a
601 formal leadership position in their team (i.e., captain or assistant-captain), followed by task
602 leaders (65%) and social leaders (57%). These findings temper previous research stating that
603 in 44% of the teams the captain was not perceived as best leader on any of the four leadership
604 roles (Fransen et al., 2014). It should be noted though that the present study included only 575
605 participants and was administered in the presence of the other teammates, whereas the study
606 of Fransen et al. (2014) included 4,451 participants and was administered on-line.

607 Third, we compared the leadership quality of the coach with the leadership quality of
608 the best athlete leader in the team. With regard to the general leadership quality (Study 1) and
609 the all-round leadership quality (Study 2), the results revealed that, in contrast to H3a, the
610 coach was perceived as best leader in only 35% of the teams. Although most coaches have
611 followed a coach education program, it is the athlete leader who is perceived as best all-round

612 leader in most teams. Study 2 provided more detail with respect to the different leadership
613 roles. Regarding the task and external leadership roles, no significant differences were
614 observed between the leadership quality of coaches and athlete leaders. In contrast to H3b,
615 coaches were not always perceived as best leaders, but instead, coaches and athlete leaders
616 shared the lead on these roles. This finding contradicts previous research demonstrating that
617 coaches exhibited more task-oriented behavior than athlete leaders (Loughead & Hardy,
618 2005). However, the results do align with a previous study demonstrating that both coach and
619 athlete leadership were equally important for task cohesion (Price & Weiss, 2013). Finally, in
620 line with H3c, the athlete leaders were perceived as significantly better leaders than their
621 coach on the motivational and social leadership role. This finding corroborates earlier
622 research, demonstrating that athlete leaders exhibit the behaviors of positive feedback and
623 social support (i.e., characteristic behaviors for the motivational and social leader) to a greater
624 extent than their coaches (Loughead & Hardy, 2005). Moreover, Price and Weiss (2013) also
625 found that athlete leadership was more strongly related to social cohesion than coach
626 leadership.

627 **Strengths, Limitations, and Further Research Avenues**

628 A major strength of this study was the large number of participating teams, including
629 male and female athletes across diverse team sports and levels of competition. To date, most
630 social network studies in sports settings have included only a small number of teams. For
631 instance, the sports studies described in the present manuscript examined one to three sports
632 teams (Bourbousson et al., 2010; Cotta et al., 2013; Lusher et al., 2010; Passos et al., 2011;
633 Warner, Bowers, & Dixon, 2012). The present study is, to our knowledge, the first in sports
634 settings that encompasses data of more than 40 teams (including 575 players) in its social
635 network analyses.

636 Moreover, the stratified sampling technique, used to select the participating teams,
637 allowed for comparison between the different sports, and between male and female teams,
638 playing at high and low level. Leaving a few marginally significant differences aside, we can
639 conclude that the consistency in the relations demonstrated for both male and female teams,
640 for high and low competition level, and for the different sports testifies to the reliability and
641 generalizability of the study's findings.

642 In addressing the limitations of the present research, several opportunities for future
643 research emerge. First, the majority of the participants in our studies were young adults (i.e.,
644 90% of the participants were between 16 and 31 years old), and hence the obtained results
645 only pertain to this age group. Future research could examine to what extent the present
646 results also apply to athletes of a different age and/or different developmental level (e.g.,
647 youth athletes or senior athletes).

648 Second, in terms of the design, a cross-sectional approach was adopted, limiting our
649 ability to examine the stability of the different leadership structures within the team over time.
650 Hoppe and Reinelt (2010, p. 600) stated that "Understanding the nature of networks and
651 changes in them is an increasingly important aspect of leadership development evaluation."
652 Related to this point, Emery et al. (2013) assessed emerging leadership perceptions at three
653 time points in a newly formed student group. Given the observed variations in leadership
654 perceptions, future research should adopt a longitudinal design that allows for the examination
655 of the evolution and the stability of the different leadership networks over the course of a
656 season.

657 Warner et al. (2012) adopted such a longitudinal approach in a sports setting and
658 assessed an efficacy network of two basketball teams at four time points during the season.
659 The results revealed that the head coach moved from a central network position during the
660 off-season to a more decentralized location at the end of the season. A longitudinal design

661 would enable researchers to verify whether this in-season shift of the coach (and team
662 captain) from a central position to a more decentralized position can also be observed in the
663 different leadership networks.

664 Third, the present manuscript proposes a radical shift from the traditional vertical view
665 on leadership (in which the coach is viewed as the primary leader in the team) to the idea of
666 shared leadership (in which the coach, together with the team captain and the informal leaders
667 take the lead). Although the present manuscript provides convincing evidence for the
668 existence of shared leadership in sports teams, future research should provide more insight in
669 the antecedents and outcomes of sharing the lead.

670 With regard to the antecedents of shared leadership, it would be interesting to examine
671 the impact of the coaching style of the coach on the emergence of high-quality athlete leaders
672 within the team. Two major coaching approaches can be distinguished: an autocratic,
673 controlling style and an autonomy-supportive style. Mageau and Vallerand (2003) proposed
674 seven autonomy-supportive coaching behaviors, among which allowing athletes to work
675 independently and to have input into solutions for solving problems. It can be assumed that
676 such a coaching style, in which athletes are given autonomy, rather than being controlled,
677 nurtures the development of athletes' leadership abilities.

678 With regard to the outcomes of shared leadership, previous research has provided
679 preliminary evidence that shared leadership is associated with higher levels of team
680 confidence, team identification, and performance (Fransen et al., 2014). Furthermore, Fransen
681 et al. (2015) demonstrated that teams with higher levels of athlete leadership quality were
682 characterized by a stronger social connectedness. However, neither of these studies examined
683 which types of shared leadership lead to the most optimal team functioning. For example, is
684 the quality of the coach or the quality of the athlete leaders essential? Or is high-quality of
685 both coach and athlete leadership a prerequisite for successful shared leadership? The answer

686 to these questions might even differ as a function of the developmental stages of the athletes
687 and the team: for teams with young athletes or for newly formed teams, leadership of the
688 coach might be the most essential, whereas in teams with adults or in more mature teams,
689 athlete leadership might gain greater importance.

690 Furthermore, future research could investigate the moderating mechanisms underlying
691 the effectiveness of shared leadership. Previous research already indicated that role
692 differentiation (i.e., different leaders fulfilling different leadership roles) is positively linked
693 with team confidence, team identification, and performance (Fransen et al., 2014). However,
694 other boundary conditions, such as a shared vision or having adequate task competence, might
695 have to be fulfilled for shared leadership to be effective. More insight into these moderating
696 mechanisms would help coaches to set up a structure of effective shared leadership.

697 Finally, a fruitful line for further inquiry is to replicate the current study in other
698 cultures. It is indeed possible that the leader status of the formal leader, and the attached
699 emotional significance, is culture-specific. For example, in Flanders, where the current study
700 was conducted, the team captain wears a specific armband or the captain's shirt number is
701 underlined. These observable signs increase the public visibility, thereby often increasing the
702 emotional value for the player and/or the importance attached to this function by the fans.
703 Future research should verify whether the same findings are also found in different cultures,
704 in which visible signs of formal leadership are absent.

705 **Implications for Theoretical Knowledge**

706 The present study extends current literature on athlete leadership by providing a
707 deeper insight in the complete leadership structure of sports teams. First, the reliability of the
708 athlete leadership categorization, developed by Fransen et al. (2014), was established for the
709 analysis of leadership networks. As such, not only with respect to the best leader in the team,
710 but also when taking into account the complete leadership structure within the team, the four

711 leadership roles emerged as clearly distinct roles. This categorization thus forms a reliable
712 theoretical framework for further athlete leadership research.

713 Second, the network approach made it possible to compare coach and athlete
714 leadership, thereby including both formal and informal leadership. The present manuscript
715 demonstrated that coach, captain, and informal leaders shared the lead on the different
716 leadership roles. The study findings are thus in line with recent theorizing in the
717 organizational leadership literature on shared leadership. The integrative model of Locke
718 (2003) constitutes a good theoretical framework to underpin our findings. This integrative
719 model combines three different leadership approaches: (1) the top-down model, (2) the
720 bottom-up model, and (3) the model of shared leadership.

721 Our findings provide support for each of the three models. More specifically, in more
722 than half of the teams, the coach took the lead on the task and external leadership role, which
723 supports the top-down influence of the coach. Second, on the motivational and social
724 leadership role, the athletes within the team were clearly perceived as being better leaders
725 than their coach, thereby supporting the bottom-up model. Finally, the results provided
726 evidence that the captain together with the informal athlete leaders shared the lead on the
727 different leadership roles, providing support for the model of shared leadership.

728 **Implications for Coaching Practice**

729 High school sports coaches have listed a lack of leadership skills as the sixth most
730 frequently cited problem among adolescent athletes today (Gould, Chung, Smith, & White,
731 2006). Furthermore, semi-structured interviews with 13 former high school captains reported
732 that not one of these captains was trained or prepared by their coaches for their leadership role
733 (Voelker et al., 2011). These are only a few examples of research studies emphasizing a clear
734 need for leadership development in young people (Gould & Voelker, 2010). The findings
735 from the present study demonstrated that social network analysis is a viable diagnostic tool to

736 identify leadership abilities of all players within a team, which constitutes the first step in a
737 leadership development program. We thereby distinguish between the contribution to
738 coaching practice of (1) a team-specific leadership network analysis and of (2) the general
739 results as presented in the current manuscript, including the 46 tested teams.

740 First, network analysis of the different leadership networks for a specific team (such as
741 presented in Figure 1, Figure 2, and Figure 3) provides a viable diagnostic tool to identify the
742 key leaders on the different leadership roles within the team. Such a network approach does
743 not only reveal the athletes who are perceived as best leader by their teammates, but also
744 provides insight in the remaining leadership structure of the team (e.g., the presence of
745 cliques). For example, this approach distinguishes between the situation in which two players
746 are perceived as best task leaders by all of their teammates and the situation in which half of
747 the team nominated one task leader and the other half of the team assigned another task
748 leader. Especially in the latter situation, it might be beneficial for the team to formally appoint
749 both leaders as task leader to impact the whole team. This network approach provides
750 leadership information that is very specific to the team, thereby allowing us to map the
751 evolution of these leadership structures over time.

752 As Bailey (2001, p. 187) stated: “the man who correctly understands how a particular
753 structure works, can make it work differently with much less effort than a man who does not
754 know these things”. With regard to sports teams, equipping a coach with knowledge of the
755 leadership structure within the team, should yield similar benefits (Warner et al., 2012). That
756 is, a coach with knowledge of the key relational structures within the team can more
757 effectively lead the team to success, and using social network analysis might be an important
758 tool to reach this aim.

759 Second, the results of the present manuscript lead to several general practical
760 implications that should be considered by coaches, sport psychology consultants, and sports

761 teams. More specifically, our findings support previous research that not only formal leaders,
762 but also informal leaders take the lead on the different leadership roles (Fransen et al., 2014;
763 Loughead et al., 2006). Therefore, coaches should not solely focus on the team captain, but
764 spend time and effort to identify the other athlete leaders on the different leadership roles
765 within their team. It is conceivable that identifying the athlete leaders within the team will
766 enhance players' role clarity and, as such, also the effectiveness of their role fulfillment
767 (Crozier et al., 2013; Martens, 1987). In other words, if players realize that teammates
768 perceive them as a leader, this recognition will strengthen their sense of responsibility,
769 thereby motivating them to fulfill their leadership role even better.

770 However, coaches and sport psychology consultants should not only *identify* the key
771 leaders, but also invest time and energy to *improve* the leadership qualities of these athlete
772 leaders with respect to the different leadership roles. In this regard, leadership development
773 programs that focus on how athlete leaders can optimally fulfill the different roles would
774 support coaches and sport psychology consultants to strengthen the athlete leadership quality
775 within their team.

776 To conclude, the study findings demonstrated that the era of one sole leader (i.e., the
777 coach as leader) has come to an end. Instead, sports teams are complex social systems
778 characterized by shared leadership. Leadership is spread throughout the team: the coach, the
779 team captain, and the informal athlete leaders lead their team together.

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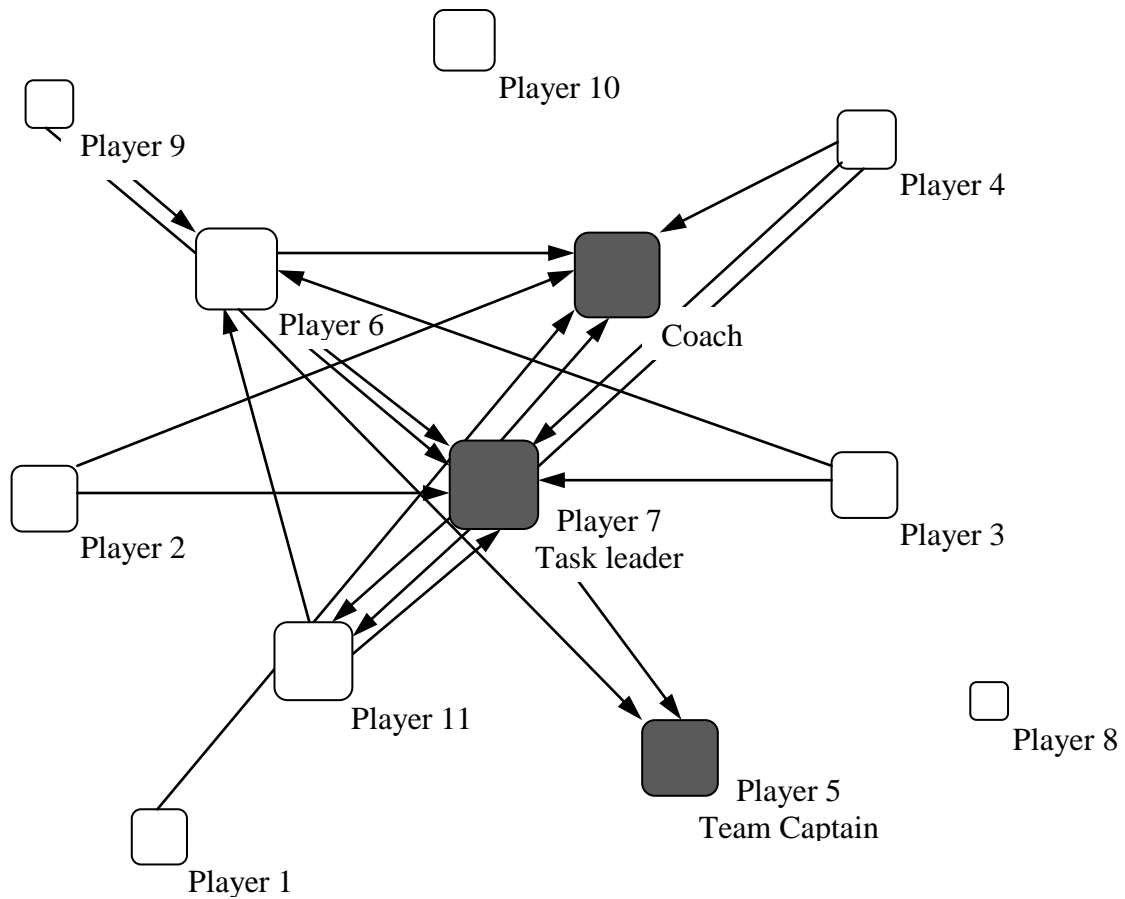
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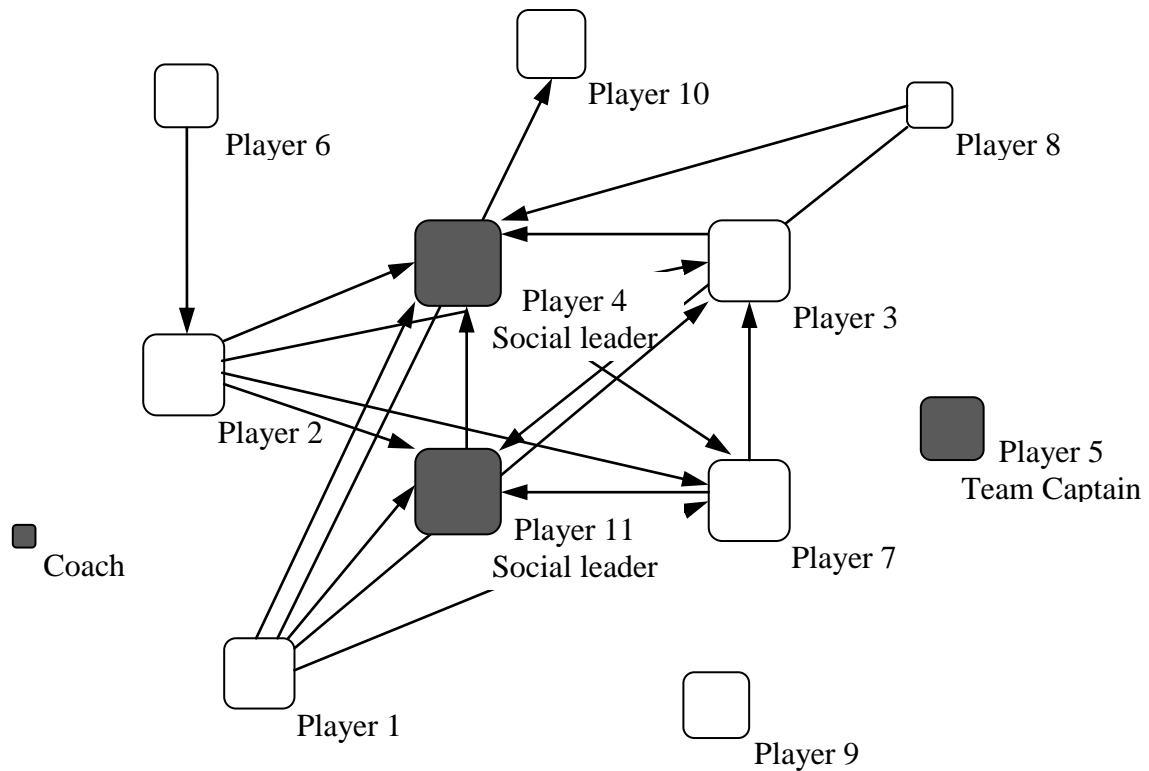
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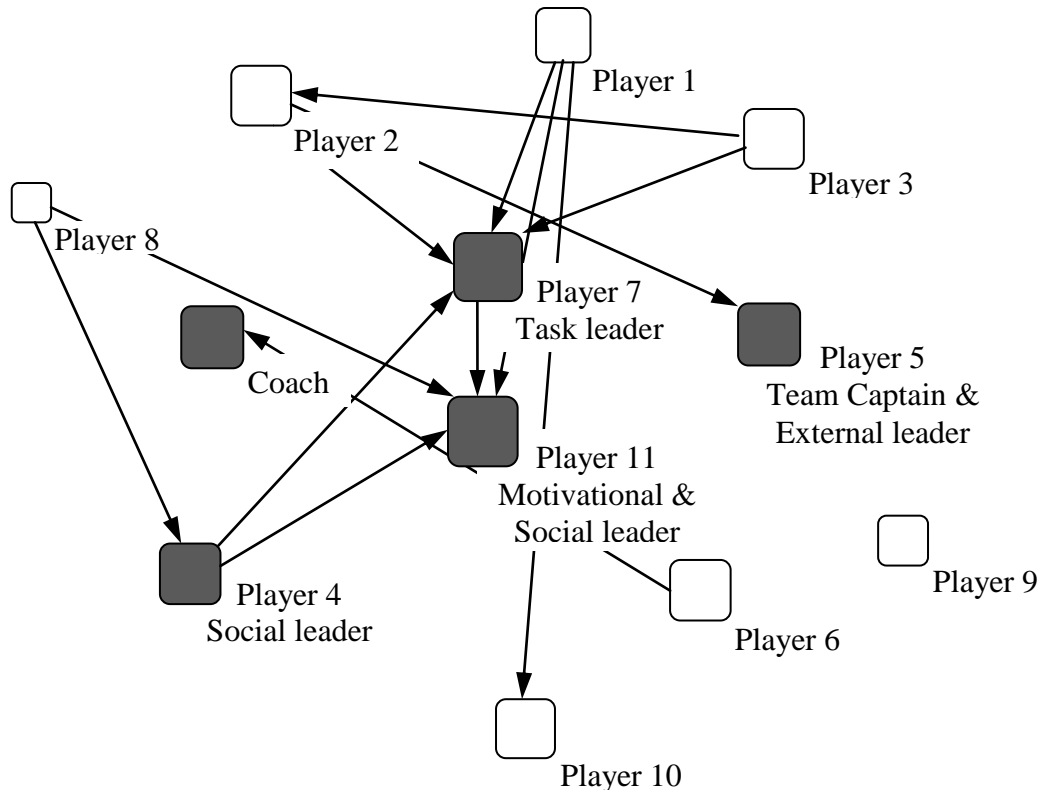
940

941 *Figure 1.* Task leadership quality network of a participating team. A directed line from Player
 942 A to Player B means that Player A perceives Player B as a very good task leader (i.e., score of
 943 4). The other scores are not visualized. The node size corresponds to the indegree centrality:
 944 the higher a player’s task leadership quality as perceived by the other team members, the
 945 larger the corresponding node, and the more central the player is positioned in the figure. The
 946 nodes of the formal leaders and the informal task leader are filled.



947

948 *Figure 2.* Social leadership quality network of a participating team. A directed line from
 949 Player A to Player B means that Player A perceives Player B as a very good social leader (i.e.,
 950 score of 4). The other scores are not visualized. The node size corresponds to the indegree
 951 centrality: the higher a player’s social leadership quality as perceived by the other team
 952 members, the larger the corresponding node, and the more central the player is positioned in
 953 the figure. The nodes of the formal leaders and the two informal social leaders are filled.



954

955 *Figure 3.* All-round leadership quality network of a participating team. A directed line from
 956 Player A to Player B means that, averaged over all four leadership roles, Player A rated Player
 957 B as a good leader (i.e., average score of 3 or higher). The other scores are not visualized. The
 958 node size corresponds to the average indegree centrality of the four roles: the higher a player's
 959 all-round leadership quality as perceived by the other team members, the larger the
 960 corresponding node, and the more central the player is positioned in the figure. The nodes of
 961 the formal and informal leaders on each leadership role are filled.

962 Table 1

963 *The definitions of the four leadership roles, as outlined by Fransen et al. (2014).*

Leadership role	Definition
Task leader	A task leader is in charge on the field; this person helps the team to focus on our goals and helps in tactical decision-making. Furthermore the task leader gives his/her teammates tactical advice during the game and adjusts them if necessary.
Motivational leader	The motivational leader is the biggest motivator on the field; this person can encourage his/her teammates to go to any extreme; this leader also puts fresh heart into players who are discouraged. In short, this leader steers all the emotions on the field in the right direction in order to perform optimally as a team.
Social leader	The social leader has a leading role besides the field; this person promotes good relations within the team and cares for a good team atmosphere, e.g. in the dressing room, in the cafeteria or on social team activities. Furthermore, this leader helps to deal with conflicts between teammates besides the field. He/she is a good listener and is trusted by his/her teammates.
External leader	The external leader is the link between our team and the people outside; this leader is the representative of our team toward the club management. If communication is needed with media or sponsors, this person will take the lead. This leader will also communicate the guidelines of the club management to the team regarding club activities for sponsoring.

964

965 Table 2

966 *Sample characteristics for Study 1 and Study 2.*

Sport	Number of participants	$M_{Team\ size}$	Team gender	Level	M_{Age} (years)	$M_{Experience}$ (years)	$M_{Team\ tenure}$ (years)
Study 1							
Soccer	6 teams ($n = 100$)	16.7	3 ♂ ($n = 55$) 3 ♀ ($n = 45$)	3 HL ($n = 58$) 3 LL ($n = 42$)	23.7 (± 4.8)	15.9 (± 6.5)	4.4 (± 5.2)
Volleyball	7 teams ($n = 75$)	10.7	4 ♂ ($n = 43$) 3 ♀ ($n = 32$)	4 HL ($n = 45$) 3 LL ($n = 30$)	28.5 (± 11.7)	17.2 (± 9.4)	7.2 (± 10.2)
Basketball	6 teams ($n = 63$)	10.5	4 ♂ ($n = 43$) 2 ♀ ($n = 20$)	3 HL ($n = 30$) 3 LL ($n = 33$)	24.4 (± 5.8)	15.7 (± 6.4)	6.7 (± 6.0)
Handball	6 teams ($n = 70$)	11.7	4 ♂ ($n = 47$) 2 ♀ ($n = 23$)	3 HL ($n = 42$) 3 LL ($n = 28$)	23.2 (± 4.8)	14.0 (± 4.8)	8.7 (± 6.1)
Total	25 teams ($n = 308$)	12.3	15♂ ($n = 188$) 10♀ ($n = 120$)	13 HL ($n = 175$) 12 LL ($n = 133$)	24.9 (± 7.5)	15.7 (± 7.0)	6.5 (± 7.2)
Study 2							
Soccer	7 teams ($n = 97$)	13.9	4 ♂ ($n = 53$) 3 ♀ ($n = 44$)	4 HL ($n = 51$) 3 LL ($n = 46$)	24.6 (± 4.4)	16.1 (± 6.7)	2.8 (± 2.3)
Volleyball	8 teams ($n = 93$)	11.6	4 ♂ ($n = 50$) 4 ♀ ($n = 43$)	4 HL ($n = 48$) 4 LL ($n = 45$)	25.6 (± 5.5)	14.4 (± 5.2)	3.4 (± 2.8)
Basketball	6 teams ($n = 77$)	12.8	3 ♂ ($n = 37$) 3 ♀ ($n = 40$)	4 HL ($n = 50$) 2 LL ($n = 27$)	22.7 (± 4.2)	13.9 (± 4.9)	5.1 (± 4.5)
Total	21 teams ($n = 267$)	12.7	11♂ ($n = 140$) 10♀ ($n = 127$)	12 HL ($n = 149$) 9 LL ($n = 118$)	24.3 (± 4.9)	14.9 (± 5.8)	3.7 (± 3.4)

967 *Note.* The standard deviation of age and experience is presented between parentheses.

968 ♂ = male team; ♀ = female team; HL = high level; LL = low level

969 Table 3.

970 *The QAP-correlations between the different leadership quality networks, averaged over all*

971 *teams.*

	1	2	3	4
1. Task leadership quality	1			
2. Motivational leadership quality	.67 (<i>SD</i> = .16)	1		
3. Social leadership quality	.53 (<i>SD</i> = .14)	.60 (<i>SD</i> = .15)	1	
4. External leadership quality	.44 (<i>SD</i> = .20)	.46 (<i>SD</i> = .23)	.43 (<i>SD</i> = .25)	1

972 *Note.* Standard deviations are presented between parentheses.

973 Table 4.

974 *The average indegree centrality scores for the players and more specifically for the team*

975 *captain and the best athlete leader, as well as for the coach.*

	All players	Team captain	Athlete leader ^c	Coach
General leadership quality ^a	1.92 ± .22	3.11 ± .49 (2.3)	3.37 ± .34	2.99 ± .74
Task leadership quality ^b	2.12 ± .38	3.11 ± .67 (2.3)	3.41 ± .46	3.52 ± .29
Motivational leadership quality ^b	2.34 ± .28	3.12 ± .58 (2.7)	3.45 ± .34	3.21 ± .45
Social leadership quality ^b	2.44 ± .22	2.97 ± .60 (3.6)	3.50 ± .22	2.54 ± .87
External leadership quality ^b	1.80 ± .53	2.70 ± .88 (2.4)	3.00 ± .76	3.09 ± .47
All-round leadership quality ^b	2.16 ± .28	2.97 ± .61 (2.4)	3.22 ± .41	3.09 ± .41

976 *Note.* For the team captain, the average athlete leadership rank is presented in parentheses.

977 ^aThese analyses are based on Study 1. ^bThese analyses are based on Study 2. ^cThe athlete

978 leader is defined as the player who is perceived on average as best leader by his/her

979 teammates on the specific leadership role.