The Impact of Intra-team Communication and Support Relationships on Team Identification and Collective Efficacy in Elite Team Sport: A Social Network Analysis

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Abstract

Team identification and collective efficacy are important determinants of team functioning. A team's collective efficacy is borne from its shared social identity and improved through iterative, interpersonal exchanges between teammates during training sessions and matches. Our study employed social network analyses to examine the impact of intra-team relationships on team identification and collective efficacy. We adopted a cross-sectional design including four elite teams ($N = 67$, 79% female) and collected athletes' data on which teammates they communicated with during matches (match communication relationships) and which teammates they sought informational support from during training sessions (informational support relationships). Regression analyses were conducted to explore the impact of these relationships on team identification and collective efficacy. Communication ties positively predicted team identification, while incoming (i.e., receiving nominations for support from teammates) and outgoing support ties (i.e., perceiving teammates as available for support) were unrelated. In addition, outgoing support ties predicted collective efficacy, while incoming support ties and communication ties were unrelated. Findings are discussed through a social identity lens, with suggestions to curate the training environment with activities that increase the reciprocity of communication relations between certain pairs of teammates to strengthen identification as well as increase the quantity and distribution of outgoing, support-seeking relations to enhance collective efficacy. Network maps of the teams sampled are used to exemplify these suggestions. Future research using social network analyses to track changes in networks over time is encouraged to understand the role of intra-team relationships in team functioning.

Keywords: social network analysis, teamwork, social identity, communication, informational support

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Teamwork makes the dream work – an expression that universally connotes optimal group functioning. Anecdotal accounts of underdog teams overcoming champions highlight exemplary teamwork in sport; the little-regarded USA Ice Hockey Team won Olympic gold in 1980 while the Detroit Pistons shocked the basketball world by beating the all-star LA Lakers to become the 2004 NBA champion. Billups, a Pistons player, highlighted the importance of teamwork in their victory: "They may have had better individual players, but we always felt we were a better team" (Braun, 2018, p. 21). As top performance is often the raison d'être for elite teams, several scientific endeavours have focused on improving it, and cultivating a social identity seems to be an important factor here.

Social identity theorising asserts that group processes are fundamentally grounded in individuals' capacity to define themselves, not only as individuals in terms of their personal identity (e.g., "I, Chauncey Billups"), but also as group members, which then becomes their social identity (e.g., "us, Detroit Pistons"). Through a process of depersonalisation, oneself comes to be defined in terms of a membership category that is shared with other in-group members (i.e., "we, Pistons"), and this self-categorisation provides the basis for people to see themselves and act as group members (Turner, 1982). Group membership endows individuals with psychological resources such as social connectedness and positive orientation toward other team members (Haslam et al., 2018). In sports teams, when athletes internalise their team into their sense of self and thus identify with their team, they also tend to adopt group norms that enable the coordination of individual efforts to better serve the team's function (Fransen et al., 2014).

Moreover, athletes that highly identify with the team are more likely to ascribe positive qualities to their team and believe in their collective abilities to accomplish their

goals (Fransen et al., 2016). The latter is termed collective efficacy, which has been defined as "a group's shared belief in its conjoint capabilities to organize and execute the courses of action required to produce given levels of attainment" (Bandura, 1997, p. 477). In sport, collective efficacy is defined as athletes' confidence in their team's ability to outplay their opponents; demonstrate effort; prepare and strategise; persist to perform in the face of challenges; and maintain unity (Short et al., 2005). Researchers have studied the contagion of collective efficacy in sports such as basketball and football and found that leaders influence team members' perceptions of collective efficacy via their shared identification with their teams (Fransen, Haslam et al., 2015; Fransen et al., 2016). In broader socio-psychological models of collective action, group identification positively predicted group members' willingness and engagement to pursue group goals directly as well as indirectly through their sense of collective efficacy (e.g., Social Identity Model of Collective Action, Van Zomeren et al., 2008, 2012). Accordingly, the first aim of our exploratory study was to corroborate this established relationship; we hypothesised that social identification positively predicts collective efficacy in elite team sport (H1).

Our second aim relates to the predictors of athletes' team identification. Here, Hogg (1996) suggested that members' social identity may be influenced by their embeddedness within the relational structures of their groups; how connected athletes are to their teammates may reflect the extent of their identification with their team. Recent studies in sport have shown support for these ideas by reporting that the strength of members' identification with their teams varied with their participation in relationships with teammates or group members (Graupensperger et al., 2019; Rodrigues et al., 2019).

To illustrate, Graupensperger et al. (2019) studied the group structure of 35 college sports teams and found that the quantity of one's social connections with teammates was positively related to one's strength of identification with the team. Specifically, the authors

found that the number and strength of friendships that athletes reported having with their teammates were positively related to their feelings of connectedness with the team. Additionally, those athletes with more incoming nominations of friendship, that is more of their teammates reported being close friends with them, reported their team's identity to be a more central part of their self-image. Likewise, Rodrigues et al. (2019) studied the peer interactions, identification with the club, and involvement with club activities in a Brazilian Jiu-Jitsu club. They found that the more popular an athlete was, that is the more peer interactions he or she had as well as the more interactions they had with other highly sought peers, the stronger this athlete's identification with the club and the greater his/her involvement in club activities. In line with these previous researchers, we hypothesised that the more teammate relationships athletes participate in, the more they identify with the team (H2). Extending conceptually from H1 and H2, we further hypothesise that the more teammate relationships athletes have, the greater their perception of collective efficacy (H3).

We have observed a growing research interest in examining peer interactions or friendships amongst teammates, not only in relation to social identification, but also behaviour. For instance, Scott and colleagues (2021) found that the greater number of close friendships athletes had, especially with peers who also shared many close friendships with other teammates, the less likely they were to engage in compulsive exercise to control their weight. Taken together, these empirical investigations have laid the groundwork to demonstrate that the relationships and interactions athletes participate in influence their cognitions and behaviour. A practical implication of these findings is that coaches and practitioners must gain information about athletes' social position and embeddedness in the relational networks of their team, to influence certain individual and team outcomes.

However, to inform real-world practice, researchers must first examine "*how* social structures revealed through peer interaction networks influence sport involvement"

(Rodrigues et al., 2019, p. 128). Social network analysis (SNA) is an interdisciplinary approach that measures relations and interactions within groups. For a detailed review of SNA methodology, we refer you to the work of Borgatti et al. (2018) and Robins (2015). SNA has been established as best-practice to understand relational patterns in business management, public health, political science, and sociology (e.g., Borgatti et al., 2009; Cross & Parker, 2004). Recently, SNA has gained traction in sport psychology with its pioneering application to map leadership networks within teams (Fransen, Van Puyenbroeck et al., 2015) as well as to examine friendship and peer interactions (Graupensperger et al., 2019; Rodrigues et al., 2019; Scott et al., 2021). All of the aforementioned SNA studies in sport have used measures of network centrality – which reflect an athlete's position in the network – to understand the contribution of relationships or interactions to valued outcomes such as the involvement in club activities (Rodrigues et al., 2019) or the perception of task cohesion (McLaren & Spink, 2019). Centrality is a family of concepts that describes an individual's position within its group structure and indicates the individual's social embeddedness and contribution to the group (Borgatti et al., 2018). Assuming the networks in Figure 1 represent information-seeking relations of one athlete within a sports team, the athlete's outdegree centrality corresponds to the number of outgoing ties (i.e., three) or, in other words, the number of teammates this athlete would typically seek sport-related advice from during training sessions [insert Figure 1 here]. Indegree centrality is the number of incoming ties an individual receives (i.e., three) or, in other words, the number of teammates who seek sport-related advice from this athlete.

There is growing evidence in sport that outdegree and indegree centrality in friendship and peer interaction networks positively predict team identification (Graupensperger et al., 2019; Rodrigues et al., 2019). However, no study to our knowledge has yet examined the associations between team identification and these centrality measures in instrumental

teammate relationships, such as communication during matches as well as information exchange during training sessions to seek advice or clarify tactics and roles (i.e., informational support). By employing SNA to examine communication and informational support relationships and measuring athletes' outdegree and indegree centralities in these networks, we extend the efforts of previous researchers who were limited by their use of self-reported perceptions of the team environment as proxy measures for these relationships - an inadequate representation because these measures assumed uniformity amongst all relationships within a team (Wasche et al., 2017). To the best of our knowledge, ours is the first examination of the impact of elite team sport athletes' communication and informational support degree centralities on team identification and collective efficacy, important determinants of team functioning.

Match Communication

Match communication has been conceptualised as the reciprocal exchange of verbal and non-verbal information between teammates to fulfil the purposes of planning, coordination, decision-making, and motivation (Blaser & Seiler, 2019), which contribute to establishing a team's collective efficacy. In their SNA study on communication and task cohesion, McLaren and Spink (2019) asked recreational basketball players to nominate the teammates with whom they regularly exchanged information with during games (i.e., outdegree centrality). They found that athletes who communicated with a larger proportion of their teammates, as indicated by their higher outdegree centrality values, reported greater task cohesion than those who nominated fewer teammates and communicated with a smaller proportion of their team. In professional basketball teams, the positive, causal relationship between cohesion and performance was mediated by collective efficacy which led the authors to suggest that coaches would do well to improve athlete interactions, both, on and off the field of play, to enhance cohesion and collective efficacy (Heuzé et al., 2006). To investigate

the utility of their suggestion, we specify our second and third hypotheses further; athletes with more reciprocal match communication relations, as indicated by the number of teammates they exchange information with during matches (i.e., degree centrality), will report stronger identification with their teams (H2a), and more collective efficacy (H3a).

Informational Support During Training Sessions

Social support from teammates, including informational support which involves providing sport-related advice and assisting with problem-solving (Cutrona & Russell, 1990), is a positive enabler of development and success in elite athletes (Rees & Hardy, 2000). Supportive interactions and relationships between teammates form "a social network of mutual assistance and obligations" (Van Yperen, 2009, p. 319), though direct measurements of these social networks have seldom been carried out in elite team sport. Furthermore, previous research has found perceived available support, rather than actually received support, to be associated with favourable outcomes in sport. Perceived available informational support, which is one's psychological impression of the support available to engage in sport-related problem-solving, has been found to protect against some dimensions of athlete burnout while actually received support had no effect (Freeman et al., 2011; Hartley & Coffee, 2019). Team identity "provides a basis for expectations of support availability" (Hartley et al., 2020, p. 257) and stronger identification can be expected to be associated with perceived support from more in-group members. Following this, we hypothesise that athletes with more outgoing informational support ties (i.e., outdegree centrality), which indicates perceiving more teammates as available for support, will report stronger identification with their team (H2b). As part of H2b, we also expect athletes who are sought for informational support by many teammates (i.e., indegree centrality) to report stronger identification by virtue of their status as a "go-to" or a leader in the technical or tactical aspects of their sport, as leaders often have higher indegree centrality (Fransen, Van

Puyenbroeck et al., 2015) and strongly identify with their teams (Fransen, Haslam et al. 2020; Fransen et al. 2016).

Recently, experimental studies have found that novice golfers with adequate support experienced better self-confidence and performance on a golf-putting task than those who had received an under- or overprovision of support (Fu et al., 2021). The authors recommended that coaches should consider athletes' preferences for the level of support they desire and tailor their support provision accordingly. Being the first study of its kind, the authors encouraged future studies to consider athletes' support networks, that is those established organically with teammates or others through frequent interactions of support, to understand the impact of adequate support upon constructs like self-confidence. The authors intimated the need for coaches to know athletes' support-related preferences – not only *how much,* but also *who* and *how many* – because the meaning and experience that athletes derive from available support depends on these preferences (Butler et al., 2018). We contribute to the social support literature by using SNA to discover these preferences in real teams and in real-world settings, and examine their impact on collective efficacy. Specifically, then, we hypothesise that the more informational support ties athletes have (i.e., indegree and outdegree centrality), the greater their collective efficacy (H3b). Overall, our study extends current understanding of the role of perceived informational support in team sport by measuring the relationships between teammates, arguably a more targeted approach that complements findings gleaned from self-reported impressions of the support available from one's whole team.

To summarise, we endeavour to make novel contributions to the understanding of intra-team communication and support relationships and their role in strengthening team identification and collective efficacy in elite team sport. We add precision to this understanding by measuring relationships directly via SNA and providing suggestions for

coaches and practitioners to use the existing communication and support networks in their teams more deliberately to increase identification and collective efficacy.

Methods

Procedure

A cross-sectional design was used. Data were collected during the teams' training sessions via pen and paper questionnaires and via email when athletes were absent from those sessions. Modes of data collection did not differ as in-person and emailed participants responded to the same questionnaire, and within the same week. The response rate within teams ranged between 80 and 100%, which was sufficient to conduct reliable social network analyses (Fransen, Mertens et al., 2020). To minimize missing data arising from participants' incomplete recollection, the questions on teammate relationships were customised to each team by listing all rostered team members as pre-set response options (Fransen, Mertens et al., 2020). All data were collected at the end of the 2018-19 competitive season. University ethical approval was obtained prior to recruitment. Participants' written informed consent was sought and participation was emphasized to be voluntary.

Participants

Our sample consisted of four teams of 14 to 20 adult athletes from cricket, field hockey, and football ($N = 67$, 21% male; 51% university-based; 28% semi-professional; 21% international; and, 79% able-bodied). Athletes had spent 0 (i.e., newly recruited) to 17 years on their respective teams ($M = 4.08$ years $\pm$ 4.02). All teams were defined as elite according to Swann and colleagues' (2015) points-based taxonomy for classifying expert samples in sport psychology research. Three teams had a 100% response rate. One team had an 80% response rate because four athletes did not participate in the study; they were absent from the training session when data was collected, and they did not respond to email invitations to participate. In SNA studies, information on non-participating individuals can be collected by

virtue of other participants indicating that they share a relationship with them. Given our small sample size and all the non-participants coming from one team, we decided to include non-participants' data to provide a more complete representation of our sample. Our decision is in line with literature on conducting and analysing SNA research (see Borgatti et al., 2018). In summary, we collected data from 63 participants and, where possible, we included data on four non-participants without the use of imputation methods. Therefore, our sample size was 67.

Measures

Intra-team Relationships and Centrality

Informational Support During Training Sessions. Participants responded to two separate questions; they were asked to indicate "whom you typically seek [insert sport type]-related information from during training sessions (e.g., clarity on a drill), besides your coach" and "whom you typically turn to for help in thinking through or solving training- or performance-related problems". The former statement centred on seeking advice related to sporting technique and skill development (i.e., information-seeking) while the latter statement sought to elucidate the problem-solving relations (i.e., problem-solving) between teammates. Given the exploratory nature of our study, we wanted to capture responses to more than one dimension of informational support. Participants were encouraged to select as many teammates as they believed fit each statement. Their responses indicated the presence or absence of ties to every team member. The presence of a tie was coded with 1, while the absence was reflected by 0. This method yielded an n x n matrix for each team, with n being the total number of team members, where each row reflected which team members each participant turned to for information or problem-solving (i.e., outgoing tie from A to B meant that Participant A turned to Participant B) and each column reflected the nominations received by each participant (i.e., incoming tie from A to B; Participant B received a

nomination from A). For every team, this methodology resulted in two binary, directed networks; one for information-seeking and one for problem-solving. In directed networks, the relationship between participants is one-way and may not be reciprocal; Participant A turning to B for advice or support does not necessitate B behaving likewise by turning to A. For every participant, we calculated two measures of centrality from each network: their outdegree centrality and their indegree centrality. For non-participants, their outdegree centrality was unavailable to us and coded as missing, while their indegree centrality was based on the nominations they received from their participating teammates. We normalised the centrality data to account for the different team sizes in our sample; participants' raw outdegree and indegree centralities were divided by the total number of possible relationships [i.e., $n(n-1)$] they could have in their teams.

Communication During Matches. Participants were asked to indicate "whom in the team you communicate most often with to accomplish your on-field tasks during games/matches". Participants were encouraged to select as many teammates as they believed fit the statement. The ties were coded and the n x n matrices were created as described for the abovementioned training support relations. Additionally, we were interested in established or iterative patterns of match communication which reflected typical relations between teammates rather than one-off interactions recalled in response to recency effect or similar biases. To reflect this shared exchange of information, we symmetrised the data; the presence of a tie was only coded when both members indicated that they communicated with each other during matches. For every team, this method resulted in an undirected network where a tie between teammates represented a reciprocal communication relationship. Therefore, the number of outgoing ties a participant has are the same as the number of incoming ties and one's outdegree centrality is the same as one's indegree centrality; we refer to this as degree centrality. Non-participants' degree centrality was based on participants' nominations of

them as teammates they communicate with. As with the informational support centrality data, we normalised participants' raw degree centrality.

Team Identification

The Single-Item Social Identification scale (SISI) measures "one's positive emotional valuation of the relationship between self and ingroup" (p. 599) and is a valid and reliable measure of team identification (Postmes et al., 2013). SISI has been used in team sport (Slater & Barker, 2019; Thomas et al., 2019). While some SNA studies have used the nine-item Social Identity in Sport Questionnaire (see Graupensperger et al., 2019; Rodrigues et al., 2019), we chose to use SISI to minimise participant burden because we were collecting data during our sample's training sessions. Participants indicated their agreement with the statement "I identify with [insert name of team]" on a 7-point Likert-type scale from 1 (*do not agree at all*) to 7 (*agree completely*), reflecting the strength of identification with their team.

Collective Efficacy

A collective efficacy measure reported in other sport psychology inquiries was used (Barker et al., 2014; Slater & Barker, 2019). Specifically, an average score was computed from responses to five items – (1) "my team is capable of achieving goals/targets that are set"; (2) "my team can manage to solve difficult problems if it tries hard enough"; (3) "my team can find a solution when confronted with a problem"; (4) "throughout a game, my team can minimise errors when under pressure"; and, (5) "as a team, we keep trying skills even when they are not going as we expect" – which were measured on a 7-point Likert-type scale from 1 *(do not agree at all)* to 7 *(completely agree*; Barker et al., 2014). As explored by Bruton et al. (2016), the collective efficacy research is rich with several multi-item instruments that have been re-worded to suit the studies' context, single-stem questionnaires, and recently a single-item stem; however, multi-item instruments remain the most common

choice because of the multidimensionality of the construct. Bandura's (see 2006) guidelines, as expounded on by Bruton et al. (2016), suggest that all "efficacy measures [be] context-specific, treat efficacy beliefs as a state and are phrased in terms of 'can do' rather than "will do" (p. 398). In keeping with these guidelines, and to minimise threats to validity, we followed Barker et al. (2014) collective efficacy measure closely because it was used to measure group functioning in elite team sport like the current study. In this way, the measure used in our study has face validity as with other similar and previously published measures in sport (see Bruton et al., 2016). Barker et al. (2014) reported Cronbach's alpha coefficients of .80 to .84. In our study, the 5-item scale has a Cronbach's alpha coefficient of .83.

Data Analysis

We had no missing data from the 63 participants. To represent the four non-participants' data, we coded their values of communication degree centrality, informational support outdegree centrality, team identification, and collective efficacy as missing, and therefore had 63 data points for each of those variables. We computed the non-participants' informational support indegree centrality from their participating teammates' responses and we had their tenure information, so we had 67 data points for each of those variables. Data were analysed in SPSS as well as SNA-specific software UCINET (Borgatti et al., 2002). While network data is generally deemed to be sufficiently rich for even a single-team study to possess satisfactory power (Kilduff & Tsai, 2007), we acknowledge that our four-team study may have inadequate power to conduct robust hypothesis testing and offer conclusive findings. We reiterate the explorative quality of this study and acknowledge its accompanying limitation.

Network data are inherently non-parametric and violate the assumptions of independent observations and random sampling from the population (Hanneman & Riddle, 2005). Subjecting network data to classical inferential tests is likely to inflate Type I errors.

To prevent this, we used permutation tests in all our correlation and regression analyses (Borgatti et al., 2018). Permutation tests[1] randomly shuffle the rows and columns of the dependent variable's matrix to create several correlations between the independent and dependent variable that are known to have no real associative value and compare these with the observed correlation (Borgatti et al., 2018). A *p*-value is computed by counting the percentage of those random correlations that are as large as the observed correlation, from a sample of 5000 to 10000 permutations. As the level of significance was set at $\alpha = .05$, a *p*-value of less than .05 indicates that the observed correlation is non-random and significant.

Pearson's correlation analyses with permutation tests were undertaken, using Hayes (1998) syntax procedure in SPSS, to explore the associations amongst athletes' communication degree centrality, informational support indegree centrality, informational support outdegree centrality, tenure, team identification, and collective efficacy. We checked for problematic collinearity ($r^2 > .80$) amongst the network variables (Kim, 2019). Given the likely possibility that athletes may turn to the same teammates for both sport-specific technical advice and problem-solving, we also used the collinearity checks to decide on combining the two networks into a single network representing informational support during training. This is in line with existing practices in SNA research and Borgatti and colleagues' (2018) suggestion that "we might take a number of network questions about coordinating at work, getting work advice from, and so on, and build an instrumental tie matrix" (p. 89).

To test our hypotheses, hierarchical regression analyses with permutation tests were conducted for each outcome variable, team identification and collective efficacy, where

[1] Essentially calculates all the ways [i.e., permutations] that the experiment could have come out given that [the variables] were actually independent of [each other], and counts the proportion of all assignments yielding a correlation as large as the one actually observed. So we cannot enumerate all possible permutations. Instead, we sample uniformly from the space of all permutations (Borgatti et al., 2018, p. 145-146).

predictor variables were added one step at a time beginning with the variable that had the highest absolute bivariate correlation with the outcome variables. All variables were added into the models as predictors, in descending order of their absolute correlations with the outcome (i.e., team identification or collective efficacy). We used the node-level regression function in UCINET to get the permutation *p*-values for our regression analyses as suggested by Borgatti et al. (2018): "run ordinary least squares as usual to obtain the regression coefficients, but then use the permutation technique to construct the *p* values" (p. 157).

Results

Mann Whitney U tests confirmed that there were no significant differences between the participants who answered the questionnaires in person and those who did so via email; they were similar in their tenure, team identification, collective efficacy, and degree centralities in the match communication and informational support networks.

Correlation Analyses

Bivariate Pearson's correlations with permutation tests were run amongst all variables. We found one case of severe collinearity; the correlation between information-seeking and problem-solving indegree centralities ($r = .90$, $r^2 = .81$, $p < .001$) suggested that the athletes who were highly sought for technical advice in the team were also highly sought for problem-solving. Thus, as we intimated earlier, these two networks likely measured the same relationship between teammates and could be combined into a single directed network representing informational support relations by multiplying their n x n matrices (Borgatti et al., 2018). Correlation analyses were conducted again; Table 1 illustrates the associations between athletes' match communication degree centrality, informational support in- and outdegree centrality, tenure, team identification, and collective efficacy [insert Table 1 here]. All further analyses involved only three relational variables – match communication degree

centrality, informational support indegree centrality, and informational support outdegree centrality.

As reported in Table 1, team identification was not associated with collective efficacy (r = .04, p = .74), suggesting initial non-support for H1. The mean team identification score across the sample was 6.3 (SD = .84, $Range$ = 4 - 7), on a scale of agreement from 1 to 7, which suggests that the athletes in our sample identified very strongly with their teams. Furthermore, we found partial support for H2. In line with our hypotheses (H2a), athletes' match communication degree centrality has a small, positive correlation with their team identification (r= .37, p < .01). However, in contrast to H2b, neither informational support indegree centrality (r = .09, p = .49) nor informational support outdegree centrality (r = -.01, p = .93) were significantly associated with team identification. H3a may not be supported as match communication degree centrality (r = -.11, p = .43) was not associated with collective efficacy. However, H3b may be partially supported as support outdegree centrality has a small, positive correlation (r = .31, p = .01) with collective efficacy but support indegree centrality has a borderline non-significant negative association (r = -.24, p = .06).

Regression Analyses

Team Identification

In summary, H1 was not supported as team identification was neither a significant predictor of collective efficacy by itself ($F_{(1,60)}$ = .12, p = .73, adj. R^2 = -1.5%) nor when it was added to the overall model predicting collective efficacy ($F_{(5,55)}$ = 4.43, p < .01, adj. R^2 = 22%, β = .02, p = .87). H2a was supported as communication degree centrality was a significant positive contributor in all the models predicting team identification. H2b was unsupported as informational support indegree centrality had a significant negative association, and informational support outdegree centrality had no association, with team identification. Overall, these findings meant that communicating with more teammates during

matches was associated with stronger team identification, though stronger identification was not related to athletes' collective efficacy.

As the variable with the largest absolute bivariate correlation with team identification, communication degree centrality was added first into the models predicting team identification, then informational support indegree centrality, followed by support outdegree centrality, and tenure was added last as shown in Table 2 [insert Table 2 here]. Multicollinearity was checked using Kim's (2019) recommendations and all models passed the checks. In Model 1, communication degree centrality was a significant, positive contributor (β= .35, p < .01) to team identification ($F_{(1,59)}$ = 8.12, p < .01, adj. R^2= 10.6%), and this was also found in Models 2 to 4. Though all four models were statistically significant, Models 3 and 4 did not meaningfully add to the prediction of team identification as the change in adjusted R^2 was -0.6% and the F-change from Model 2 to 3 was non-significant ($F_{(1,57)}$ = .57, p = .45), as was that from Model 3 to 4 ($F_{(1,56)}$ = .98, p = .33).

When added in Model 2, informational support indegree centrality was a significant, negative contributor (β= -.42, p = .02) to team identification ($F_{(2,58)}$= 7.28, p < .01). This result was not anticipated as informational support indegree centrality was uncorrelated with team identification, as reported previously. On one hand, this result may be due to the low power of our study and was not a true effect. On the other hand, this result may reflect a true effect in the form of classical suppression as the behaviour of support indegree centrality meets the initial, descriptive criteria: support indegree has a moderate, positive zero-order correlation with match communication (r = .74, p < .001) which is a significant predictor of team identification; but, no significant correlation with team identification (r = .09, p = .49); and, a significant negative regression weight (β = -.42, p = .02) when added to the model after communication (Pandey & Elliott, 2010). If support indegree centrality was a true suppressor, it would improve the predictive validity and utility of the overall model by

suppressing the variation in communication degree centrality that was irrelevant to team identification (Ludlow & Klein, 2014). However, no further analyses were undertaken as they were outside the scope of our exploratory study.

Informational support outdegree centrality was included in Model 3 and was unassociated with team identification ($F_{(3,57)}$= 5.00, p < .01, β = -.09, p = .46). Taken together, these results support H2a, but not H1 or H2b. In summary, increasing the number of teammates one communicates with during matches is likely to strengthen one's identification with the team.

Collective Efficacy

H3a was not supported as match communication degree centrality was unrelated to collective efficacy. However, H3b was partially supported as higher informational support outdegree centrality positively contributed to collective efficacy, but not informational support indegree centrality which was negatively associated. This meant that seeking informational support from more teammates would likely increase athletes' collective efficacy, while communicating with more teammates during matches would have no effect and being sought for support by many teammates may compromise one's collective efficacy.

As the variable with the largest absolute bivariate correlation with collective efficacy, tenure was added first into the model predicting collective efficacy, then informational support outdegree centrality, followed by support indegree centrality, communication degree centrality, and team identification was added last as shown in Table 3 [insert Table 3 here]. No problematic multicollinearity was found. Informational support outdegree centrality, a significant positive contributor (β = .30, p = .02), accounted for 7.5% of the variance in collective efficacy when it was included in Model 2 ($F_{(2, 58)}$= 6.97, p < .01, adj. R^2= 16.6%). Informational support indegree centrality, included in Model 3, was significantly and negatively associated with collective efficacy ($F_{(3, 57)}$= 6.99, p < .01, adj. R^2= 23%, β = - .30,

p = .02). We treat the latter result with more caution because while support indegree centrality and collective efficacy shared a small, negative correlation (r = -.24) as previously reported, the p-value of this association is borderline non-significant at .06 which may or may not be a Type 2 error resulting from an underpowered study. On balance then, H3b was only partially supported as only informational support outdegree centrality was positively associated with collective efficacy.

Match communication degree centrality, which was added in Model 4 ($F_{(4,56)}$= 5.63, p < .01, adj. R^2= 23.6%) , was unassociated with collective efficacy (β = .20, p =.42) and therefore H3a was not supported. Though all five models were statistically significant, Models 4 and 5 did not meaningfully add to the prediction of collective efficacy as the change in adjusted R^2 from Model 3 to 4 was only 0.6% and the F-change was non-significant ($F_{(1,56)}$ = 1.40, p = .24) while that from Model 4 to 5 was, respectively, -1.6% and non-significant too ($F_{(1,55)}$ = .03, p = .86). As a final observation, we noted that tenure was negatively associated to collective efficacy though the statistical significance of this relationship was not consistently found across all models, as seen in Table 3 ($\beta \leq$ -.23, $p \leq$ .06). Taken together, these results did not support H3a but partially supported H3b; seeking informational support from more teammates contributed to higher collective efficacy.

Discussion

To the best of our knowledge, no previous study has explored team identification and collective efficacy in elite team sport by directly quantifying and examining the intra-team relationships of match communication and informational support between teammates. Unlike previous researchers, we found no relationship between team identification and collective efficacy (H1) in our sample. Extensive research in diverse settings suggests that shared social identity undergirds collective efficacy (e.g., Clare et al, 2008; Fransen et al., 2014; Van Zomeren et al., 2012). Our results depart from these findings, likely due to limitations in our

study rather than the true lack of association between team identification and collective efficacy. The high frequency of responses at the upper limit of the scale suggests very strong identification amongst the athletes, which is not uncommon in established, high-performing sports teams (Barker et al., 2014; Slater & Barker, 2019). Perhaps, a multi-item and -scale questionnaire such as the Social Identity Questionnaire in Sport (see Bruner & Benson, 2018) would have provided more spread in the data and mitigated the risk of ceiling effects, thus being a more appropriate choice to study elite teams.

Regarding intra-team relationships, we found that athletes with more match communication relationships reported stronger team identification (H2a) but not those with more informational support relationships (H2b). While communication relationships were unrelated to collective efficacy (H3a), those who sought support from more teammates experienced more collective efficacy whereas those who were a popular choice for support-seeking may experience less collective efficacy (H3b). Although our cross-sectional design limits conclusions on the causality of effects, we can consider athletes' communication degree centrality and informational support outdegree centrality to be predictors of their team identification and collective efficacy, respectively, by virtue of temporal precedence as athletes' relationships with their teammates were established *before* their participation in this study and the collection of their responses to team identification and collective efficacy questions (Graupensperger et al, 2019; Rodrigues et al., 2019). That said, future longitudinal and experimental research is encouraged to clarify these initial findings as well as investigate the impact of team identification and collective efficacy on teammate relationships.

Match Communication Relationships

As directly corroborative evidence supporting the relationship between reciprocal communication ties and team identification was not available, we substantiate our findings with the theoretical implications that have arisen from network-based studies of related

constructs. As discussed previously, McLaren and Spink (2019) measured athletes' on-field communication using sociometric techniques similar to those in our study and found that the athletes who communicated with a large proportion of their teammates reported higher task cohesion than those who communicated with a smaller proportion. Also using SNA, Loughead and colleagues (2016) explored athlete leadership and cohesion. They found that motivational leadership was the strongest predictor, amongst all leadership dimensions, of task cohesion and that task leadership was a significant predictor in half of the 24 teams sampled. Both motivational and task leadership roles are considered on-field roles where athletes are responsible for tactical decision-making and managing the energies of their team during matches; on-field match communication is an essential means to fulfil these responsibilities. Therefore, a theoretical argument can be made that the athletes in our study, who were highly central in their match communication networks, also had high task and/or motivational leadership and likely shared interactions with their teammates that were characterised by strong team identification which contributed to high task cohesion. Identification with the team has been found to fully mediate the athlete leadership-task cohesion relationship (Worley et al., 2020). Following this line of argument, our findings are consistent with the existing literature on how athletes' match communication relationships contribute to team functioning; establishing reciprocal communication between more pairs of teammates will strengthen athletes' identification with their teams, a precursor to team performance (Thomas et al., 2019).

To translate this implication into practice, coaches and practitioners can, first, discern which athletes identify less with the team: newcomers to an established team; culturally diverse or minority athletes; or, players returning after a long hiatus may be particularly susceptible to weaker team identification. Thereafter, coaches can set training tasks that involve communication exchange between those particular athletes and teammates who are

more central in the match communication network or whom they share unidirectional communication ties with. To illustrate, we refer you to Figure 2, a network map of non-reciprocal communication ties within a football team in our sample [insert Figure 2 here]. Athletes 3, 7, 8, 10, and 14 have no reciprocal ties with any of their teammates and identify less with their team than the sample mean (i.e., 5.6 ± .55 vs 6.3 ± .84). That said, they share some unidirectional ties with each other and with a highly central teammate, Athlete 9. Perhaps, creating a training group that involves the six of them in small-sided games or partnering them strategically for drills (for e.g., Athletes 3 and 7; 8 and 10; 9 and 14) may encourage the existing unidirectional communication ties to become reciprocal in time. The frequency of these exchanges during training may increase the likelihood of these exchanges taking place during matches and reciprocal communication ties developing, which may increase identification with the team.

Such efforts are also likely to have knock-on effects on team coordination and cohesion (Araújo & Davids, 2016). Additionally, task-oriented activities during training sessions may be perceived as low-threat social situations to strengthen identification compared to other off-field team activities, and may present less barriers to players who do not identify much with their teams yet. Therefore, interventions informed by SNA enable a targeted approach to optimising match communication between particular pairs of teammates to address specific needs. In contrast, an unsystematic or uniform, overall increase in match communication between all teammates may result in arbitrary patterns that are tactically unhelpful or unsustainable.

Training Informational Support Relations

As hypothesised, athletes with more outgoing, informational support-seeking ties reported higher collective efficacy. This result corroborates previous findings where athletes' perceptions of informational support predicted their self-confidence as well as buffered them

against stress (Freeman & Rees, 2010). Though they are different constructs, self-confidence and collective efficacy share similar sources such as performance accomplishments and vicarious experiences (Bandura, 1997). Theoretically then, it can be argued that athletes with more support-seeking ties perceive several of their teammates to be knowledgeable, accomplished, or experienced, and they derive a bolstered sense of collective efficacy from playing alongside these teammates as well as perceiving them as an available source of informational support.

Additionally, our results revealed the presence of similar group norms across the diverse teams sampled. Firstly, tenure was positively correlated with indegree centrality in the informational support network as, expectedly, the more experienced athletes were approached by many others for support. Secondly, tenure was not correlated with support-seeking, so more seasoned athletes sought support from as many teammates as their less experienced peers. Lastly, the athletes who engaged in greater outreach for support (i.e., high outdegree centrality) were also perceived to provide support to more teammates (i.e., high indegree centrality). Support begets support; these group norms can reduce perceptions of identity-based threat (e.g., "I cannot ask you for help because we are elite, expert hockey players") and increase athletes' willingness to engage in support-seeking behaviour (Butler et al., 2018). These norms may also inspire psychological safety, which creates a conducive team environment for support-seeking and has been found to underpin high-performance in teams and contribute to outcomes of collective efficacy such as teamwork and resilience (Fransen, McEwan et al., 2020).

Given the positive implications of seeking informational support from many teammates, coaches and practitioners can curate the training environment with activities that increase opportunities for athletes to seek informational support from numerous teammates. For instance, Thinking Thursdays were weekly training sessions where Danny Kerry, the

coach, would split the Great Britain Women's Hockey Team into three groups and set them challenges to overcome, often changing the rules mid-way (Slot, 2018). These sessions created a high-pressure yet facilitative learning environment to seek and provide informational support to one another to achieve their groups' objectives. During the last 15 minutes of the 2016 Olympic final, one team member said, "it's Thinking Thursday. We've been here before, we're back at Bisham, except this time we're all in the same team. Find a way to win" (Slot, 2018, p. 118); they emerged victorious. Increasing intra-team informational support relationships through training activities enhances team coordination and productivity as team members gain enhanced role clarity, evolve shared mental models, and develop collective confidence (Filho et al., 2015).

Our finding that athletes with more outgoing support ties did not report stronger team identification is consistent with the theoretical underpinnings of the social identity approach in sport, though counter to our hypothesis. Crucially, via SNA, we acquired direct insight into athletes' support-related preferences. Despite being on the same team, athletes have differing preferences for which teammates they would like to seek support from and whom they would not, and other, non-team shared identities drive these support-related preferences (Hartley et al., 2020); it seems that simply being a teammate is an insufficient condition for participation in a support relationship. These support-related preferences potentially explain why the team identification scores of our sample were not related to informational support relations. Self-categorisation is context-sensitive and an "identity must be psychologically *salient* in order for it to be harnessed as a useful resource" (Hartley et al., 2020, p. 258). This may explain why Nicholson and colleagues (2011) found that elite indigenous Australian Football League players perceived their fellow indigenous teammates to be their key sources of support within the team and pivotal to their sporting success. The authors concluded that indigenous athletes may "require more culturally relevant and specialised support structures" (p. 131) than their

non-indigenous counterparts, though the latter were never interviewed and may have similar needs. Given the international mobility of elite athletes and the resulting diverse composition of teams, coaches and practitioners are encouraged to consider the support-related preferences of athletes in line with other salient, non-team identities they share with *some* of their teammates, to increase the likelihood that all athletes perceive options for informational support amongst their teammates. Social identity mapping can be used to investigate athletes' group memberships, to surface other identities that a subset of their teammates may share and derive support from (Cruwys et al., 2016).

Finally, we consider training support indegree centrality and its lack of association with team identification. Given the previously mentioned ambiguousness of the role of incoming support ties in the regression models, we interpret here just the bivariate correlation between informational support indegree centrality and team identification. We might interpret the lack of association between them as the net effect of zero correlation: when the effect of some athletes with several incoming support ties identifying strongly with their teams was cancelled out by that of other athletes with several incoming support ties identifying less strongly (Ludlow & Klein, 2014). Having high indegree centrality in the informational support network implies leadership (Fransen, Van Puyenbroeck et al., 2015) and athlete leaders, often, identify strongly with their teams (Fransen, Haslam et al. 2020; Fransen et al. 2016). Counterintuitively, athletes highly involved in providing support to their teammates may experience low identification with their teams by virtue of realising how many teammates need help. For elite athletes, this realisation may destabilise their internalised group norms of proficiency (i.e., "my teammates are not as proficient as I thought they were") and they may cognitively disassociate with their team (i.e., reduced identification) to protect their own sense of expertise (Haslam et al., 2018). This interpretation is supported by our finding that athletes with more incoming support ties reported less collective efficacy.

Additionally, these central members may feel under-appreciated for the support they provide to others, which may undermine their shared sense of identity. For example, Soltis and colleagues (2013) reported that support ties in the workplace increased turnover intentions in central members because they promoted feelings of being under-rewarded. As leaders, these central members may also experience role overload where they cannot cope with the demands of supporting others (Charlesworth, 2001). For example, in one of the teams sampled, the captain received ~23% of the total number of incoming support ties in the network. Therefore, it is possible that higher identification scores attributable to being central members with large support indegree centralities were offset by lower identification scores due to some members becoming disillusioned, feeling under-appreciated, or being overwhelmed with the many incoming ties of support; this might explain the net effect of zero correlation between informational support indegree centrality and team identification.

Limitations and Future Research

Though significant findings were observed in some analyses, caution is advised when generalising from our study given the small sample size and low power. Relatedly, we did not pursue further statistical analyses to investigate suppression effects though our results suggested that the initial conditions for them may exist. Also, the cross-sectional nature of our study is a limitation. As social structure is context-dependent, it may be more prudent to take guidance from our methodology. Additionally, the current limitations in UCINET's regression functions prevented the unique variances of the predictor variables (i.e., the centrality measures of the communication and support networks) in the models to be known. Real-world intervention studies that use SNA to track changes in intra-team relational networks over time could enable practitioners to build teams more effectively.

Conclusion

In conclusion, we examined the impact of match communication ties and informational support ties during training on team identification and collective efficacy. Though only two of our five hypotheses were supported, this exploratory inquiry adds value by employing SNA to study intra-team relationships in elite teams and examining their associations with important determinants of team functioning. We found that athletes with more match communication ties and more outgoing informational support ties experienced stronger team identification and collective efficacy, respectively. Our study contributed to the understanding of intra-team informational support relationships and shed light on the non-trivial role of athlete preferences. Looking beyond elite teams' objectives of optimising team functioning, it is imperative to improve productive relational patterns and reduce unproductive ones because a team's success can positively impact the health, social connectedness, and subjective well-being of all who identify with it (Neville et al., 2019). Appreciating the impact that identifying with a sports team can have on our lives can embolden the future study of intra-team relationships and team functioning, and perhaps validate the relevance of ours.

Declaration of Interest

We have no conflicts of interest to disclose.

Data Availability Statement

The data that support the findings of this study are available from the corresponding author, EJS, upon reasonable request.

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