

Social Network Analysis as a Complimentary Tool to Measuring Team Cohesion

Arden J. Anderson
Texas A&M University

and

Stacy Warner
East Carolina University

In addition to the Group Environment Questionnaire (GEQ), Social Networking Analysis (SNA) has emerged as a promising approach to measuring team cohesion. However, little to no research has simultaneously used both measures to compare and contrast their unique benefits. Using a multilevel theoretical approach, this study examined the relationship between SNA (friendship and efficacy) and the GEQ, and their relationships with team performance, over a playing season for four volleyball teams (N = 49). Findings indicated that the GEQ and SNA are likely measuring different constructs. While the GEQ was a better global measure of team cohesion, SNA was able to offer a multilevel perspective and unique insight into the evolution of the teams over the season. The SNA networks revealed that the team with fewer friendship connections was more successful in terms of team performance. The results further position SNA and the GEQ as important, yet unique, tools for understanding the functioning, or lack thereof, of teams. Practical applications, theoretical implications, and recommendations for future research are provided.

Address correspondence to: Stacy Warner, East Carolina University, Department of Kinesiology, 173 Minges Coliseum; MS 559, Greenville, NC 27858,
Email: stacywarner@gmail.com, Phone: 252-328-0095

Throughout history, people have joined together in groups to accomplish an array of goals. In order to understand the factors that facilitate group success, it is important to investigate the development and maintenance of a group, or the cohesion process. Carron (1982) defined cohesion as “a dynamic process which is reflected in the tendency for a group to stick together and remain united in the pursuit of its goals and objectives.” Team cohesion is particularly important in sport, because it enables athletes and the team as a whole to reach peak performance and fosters athlete satisfaction and overall well-being.

Consequently, a variety of fields including psychology, kinesiology, and sport studies have investigated the antecedents and consequences of cohesion using various measures. In particular, the sport psychology field has seen slight variations in the operationalization and measurement of cohesion. Of the few measures developed to assess cohesion, the Group Environment Questionnaire (GEQ) has been recognized as the prominent cohesion instrument (Carron, Widmeyer, & Brawley, 1985; Leeson & Fletcher, 2005). The GEQ consists of 18 items and utilizes a 9-point Likert-type scale.

In addition to the GEQ, social network analysis (SNA) has recently emerged as a promising research approach for measuring team cohesion (Fleming, Grace, Baker, & Sculthorpe, 2014; Lupu, 2013; Lusher, Robbins, & Kremer, 2010; Warner, Bowers, & Dixon, 2012). It has been used in a variety of disciplines and is based upon the field of measurement called sociometry, which provides a means for illustrating the interpersonal structure of groups using sociograms (Quatman & Chelladurai, 2008). Sociograms represent individuals within a network as points and the relationship between two individuals as a line, or tie, connecting the points to one another creating a web-like graphical output (Quatman & Chelladurai, 2008). Network cohesion deals with whether an individual is connected to people who are in turn tied to many others, constituting a highly interconnected or cohesive social network (Ho, Rousseau, & Levesque, 2006).

SNA sociograms have the capacity to examine network structures (teams, organizations, etc.) in combination with individual attributes (age, playing experience, team position, etc.) making it well suited for investigating the complex relations that exist within sport teams (Lusher et al., 2010). In addition, SNA has been utilized in studies of coaching burn-out and deviance, managerial recruitment, and even racial stacking in sport (Nixon, 1993). While the cohesion-performance relationship research has been dominated by the GEQ, a recent study conducted by Warner, Bowers, and Dixon (2012) used SNA as a tool to investigate the cohesion and performance of two Division-I women’s basketball teams. The more successful team showed steady increases and highest levels reported on the efficacy and trust networks, while the less successful team reported the highest levels on the friendship and advice networks. Overall, the efficacy and trust networks were more task-oriented and seemed

to improve performance, whereas friendship and advice were more social in nature and did not improve performance.

It is important to acknowledge that SNA is not a replacement to existing instruments (such as the GEQ), but as an addition or complementary way to consider cohesion. "While the laudable contributions from Carron and colleagues' (1985) Group Environment Questionnaire continue to provide a useful measurement for team cohesion, the field must continue to advance through the introduction of complementary tools such as those available within an SNA perspective" (Warner et al., 2012, p. 64). Warner and colleagues further suggested that research would "benefit from synthesizing the relative contributions of the GEQ and SNA" (p. 64).

Although, Eys & Burke (2008) utilized the GEQ and a sociogram to examine the relationship between perceptions of cohesion and the percentage of social contacts that exercisers knew and interacted with in a group exercise setting, these measures (i.e., GEQ and SNA) have not yet been used simultaneously in an investigation of team cohesion in sport to the knowledge of the researchers. By answering the call from Warner and colleagues (2012), it is expected that the results of this study will help further shed light on the use, and possible unique benefits, of the GEQ and/or SNA as a diagnostic tool for coaches to better understand team cohesiveness and its relationship to team performance. Therefore, the current study utilized both the GEQ and SNA to assess the cohesion of collegiate volleyball teams in order to explore the use of SNA as a complementary tool in cohesion research and compare it to the more widely used and accepted, GEQ.

In addition, understanding the relationship between cohesion and performance also could benefit coaches in pursuit of peak performance. The extant literature seemed to be in disagreement as to whether or not higher levels of cohesion would result in better team performance (Mullen & Copper, 1994; Widmeyer & Williams, 1991). Yet, simply establishing a relationship, either positive or negative, between cohesion and team performance, does little to aid coaches in creating the best possible athletic environment. Thus, utilizing a longitudinal design (i.e., three time points during the season) will not only provide insight into the evolution of social networks and team cohesion over the course of a season, but could also aid in establishing directionality between cohesion and team performance.

Thus, the purpose of the current study is two-fold. First, the current study intends to determine areas of agreement and disagreement between the GEQ and SNA regarding the measurement of team cohesion and temporal patterns in cohesion across the three time points. Second, this study intends to determine the relationships among cohesion, using the GEQ and SNA, and team performance over the course of a season. The guiding research questions were:

RQ1: Is there agreement between the GEQ and SNA at each time point and in longitudinal patterns?

RQ2: Is the GEQ or SNA a better predictor of team performance?

Based upon theory and previous literature, the researchers hypothesized that there would be agreement between the GEQ and SNA at each time point and across time (H1) and that SNA would act as a better predictor of team performance (H2).

Methods

Participants

Participants included members of four NCAA Division-I women's volleyball teams from the Southeastern U.S. who gave their informed consent and completed measures at all three time points ($N = 49$). The teams competed in comparable athletic conferences. Participants received an email regarding the study and making them aware that participation was voluntary and had been approved by the University Institutional Review Board. All team members were invited to participate including the players and coaches. It was integral to the social network analysis that all members of the teams participated in the study in order to gain a complete depiction of the team as a network. Furthermore, the decision to include coaches and support staff in the networking analysis was based on the idea that the functioning of a team depends on the synthesis of all parts, not just the players.

Team A ($n = 9$) consisted of eight players and one female head coach. Team B ($n = 9$) consisted of eight players and one male head coach. Team C ($n = 15$) consisted of 14 players and one female assistant coach. Team D ($n = 16$) consisted of 13 players, one male head coach, and two female assistant coaches. Using roster information, each participant was labeled based on their position (HC = head coach; OH = outside hitter; MH = middle hitter; RS = right side hitter; DS = defensive specialist; S = setter). Based upon the end of season statistics, players were given a color based on their playing status (green = starters; red = reserves); those who started a majority of the games were classified as starters.

Cohesion Measures

Group Environment Questionnaire (GEQ). The GEQ was used to measure team cohesiveness. The GEQ, developed by Carron et al. (1985), is an 18-item self-report questionnaire that assesses cohesion by way of perceptions of four factors: Individual Attractions to the Group-Task (ATG-T), 4 items (e.g., "I do not like the style of play on this team."); Individual Attractions to the Group-Social (ATG-S), 5 items (e.g., "Some of my best friends are on this team."); Group Integration-Task (GI-T), 5 items (e.g., "Our team is united in

trying to reach its goals for performance.”); Group Integration-Social (GI-S), 4 items (e.g., “Members of our team do not stick together outside of practice and games.”). Athletes are required to respond to the items about their team using a 9-point Likert-type scale, with responses ranging from 1 (strongly disagree) to 9 (strongly agree). Thus, higher scores reveal stronger perceptions of cohesiveness among team members with the exception of reverse-scored items. Cronbach’s alpha values range between .65 and .85 in most studies using the GEQ (Carron, Widmeyer, & Brawley, 1988), which suggests that it is an internally consistent instrument. Research has shown that the GEQ exhibits content, factorial (Carron et al., 1985), predictive (Carron et al., 1988), and concurrent (Brawley, Carron, & Widmeyer, 1988) validity.

Social Network Analysis. The researcher developed an online roster-based survey in which the participants indicated which team members (players and coaches) fit a given criteria by simply placing a check next to their name. The criteria employed to generate the two networks (i.e., friendship and efficacy) included: I consider this person a close friend; I feel confident about this person’s sport-related knowledge and/or ability. Thus, each question had the same number of opportunities to answer as members on their given team roster. Similar to the distinction between social and task cohesion provided by the GEQ, the friendship network captures relationships that are social in nature, while the efficacy network is task-oriented. Although friendship and cohesion are two separate constructs, both focus on interpersonal affinity among group members. Past studies suggest that friendship (often operationalized as cohesion) in work groups may have such benefits as information sharing, productive conflict, and increased motivation (Jehn & Shah, 1997). Furthermore, both cohesion and efficacy have been positively linked to performance success and persistence, which suggests that common ground relating these two concepts exists (Spink, 1990). Participant responses to the SNA networks were then formatted as square adjacency matrices comprised of the collective responses of each individual regarding his or her teammates or players for each separate network. That is, an $n \times n$ table (where n is the number of team members), with the rows indicating outgoing ties to other team members and the columns reflect the incoming ties to each team member for that specific network. These matrices were then converted into network maps or visualizations using NetDraw software. In regard to the network maps, starters versus reserves were determined based on the end of the season game statistics; those who started a majority of the games were classified as starters.

Team Performance

In terms of team performance, the most prominent global measure that is impacted by all members of a team is win-loss record. Therefore, during the season in which the teams

were surveyed, the teams' performance was measured via winning percentage. At each time point, the teams' win-loss record was verified and the team's winning percentage was calculated.

Procedure

Initially, 8 Division I Women's volleyball coaches from teams were contacted to determine their interest and request their participation; 50% of contacted teams agreed to participate in the study. Participants were assured that their responses would remain confidential.

Upon consent, all members of each team were emailed a link to a short online survey at three critical points during the calendar year. These points in time included preseason (at the completion of nonconference play and prior to the completion of two regular season games), midseason (at the completion of approximately half of the regular season games), and postseason (at the completion of all regular season games and prior to any postseason play). A longitudinal research design was employed as team cohesion and performance are considered to change across time (Paskevich, Estabrooks, Brawley, & Carron, 2001). In fact, previous research has found that group cohesion changes during the sport season (Heuze, Sarrazin, Masiero, Raimbault, & Thomas, 2006; Leo, Sanchez-Miguel, Sanchez-Olivia, Amado, & Garcia-Calvo, 2012). Thus, utilizing a longitudinal design (i.e., three time points during the volleyball season) will not only provide insight into the evolution of team dynamics over the course of a season, but will also aid in establishing directionality between cohesion and performance.

Data Analysis

After the data were collected at each time point ($N = 49$ completed all three time points), SNA software (Borgatti, Everett, & Freeman, 1999) was used to generate a cohesion measure for each individual and team as a whole for the friendship and efficacy networks. Individual responses were combined to arrive at complete network for each team (i.e., each team had both friendship and efficacy network maps completed at each point in time). Within the software, the density calculation was used to measure structural cohesion. This measure identifies the proportion of the number of connections that exist between actors in relation to the number of the maximum possible connections in the network. Network cohesion can range from 0 to 1 and the larger the measure, the more cohesive an individual's network. For instance, if all members of a team were unconnected, the cohesion measure of density would be zero; yet, if all members were connected to one another, the cohesion measure of density would be one.

Since SNA utilized a ratio measurement and team performance was measured via winning percentage, these two measures represent nonparametric data due to the limited range

of values. Therefore, the researcher utilized Spearman's rho (r_s) when analyzing correlations that involved these variables. Only those who completed the survey at all three time points were included in the analyses. A significance level of $p < .05$ was adopted for the study.

Measurement of Cohesiveness. In order to assess whether the GEQ and SNA are related (RQ1), correlations between the total cohesion measures generated by the GEQ and SNA were employed to assess the degree to which these measures agreed over the three time points. That is, correlations were conducted between the total GEQ and total SNA cohesion scores at each time point – preseason, midseason, and postseason. Based upon the 9-point scale employed by the GEQ for each of the four GEQ subscales, the total GEQ score had a possible range from 4 to 36. In regard to SNA, the density measure ranged from 0 to 1 for both the efficacy and friendship networks. In order to generate a total score, the density measures from the two networks were averaged. Thus, the total SNA score still had a possible range from 0 to 1. These correlations between the GEQ and SNA totals were conducted across all participants and between each team.

Temporal Patterns. Due to the longitudinal measurement of cohesion using the GEQ and SNA at three time points, a series of 3 X 4 repeated-measures ANOVAs were employed for (1) the GEQ total score, (2) SNA total score, and (3) SNA networks across all participants and between each team.

Team Performance. Due to the small sample size of four teams, a correlational relationship between cohesion and team performance could not be assessed within statistical reason. Thus, visual inspections of the GEQ and SNA total scores, SNA network maps, and team winning percentages were conducted in order to examine the relationship between cohesion and team performance. By cross-referencing the graphical output of the SNA network maps with both the generated indices of team cohesion and the team's winning percentage, conclusions regarding cohesion and team performance were drawn.

Results

Cohesion Measures – GEQ vs. SNA

Measurement of Cohesiveness. The first purpose was aimed at better understanding the agreement, or lack thereof, between the GEQ and SNA total cohesion scores at each time point (RQ1). At preseason, there was a small, significant correlation between the GEQ and SNA ($r_s = .351, p = .014$) (see Table 1). In addition, there was a moderate, significant relationship between the GEQ and SNA at midseason ($r_s = .506, p < .001$) and postseason ($r_s = .482, p < .001$). Furthermore, Spearman's correlations indicated a strong, significant relationship between the GEQ and SNA at pre- ($r_s = .711, p = .032$) and post-season ($r_s = .681, p = .043$) for Team A, whereas Team C demonstrated a moderately significant relationship

between the GEQ and SNA at midseason ($r_s = .575, p = .025$) (see Table 2). Although there was weak to moderate agreement between the GEQ and SNA at each of the three time points and for certain teams, the cohesion measures did not strongly align. Since these relationships were only small to moderately strong, the data indicated that the GEQ and SNA are measuring different, although related, constructs.

Table 1
Correlations Between the GEQ and SNA at Pre-, Mid-, and Post-season

	GEQ		SNA		Correlation	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	r_s	<i>p</i>
Preseason	29.362	4.719	.529	.218	.354	.014*
Midseason	26.664	4.726	.553	.221	.506	< .001**
Postseason	25.902	4.829	.605	.206	.482	< .001**

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

Table 2
Correlations Between the GEQ and SNA at Pre-, Mid-, and Post-season for Each Team

Team	Time	GEQ		SNA		Correlation	
		<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	r_s	<i>p</i>
A (n = 9)	Preseason	26.717	4.389	.432	.157	.711	.032*
	Midseason	24.944	4.812	.494	.225	.622	.074
	Postseason	21.794	5.448	.494	.168	.681	.043*
B (n = 9)	Preseason	31.144	3.723	.716	.109	.405	.279
	Midseason	28.800	3.971	.667	.219	.151	.698
	Postseason	28.417	4.133	.728	.146	.271	.480
C (n = 15)	Preseason	28.607	5.054	.536	.283	.229	.412
	Midseason	26.580	5.284	.555	.263	.575	.025*
	Postseason	26.843	3.967	.636	.265	.449	.093
D (n = 16)	Preseason	30.556	4.643	.473	.165	.435	.093
	Midseason	26.509	4.484	.522	.170	.482	.059
	Postseason	25.916	4.495	.569	.159	.278	.298

Note. * $p < .05$

Temporal Patterns. As shown in Table 3, a series of repeated-measures ANOVAs were used to examine whether cohesion changed over the course of the season in an effort to better understand the agreement in longitudinal patterns between the GEQ and SNA total cohesion scores and SNA networks.

A repeated-measures ANOVA revealed a significant main effect of time for the GEQ total cohesion scores, $F(2, 90) = 23.347, p < .001, \eta^2 = .342$. Pairwise comparisons revealed a significant decrease in cohesion as measured by the GEQ from preseason ($M = 29.362, SD = 4.719$) to midseason ($M = 26.664, SD = 4.726$) and to postseason ($M = 25.902, SD = 4.829$). However, there was not a significant decrease in cohesion from midseason to postseason. In addition, a repeated-measures ANOVA revealed a significant main effect of time for the SNA total density scores, $F(2, 96) = 5.580, p = .005, \eta^2 = .104$. Pairwise comparisons discovered a significant increase in cohesion from preseason ($M = .529, SD = .218$) to postseason ($M = .605, SD = .206$), $p < .05$, and midseason ($M = .553, SD = .221$) to postseason, $p < .05$. Thus, GEQ total scores decreased over time, whereas SNA total scores increased over the season.

A repeated-measures ANOVA indicated a significant main effect of time for only the SNA friendship network, $F(2, 90) = 7.967, p = .001, \eta^2 = .150$. Pairwise comparisons revealed a significant increase in friendship across all participants from preseason to postseason ($M = .105, SE = .033, p = .007$) and midseason to postseason ($M = .071, SE = .025, p = .024$). (Note: M here is the mean difference score.) However, there was not a significant main effect of time for the SNA efficacy network. Thus, the friendship network significantly increased over the course of the season, while the efficacy network did not significantly change across all four teams.

In conclusion, these findings demonstrate inconsistency between the GEQ and SNA/friendship network over a competition season as one decreased and the other increased. This pattern (i.e., GEQ decrease and SNA/friendship network increase over time) was consistent for each of the four teams. Therefore, there is a clear disagreement in the longitudinal patterns of cohesion between the GEQ and SNA total scores across all participants and teams.

Team Performance

Next, this research sought to assess if the GEQ or SNA were better predictors of team performance (RQ2). As seen in Table 4, the winning percentages for the four teams tended to decrease over the course of the season. A visual inspection of the data revealed a pattern between the GEQ total scores and winning percentages as both measures declined over the course of the season. Thus, the current sample of four teams demonstrated a positive relationship between cohesion, as measured by the GEQ, and team performance.

Table 3

Main Effect of Time Between the GEQ and SNA

	<i>F</i> (2,90)	<i>p</i>	η^2	Preseason		Midseason		Postseason	
				<i>M</i>	<i>SE</i>	<i>M</i>	<i>SE</i>	<i>M</i>	<i>SE</i>
GEQ	23.347	< .001	.342	29.256	.679	26.708	.700	25.743	.662
SNA	5.580	.005	.104	.529	.031	.553	.032	.605	.029

Table 4

Team Cohesion and Team Performance at Pre-, Mid-, and Post-season

Team	Time	GEQ		SNA		Performance
		<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	%
A (<i>n</i> = 9)	Preseason	26.717	4.389	.432	.157	85.71
	Midseason	24.944	4.812	.494	.225	69.57
	Postseason	21.794	5.448	.494	.168	56.25
B (<i>n</i> = 9)	Preseason	31.144	3.723	.716	.109	33.33
	Midseason	28.800	3.971	.667	.219	15.79
	Postseason	28.417	4.133	.728	.146	16.67
C (<i>n</i> = 15)	Preseason	28.607	5.054	.536	.283	100.0
	Midseason	26.580	5.284	.555	.263	55.0
	Postseason	26.843	3.967	.636	.265	48.39
D (<i>n</i> = 16)	Preseason	30.556	4.643	.473	.165	33.33
	Midseason	26.509	4.484	.522	.170	40.74
	Postseason	25.916	4.495	.569	.159	37.14

Specifically, Team A had the highest winning percentage at the end of the season and Team B had the lowest winning percentage. Since these two teams (i.e., Team A and Team B) represented the most and least successful teams, the researcher chose to conduct visual inspections of the networks for only these two teams due to journal space limitations. In order to assess the change in these networks over the season, the friendship and efficacy network maps at pre- and post-season for Team A and B are provided (see Figures 1, 2, 3, and 4).

Although both Teams A and B consisted of the same number of network members, each having 9 members, there is an evident and visual discrepancy in the density, or number of connections, reported at pre- and post-season (see Figures 1, 2, 3, and 4). Across the SNA networks (i.e., including both friendship and efficacy combined), Team A, the most successful team, started the season with a 0.432 density measure and ended the season at 0.494, while Team B, the least successful team, started at 0.716 and ended at 0.728. Thus, SNA indicated that Team B was more cohesive at the beginning and end of season compared to the other three teams. While the GEQ total score also demonstrated that Team B was the more cohesive team, SNA is able to generate an assessment of the team that is defined by individual relationships rather than an overall perception of the environment.

A visual inspection and comparison of Figures 1 and 3 reveal that Team A, the better performing yet less cohesive team, reported far fewer friendships between fellow teammates compared to Team B, the less successful team. Thus, the team with fewer friendship connections was more successful in terms of team performance. As depicted in Team A's friendship network maps at pre- and post-season (see Figure 1), the head coach is completely removed from the preseason network and only connected by one tie at postseason. Considering this team (i.e., Team A) had the highest winning percentage at the end of the season, it seems that the lack of social connection between the head coach and the players could have positively influenced their performance in comparison to the other three teams.

Overall Results

The overall results demonstrated that GEQ total scores significantly decreased, while SNA total scores increased over the course of the season for each team (see Table 2). Specifically, the social SNA network (i.e., friendship) demonstrated significant change over time, whereas the task network (i.e., efficacy) did not significantly change over time. Although there was some agreement between the GEQ and SNA at select time points and for certain teams, "cohesion" as measured by the GEQ and SNA were not in consistent agreement. As a result, GEQ and SNA total scores were not in agreement in terms of the longitudinal patterns over the season. Furthermore, the team with fewer friendship connections (i.e., Team A), as pictured in the SNA friendship maps, was more successful in terms of team performance.

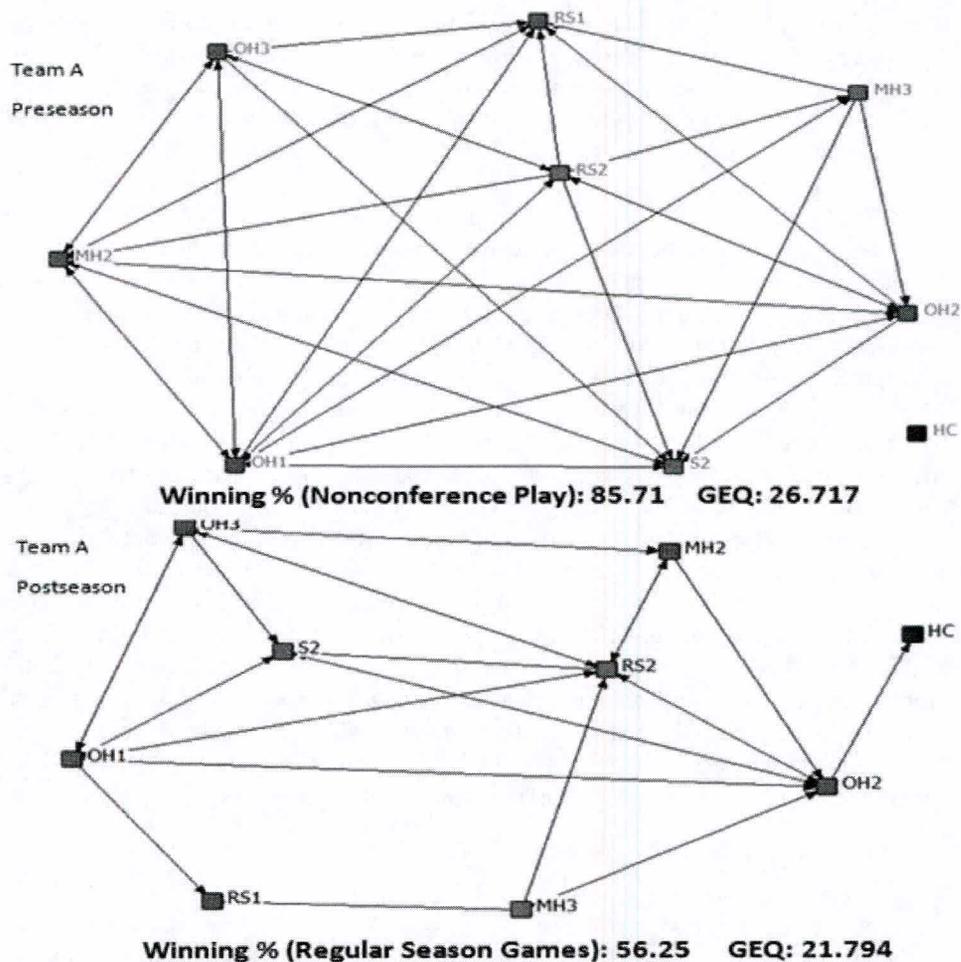


Figure 1. Team A: Friendship Network Map at Preseason (top) and Postseason (bottom). Each participant was labeled based on their position (HC = head coach; OH = outside hitter; MH = middle hitter; RS = right side hitter; S = setter) and players were assigned a color based on their playing status (green = starters; red = reserves). The winning percentage and GEQ score at that time point is indicated below each network map.

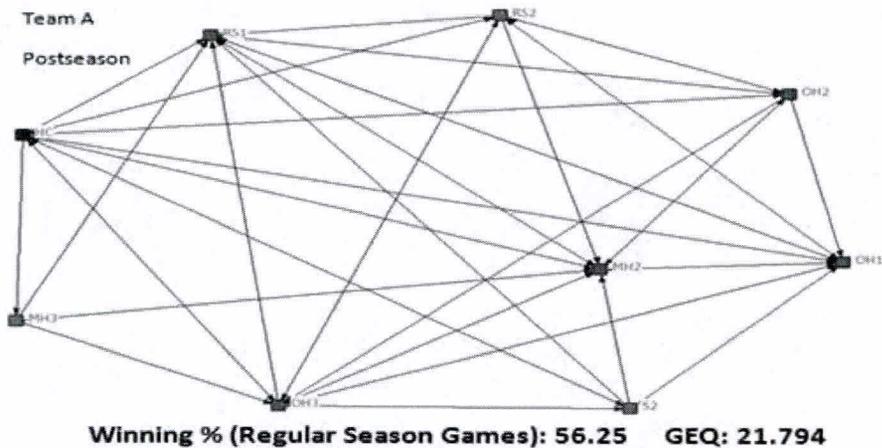
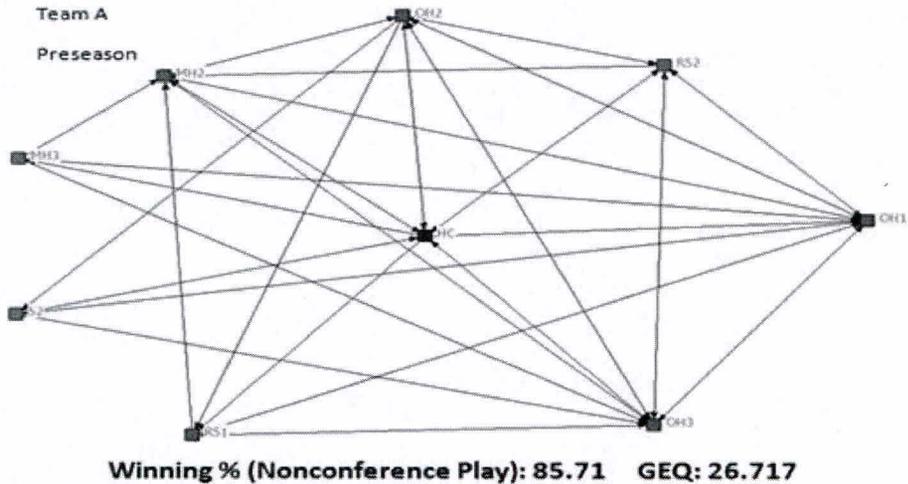
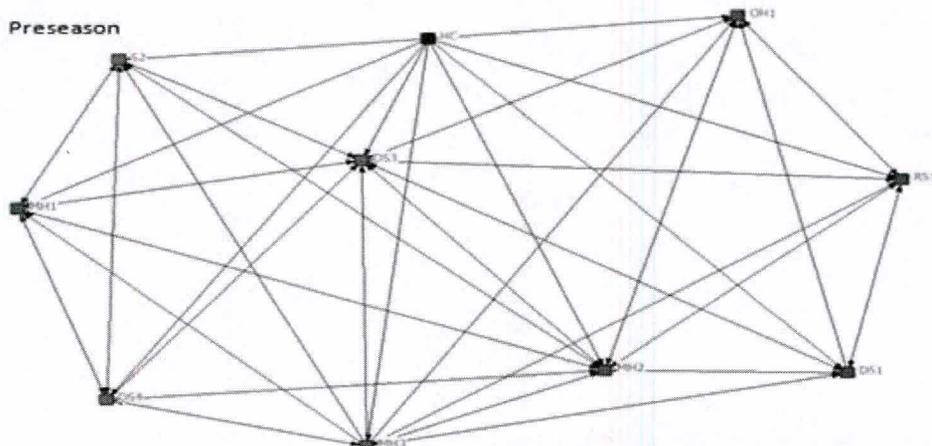


Figure 2. Team A: Efficacy Network Map at Preseason (top) and Postseason (bottom). Each participant was labeled based on their position (HC = head coach; OH = outside hitter; MH = middle hitter; RS = right side hitter; S = setter) and players were given a color based on their playing status (green = starters; red = reserves). The winning percentage and GEQ score at that time point is indicated below each network map.

Team B

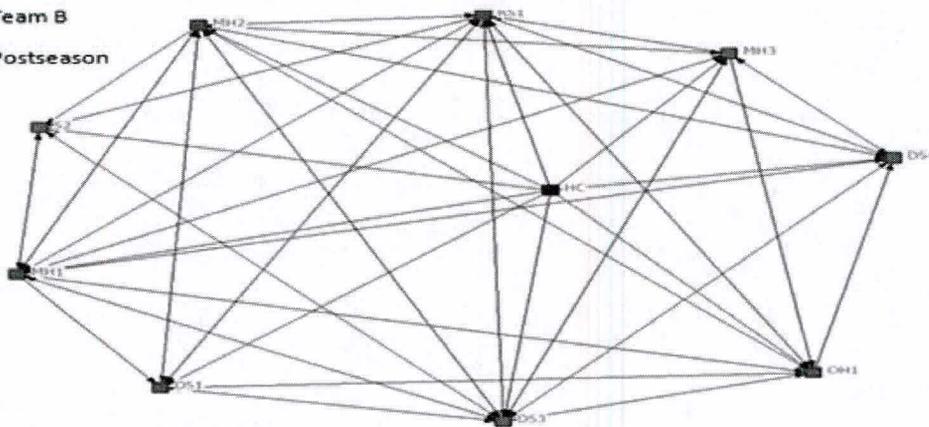
Preseason



Winning % (Nonconference Play): 33.33 GEQ: 31.144

Team B

Postseason



Winning % (Regular Season Games): 16.67 GEQ: 28.417

Figure 3. Team B: Friendship Network Map at Preseason (top) and Postseason (bottom). Each participant was labeled based on their position (HC = head coach; OH = outside hitter; MH = middle hitter; RS = right side hitter; DS = defensive specialist; S = setter) and players were given a color based on their playing status (green = starters; red = reserves). The winning percentage and GEQ score at that time point is indicated below each network map.

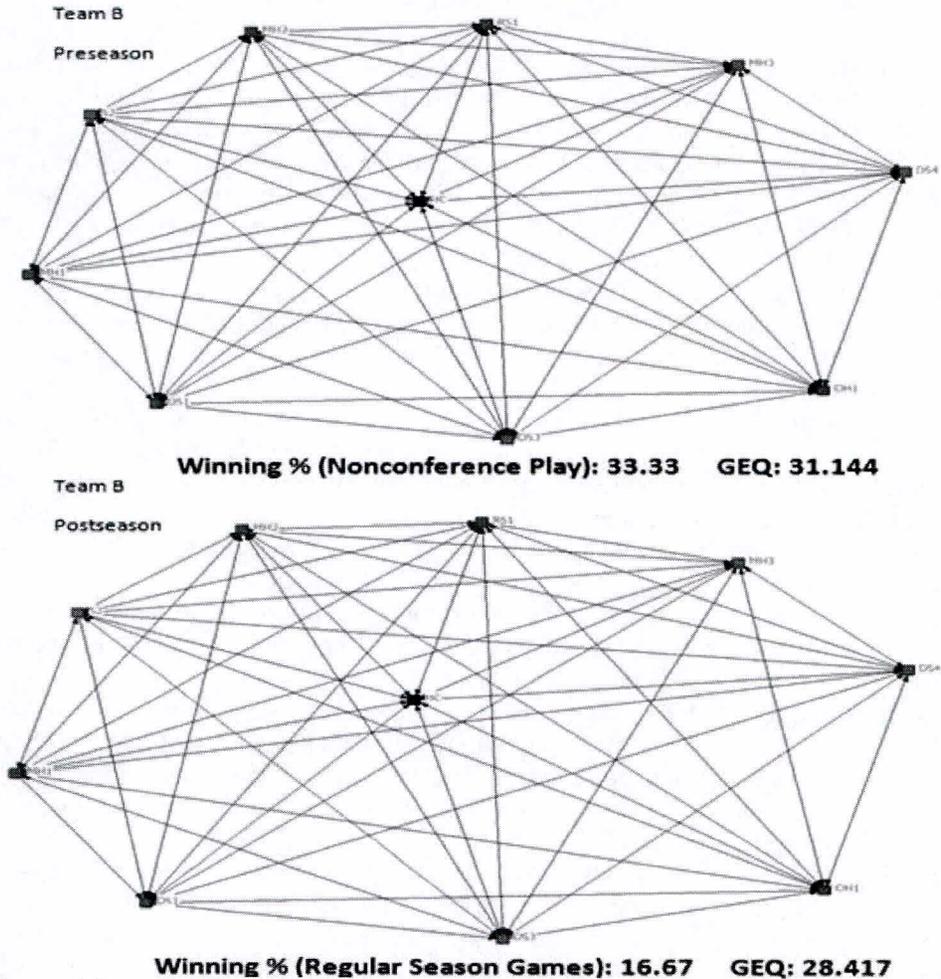


Figure 4. Team B: Efficacy Network Map at Preseason (top) and Postseason (bottom). Each participant was labeled based on their position (HC = head coach; OH = outside hitter; MH = middle hitter; RS = right side hitter; DS = defensive specialist; S = setter) and players were given a color based on their playing status (green = starters; red = reserves). The winning percentage and GEQ score at that time point is indicated below each network map.

Discussion

This study investigated the use of both the GEQ and SNA as methods of measuring cohesion among elite volleyball teams, while also attempting to clarify the relationships between cohesion and team performance. This study builds upon Warner et al.'s (2012) work by answering the call to synthesize the relative contributions of the GEQ and SNA to the measurement of team dynamics. Warner and colleagues posited that the SNA could be used a complementary tool to Carron et al.'s (1985) GEQ. Yet, they noted that a study had yet to use both measures simultaneously and doing so would be beneficial to advancing research in this area. Therefore, the first purpose of the present study was to determine areas of agreement and disagreement between the GEQ and SNA in regard to the measurement of team cohesion and temporal patterns in cohesion across the three time points. Our findings indicated that there was disagreement between the two measures for this sample. Furthermore, the second purpose of the present study was to determine the relationships among cohesion, using the GEQ and SNA, and team performance over the course of the season. Our findings seem to indicate that teams with fewer friendship connections tend to perform better and this finding is consistent with previous research (Warner et al., 2012). Yet, higher levels of team cohesion as measured by the GEQ were associated with higher winning percentages within each team. The results from this study suggest that the GEQ and SNA differ in the measurement of and longitudinal pattern in cohesion for elite volleyball teams. In addition, the GEQ and SNA displayed differing relationships with team performance. Several conclusions can be drawn as a result of the findings.

First, the GEQ and SNA did not demonstrate concrete evidence of agreement in the measurement of cohesiveness at each of the time points or longitudinal patterns for the four elite volleyball teams. Correlation analyses revealed moderate relationships between the GEQ and SNA at mid- and post-season and for two of the teams. Although there was agreement between the GEQ and SNA at select time points and for certain teams, the cohesion measures did not align consistently across the season. Furthermore, there was clear disagreement in the longitudinal patterns of cohesion between the GEQ and SNA total scores across all participants and teams. In particular, the GEQ as a whole significantly decreased, while SNA as a whole increased over the course of the season.

Because these two measures of cohesion did not agree, it seems that the GEQ and SNA are not measuring the same construct of "cohesion". This is exemplified by the fact that cohesion as measured by the GEQ total score decreased and the SNA total score increased over the course of the season across all teams. The researchers choose to only use the friendship and efficacy networks to assess cohesion using SNA in the present study. So,

it is possible that the trust (i.e., I trust this person) and advice (i.e., I went to this person for advice) networks that have previously been used by Warner and colleagues (2012) may be a better measurement of team cohesion and more strongly agree and correlate with the GEQ. Future research should explore the use of the trust and advice networks in comparison to the GEQ as measurements of team cohesion.

It should be noted that the disagreement between the GEQ and SNA could be due to the fact that the GEQ is more of a global measure (Carron et al., 1985), whereas SNA depends on the sum of individual relationships (Wellman, 1988). That is, the GEQ is comprised of 18 items regarding the general team environment and overall relationships with teammates by grouping all individuals together. SNA, on the other hand, measures team cohesion (i.e., density) based on the amalgamation of explicitly defined dyadic relationships (i.e., relationships between two individuals) and tailors the analysis to each team by asking specific questions regarding teammates by name. This allows SNA to provide insight into team structure and the process by which team cohesion evolves over the course of a season. Lusher et al. (2010) asserts that a focus on actual relations between team members is important (i.e., SNA), rather than just a focus on the attitudes of the team members about the team more generally (i.e., GEQ). Although there are formal relations between team members, there are also informal relations, such as friendships, that impact how a team operates. The influence of these informal relations on team dynamics cannot be readily understood by just asking about the team in general. Thus, the exploration of these informal social relations between team members lends itself to the use of SNA, rather than the GEQ. These two methodologies take distinct paths in understanding the intra-group relations of a team. Therefore, this incongruence further explains the lack of agreement in the measurement of a team dynamic, such as team cohesion, as found in this study.

The second driving research question examined the predictive value of the GEQ and SNA in relation to team performance. The current study revealed that the GEQ total cohesion score maintained a positive relationship with team performance, yet the SNA friendship network had a negative relationship with performance. Although the inverse relationship between friendship and winning percentage was not predicted in the present study, it is still interesting that this sample exhibited an association between higher levels of cohesion as measured by the SNA friendship network and lower levels of performance. This is opposed to the general hypothesis that the cohesion-performance relationship is positive among interacting sports, such as volleyball, and contradictory to the findings that a stronger, positive cohesion-performance effect has been found among female athletes/teams (Mullen & Copper, 1994; Williams & Widmeyer, 1991).

Within the present sample, the team with the highest perception of self-reported team cohesion as measured by SNA (Team B) had the lowest winning percentage at all three time points. This suggests that too much team cohesion could negatively impact team performance. Wise (2014) supported this idea of an inversely curvilinear relationship between cohesion (i.e., network density) and performance and challenged the strictly positive relationship between the two variables that much of the literature supports (Carron et al., 2002; Mullen & Copper, 1994). Thus, Wise's work implies that the network structures that help some teams accomplish their goals reach a point of diminishing returns, after which further increasing that team cohesiveness leads to negative performance consequences. That is, there is an optimal level of cohesion at which performance is maximized; whereas, too little cohesion produces structural holes and too much cohesion leads to group think, which both decrease team performance.

In particular, the team with fewer friendship connections (i.e., Team A) was more successful in terms of team performance, which is consistent with the findings of Warner et al. (2012) that increases in cohesion based on friendship were negatively associated with team performance. Therefore, one might conclude that female teams with fewer friendships and fewer overall network connections are more likely to have team performance success. Although the socially-oriented friendship network appeared to not be as strongly related to performance, coaches and sport managers should not dismiss the importance of socially cohesive networks, especially in the case of female athletes. Research also suggests that female athletes place a greater importance on the social aspect of the team experience, which in turn contributes to athlete satisfaction (Warner & Dixon, 2015; White, 1993). Clearly cohesiveness is important, however, a greater number of friendship connections did not relate to improved team performance.

The longitudinal social networking data collected over the course of a season lends further insight into the relationship between cohesion and performance. For instance, if a coach moves to the periphery of the team during the course of a season, one would assume that the coach does not have a sound relationship with the other team members; however, perhaps this is a result of the coach empowering the players to take a more prominent and central role within the team. Heydarinejad and Adman (2010) demonstrated that coach leadership styles, particularly the relationship-oriented and combined leadership style, play a predictive role in team cohesion. When comparing SNA with the GEQ, the GEQ cannot illustrate the coach's position within the team, so conclusions cannot be drawn regarding the relationship between the coach and other team members and the potential impact this might have on performance and other outcome variables. Future research should consider the use of SNA within a longitudinal approach to better understand the possibly changing coach leadership styles and their relationship to both team cohesion and team success.

Practical Applications

As noted by Carron (1982), the standard approach to measuring cohesion (i.e., the GEQ) makes no attempt to determine the structure of relationships and interactions in the collective whole, including the task- and interpersonal-oriented behaviors and interlocking roles assumed by members. When the group is treated as an aggregate of its components, this particular implication arises. Instead, SNA seems to make up for what the GEQ lacks in regard to assessing the network structure of teams. The use of more than one mode of assessment by concurrently using traditional self-report measures (i.e., GEQ) and behavioral correlates which reflect cohesiveness (i.e., friendship and efficacy networks) would provide convergent validity for the estimates of team cohesion. The current study was meant to introduce coaches and sport scholars to a tool that is available to generate richer explanation and prediction of team dynamics. As team cohesion research continues to evolve, it is important that the field continues to advance by introducing complementary tools, such as social networking, in combination with the contributions of the GEQ. This study, however, pointed to the GEQ and SNA likely measuring different constructs. Nonetheless, both measures can be useful for coaches and administrators.

Despite the fact that the more socially-oriented network, friendship, appeared to not positively influence team performance, a coach or sport manager should not dismiss the important of socially cohesive networks (Warner et al., 2012; Warner & Dixon, 2015). Based upon the current findings, fostering significant friendships among team members may not contribute to team performance. This does not mean that friendship has no bearing on individual athlete performance or experience, only that it is not significantly associated with team winning percentage. Thus, coaches should allocate time and effort into creating an environment that fosters social relationships and encouraging athletes to build meaningful friendships with fellow teammates in order to improve the overall athletic experience (Warner & Dixon, 2011, 2013).

From an applied perspective, research has found that team building, which refers to programs aimed at promoting increased cohesiveness, does have a positive impact on cohesion in sport teams (Martin, Carron, & Burke, 2009). If in fact team building programs have a positive impact on cohesion in sport teams, then coaches and sport practitioners should invest in team building efforts to increase cohesion among team members.

Theoretical Implications

This work also offers some important theoretical insight. The GEQ is more of a global measure (Carron et al., 1985) and therefore, provides a macro perspective. While this study also demonstrated that SNA could provide a macro perspective, the use of SNA *also* allowed

for the exploration of the micro perspectives through the visual inspection of the sociograms or network maps. Thus, from a theoretical perspective this lends further credence to the importance of considering a multilevel perspectives in future research. The macro perspective can neglect the individual behaviors impacting sport phenomena, while just a micro perspective can neglect the contextual factors impacting sport phenomena. Or in this case, "a coach with knowledge of the intricacies and key relational structures within his or her team can more effectively lead the team to success" (Warner et al., 2012, p. 54). As this study highlights, this knowledge could only be revealed through the adoption of a multilevel perspective and approach.

Conclusions

The results of this study help to highlight the positive outcomes of team cohesion, while also further positioning SNA and the GEQ as important tools for athletic administrators and coaches to better understand the functioning, or lack thereof, of their teams. While it is clear that the GEQ and SNA may be measuring different constructs, SNA was able to offer unique contributions in exploring how specific dyadic relationships among team members evolve over the course of the season and relate to team performance. Although the limitations inherent in this study may underscore the tentative nature of the conclusions, the findings are suggestive enough to warrant further study in an attempt to replicate the findings of the present study with a larger sample size. In an effort to advance the team cohesion research, future research must continue to explore the unique contributions provided by SNA in regard to team dynamics.

References

- Borgatti, S. P., Everett, M. G., & Freeman, L. C. (1999). *UCINET 5.0, version 1.00*. Natick: Analytic Technologies.
- Brawley, L., Carron, A., & Widmeyer, W. (1988). Exploring the relationship between cohesion and group resistance to disruption. *Journal of Sport & Exercise Psychology*, *10*(2), 199-213.
- Carron, A. V. (1982). Cohesiveness in sport groups: Interpretations and considerations. *Journal of Sport Psychology*, *4*, 123-138.
- Carron, A. V., Widmeyer, W. N., & Brawley, L. R. (1988). Group cohesion and individual adherence to physical-activity. *Journal of Sport & Exercise Psychology*, *10*(2), 127-138.

- Carron, A. V., Widmeyer, W. N., & Brawley, L. R. (1985). The development of an instrument to assess cohesion in sport teams - the group environment questionnaire. *Journal of Sport Psychology*, 7(3), 244-266.
- Eys, M. A., & Burke, S. M. (2008). Social Contacts and Cohesion in a Group Exercise Context. In M. P. Simmons, & L. A. Foster (Eds.), *Sport and Exercise Psychology Research Advances* (pp. 191-205).
- Fleming, A., Grace, F., Baker, J., & Sculthorpe, N. (2014). Social network analysis: an approach to observing changes in sports team dynamics. *Journal of Sports Sciences*, 32, Supplement 2, s63.
- Heuze, J. P., Sarrazin, P., Masiero, M., Raimbault, N., & Thomas, J. P. (2006). The relationships of perceived emotional climate to cohesion and collective efficacy in elite female teams. *Journal of Applied Sport Psychology*, 18, 201-218.
- Heydarinejad, S., & Adman, O. (2010). Relationship between coaching leadership styles and team cohesion in football teams of the Iranian university league. *Studies in Physical Culture & Tourism*, 17(4), 367-372.
- Ho, V. T., Rousseau, D. M., & Levesque, L. L. (2006). Social networks and the psychological contract: Structural holes, cohesive ties, and beliefs regarding employer obligations. *Human Relations*, 59(4), 459-481.
- Jehn, K. A., & Shah, P. P. (1997). Interpersonal relationships and task performance: An examination of mediating processes in friendship and acquaintance groups. *Journal of Personality and Social Psychology*, 72(4), 775-790.
- Leeson, H., & Fletcher, R. (2005). Longitudinal stability of the group environment questionnaire with elite female athletes. *Group Dynamics-Theory Research and Practice*, 9(3), 147-160.
- Leo, F. M., Sanchez-Miguel, P. A., Sanchez-Olivia, D., Amado, D., & Garcia-Calvo, T. (2012). Evolution of perceived cohesion and efficacy over the season and their relation to success and expectations in soccer teams. *Journal of Human Kinetics*, 34, 139-147.
- Lupu, S. G. (2013). The sociometric techniques and their implementation in the athletic performance activity. *Sport & Society*, 13, 137-140.
- Lusher, D., Robbins, G., & Kremer, P. (2010). The application of social network analysis to team sports. *Measurement in Physical Education and Exercise Science*, 14, 211-224.
- Martin, L. J., Carron, A. V., & Burke, S. M. (2009). Team building interventions in sport: A meta-analysis. *Sport & Exercise Psychology Review*, 5(2), 3-18.
- Mullen, B., & Copper, C. (1994). The relation between group cohesiveness and performance - an integration. *Psychological Bulletin*, 115(2), 210-227.

- Nixon, H. (1993). Social network analysis of sport - emphasizing social-structure in sport sociology. *Sociology of Sport Journal*, 10(3), 315-321.
- Paskevich, D. M., Estabrooks, P. A., Brawley, L. R., & Carron, A. V. (2001). Group cohesion in sport and exercise. In R. N. Singer, H. A. Hausenblas & C. Janelle (Eds.), *Handbook of sport psychology* (pp. 474-494). New York, NY: Wiley.
- Quatman, C., & Chelladurai, P. (2008). Social network theory and analysis: A complementary lens for inquiry. *Journal of Sport Management*, 22(3), 338-360.
- Spink, K. S. (1990). Group cohesion and collective efficacy of volleyball teams. *Journal of Sport & Exercise Psychology*, 12(3), 301-311.
- Warner, S., Bowers, M. T., & Dixon, M. A. (2012). Team dynamics: A social network perspective. *Journal of Sport Management*, 26(1), 53-66.
- Warner, S., & Dixon, M. A. (2011). Understanding sense of community from the athlete's perspective. *Journal of Sport Management*, 25(3), 257-271.
- Warner, S., & Dixon, M. A. (2013). Sport and community on campus: Constructing a sport experience that matters. *Journal of College Student Development*, 54, 283-298. DOI: 10.1353/csd.2013.0044
- Warner, S., & Dixon, M. A. (2015). Competition, gender and the sport experience: An exploration among college athletes. *Sport, Education & Society*, 20(4), 527-545.
- Wellman, B. (1988). Structural analysis: From metaphor to substance. In B. Wellman, & S. D. Berkowitz (Eds.), [Social structures: A network approach] (pp. 19-55). New York: Cambridge University Press.
- White, S. A. (1993). The relationship between psychological skills, experience, and practice commitment among collegiate male and female skiers. *Sport Psychologist*, 7(1), 49-57.
- Widmeyer, W., & Williams, J. (1991). Predicting cohesion in a coacting sport. *Small Group Research*, 22(4), 548-570.
- Williams, J., & Widmeyer, W. (1991). The cohesion-performance outcome relationship in a coacting sport. *Journal of Sport & Exercise Psychology*, 13(4), 364-371.
- Wise, S. (2014). Can a team have too much cohesion? the dark side to network density. *European Management Journal*, 32(5), 703-711.

Copyright of Journal of Sport Behavior is the property of University of South Alabama and its content may not be copied or emailed to multiple sites or posted to a listserv without the copyright holder's express written permission. However, users may print, download, or email articles for individual use.