Social Network Analysis in Sport Research

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CHAPTER ONE

INTRODUCTION TO SOCIAL NETWORK ANALYSIS IN SPORT RESEARCH

Introduction

Attending a sporting event with other fans. Playing softball with coworkers. Participating in a walking challenge with members of the local gym. Posting photographs on Instagram for friends, family members, and other followers to see. Serving on the board of a nonprofit organization. Watching the Super Bowl and chatting about it with other viewers on Twitter. Conducting a research project with likeminded colleagues. Each of these scenarios involves people coming together and creating social networks.

In 2000, Robert Putnam published *Bowling Alone: The Collapse and Revival of American Community.* He lamented the demise of bowling leagues, volunteer and civic organizations, and other community activities that bring people together. Social media studies indicate users dedicate approximately three to four hours per day interacting with their smartphones while looking at Twitter, Instagram, Facebook, and other social media platforms. This time is included in the approximately eleven hours per day individuals spend looking at a variety of screens, from the previously mentioned smartphones to computers to televisions (Manjoo 2018). This translates into less time interacting with friends and family members, reading books, or engaging in other hobbies and social activities. Despite these shifts in consumer behaviors over the last two decades, people still meet in person and online, form relationships and groups large and small, and create social networks, as evidenced by the examples in the previous paragraph.

Social networks represent collections of individuals, groups, or organizations and the relationships formed among them (Wasserman and Faust 1994). Social network analysis is a methodological approach that allows us to explore social networks in detail, understanding the network members and their shared interactions within various environments. Through social network analysis, we can learn about these relationships and interactions, whether the social networks are used to disseminate information (Granovetter 1973); diffuse innovations (Rogers 2003); or build social capital and resource capacity through the sharing of human, financial, infrastructure, and strategic resources (Jones, Edwards, Bocarro, Bunds, and Smith 2017a, 2017b), among other activities and opportunities.

Introduction to Social Networks

The study of social networks gained popularity in the early 1930s. Researchers during this time introduced sociograms, or two-dimensional diagrams that display shared relationships among social network members (Wasserman and Faust 1994). Figure 1-1 is an example of a sociogram, depicting a social network. The squares represent the network members, and the lines reflect the shared relationships among them. For example, network member #1 shares relationships with network members #3 on the right and #5 on the left. Network member #10 occupies a central location in the middle of the network, connecting with numerous members.



Fig. 1-1 Social network

Sociologists and anthropologists began using sociograms more frequently in the 1940s and 1950s. For instance, Menzel and Katz (1955) studied the medical community and incorporated sociograms into their analysis. Their sociograms depicted the relationships formed among physicians within a specific medical setting. The mapped interactions represented the flows of information about a new drug spreading through the community. To construct the sociograms and outline the diffusion of this innovation, Menzel and Katz asked the physicians to list colleagues with whom they interacted professionally and socially and from whom they solicited medical advice. Their responses were used to construct the social network. The subsequent sociogram revealed the most frequently cited physicians played a key role in the diffusion process and were located at the center of the network, connecting to other physicians within the network. Some physicians, conversely, operated on the fringes of the network, less often cited by their peers. The results also revealed the most popular physicians read more medical journals and attended more conferences than their peers. They provided the most advice to other physicians and had the most power within this community. This study highlighted the benefits of using sociograms to portray social networks and identify network stars, or key members, within them (Menzel and Katz 1955).

Continuing this work in the 1960s, Merton (1968) argued these social network stars would accrue more benefits in contrast to others. He dubbed this phenomenon the "Matthew effect," quoting the Bible's Gospel of Matthew: "For unto every one that hath shall be given, and he shall have abundance: but from him that hath not shall be taken away even that which he hath" (58). Merton studied scientific researchers and found the largest share of benefits often went to the smallest, most privileged group, in this case Nobel Prize winners. Future Nobel laureates often studied under previous winners. Through these academic relationships and preferential attachment, they had access to esteemed knowledge sources and connections. The students grew into well-known scientists, as they were mentored by scholars with high levels of visibility and prestige. As a result, they often received a sizeable share of acclaim, while more obscure scientists gained less recognition. When these famous scientists coauthored research with others, they typically received the most credit for the collaborations. They also received higher levels of resources and recognition in the scientific community (Merton 1968).

Crane (1969) found evidence of this effect in other academic social networks. The researcher used the term "invisible colleges," which "refers to an elite of mutually interacting and productive scientists within a research area" (348). In her study, rural sociology researchers were asked to name fellow academics who most influenced their research. Crane used this data in conjunction with bibliographic citations to analyze direct and indirect relationships among the academics. A small group of star sociologists emerged within the network, and they wrote a large percentage of the published articles. These researchers, highly productive in terms of their

academic output, formed a core group within the network of scholars. This network and their connections within it allowed them to collaborate with other researchers, publish more frequently, and exert a strong influence on the academic discipline (Crane 1969).

Published the same year, Travers and Milgram (1969) explored the "small world problem" occurring within social networks (425). This problem queried "what is the probability that any two people, selected arbitrarily from a large population, such as that of the United States, will know each other" (425)? To answer the question. Travers and Milgram asked participants living in Nebraska and Massachusetts to use their personal social connections to move a mailing from their individual locales to a specific Boston resident selected by the researchers. None of the study participants knew this Bostonian in advance. Instead, they relied upon their friends and friends of friends to help deliver the mailings. The researchers tracked the paths of these mailings from person to person. They found it took an average of five steps to complete the connection between each study participant and the end recipient (Travers and Milgram 1969). Those familiar with the play Six Degrees of Separation by John Guare or the Six Degrees of Kevin Bacon game, referencing American actor Kevin Bacon, can see the popular culture references reflected in the work of Travers and Milgram.

These four studies represented some of the seminal works investigating social networks and using social network analysis tools such as sociograms in their investigations. They introduced social network terms such as *sociograms, stars, preferential attachment,* and *paths,* which will appear in the research discussed throughout this text. Their studies also provided early examples of social network analysis in academic areas outside of sports. The application of social network analysis in sport research began decades later.

Social Network Analysis in Sport

Gould and Gatrell (1979) conducted an analysis of team and player performances occurring between the professional soccer teams Liverpool and Manchester United in the 1977 Football Association (FA) Cup Final. The researchers explored some of the foundational questions arising with future sport related social network research. In discussing the match, they stated,

Most devotees would acknowledge that soccer matches between different sets of players may have a different "feel" about them. People might report that "team X were much better organized," that "team Y were falling apart," that "team Z played a very tight defensive game," and so on. We would like to suggest that contained in these intuitive descriptive phrases are very powerful and important notions of structure. Our task, therefore, is to find operational definitions of these intuitive ideas, and see whether a structural examination can lead to insights not readily obtainable by simply watching the game itself, or by observing a replay (253-254).

The researchers highlighted the idea of structure, whether observable or hidden, occurring between players and teams during sporting events. When we watch soccer matches and other competitions, we know something is happening, but might struggle to articulate why it occurs. Gould and Gatrell (1979) argued social network analysis can help with this articulation. They noted the available levels of analysis, whether interactions between groups of players within each team or interactions between the two teams. They also remarked that this analysis can include visual, qualitative, and quantitative elements. With these three lenses, they believed researchers can better understand team and game structures occurring on the pitch. Gould and Gatrell also argued that social network analysis can address questions such as the following:

Is there a deeper structure of relations on the set of players that defines a backcloth upon which the passage of the ball may be considered as traffic? Do players have private evaluations and preferences forming a real, but still undefined and invisible, structure that actually underpins the sort of structural description we have provided here? (272).

These questions pointed to the deliberations researchers can address when using social network analysis to investigate sport contexts. Social network analysis studies of this nature attempt to make sense of what occurs during competition among players and between teams. This analysis allows researchers to look beyond the basic team rosters and game statistics and try to describe the underlying structures—the social networks—occurring during competition. Gould and Gatrell (1979) highlighted some of the key objectives of using social network analysis to assess sports, including utilizing this tool to confirm what we see during matches and unearth findings and insights previously hidden.

Nixon (1992) also promoted the use of social network analysis in sports. He argued for using this methodological tool to explain why college athletes opted to continue playing despite suffering from pain and injuries related to their sports. He labeled social networks containing athletes, coaches, medical trainers, and other support staff as "sportsnets" (128). Nixon believed these social networks promoted certain social norms and behaviors such as having athletes ignore or play with pain and injuries.

Chapter One

Social network analysis allows researchers to explore who exists within the networks, what kinds of relationships network members form, how information and other resources are distributed among network members. and how these interactions can influence the attitudes and behaviors of network members. Nixon asserted the "athletic subculture" (128) identified through social network analysis isolated athletes from other groups and perspectives on campus and instead encouraged athletes to rely upon their team members, coaches, and mentors for advice. The researcher argued these network structures promoted a closed environment. The networks were large, where athletes were deemed replaceable; dense, where athletes communicated primarily with individuals in the network as opposed to others outside of it; and centralized, where a small set of individuals (e.g., coaches) played key roles and controlled resources within the networks. Because of these conditions, athletes rarely received information from different sources or those with alternative views. Instead the consistent message from within centered on them continuing to play. Nixon proposed ways to address this environment, including having athletes meet with outside medical personnel and integrating athletes more fully into the larger university academic environment to gain access to diverse perspectives.

These early works produced by Gould and Gatrell (1979) and Nixon (1992) highlighted the potential benefits of applying social network analysis to sports. Almost two decades later, Lusher, Robins, and Kremer (2010) articulated the usefulness of examining sports teams using social network analysis. They argued this analytical lens gave researchers the opportunity to investigate informal and formal relationships occurring within teams. "[Social network analysis] offers a range of tools that can augment and extend existing instruments and methods for the analysis of a number of complex processes that operate within sporting teams" (215). They argued social network analysis should not replace commonly used qualitative and quantitative methods, but instead can add to the research toolkit and augment findings stemming from these methods.

We will see in the following chapters that researchers agreed with Lusher and colleagues (2010) and increasingly used social network analysis in their investigations. As a result, more social network analysis studies focused on sport have been published. This text reviews nearly 70 of those studies appearing between 1979 and 2018. Figure 1-2 reveals the application of social network analysis to sport contexts started slowly. The aforementioned work by Gould and Gatrell was published in 1979. A gap occurred between this study and the next one, which arrived in 1992 with Nixon's examination of college athletes. Multiple years passed before a new study appeared in 2004, followed by four more years until researchers

published two studies in 2008. A steadier flow of research occurred thereafter, with at least one publication each year from 2008 to 2018. The largest number of studies appeared in 2012, followed by a drop-off in publications from 2013 to 2018. This decline begs the question of why researchers moved away from using social network analysis after a period of increasing growth from 2010 to 2013. What precipitated this change: researchers moving to other tools and topics, shifting research interests, or something else? Nevertheless in 2018, researchers again embraced social network analysis in sport contexts with the number of studies close to the 2012 output. Perhaps 2018 marks the beginning of a new era of social network analysis in sport studies, as the tools and related works continue to disseminate among researchers in a variety of areas within sport.



Fig. 1-2 Published social network in sport studies

We can split this research into specific sport contexts to investigate the potential for additional publication trends. Wäsche, Woll, Brandt, and Dixon (2017) analyzed 26 sport related social network analysis studies and proposed six social network contexts: (a) competition, (b) interaction or intra-event, (c) interorganizational, (d) intraorganizational, (e) affiliation, and (f) social environments. Competition networks reflected team performances such as player rankings and team results. Interaction or intra-event networks incorporated activities taking place during games, such as passing and scoring. Interorganizational networks reflected interactions occurring within organizations, including teams. Affiliation networks incorporated networks formed by individuals, and social environment

networks involved the broader sport industry. Their study represented the first attempt to categorize sport related social networks into a typology.

The current text proposes a somewhat different typology, given the inclusion and assessment of a larger number of sport related social network analysis studies. This text combines the team competition and interaction networks to reflect the activities of athletes during competition and the results of these activities. In addressing organizations, this text distinguishes between teams and other types of organizations (e.g., nonprofit agencies, corporate sponsors), given the somewhat unique characteristics of various organizational types. This text also focuses on social network analysis studies addressing social media and research on sport in lieu of a broader sport environment network. Using this rationale, I propose the following six sport contexts: (a) individuals, (b) teams away from competition, (c) teams during competition, (d) organizations, (e) social media, and (f) research on sport. We will examine social network analysis studies in these contexts in the coming chapters.



Fig. 1-3 Published social network in sport studies by context

Using these categories, Figure 1-3 reveals how the research from 1979 to 2018 examined in this text breaks down among the six sport contexts. Studies centered on teams during competition were published in 1979, 2004, and 2009, the only social network analysis research focused on sport in

those three years. The one study published in 1992 addressed teams outside of competition, while the two studies appearing in 2008 explored research on sport. Moving forward to the period from 2010 to 2018, a varied mix of studies was published each year. The years 2010 to 2012 offered studies on organizations and teams during competition, with a smaller number of studies examining research, social media, teams away from competition, and individuals. The years 2013 to 2017 presented a relatively equal mix of studies, but research on teams during competition and organizations were the most predominant. Finally, 2018 featured the most studies. Research on individuals occurred frequently, followed by an equal number of studies on teams away from competition, and organizations. Social media and research studies also appeared during this period.

Text Overview

Despite the exponential growth of social network analysis in sport studies, researchers noted its relatively limited use in comparison to other methods, and they encouraged its application in future studies to grow this research (Wäsche *et al.* 2017). "Social network analysis is becoming a very popular statistical method. However, we believe that it is still not sufficiently exploited in the field of sport" (Breznik 2015, 1224). The current text attempts to remedy this situation: promoting the use of social network analysis in research, encouraging current and future researchers to employ this methodological tool in more sport contexts and studies, and providing study proposals and suggestions to spur additional ideas for research. The text reviews the extant literature focused on social network analysis in sport within various contexts, such as among individuals or organizations, within team settings, and in social media and research on sport.

Chapter one provides an overview of social network analysis and its role with sport related research. Chapter two offers a detailed introduction to social network analysis, defining basic terms and offering an outline of the data collection and analysis processes. The chapter serves as a guide to exploring and understanding the sport research using social network analysis presented in the following chapters.

Chapters three through eight examine the six sport contexts listed above in greater detail. Each chapter investigates a specific context, followed by a discussion of the theoretical frameworks as well as the data collection and analysis techniques used with those studies. Next, each chapter highlights one or more challenges faced by researchers using social network analysis and concludes with a proposed study examining the featured sport context.

Chapter One

Chapter three discusses the use of social network analysis to examine individuals and their personal social networks. Chapter four addresses the application of social network analysis in team settings and interactions taking place away from competition. Chapter five focuses on the application of social network analysis in team settings and interactions taking place during practice, play, and competition on the field, court, or other playing surfaces. Chapter six provides an overview of the research investigating social network analysis with organizations in the sport industry. The chapter covers organizations in sport delivery, event management and tourism, and other exchanges. Chapter seven offers an overview of research exploring social network analysis with social media and popular platforms such as Twitter. Chapter eight examines the use of social network analysis to explore research on sport, how researchers interact, collaborate, and contribute to the academic investigations of sport.

Chapter nine provides a framework for conducting social network analysis studies in sport contexts. The chapter outlines key questions and challenges researchers face when conducting these studies. This chapter offers a research checklist and guidelines, culled from studies outlined in the previous chapters and other social network analysis research. Opportunities for future research also are presented. Chapter ten provides a conclusion, summarizing the various research findings and applications across the six sport contexts. This chapter also sets the stage for the future application of social network analysis in sport.

CHAPTER TWO

INTRODUCTION TO SOCIAL NETWORK ANALYSIS

Introduction

Social networks include individuals, groups, or organizations and the relationships formed among them. Social network analysis helps us investigate these social networks in more detail—the overall network and the network members and their shared interactions (Borgatti, Everett, and Johnson 2018). Arguably one of the greatest benefits of social network analysis is the ability to investigate these networks using qualitative and quantitative approaches. Social network analysis tools allow us to create sociograms, or visual depictions of the social networks under investigation. We also can explore the network and its members through network metrics at the network structural and individual actor levels (Borgatti *et al.* 2018).

Sociograms contain the network members, or *nodes*, which can represent individuals, groups, teams, organizations, or a combination of network member types. The sociograms also include network relationships, or *edges*. These relationships can be operationalized as pathways to spread innovations (Rogers 2003) or share resources (Jones, Edwards, Bocarro, Bunds, and Smith 2017a, 2017b). They also can reflect relationships such as friendship, knowledge, advice, and efficacy (Warner, Bowers, and Dixon 2012) or leadership (Lusher, Robins, and Kremer 2010) and trust (Lusher, Kremer, and Robins 2014).

Another benefit of social network analysis is the flexibility it affords in operationalizing networks. This operationalization is limited only by our research focus and areas of investigation. The coming chapters reveal how researchers used social network analysis to investigate a variety of network members and settings, including teams during competition, sport tourism and event management, and social media interactions (Wäsche, Dickson, Woll, and Brandes 2017). These examples demonstrated the ability to apply social network analysis in various ways. Other research disciplines such as anthropology, psychology, and sociology also used social network analysis (Wasserman and Faust 1994), creating a pathway for similar applications within sport research.

Social Network Analysis Example

To better illustrate social networks and the concepts related to social network analysis, we begin with an example. Our hypothetical social network includes ten people. Some of these individuals work together, some play fantasy football together, and some work and play fantasy football together. Table 2-1 provides information about the ten individuals. We have details about each person's work location, work experience, fantasy football experience, children, and gender.

Person	Work Location	Work Experience	Fantasy Football Experience	Children	Gender
#0	1	High	High	Yes	Male
#1	2	Med	High	Yes	Male
#2	1	Med	Med	Yes	Female
#3	1	Med	Low	Yes	Female
#4	1	Med	Med	Yes	Male
#5	3	Low	Low	Yes	Female
#6	2	Low	Med	No	Female
#7	1	High	High	No	Female
#8	3	High	Med	Yes	Male
#9	3	Low	Low	No	Male

Table 2-1. Social network members

The next two tables, or social network matrices, indicate the shared relationships among these individuals. Table 2-2 shows whether these individuals work together (1 = yes, 0 = no), and Table 2-3 indicates whether the same individuals play fantasy football together (1 = yes, 0 = no). We can draw a Venn diagram of the two matrices reflecting these sets of shared relationships. It will show some individuals work together (e.g., network members #2 and #6), some play fantasy football together (e.g., network members #3 and #8), and some do both (e.g., network members #4 and #7). This is likely a familiar scenario, where people who work together also participate together in another activity outside of work.

	#0	#1	#2	#2	#1	#5	#6	#7	#0	#0
	#0	#1	#2	#3	# 4	#3	#0	#7	#0	#9
#0	0	1	1	1	1	0	1	0	0	0
#1	1	0	1	1	1	0	1	0	0	0
#2	1	1	0	1	1	0	1	1	0	0
#3	1	1	1	0	1	0	1	1	0	0
#4	1	1	1	1	0	1	0	1	0	0
#5	0	0	0	0	1	0	0	0	0	0
#6	1	1	1	1	0	0	0	0	0	0
#7	0	0	1	1	1	0	0	0	0	0
#8	0	0	0	0	0	0	0	0	0	1
#9	0	0	0	0	0	0	0	0	1	0

Table 2-2. Social network work relationships

Table 2-3. Social network fantasy football relationships

	#0	#1	#2	#3	#4	#5	#6	#7	#8	#9
#0	0	1	1	0	1	0	1	1	1	0
#1	1	0	1	0	1	0	1	1	1	0
#2	1	1	0	1	1	0	0	1	1	1
#3	0	0	1	0	1	0	0	1	1	0
#4	1	1	1	1	0	1	1	1	1	0
#5	0	0	0	0	1	0	0	0	0	0
#6	1	1	0	0	1	0	0	1	1	0
#7	1	1	1	1	1	0	1	0	1	0
#8	1	1	1	1	1	0	1	1	0	1
#9	0	0	1	0	0	0	0	0	1	0

We can use the information in these tables to create a sociogram for each social network—the work social network and the fantasy football social network—and calculate the network metrics for each network. These can include metrics describing the networks overall and metrics describing the individual network members within them.

With a network containing a small number of network members and relationships, a sociogram makes it possible to see the individual members and their positions and interactions within the network. Network members located at the center of the network typically have more power, access to resources, and connections in comparison to other network members. These members can serve as gatekeepers, dictating the flow of information and resources through the network. Conversely, network members located along the periphery of the network have relatively limited power, access to resources, and connections to other network members. To improve their positions, they might attempt to build relationships with more powerful, centrally located network members. The network also might contain *isolates*, or network members with no shared relationships. These network members are essentially cut off from the larger network and need to establish relationships with one or more network members, if they want to connect with others and participate in network activities.



Fig. 2-1 Work social network

In our example, the work network contains a core that includes network members #1 and #3 (Figure 2-1). Network member #5 is located on the periphery of the network, only connected to the larger group through network member #4. Network members #8 and #9 are connected to one another, but not to the rest of the network. If network members #5, #8, or #9 lose their one respective relationship, they will become isolates, disconnected from the network. The network sociogram is color coded, based upon where the network members work. Network members coded pink work together in organization #1, and network members coded blue

work together in organization #2. Network members coded black work for neither organization. Visually, we see network members in organization #1 group together in the sociogram, as do those in organization #2. Two network members who work for neither organization (#8 and #9) connect to one another.

Network members #1 and #3 help form the core of the network and can act as gatekeepers, controlling the flow of information and other resources. Meanwhile, network members #8 and #9 must rely upon one another for resources, limiting their access. Network member #5 has a connection with network member #4, who works for organization #1. This can be a useful connection, particularly if either person wants to learn about job opportunities or gain access to resources different from what they can obtain in their current organizations. They have a relationship with someone who works in a different place, someone who potentially can provide them with access to different information and opportunities.



Fig. 2-2 Fantasy football social network

The fantasy football network also contains a core, where network members such as #0 and #7 are found (Figure 2-2). Additionally, the network contains a periphery, where network members #3, #5, #6, and #9 are located. The network sociogram is color coded. The black nodes indicate network members who have the highest level of fantasy football playing

experience. The blue nodes represent network members with a medium level of experience, and the pink nodes indicate those with the lowest level of experience. We can see the black nodes are located at the center of the network, members who connect to one another and to other members. Conversely, the pink nodes are located on the periphery of the network. These are network members with the lowest level of fantasy football experience. We might find in the fantasy football network that the core members can influence the interactions with and between other network members, sharing information about the upcoming games and players available to trade. Network members on the periphery may not receive this information directly, instead hearing about it secondhand from wellconnected network members.

The sociograms for both networks—work and fantasy football—provide us with a visual display of the connections formed among the network members. They offer information about key members at the core of the network in comparison to those operating along the periphery. The sociograms also give us information about how relationships can shift among network members based on the types of networks examined, in this case, working together and playing fantasy football together.

Granovetter (1973) called relationships between network members *ties*. He evaluated the ties occurring within social networks on the basis of their relative strength, whether *strong ties* or *weak ties*. Factors affecting the strength of network ties include time spent with other network members, emotional and intimate bonding, or a willingness to exchange resources. Strong ties between network members typically result from shared similarities (e.g., socioeconomic status, employer, political views). People tied strongly to one another often have comparable thoughts, feelings, and values (e.g., you and I have progressive views and vote for candidates from the Democratic Party). Strong ties can prove beneficial as they reflect these connections and bring likeminded people together. They, however, can reduce the receipt of new information and resources (e.g., we only obtain news from each other and liberal media outlets).

Weak ties exist among network members who might not share similarities. Instead, these individuals might work in different places or express different sentiments. Despite their differences, network members can benefit from developing weak ties with other network members (e.g., I identify as a Democrat, but am friends with Republicans). Granovetter (1973) asserted, "Those to whom we are weakly tied are more likely to move in circles different from our own and will thus have access to information different from that which we receive" (p. 1371). Weak ties can help to create connectedness within a social network, as network members build relationships with members different from themselves and generate potentially positive outcomes (e.g., developing and adopting a bipartisan policy). These relationships can facilitate a more efficient dissemination of information, innovations, and resources among different groups, as network members interact within and across different parts of the network.

In our example, we can see network members #8 and #9 are isolated in the work network, but they connect with other members in the fantasy football network. Network member #9 connects with network members #8 and #2, and network member #8 shares connections with even more individuals in this network. Both can use their additional connections in the fantasy football network to offset their relatively disconnected positions in the work network. For example, if network member #9 wants to leave his current job, he can gain information about potential job opportunities through his connections in the fantasy football network. Individuals in the latter network might know about possible openings he is not privy to in the work network. Information can spread among the network members as they play fantasy football together, in a way that might not happen if network members #8 and #9 tried to discuss career options with each other in the work network. Leveraging different types of network relationships allows network members to gain access to new and different resources.

Other Examples

We can consider other social network examples in addition to the one outlined above. If we think back to the physicians discussed in the previous chapter, the most well-informed and well-connected physicians appeared in the center of the medical community network (Menzel and Katz 1955). These individuals had the greatest access to information about new medicine and shared this information with peers located along the periphery of the network. Physicians at the periphery relied upon their centrally located peers, who served as gatekeepers of this knowledge. We saw similar advantages for scientists mentored by Nobel Prize winners (Merton 1968) and well-connected scholars in academic settings (Crane 1969). Scientists and scholars on the periphery of these networks in contrast often had fewer network relationships and access to resources.

In the fantasy football network, network member #5 has one relationship with network member #4. In turn, network member #4 has relationships with network members #0, #1, #2, #3, #6, #7, and #8. If network member #4 discontinues his fantasy football interactions, network member #5 becomes isolated and loses her connection to the network. For physicians in the medical community, this loss might create challenges with learning about and administering the newest products needed to successfully treat patients. Within sports, this disconnect might create challenges with teams gaining access to corporate sponsors (Pieters, Knoben, and Pouwels 2012) or connecting with their fans through social media (Clavio, Burch, and Frederick 2012).

Social network analysis and sociograms allow us to map these relationships and interactions. Visual depictions can help reveal or verify the presence of centrally located network members versus peripherally located ones. This information can help in understanding the benefits and advantages network members can obtain or the barriers they can face based upon their network locations (Borgatti *et al.* 2018).

Researchers also have suggested social network analysis can reveal previously unseen relationships or highlight the differences between formal organizational structures and informal ones (Gould and Gatrell 1979). For example, we can consider an organizational chart for a university athletic department. Figure 2-3 reveals the athletic director heads the athletic department. Senior associate athletic directors report to the athletic director. Associate athletic directors, head coaches, and the director report to the senior associate athletic directors.



Fig. 2-3 Athletic department organizational chart

The official hierarchy suggests a tiered organization. Following the chain of command, the athletic director provides direction to the senior associate athletic directors, who share this information with their respective direct reports such as associate athletic directors and head coaches, and so on. Individuals further down the organizational chart send information to their direct supervisors, who can choose to send this information back up the chain of command, where it can eventually reach the athletic director.

With this formal organizational chart, we have a hierarchical structure, where communications are received and disseminated by the athletic director in a *star network* (Figure 2-4). This network structure indicates information and other resources flow into the athletic director, who in turn can spread this information back to subordinates.



Fig. 2-4 Athletic department formal network

Management research, however, suggests these communications might not always occur in such a linear fashion (Cross, Borgatti, and Parker 2002). For example, a head coach might be a family friend of the athletic director, and the two individuals play tennis and engage in other extracurricular activities together. Rather than going through the formal communication structure, the coach instead might ask the athletic director to lunch in order to have a direct conversation. If these types of conversations occur throughout the organization, we now have an informal organizational structure alongside the formal one (Cross *et al.* 2002). Social network Chapter Two

analysis can help unearth or reveal these informal structures, as shown in Figure 2-5. This sociogram shows that the athletic director remains a central figure in the network; however, the senior associate athletic directors, associate athletic directors, and head coaches form separate subgroups. The associate athletic directors are positioned on the left side of the sociogram, the senior associate athletic directors are in the middle, and the head coaches and director are on the right side.



Fig. 2-5 Athletic department informal network

What are the benefits of this analysis? If I work in this athletic department, I might find it prudent to use the informal network structure and relationships to get the information and resources I need—or at the very least recognize this informal structure exists. This can help as I pursue career opportunities and other activities within the athletic department.

Sociograms can provide a number of benefits with social network analysis. We will see in upcoming chapters the use of sociograms to outline the structures and interactions within settings as varied as outdoor recreation groups (Paisley, Jostad, Sibthorn, Pohia, Gookin *et al.* 2014), sport tourism sites (Leung, Wang, Wu, Bai, Stahura, and Zie 2012), and corporate sponsorship networks (Cobbs 2011). We are only limited in our development of sociograms and analysis of social networks by the settings around us,