THE USE OF SOCIAL NETWORK ANALYSIS BY SCHOOL LIBRARIANS TO EVALUATE AND IMPROVE COLLABORATIVE NETWORKS IN THEIR SECONDARY SCHOOLS: A PILOT STUDY

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Abstract

Social capital, in the form of relationships among teachers, results in sharing information and resources, which leads to improved student academic achievement. As schools continue to seek out ways to improve performance, social capital is often overlooked in favor of development of human capital in the form of professional development and training. Schools that have implemented collaborative groups have the potential to increase social capital, but often fail to structure the groups intentionally or evaluate their outcomes.

School librarians in secondary schools often face challenges when it comes to collaboration. The job of a school librarian is inherently collaborative. To effectively serve the school's population, school librarians must understand the needs of their community. To teach information literacy skills, they must have access to students, typically via classroom teachers. Not surprisingly, collaboration between teachers and librarians is a major focus of both professional and research literature, yet librarians report it is one of their biggest challenges. Librarians are urged to start small, work with the teachers who are willing, and hope that others in the school will see the value of collaboration; in other words, *build it and they will come*.

This research sought to determine if school librarians could use social network analysis as an evaluative and strategic planning tool. This study used a mixed-methods approach in a three-phase process to collect social network survey data in two secondary schools, develop the Social Network Analysis for School Librarians (SNASL) Process, and pilot test the process with the school librarians in the pilot schools using participatory analysis. Analysis revealed that the SNASL Process has the potential to enable school librarians to evaluate and improve upon the collaborative network of their school by identifying individuals in specific role positions and producing generative insight regarding the structure of the school network.

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Chapter 1: Introduction

This research is concerned with collaboration practices between school librarians and teachers in public schools. The following question guided this work: *How can social network analysis be used by school librarians to evaluate and improve the collaborative networks in their school?* In order to answer this question, a method titled the Social Network Analysis for School Librarians (SNASL) Process was developed using social network analysis and then pilot tested at two schools in a mixed methods approach utilizing participatory analysis by the school librarians.

Statement of the Problem

The ultimate goal of any education setting is to improve student achievement. Research indicates direct links between teacher collaboration and student achievement (Y. L. Goddard, Goddard, & Tschannen-Moran, 2007; Ronfeldt, Farmer, McQueen, & Grissom, 2015); as well as indirect benefits to student achievement through improved teacher self-efficacy (*A teachers' guide to TALIS 2013*, 2014) and diffusion of ideas through dense teacher networks (Pil & Leana, 2009).

School librarians have been particularly focused on collaboration for decades. Since the 1960s, professional literature and guidelines for librarians have emphasized collaboration (Bergen, 1963). Despite this focus in both the professional literature and research, librarians find collaboration difficult to initiate. One promising methodology is social network analysis, which enables the school librarian to explore collaboration from a school wide perspective. Social network analysis as a means of understanding increasing collaboration features prominently in general educational research but a review of the literature confirmed that it has been mostly

overlooked in research specific to school librarians. Utilizing social network analysis, the school librarian can develop a systematic means of increasing collaboration throughout the school.

In order to determine an efficient and effective process for school librarians to implement social network analysis, and to determine if the resulting process would lead to the potential for strategic planning, research was conducted in two secondary schools in a mid-size suburban school district with experienced librarians that were new to their specific schools.

Rationale

Since the first professional standards and guidelines for the school librarian in 1988, the American Association of School Librarians (AASL) has included some form of instructional partnership as one of the roles of the school librarian (American Association of School Librarians, 2007; American Association of School Librarians & Association for Educational Communications and Technology, 1988, 1998). Callison (1999) noted that in *Information Power* the word "collaboration" appeared over sixty times. In the newest version of the national standards, "collaboration" appears seventy times (*National school library standards for learners, school librarians, and school libraries*, 2018). Not surprisingly, teacher and librarian collaboration is a main theme in the professional literature as well as research, focusing on: the role of the librarian as instructional partner (Ballard, 2009; Loertscher, 2014); views of collaboration (Asper, 2002; Bush, 2003); encouraging teachers to collaborate (Brown, 2004; Gess, 2009; Hylen, 2004; Morris, 2015); theories of collaboration (Montiel-Overall, 2005, 2008, 2010); impact of collaboration on students (Dadlani & Todd, 2016; Vermillion & Melton, 2013); and how to collaborate effectively (Buzzeo, 2010; David, 2008; Harvey II, 2008; Husid, 2013; Johnson, 2010; Lankau, 2015).

These authors often cite student learning and student achievement as the desired outcomes of collaboration. Haycock (2007) stated that "collaboration is the single professional behavior of teacher-librarians that most affects student achievement" (p. 32). Improving collaboration in schools, and particularly teacher and librarian collaboration, is of benefit to students both directly and indirectly (Haycock, 2003, 2007; Houston, 2008; Lance & Loertscher, 2001; Lonsdale, 2003). Several studies support the assertion that teacher and librarian collaboration improve student academic achievement (Lance, Rodney, & Hamilton-Pennell, 2000, 2003; Lance, Rodney, & Russell, 2007; Smith, 2006). Librarians provide expertise in locating instructional resources, teaching information literacy skills, and engaging in the research process.

Yet, librarians report that one of the major challenges they face is teacher collaboration. They complain that "it does not happen often enough, and the collaboration that does take place many times does not approach a level where the school library media specialist would be considered an indispensable member of the instructional team" (Cooper & Bray, 2011, p. 48). The answer to this problem is often tantamount to *build it and they will come*. Librarians are urged to start small, work with the teachers who are willing to work with them, continue to communicate, and hope that eventually the other teachers in the building will see the value of collaboration (Gess, 2009). Although this is necessary and useful advice, it requires a large investment in time and energy and has an uncertain result. Some teachers will respond to this approach, while others will not. Additionally, a librarian that is new to a school may not be fully aware of the existing collaborative structure of the school. He or she may waste time in rebuilding relationships with the library that already existed or focus energy in a haphazard way.

Although school librarians must reach out to teachers to build collaborative opportunities, this by itself, without a holistic and systematic approach, offers a murky and unknown result.

A review of the research suggestions that the tools and information provided through social network analysis offers schools a means of systematically analyzing their existing collaborative networks. Librarians can then use this information to strategize their collaborative attempts and better understand the collaborative structure of their building. With a basic understanding of social network theory and using social network analysis to investigate networks within a school, a librarian that is new to their building - regardless of their years of experience - can quickly get a picture of how much collaboration occurs in their building and establish an intentional plan for increasing teacher and librarian collaboration that allows them to manage and leverage their interactions with colleagues.

Librarians without these tools at hand may view collaboration in their school from an egocentric viewpoint because they know who they collaborate with and who they do not, but they are likely unaware of all the connections between the teachers in their building, especially in a larger school. For example, they may not know that the music teacher that they work with closely does not work with any other colleagues, or that the science teachers they meet with monthly to share resources work closely together but never in a cross-curricular unit with other teachers. Of course, this sort of information will be learned naturally over time as the librarian works with more educators in his or her building; but it is unlikely to be complete and may take several years of establishing relationships and gathering information. Social network analysis has the potential to speed up this data-collection process and ensures a greater degree of comprehensiveness (Cross & Parker, 2004). It also allows other educators in the building, including school leaders, to benefit from the information.

Limitations of the Research

The goal of this research is to outline a process that school librarians can use to evaluate and increase the quantity and quality of collaboration within their schools. It is important to note that the process investigated and suggested here is an initial idea based on preliminary data in two testing sites. Additional testing and research is needed to determine if the process will be applicable to other schools beyond the initial study population.

Chapter 2: Literature Review

This research study was informed by theories on social capital, social network theory, and collaboration. In this chapter, the literature regarding the value of teacher collaboration is presented and situated within the concepts of human and social capital.

Human capital is the knowledge, skills, and abilities of individuals. Social capital is the knowledge and resources that individuals have access to as a result of their social networks. In schools, social capital is developed when teachers collaborate, when they interact with each other to share information and resources, and benefit from each other's expertise and experience. The ultimate goal of any school is student achievement, and recent research suggests that teacher collaboration in schools and the resulting social capital has just as much, if not a greater effect, on student achievement than teachers' human capital (Brownell, Yeager, Rennels, & Riley, 1997; Bryk & Schneider, 2003; Coburn, Penuel, & Geil, 2013; McNicholl, 2013; Moolenaar, 2012; Moore Johnson, Reinhorn, & Simon, 2016; Perry, Phillips, & Hutchinson, 2006; Poulos, Culbertson, Piazza, & d'Entremont, n.d.; Stoll, Bolam, McMahon, Wallace, & Thomas, 2006). In other words, as depicted in Figure 2.1, when teachers collaborate, social capital within the school increases, and as a result students perform better than when teachers work in isolation.

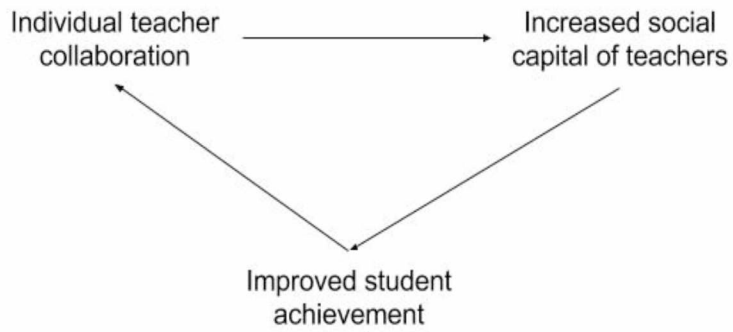

Figure 2.1: Cycle of Student Improvement as Result of Teacher Collaboration in Schools.

The Value of Teacher Collaboration

Leana and Pil (2006) found that social capital in the form of the structure and content of relationships among teachers significantly predicted student academic achievement. Goddard (2003) found a positive relationship between high levels of social capital and student academic achievement in mathematics and writing on the state standardized tests. Furthermore, Papa (1990) provided evidence that workers further improve skills acquired through training when they later communicate that knowledge to others. In all of these studies, researchers demonstrated that social capital in the form of instrumental relationships resulted in positive change.

The Teaching and Learning International Survey (*A teachers' guide to TALIS 2013*, 2014) examined collaborative activities of teachers worldwide and found that teachers that engage in collaboration at least five times per school year had higher rates of self-efficacy and job satisfaction, which has a positive association to student achievement. Collaboration was defined as taking part in collaborative professional learning, engaging in joint activities across

age and grade groups, observing and providing feedback on each others' practice, and teaching jointly in the same class.

One of the first studies to demonstrate a direct link between teacher collaboration and student achievement was Goddard, Goddard, and Tschannen-Moran's (2007) study; in their study of elementary schools in a large Midwestern district, they found teacher collaboration to be a statistically significant predictor of student math and reading achievement. Ronfeldt, Farmer, McQueen, and Grissom (2015) found that schools whose instructional teams engage in a higher quality of collaboration also reflect higher achievement scores in math and reading. Such communities of practice have been shown to improve student academic achievement. But implementing them alone is not enough to ensure improvement. One must be able to assess those communities of practice to determine if they are achieving their intended effect. Examining communities of practice through the lens of social network theory allows organizations to visualize the flow of communication among employees. By doing so, they can see where bottlenecks are occurring, where members of the staff are disconnected from their colleagues, and where certain individuals bridge the gaps between groups (Cross & Parker, 2004).

Even within an established team of teachers, quality of collaboration can vary. The quality of the collaboration influences how likely teachers' practices will change and thus student achievement will be impacted (Ronfeldt et al., 2015). Leana and Pil (2006) echoed this finding in their study of 88 urban public schools. They found that social capital - the structure and content of relationships among teachers - was a significant predictor of student math and reading achievement.

Examining collaboration from a social network perspective means accepting several assumptions. One assumption is that within relationships among individuals resources, such as

information and knowledge, are exchanged. In the classroom, this is evidence in the sharing of instructional resources and approaches to overcome classroom challenges (Degenne & Forsé, 1999). Strong group ties between teachers result in greater student achievement (Pil & Leana, 2009), because strong relationships facilitate and enhance the flow of resources and ideas. Vertical ties, such as those between administrator and teacher, do not affect the teacher team but result in student gains for those individual teachers who have strong relationships with administrators (Pil & Leana, 2009).

Pil and Leana (2009) also found that more-able and less-able teachers benefit from strong group ties in different ways. Students of more-able teachers performed significantly better when those teachers had strong horizontal ties. Less-able teachers benefited most from dense ties, meaning that all the teachers representing that educational focus are members of the community of practice; for example, all 4th grade teachers. In this way, the diffusion of ideas through the group is consistent and less-able teachers are sure to become aware of the teaching practices of their more-able peers. Additionally, density of connections increases trust, which makes willingness to be vulnerable to others more likely.

Another benefit of effective teacher communities of practice is the spillover effect described by Pil and Leana (2009). Although individual teacher educational attainment has no direct impact on student achievement, Pil and Leana (2009) found that within teacher teams, educational attainment had a positive association with student growth. Having a teacher with a higher educational degree in an effective team creates spillover that impacts the teaching of the other team members, regardless of their own formal education. In a similar study of five biology teachers engaged in collaborative professional development, McNicholl (2013) found that the presence of teachers of varying levels of knowledge and expertise was significant. These more

educated teachers often serve as informal mentors, providing instructional advice and new resources to less experienced teachers.

Collaboration Between Teacher & Librarian. Just as quality of collaboration within schools varies, so to does collaboration specifically between librarian and teachers. Constantly changing priorities, increasing demands on teachers' time, lack of training, and insufficient time to collaborate can hinder even the most willing participant. Studies show a considerable difference in the social network structure across schools (Daly, Moolenaar, Bolivar, & Burke, 2010; Moolenaar, 2010; Spillane & Healey, 2010). For example, Moolenaar's (2010) research into 53 Dutch elementary schools showed variation in teacher interaction across schools from 10% of teachers with relationships in some schools to 77% in others.

The difficulties involved in collaborating in schools can be exacerbated when cross-disciplinary teams such as teachers and librarians begin working together, or when teachers move from sharing resources to co-teaching (Zaretsky, 2007). Issues such as dividing responsibilities, respecting each other's expertise, and scheduling become more prominent. When librarians and teachers work together, it is not uncommon for librarians to allow the teacher to focus on content knowledge while the librarian handles process skills. Unfortunately, many teachers view process skills as less important; they are rarely tested and appear as a small portion of overall standards and curriculum objectives. Thus, when time grows short, they will minimize the time available for process and remove much, if not all, of the librarian's contribution to the class (Achterman & Loertscher, 2008). Librarians, on the other hand, view process skills as a core skill and necessary for developing life-long learning and believe inquiry can and often should be the vehicle for content rather than an addition to that content (American Association of School Librarians, 2007).

In fact, librarians report that one of the major challenges they face is teacher collaboration; "it does not happen often enough, and the collaboration that does take place many times does not approach a level where the school library media specialist would be considered an indispensible member of the instructional team" (Cooper & Bray, 2011, p. 48). The answer to this problem is often tantamount to *build it and they will come*. Librarians are urged to start small, work with the teachers who are willing to work with them, continue to communicate, and hope that eventually the other teachers in the building will see the value of collaboration (Gess, 2009). Although this is necessary and useful advice, it requires a large investment in time and energy; by itself, without a holistic and systematic approach, it offers a murky and unknown result.

Montiel-Overall (2005) proposed four stages or models of collaboration specifically with the librarian teacher collaborative relationship in mind: coordination, cooperation/partnerships, integrated instruction, and integrated curriculum. For Montiel-Overall, coordination might involve sharing of resources, time, space, or students. The model denotes the idea of efficiency to remove duplication of efforts, but in general requires minimal communication between partners. Cooperation describes relationships with members who come together to share funds, space, collections, shared time, and students (Fitzgibbons, 2000 as cited in Montiel-Overall, 2005). Cooperation involves setting goals; it reflects a philosophy of teamwork, however it is also associated with terms like help, aid, and assist, which denote one-sided relationships. In the librarian teacher relationship, the librarian is often a support to the teacher in a cooperative model of collaboration. However, this model can also be similar to a multidisciplinary unit where each teacher is responsible for the content that is specific to his or her area of expertise.

Integrated instruction, on the other hand, requires "shared thinking, shared planning, and shared creation of integrated instruction" (Montiel-Overall, 2005, para. 1). Collaborators work together toward a shared goal, each an equal partner with defined roles and shared responsibility. An integrated curriculum model requires that the librarian work with each teacher each year to plan, implement, and evaluation instruction integrated with library curricula.

Unfortunately, without effective social networks teachers often do not view the librarian as a suitable co-teacher. In a study of college faculty, Christiansen, Stombler, and Thaxton (2004) found that faculty often view librarians as a last resort for gaining access to research materials, rather than an expert on the research process; and do not view librarians as experts in their own fields of expertise and therefore not credible sources for consultation.

Librarians experience this disconnection directly in the form of interactions with faculty that reflect a perception that librarians are in a service position to faculty, and also indirectly through students who bring assignments that reflect out of date library practices. This disconnection interferes with the librarian's' ability to effectively serve students. Although faculty also are aware of the disconnection, they do not view it as problematic (Christiansen et al., 2004). The disconnect between faculty demands for student information literacy skills, the perception of the importance of those skills, and belief that librarians are or are not experts in these skills is troubling and must be overcome for students to benefit fully from librarian expertise and effectively master information literacy skills.

Montiel-Overall (2010) found similar results in her study of teachers and librarians in elementary schools. Teachers did not understand the role of the librarian, their areas of expertise, or how to effectively engage in collaborative teaching. Without effective trust, communication, awareness of each other's expertise, and time to engage in inquiry around instructional problems,

true collaboration cannot be effective. Social network theory offers a mixed methods means of analyzing the current state of collaboration in a school. With social network analysis data and reflection, librarians can work strategically to improve collaboration and thereby improve teaching practice and student academic achievement.

The Importance of Trust

Trust is essential to effective collaboration. In Chicago, an examination of reform efforts demonstrated that the level of trust among teachers was the distinguishing characteristic between schools that thrived under reform and those that did not (Bryk & Schneider, 2003), indicating that trust can be critical to effective change in schools. Trust between teachers, and between teachers and administrators, is so critical to effective collaboration that Putnam (1993, 1995) refers to trust as "social capital" and describes it as an asset that can be accumulated and spent. Communities that rely on and use trust accumulate more social capital and those that do not use trust diminish social capital.

In developing and maintaining social capital, two types of relationships are generally defined: instrumental and expressive. Instrumental relationships are work-related and ultimately aimed at achieving school goals, such as instructional reform. When teachers collaborate, they are engaged in instrumental relationships. Expressive relationships are not directly work-related and place the individual's interests above that of the organization; for example, friendship or personal guidance. Expressive ties are generally agreed to be more durable than instrumental ties (Moolenaar, Sleegers, & Daly, 2012), but both are necessary for school improvement.

Necessary to establishing and maintaining both expressive and instrumental ties is trust. Trust is typically defined as a judgment that another party will not act opportunistically, is honest in their negotiations, and makes a good faith effort to fulfill commitments (Tschannen-Moran &

Hoy, 2007). Improving instructional practice requires the acknowledgement of problems and areas of improvement. In trusting environments, teachers are more likely to disclose more accurate, relevant, and complete information regarding problems. However, when distrust is present, especially when one individual holds more power within the organization, communication becomes an effort to protect one's personal interest rather than presenting accurate information and sharing ideas. In her study of 45 schools in an urban school district, Tschannen-Moran (2001) found that trust was a statistically significant predictor of collaboration. The higher the levels of trust were, the higher the levels of collaboration. Both trust and communication are vital to successful collaborations. Each party needs to trust that the other will do their job effectively and communicate consistently in order to avoid duplicating efforts and ensuring they are meeting student needs (Wood, 2012).

Unsurprisingly, collaboration and trust are also cyclical in nature. Trust breeds more effective collaboration and collaboration results in greater trust between colleagues. These relationships affect teacher's social capital (access to knowledge and resources) and directly and indirectly affect student performance. In other words, the stronger the networks within a school, the greater the collective responsibility, collective efficacy, trust between administrators and teachers, and teacher influence on decision making, all of which positively impact student achievement (Moolenaar, 2012). Prior research suggests the trust generated in professional communities results in a culture that supports risk taking (Bryk & Schneider, 2003; Louis, Marks, & Kruse, 1996; Newmann, King, & Youngs, 2000). Being able to collaborate effectively requires trusting relationships and the need to feel safe (DeLuca, Bolden, & Chan, 2017). Although it is not required for colleagues to become friends, understanding each other on a more than instrumental basis by having non-work connections helps to make people seem

approachable and safe and helps build respect among colleagues (Abrams, Cross, Lesser, & Levin, 2003; Brown, 2004).

Rich and frequent communication also fosters trust. Increased communication provides more information resulting in a better assessment of another person's abilities, intentions, and likely behavior. Additionally, it helps in developing shared vision, goals, and language. Face-to-face interactions are stronger than other forms of communication, but what's most important is that one communicates frequently. This increases the information available for others to assess one's abilities, intentions, and behaviors (Cross & Parker, 2004). It is important, however, not to merely seek a connection, but to ensure that connection is a quality one (Abrams et al., 2003). This means that interactions should include both a personal and professional component, both expressive and instrumental qualities. Although every organization has a different culture and norms of behavior, it is often important for individuals to catch up on a personal level before engaging in work-related dialogue. Not every encounter needs to follow this format, but it is important that the relationship as a whole include both parts for the most efficient development of trust.

Further, teachers who have closer and more expressive relationships and interact frequently are more likely to reveal vulnerabilities and problems they experience in the classroom (Pil & Leana, 2009), thus opening themselves up to risk, but also to potential reward through evaluating and seeking solutions to problems and thus improving their practice. Zaretsky (2007) describes how practitioners engaging in collaboration for the first time initially experienced conflict as programming decisions were made unilaterally rather than with consultation from stakeholders and team members. As time went on, participants confronted

these issues and engaged in healthy confrontation to improve their working relationship and partnerships.

It is human nature that it takes time to develop trust. In any given situation, individuals must decide whether to trust another person. That decision is based on prior interaction and the current level of trust that exists. In other words, a person is much more likely to trust someone they know well than someone they do not. And yet, we are all aware of situations where someone was swindled or conned; where does trust come into play here? Coleman's formula for the trust relationship can help with understanding the reason, and how this might apply to the school setting. When a decision is made whether to trust someone, the difference between the absolute potential loss and the difference in gain between one friend and another is examined (Coleman, 1990). For example, if Teacher A is known for being disorganized, Teacher B may choose to go to Teacher C instead, even though no prior relationship exists between Teacher B and C. The potential loss in consulting Teacher C is low, and the potential gain compared to Teacher A is high.

In respect to the teacher and librarian relationship this emphasizes the importance of the school librarian getting to know the staff so that trust can be developed. Further, it demonstrates that people are willing to work with someone they do not know well (and thus cannot trust fully) if the potential gain is higher than working with someone they do trust. This means if the librarian has demonstrated him or herself as an expert, it is more likely that staff will work with him or her since the potential gain of working with an expert who is not a friend is higher than working with a friend who is not an expert. Of course, many of these decisions are made subconsciously and how we weigh perceived trust and perceived gain or loss from an interaction

is relative and personal. However, by understanding how these decisions are made, librarians can help shift things in their favor.

Similarly, as information becomes increasingly accessible through websites, databases, and internal networks, the quality of the resources plays a role. The principle of least effort is often applied, where information seekers go to the most easily accessible source regardless of its quality. However, when a decision is being made about which person to seek information from, quality does play a role (Cross & Parker, 2004). Thus, it is critical for the librarian to be trustworthy as an effective and reliable source of information.

Another aspect of trust is the fidelity demonstrated between words and actions. If someone says they will do something and then does not, or does something else, it is likely one will question their dedication to the others' interests. This is more complicated than it appears on the surface, however, especially in the busy environment of a school. This is not just about words matching deeds, but expectations matching deeds. That is why when a school librarian collaborates with a teacher, it is important to lay out the expectations. Who will accomplish what task and in what timeline? Once those expectations are set down in a clear way, it is important that they be enacted in order to build and keep that trust. A teacher that asks the librarian to prepare an online resource guide for a class project and finds when the class arrives that the guide was never finished is less likely to work with that librarian in the future, as he or she is now deemed untrustworthy. Of course, all of these concepts are relative. The first few collaborative interactions with a colleague are much more important than after several years of working together. This is not to say that one should prioritize new colleagues above colleagues with more established relationships, but that once trust has been built it is more likely to

withstand some pressure. A colleague that has a negative first impression has a much harder time gaining traction.

However, it is just as important to understand the skills and expertise of the others in the school environment. One of the most overlooked dimensions of trust within school districts is the ability to accurately determine who knows what. The lack of awareness of each other's skills and expertise is one of the major hindrances to individuals working together. Even if all other aspects of the organization foster and support collaboration, people will not connect on new projects or to solve existing problems if they do not have an understanding of the other person's knowledge base (Cross & Parker, 2004). Administrators can overcome this by grouping together individuals who do not normally collaborate when engaged in specific projects; this gives them the structure and time to get to know each other's skills and personalities.

Once they have this information, teachers can use it when opportunities or problems arise. Teachers need to know who has relevant expertise in order to know who to reach out to for their particular problem. Administrators cannot just present one-fits-all solutions; rather each situation needs to be examined independently and solved as fits its particular circumstances. Having this information can help determine who to seek for each task and therefore has a positive impact on collaboration (Cross & Parker, 2004).

Furthermore, it is important that individuals not only identify what they know to others within their organization, but also set boundaries on the limits of their knowledge. Although this can be a challenge, it is important not to let the pressure to be an expert in all areas drive one to answer questions with more confidence than they should. The possibility of incorrectly answering a question can create a wedge in the trust that exists. This can be especially difficult for librarians due to the expansive nature of their job, which involves not only information

literacy instruction and library operations, but also technical support and instructional technology. It is important that people clarify what they know, and what they are willing to find out. For example, if a teacher came to the librarian with a DVD stuck in a computer disc drive, the librarian might say something like: "I know a few tricks but I'm not sure exactly where the problem lies. I'll look into it for you and let you know." Rather than saying, "Sure. I'd be happy to fix that for you." The first is very clear about the librarian's intentions and does not offer false expectations.

The Role of Homophily in Trust. Because of the historically isolated nature of teaching, creating a culture of sharing can be difficult due to the inherent risk involved in sharing (Gajda & Koliba, 2008). In her study of collaboration between teachers of gifted students and school counselors, Wood (2012) found that each party believed they needed to understand what the other did in order to collaborate. Similar to the case of school librarians, teachers respect school counselors and think their work is important, but view them as possessing a completely separate set of skills; the lack of perceived similarity results in greater risk, and so collaboration is rarely initiated or sustained. This principle, that individuals tend to form relationships based on how similar they are, is called homophily. Research shows that the more similar individuals are, the more quickly resources will travel between those individuals; and the more dissimilar individuals are, the less likely they are to share information (Coburn et al., 2013; Cross & Parker, 2004; Moolenaar, 2012).

Teachers tend to seek out others like themselves (e.g., same grade-level, same subject-area, similar levels of experience) to mitigate this risk, but schools and districts can influence whom teachers perceive as similar via organizational structures (Coburn et al., 2013). In their examination of a failed mathematics reform effort in a public school district, Coburn et al. (2013) found that district policy influenced tie formation (i.e., formal relationships) between teachers. In the first year of the initiative, when teachers discussed mathematics in their traditional grade-

level groups, their tie formation was based on proximity and homophily. In year 2, when the district changed the structure of the meetings, proximity and then expertise became the most important quality for new tie formation. Teachers sought out other teachers because they identified new experts in their social networks based on groups formulated by the district. Had the teachers not been asked to interact with new groupings, is it likely that homophily would have continued to be the predominant method for social connections and teachers would have had less access to social capital.

Studies of collaborative inquiry that involved diverse groups of educators indicate the value of bringing diverse viewpoints and experience to the table (Borgatti & Cross, 2003; Cantalini-Williams et al., 2015). In a study involving teachers, administrators, school board members, and university partners working together to solve instructional challenges, Cantalini-Williams et al. (2015) noted that teacher participants were able to learn from each other and felt more supported in their mission by having both other teachers and administrators participating in collaborative instructional-focused dialogue. The structural diversity of the team was cited as one of the main advantages of the study, bringing diverse viewpoints and experiences to the table and enabling participants to discuss future possibilities and the potential impact of their work on others in the school and district.

Physical proximity is an important dimension to why individuals work with each other. Physical proximity increases the likelihood that people will have chance meetings that enable them to learn about each other, develop bonds, and thus enable intentional encounters in the future (Borgatti & Cross, 2003). Although proximity alone is not a determinant, it increases the likelihood that people will have chance meetings that enable them to learn about each other, develop bonds, and thus enable intentional encounters in the future (Borgatti & Cross, 2003). In

a school setting is it particularly important to pay attention to this. No matter how a school is organized (grade level, subject area, etc.) there will always be teachers that are physically farther away from each other than others.

Whether via proximity or other variables such as workload and flexibility of scheduling, accessibility is a critical factor of how people make choices regarding who to consult for information and resources (Borgatti & Cross, 2003). Administrators can mitigate the effect of proximity by structuring professional learning communities and other school events so that teachers from diverse backgrounds and physical locations have an opportunity to work together and get to know one another.

Communities of Practice or Professional Learning Communities (PLCs)

Frequent interaction can also help build trust. Thus, schools and districts can create environments that breed that interaction through professional development or meetings that encourage teachers to engage frequently and in sustained ways, as well as by arranging physical space such that teachers interact with colleagues more or less frequently based on proximity. Focusing teacher communities of practice on a particular topic or idea, such as an instructional reform, may also impact whom they seek out in discussing instruction (Coburn et al., 2013).

Communities of practice are groups of people that share a concern or passion around a topic and who deepen their knowledge of the topic through ongoing discussion and inquiry. It is important for successful school wide collaboration that all teachers be part of a community of practice and those communities of practice have strong ties between them. Having a shared purpose and engaging in a cycle of inquiry ensures that teachers store, retrieve, examine, transform, apply, and share knowledge and experiences about practice for a shared purpose. It is through this process that a group of teachers in a school becomes a professional learning

community. Having that shared purpose functions as a glue that holds each team together in their cycle of inquiry, and focuses dialogue, action, and evaluation (Wenger, McDermott, & Snyder, 2002).

Teachers in schools with strong professional communities are more likely to make changes to their instruction practice (Louis & Marks, 1998; Louis et al., 1996; Newmann et al., 2000) and experience increases in student learning (Lee & Smith, 1996; Louis & Marks, 1998; Yasumoto, Uekawa, & Bidwell, 2001). The access to support and resources that students possess as a result of social network connections can facilitate their success in school. Furthermore, the literature reveals that professional development in schools is most effective when teachers conduct professional inquiries into their own practice via teacher teams or professional learning communities (McNicholl, 2013; Moore Johnson et al., 2016; Perry et al., 2006; Stoll et al., 2006). School administrators can form these communities of practice purposefully to accomplish a specific goal, or allow them to develop organically, as teachers tend to gravitate toward others that share similar interests or have similar backgrounds.

Allowing teachers the time to collaborate with each other also allows them to situate new information into the schema of their existing beliefs and forge shared values amongst their colleagues, resulting in supportive risk taking and transformative practice (Tschannen-Moran, 2001). In a case study in Canada, Zaretsky (2007) found that even though teachers noted that their collaboration resulted in more questions and tensions as participants shared different values and beliefs, they found that it was necessary to gain a better understanding of issues in education and their own practice. In her two-phase study of middle schools, Pounder (1999) found that schools where teachers worked in grade-level teams were more likely to be aware of student circumstances that might affect learning, such as family concerns and educational histories, and

have a greater professional commitment than non-teamed teachers. Engaging in dialogue around instructional practices also allowed teachers to learn new strategies, reaffirm their practice, and think more deeply about their practice than they would have otherwise.

Unfortunately, schools and districts rarely provide teachers enough opportunities to engage in substantive dialogue with other teachers regarding instructional practice (Tschannen-Moran, 2001). Insufficient time is often cited as a barrier to implementing collaboration. However, in a study of six high-poverty schools in Massachusetts, Moore Johnson et al. (2016) found that collaboration reduced the stress of teachers, even when they complained about the pace of their work. These six schools had all achieved the state's highest performance rating, based on student growth and the narrowing of achieving gaps in student subgroups. The schools followed various models including traditional, turnaround, and charter schools. In all six schools, Moore Johnson et al. (2016) found that collaboration was emphasized and teachers found it to be beneficial, despite the workload. Although collaboration took a substantial amount of time, teachers believed it improved their teaching.

Nevertheless, most public schools in the United States have focused on the human capital of teachers - their competencies and experience - rather than social capital - the resources and information accessible to them through their social networks (Pil & Leana, 2009). This emphasis stems from the emphasis by government, business, and school leadership that there is a need for *highly qualified* teachers. However, far less agreement exists on what qualifications teachers should possess and how those qualifications can be attained (Darling-Hammond, 2004). To respond to the perceived inequities, policy makers have called for increased professional development, mandatory testing of teacher subject knowledge, and improved training for

aspiring teachers (Schneider & Keesler, 2007), putting human capital at the center of school reform efforts.

Within this environment, building and maintaining the relationships necessary for effective collaboration is not an easy task. Poulos et al. (n.d.) recommends that school leaders establish structures for school-wide participation in collaboration; model constructive feedback; prioritize a cultural fit when hiring; and create opportunities for teachers to work together. With competing priorities, full schedules, and varying needs, it can be difficult for school leaders to invest their time in improving staff professional relationships. Many districts have implemented communities of practice or professional learning communities (PLCs), discussed in more detail later in the chapter, as a means of supporting teacher collaboration, but setting aside time alone for teachers to talk will not ensure that these PLCs are effective at improving teacher practice or increasing student achievement (McNicholl, 2013).

To study the impact of social capital (the access to information and resources) on schools, and determine whether PLCs are effective, numerous education scholars have adopted a social network perspective to study teacher collaboration (Daly & Finnigan, 2010; Moolenaar et al., 2012; Penuel, Riel, Krause, & Frank, 2009). This method enables the researcher to see the patterns of social relationships among teachers and to determine the degree to which collaboration takes place. Although now common in the field of education, this approach has been overlooked in the specific realm of school librarianship; only one study has used social network analysis as a methodological approach (Schultz-Jones, 2009).

And yet teacher and librarian collaboration is a main theme in school librarianship literature and research, focusing on: views of collaboration (e.g., Asper, 2002; Bush, 2003); encouraging teachers to collaborate (e.g., Brown, 2004; Hylen, 2004); theories of collaboration

(Montiel-Overall, 2005, 2008); and how to collaborate effectively (Buzzeo, 2010; Harvey II, 2008; Husid, 2013; Johnson, 2010). Research on how to improve collaboration primarily focuses on observing successful collaboration and extrapolating best practice from these observations (e.g., Brown, 2004; Haycock, 2007). These sets of advice often treat the librarian as an isolated actor. They overlook the other existing relationships in the school and the culture of collaboration that may or may not exist in that school. Social network theory offers a lens through which to examine collaboration in schools by examining the relationships between teachers in schools. This information can then be used to improve collaboration and by extension student learning.

Social network analysis enables the librarian to improve collaboration by not only examining one's personal network, but the network of the school as a whole and the relationships between individuals. In the only study that utilizes social network analysis in specifically examining the role of the school librarian, Schultz-Jones (2009) found that establishing and maintaining a social network within the school environment is critical to the school librarian, regardless of length of service. Visualizing the social connections within the school allowed the librarians in her study to think strategically about building relationships, as opposed to focusing on a specific subject area - a common trend in school librarianship.

By embedding teachers' individual behaviors into the pattern of their interpersonal relationships, social network analysis captures collaboration in a way that other methods cannot and facilitates the researcher's generative insight in a way that can result in transformative change. It allows the analyst - in this case the school librarian - to notice characteristics of the entire school network (e.g., density) as well as characteristics of subgroups and individuals within the network (e.g., math department is highly collaborative but isolated). This new source

of information enables the librarian to become strategic about his or her own collaborative practices and improve collaboration school-wide.

Chapter Summary

The intent of this study is to answer the research question: *How can social network analysis be used by school librarians to evaluate and improve the collaborative networks in their schools?* Social network theory relies on an understanding of social capital. In this chapter, an introduction to social capital and its role in teacher collaboration was presented. Prior studies that build on this foundation, explicitly or implicitly, were presented that demonstrate the value of teacher collaboration, the importance of trust, and the role of communities of practice both for schools in general and particularly in regards the teacher and librarian relationships. The existing research demonstrates the necessity for strong social networks and sufficient social capital for strategic improvement of collaboration and by extension teaching practice and student academic achievement.

To fully address this question however, a more extensive and purposeful dive into the theoretical foundation of social capital and social network theory is required. In the following chapter, the theoretical framework for the research is presented: more completely defining social capital, explicating social network theory, and defining and explaining individual network positions. This information will provide a necessary foundation for the reader to better understand the methods and findings.

Chapter 3: Theoretical Foundation

In this chapter, social and human capitals are contrasted to highlight the opportunities and limits of ongoing teacher and librarian collaborative practice at a particular place. Existing models of school improvement often focus on human capital - the knowledge, skills, experiences, and abilities - possessed by individuals. Schools and districts provide professional development to teachers in an effort to increase their human capital. Some research suggests, however, that social capital - the information and resources accessible through one's relationships - has just as much, if not a greater, effect on student achievement than teacher human capital (Bryk & Schneider, 2003; Daly et al., 2010; Leana & Pil, 2006; Pil & Leana, 2009).

Drawing from both human and social theories of capital, social network analysis is a means to help generate strategies for deeper collaboration inside a school. A social network analysis affords a contrast between collaboration as current practice and collaboration as potential practice. For example, through a social network analysis, the potential for collaboration is highlighted so that the individual librarian can not only assess his or her own current collaborative potential and that of the school as a whole, but also develop ways to increase such social capital within that school, thereby potentially increasing collaborative capacity throughout the system. Analysis of how capital is dispersed enables both insight into current practice and future strategic action.

Social capital as a concept is not inherently *good* or *bad*; it is a tool (Putnam, 2001). Social network analysis can reveal existing power structures and the flow of power within and between organizations. For this reason, the exchange of information and resources can be used to improve the availability of social capital through a school, just as it can be used to maintain and

reinforce existing power structures that limit social capital. This is not to say that collaborative relationships do not possess power structures, but rather that the flow of power within networks is not the focus of this research. For the purpose of this research, social network analysis is used to examine the collaborative structures within individual schools. Additionally, it is assumed that educators in a school have positive intentions and use social capital to improve student learning, growth, and working conditions.

Within this chapter, content is organized from broad to narrow in scope: beginning with a definition of social capital, moving to the study of social capital through social network theory, and finally to an examination of the specific roles individuals play within social networks.

A Note on Language Used in this Dissertation

The language of social network analysis stems from the communication discipline. Terms like boundary spanner, information broker, peripheral person, and central connector are not value judgments. Used out of context, these terms can reduce the individual to their role in information flow rather than the more complex reality who they are and their role in the organization. I chose to use the terms of social network analysis, including words that reduce an individual to a specific set of characteristics because these terms reflect the flow of information and resources throughout the network, and the ultimate goal of social network analysis is to map those patterns.

The school librarian (or administrator or teacher) who uses this methodology to identify role positions in the network will have a more complete awareness of each individual's contributions to the network than is present in the anonymous version presented in this research, because they have context and experience with the various members of the network. Using social network analysis enables the school librarian to distance themselves from their preconceived

notions about each individual's role in information flow, while still viewing them as a whole and complete individual with multiple contributions to bring to the network.

One's position in the network may increase or decrease their ability to disseminate or obtain information, but this positioning does not make that individual's role in the network any more or less valuable. For example, a peripheral person, who exists on the edges of the network, may be positioned there due to his or her role as an expert in the community. Operating on the fringes allows this person to work undisturbed. Their connection to the remainder of the network may exist through a boundary spanner that facilitates the flow of information between the peripheral person and the remaining network. It is only through additional exploration beyond social network analysis visualizations that one can determine whether an individual's position in a network is of benefit, detriment, or neutral to the greater whole.

The school, like any organization, is an information network. The identification of individuals in these positions within the network allows the viewer to see specific junctures where information and resources travel in recurring patterns. By identifying the individuals that hold these positions, the school librarian can better see those patterns of information flow and have the potential for leveraging that information flow to improve social capital throughout the network.

These patterns of information and the communication that enables the flow between individuals and groups is a source of power because "communication, and particularly socialized communication, the one that exists in the public realm, provides the support for the social production of meaning" (Castells, 2009, p. 238). This type of power suggests that influence is not relegated to the authority figure in a particular network due to his or her position, but is a

feature of the network that any individual can possess based on access to and redistribution of information and resources within that network.

Defining Social Capital

Social capital's principal theorists (Coleman, 1990; Putnam, 1995) define social capital as "features of social organization, such as trust, norms, and networks, which act as resources for individuals and facilitate collective action" (Lochner, Kawachi, & Kennedy, 1999, p. 260). For example, in a network of friends where everyone is connected to everyone else, all members tend to exchange information and resources, trust each other, and share similar attitudes (Coleman, 1988). In contrast, individuals with no ties to each other have difficulty exchanging resources and ideas because there are no established ties from which those ideas and resources can flow. One way to distinguish between social capital and human capital is that human capital is a quality possessed *by* an individual; whereas, social capital is a quality created *between* people (Burt, 1997). In the world of education, as with many other fields, social capital can be more concretely defined as access to valuable resources (e.g., lesson materials, information) through one's social relationships with others.

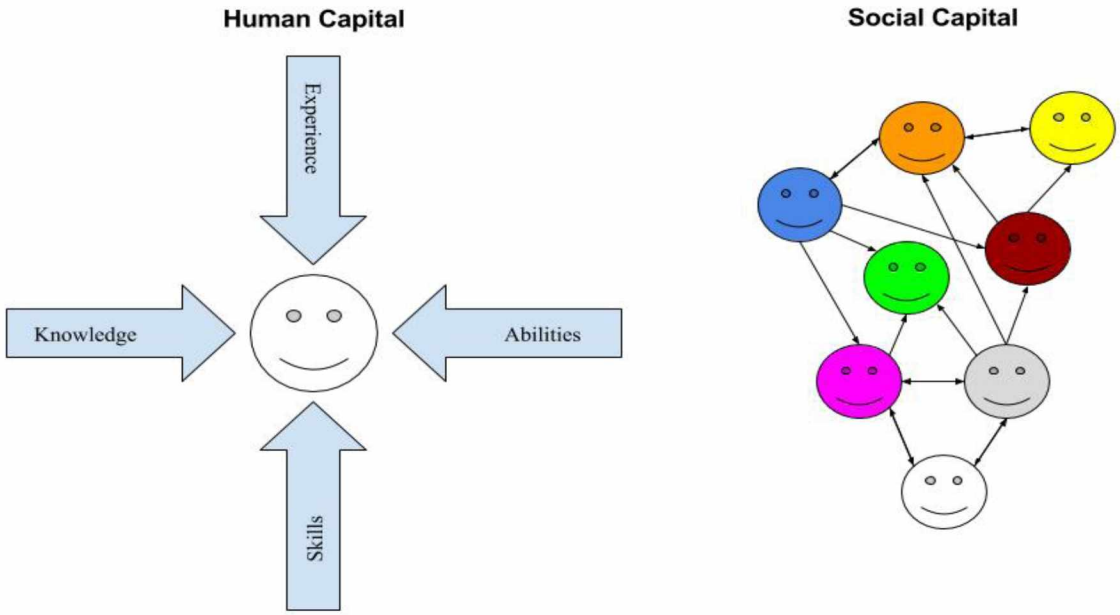

Figure 3.1: Visualization of human and social capital.

Figure 3.1 visualizes the distinction between human and social capital. Human capital is internal to the individual and consists of the knowledge, experience, abilities, and skills that one possesses. Social capital is the access we hold to each other's human capital, as well as the forces our social relationships exert on us, and the opportunities they provide (Burt, 1980). Within a school each teacher possess human capital in their educational background, training, knowledge, skills, and abilities. When those teachers collaborate, they benefit from each other's human capital via social capital. For example, librarians are research experts and often have access to research tools such as inquiry process models. A librarian that does not collaborate with teachers still possesses knowledge and resources about research, but the teacher does not benefit from that knowledge. When the teacher collaborates with the librarian on a research project, he or she gains access to the knowledge and resources of the librarian.

The foundational theorists (Burt, 1995; Coleman, 1990; R. D. Putnam, 1993) define social capital as a function of social structure producing advantage. Putnam (1993) specifically defines social capital as "features of social organization, such as trust, norms, and networks, that can improve the efficiency of society by facilitating coordinated action" (p. 167).

As other researchers and theorists have taken up a social capital framework and approached the idea from different perspectives using various forms of evidence, they all operate under the assumption that "better connected people enjoy higher returns" (Burt, 2000, p. 347). In the educational community, this concept can be seen in the work of Pil and Leana (2009), who found that teachers that work with more highly educated teachers will experience benefits in their own teaching practice and student academic achievement, regardless of their own level of education, or human capital. In other words, the human capital of the teacher has a higher benefit to the school when accessed via social capital than it does when the teacher works exclusively in isolation.

However, public schools often place a stronger emphasis on human capital than social capital (Pil & Leana, 2009). The concept of human capital (Becker, 1964) has played a central role in models of individual and organizational performance since their introduction. Human capital is defined as “an individual’s cumulative abilities, knowledge, and skills developed through formal and informal education and experience” (Leana & Pil, 2006, p. 1103). Human capital leads to superior performance, productivity, and career advancement for individuals.

Coleman (1988) theorized that for human capital to benefit the collective, it must be shared with others through social interactions. He provides the example of a family, whereby a parent may have extensive human capital yet does not spend time with their children (Coleman, 1988). If the human capital of the parent (his or her knowledge, experience, skills, and abilities)

is not employed at home - in other words, if the parent is absent or does not engage with the child - then that human capital is mostly irrelevant to outcomes for the children. The social capital, in the form of relationships between the parents and children, is what determines the value of that human capital. Without the relationships between individuals, human capital is available only to the individual that possesses it. However, when individuals come together, they can access each other's human capital. This accumulation of capital, along with the social forces exerted by those relationships, is social capital.

Human capital, when isolated from social capital, makes it possible for the individual who invests in it to reap its benefits. The individual who seeks additional schooling or training reaps its benefits in the form of more satisfying work, a higher-paying job, or a greater understanding of the world. Although an individual may benefit from social capital, the individual's actions have an impact on all those in the system. Coleman (1988) provides the example of a school parent group. For example, imagine a group with a large population of parents who do not have full-time jobs outside of the home. If one heavily involved parent decides to take a full-time job and remove him or herself from the parent group as a result, that specific parent may not feel a loss, but the withdrawal of the loss of the individual constitutes a loss to all the other parents whose associations and contacts were dependent on them.

This same experience can occur if a heavily involved teacher retires. It can take several months, or even years, to regain the bulk of the knowledge lost when a well-connected individual leaves an organization (Coleman, 1988). When a librarian retires or moves schools, he or she does not take the books and databases with them, but the knowledge of how to access those resources, the most efficient way to find information. Another librarian may learn this type of information quickly, but it takes longer to develop the social relationships that enable that

information to be widely shared. It is the networks of relationships within the school that enable the information to flow between individuals.

The school librarian, or any school leader, who understands these distinctions between human and social capital and the impact of each on the system as a whole is equipped to put this knowledge to use in educational initiatives, such as professional development, since public schools often focus their professional development on providing information and developing skills in the individual to increase the effectiveness of the teacher in his or her classroom. If the administrator recognizes the value of social capital, he or she will ensure that staff and faculty build relationships with each other as well. Then, when one teacher receives training he or she will be more apt to share it with the other teachers. They too will then benefit from the training and their students by extension. As teachers begin to implement the new ideas, resources, or strategies in their classrooms, the social networks that enable them to discuss their challenges, successes, and questions will positively impact the entire school. If instead, those teachers are isolated and do not communicate, their human capital may still increase, but the social capital of the school will not. In fact, Daly, Moolenaar, Der-Martirosian, & Liou (2014) compared teacher social capital and human capital through interim student assessments and found that teacher social capital had a greater influence on student success on interim benchmark exams than human capital did, suggesting that teachers' social networks are more important for student achievement than their individual experiences or educational attainment.

Public school districts often invest money and time in training employees and seek to hire those with the strongest credentials. For example, many school districts incentivize more education by paying a higher wage for more educated teachers. This human capital is valuable to an organization, but only to the extent that there exists social capital - the information and

resources accessible through one's social contacts (Coleman, 1988). If a single employee gets training on a new technology, but does nothing to share that knowledge with his or her co-workers, the effect of that training is minimized.

In the context of the school library, social capital enables the teacher to gain information and resources from the librarian. Those resources may include the physical items of the library, but are also the librarian's expertise in information literacy skills and pedagogical practices. One of the roles of the school librarian is to build a collection of resources and curate that collection. With modern technology, many teachers do not need to interact with the librarian to access library materials; they can find them through the library or school district's website. However, the teacher that includes the librarian in their social network benefits from the human capital of the librarian, as well as the physical and electronic resources that the librarian manages. Seeking the librarian's expertise adds to the teacher's social capital; adding to the resources and information that the teacher has access to and thereby creating an advantage for that teacher. The best teacher may not necessarily be the one with the most education or experience, but the one with the greatest social capital. In fact, Pil & Leana (2009) that human capital of teachers benefits other teachers more than it benefits the individual who possess the capital, helping to demonstrate that it is not the human capital of the individual that is most important but the social connections within the organization that define success.

Referring back to Figure 3.1, the teacher that effectively builds a social network within his or her school that includes the librarian, increases his or her knowledge, abilities, and skills, and also now has the capacity to transmit that knowledge through the network. Social capital research in education has demonstrated that teachers who have greater access to social capital - typically measured as the quantity and quality of their social relationships - are in a better

position to implement new initiatives and demonstrate innovation (Coburn & Russell, 2008; Frank, Zhao, & Borman, 2004); achieve higher student achievement (Moolenaar, Sleegers, & Daly, 2011; Pil & Leana, 2009; Spillane & Kim, 2012) and experience greater quality of the resources that flow through their networks (Carolan, 2014). In contrast, teachers who possess a large amount of human and physical capital in the form of experience, education, and personal materials, but very little social connections are unable to access the information and resources that are possessed by their colleagues. Their potential for gaining access to information and resources is reduced due to their small social network. The teachers with large social networks, by having a higher quantity and quality of relationships, have a larger knowledge network to draw from when necessary, and can thus improve their teaching practice through access to information and instructional resources from their colleagues.

Social Network Theory

Social capital theory foregrounds how relationships are necessary to access the information and resources possessed by others; in contrast, social network theory reveals the patterns in the social structure that enable social capital to exist (Burt, 2000). In education, social network research has been used to examine leadership practices, professional learning communities, teacher collaboration, reform implementation, and teacher induction and retention (Moolenaar, 2012). Social network theory is a mechanism for understanding the social capital relationships between embedded individuals in a particular system. Thus, it can be used to better understand how librarians and teachers collaborate. It is important, however, in order to get a full perspective, to examine both the whole system level and also the component parts within that system.

One of the advantages of social network theory is the dual nature of the study of the individual and the group. Therefore, it is uniquely situated for the study of the librarian in the greater context of the social relationships within the school. Social network theory offers a holistic perspective in which macro level actions produce micro level interactions and vice versa (Coleman, 1990). One of the most well known examples of the micro level influencing the macro level is the "tragedy of the commons" in which the grazing of each farmer's sheep reduces the availability of pasture for the sheep of other farmers. Another example that teachers can relate to is union-management bargaining. Although there are only two actors arriving at a decision, the outcome impacts all parties in the system. In other words, the transition of information from the macro level to individual actors can affect the actions they take and thus affect system behavior. Another reason for examining a system from a macro-level perspective is the fact that actors are not fully in control of their activities, but find some of those activities partially or wholly controlled by others. The rules and norms of behavior of an organization are one such example of this sort of control.

There are three assumptions that underlie social network theory (Degenne & Forsé, 1999): individuals are embedded in social structures meaning that they are interdependent, resources that flow through a network must do so through interactions between individuals; and social networks both provide opportunities for and constrain the actions of individuals and organizations.

The first assumption that individuals are embedded in social structures refers to the fact that actors are interdependent (Burt, 1980). This social embeddedness in the school environment is visible in the way that teachers work in various groups, including grade-level teams, subject departments, one-to-one interactions, and larger structures such as a schools and districts.

Acknowledging this interdependence means that changes at one level will impact other levels. For example, increasing the human capital of teachers by increasing their knowledge will have impacts on the various teams they interact with, thus improving grade-level knowledge.

The second assumption is that resources flow through a network and are transferred by social interaction between individuals. This may consist of transfer of information from one individual to another, or a larger diffusion of ideas throughout an entire school community. Rogers (1983) defined diffusion as "the process by which an innovation is communicated through certain channels over time among members of a social system" (p. 5). Rogers' (1983) process consists of an individual's awareness of an innovation, decision to adopt or reject the innovation, implementation of the decision, and confirmation of the decision. In schools, teachers routinely exchange instructional materials, ask for pedagogical strategies to overcome common problems, and gather information from each other on various educational ideas and opportunities. As they encounter new ideas, they engage in Rogers' process. Deciding to co-teach with the librarian is an example of this process. A teacher must first be aware of the opportunity, then decide to engage with it or not, implement the decision to co-teach or not, and then confirm that decision through assessment of student outcomes. Social network analysis can be used to examine the diffusion or exchange of ideas at an organizational level (Frank et al., 2004).

Third, the social network perspective acknowledges that social networks both provide opportunities for and constrain the actions of individuals and organizations (Burt, 1980). In schools, teachers may benefit from instructional resources and the expertise of co-workers, but they can only benefit from those resources if they have access to them through their relationships that are available within their social network. Thus, lack of access to necessary resources may

hinder a school's capacity for improvement. Social networks with strong ties tend to exhibit norms of behavior. These norms may develop naturally or be crafted intentionally, as a result of groups working together. In a cohesive group, norms can result in sanctions or rewards for members of the group. For example, in a school library that loans technology such as computer carts, it might be a norm that the teacher loaning the equipment returns it in good condition on time. If the teacher chose not to do this, and the next teacher receiving the equipment receives it late, the librarian might choose to deny the first teacher the opportunity to use the equipment in the future. This type of sanction is most effective when it derives from the group as opposed to the individual. If the teacher using the cart, the teacher who received it late, and the librarian all have strong ties, the sanction has more weight than if it is purely the librarian imposing a sanction on the first teacher.

Whole Network Measurements

Most social network studies of the educational environment examine system-wide macro-level features of the schools, such as the density or centrality of the whole network as described below. These system-level measurements are useful in examining the change in schools over time and comparing multiple schools. On the other hand, ego-level measurements - those that measure the characteristics of a specific individual in the network - enable the researcher to understand how individuals interact with each other within a network (Coleman, 1990). Understanding the characteristics of a particular individual can enable the researcher to ascertain their role in transmitting or receiving information and resources to others in the network.

As a participant in the community, school librarians also gain the ability to understand their own role in the system and how they interact with individuals and subgroups in the social network of their schools. By first noticing the characteristics of individuals within the network,

the participant researcher can use that information to create a strategic plan to leverage or modify those characteristics. Nevertheless, examining macro-level characteristics and qualities of social networks can provide a foundation for understanding how social capital flows within the network as a whole and within and between network subgroups, which can be useful to the participant researcher.

Density. The interconnectedness of actors in a network is referred to as the density of the network; in other words, the ratio of existing ties between team members relative to the maximum number of possible ties (Borgatti, Everett, & Freeman, 2002). A network where every actor is connected to every other actor would have a network density of 1.0. Figure 3.2 displays three networks of size six with densities of 1.00, 0.40, and 0.20. This could represent the math department and science department in a school each had six members. If the math department had 12 pairs of collaborative ties (density of 0.40) and the science department had six pairs of ties (density of 0.20), the math department would be considered more dense and therefore, for our interests, more collaborative.

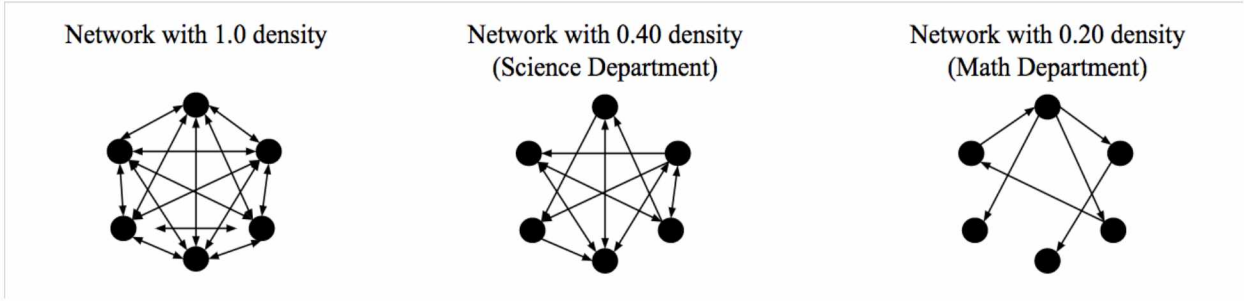

Figure 3.2: Three networks of size six with densities of 1.00, 0.40, and 0.20.

Unsurprisingly, an individual is more likely to seek someone out when they know how to gain timely access to the other person and understand his or her level of expertise (Borgatti & Cross, 2003); getting to know one another increases the likelihood of information and resource

sharing. Thus, understanding the density of social networks in schools can be a starting point in determining the potential for how much information and resources are exchanged, whether members are engaging in problem solving and dialogue around instructional practices, and the impact of group norms and sanctions on group members.

Furthermore, teams in which there is a high-density of instrumental ties will have more information sharing and collaboration, and thus more task completion than teams with low-density (Burt, 1997). Low-density teams will be unable or unwilling to exchange information with each other and may have to rely on individuals that act as brokers to communicate with disconnected members of the team. Although brokers can be important figures in a social network, tying together disparate departments or levels of a network, they are not a substitute for an effective team. For example, a principal might serve as a broker between teachers and school district administrative staff. It would not be efficient for the teachers within the school to all have instrumental ties with district staff. Similarly, each department in a school (grade level or academic unit) is likely to have instrumental ties within the department (e.g., all the social studies teachers work closely together), but they may also have instrumental ties with other teachers in the building. In fact, having cross-curricular ties is important to the formation of new ideas and pedagogical practices (Butti, 2016). Although it is important to have high-density teams for effective collaboration it is also important to recognize that too many strong ties within a network may result in losses of efficiency, as members spend too much time maintaining ties (Burt, 1997).

Closure. Closure is the idea that a group is bounded. In a network with closure, everyone is connected such that each person is connected to each other person (Burt, 2000; Coleman, 1988). This type of closed group is also referred to as a clique and typically features actors with

strong ties. A closed network results in sanctions and opportunity, making it less risky for those within the network to trust one another and increasing the power of sanctions when one violates group norms or trust. These norms come about as a means of limiting negative effects or encouraging positive ones. Sometimes norms occur organically, or sometimes they are intentionally created and fostered through purposeful action. However, norms are only effective in a closed system. Take Figure 3.3 for example. In figure 3.3(a), actor A can carry out actions that have negative or positive implications on B or C. However, since B and C do not have ties to each other, they cannot combine forces to sanction or reward A, and thus have no power over A unless B or C alone is sufficiently powerful. However, in figure 3.3(b), B and C can combine forces to provide a collective sanction or reward. By having a closed system, the members of the social network can exert more force on the other members.

Recreation of figure on Page 106 from Coleman, J. S. (1988). Social Capital in the Creation of Human Capital. *American Journal of Sociology*, *94*, S95–S120.

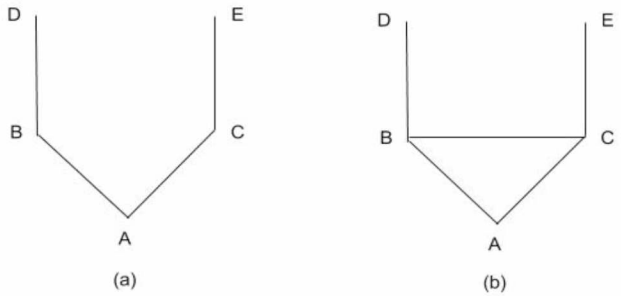

Figure 3.3: Diagram of closure; Recreation of figure from Coleman, J.S. (1988), p. 106

Strong versus Weak Ties. Both strong and weak ties serve important purposes in a social network. We tend to have strongest ties with those we are most familiar and most similar to. As a result, our strong ties - although still very useful - are less likely to present us with new

ideas than our weak ties do. Weak ties are more likely to be bridges to socially distant regions of a network, resulting in new information. Research has demonstrated the value of weak ties in finding a job (Granovetter, 1973), individual advancement (Burt, 1995, 1997, 2000), and diffusion of ideas (Granovetter, 1983; Rogers, 1983). "Weak ties may lead to search benefits in a social network but they may also cause problems in transferring complex forms of knowledge" (Hansen, 1999, p. 83).

Strong ties, on the other hand, have been shown to be necessary for transferring complex knowledge across departmental boundaries within an organization (Hansen, 1999) and engaging in rich exchanges of knowledge (Pil & Leana, 2009). Borgatti & Cross (2003) suggest that information seeking is dependent on how well a person knows and values the expertise of another, the accessibility of the other, and the potential costs in seeking information from the other person. However, strong ties also are more likely to result in constraints as group norms influence processes and decisions (Coleman, 1990; Granovetter, 1973; Hansen, 1999).

Structural Balance and Homophily

Structural balance is the idea that individuals are more likely to create new direct ties with friends of friends, and discontinue relationships with friends of enemies and enemies of friends (Cross & Parker, 2004). Due to this effect, subgroups or cliques will emerge within schools.

The other reason teachers tend to cluster is the principle of homophily, which states that individuals tend to form relationships based on how similar they are; such as age, gender, or educational level. The more similar individuals are, the more quickly resources will travel between those individuals; and the more dissimilar individuals are, the less likely they are to share information (Moolenaar, 2012). Teachers are often isolated and autonomous within the

school environment. Seeking out others to discuss teaching and learning involves the risks of violating norms or revealing teaching problems. There is greater perceived safety in communicating with those who are similar. Research suggests that principle of homophily shapes teacher networks into relatively homogenous subgroups based on similarities (Frank, 1995; Penuel et al., 2009). People have a tendency to trust those with whom they share similarities, and to regard those who are members of the out-group with suspicion and with stereotypes. These types of biases can create and sustain feelings of distrust. Thus, trust is more difficult to create and sustain in situations of diversity, whether it be diversity of gender, ethnicity, age, or teaching specialization (Tschannen-Moran & Hoy, 2007).

Structural Holes. The disconnections between each team, subgroup, or clique, in an organization are referred to in social network research as structural holes. Brokerage is the transmission of information across subgroups. The concept of structural holes is built upon the idea that social capital is a function of brokerage opportunities and builds on the work of sociologists that emerged in the 1970s regarding the strength of weak ties (Granovetter, 1973); betweenness centrality (Freeman, 1978); the benefits of exclusive exchange partners (Cook & Emerson, 1978); and structural autonomy created by complex networks (Burt, 1980).

The structural hole between groups indicates a place where each group is focused on their own work and not on working together. This doesn't mean they are unaware of each other, but information does not flow directly between the two groups. Within each group, there are typically strong ties, but across groups ties are more likely to be weak. Burt (2000) uses the metaphor of an insulator for an electric circuit, the electrical current still travels from point A to point B but in a less directed pattern and perhaps a little slower. It is tempting to view structural

holes as a negative thing, a place where groups are not working together. However, they can also be viewed as an opportunity to broker the flow of resources between the two groups.

Individual Network Positions

One of the hallmarks of social network theory is it's holistic perspective in which macro level actions produce micro level interactions and vice versa (Coleman, 1990). One of the most well known examples of the micro level influencing the macro level is the "tragedy of the commons" in which the grazing of each farmer's sheep reduces the availability of pasture for the sheep of other farmers. Another example that many teachers can relate to is union-management bargaining. Although there are only two actors arriving at a decision, the outcome impacts all parties in the system. In other words, the transition of information from the macro level to individual actors can affect the actions they take and thus affect system behavior.

Overall network structure is important for understanding organizational phenomena, but so too are individual network positions. These positions are related to the different types of relationships an actor possesses and the amount of those relationships. At the individual or actor level, the position of an actor within a network can determine whether they have a structurally advantageous position and thus have greater access to knowledge and resources, or more control over knowledge and resources (Burt, 1995).

Teachers with high levels of social capital have a greater opportunity to use and expand that social capital to improve student learning. Therefore, understanding teachers' network positions may be useful in understanding how resources (knowledge and information) support or constrain their efforts at improving student achievement (Baker-Doyle, 2011; Coburn & Russell, 2008; Moolenaar et al., 2011; Penuel et al., 2009).

There are four network positions commonly referred to in the business community (Cross & Parker, 2004): information broker, central connector, boundary spanner, and peripheral people. Each role plays a unique position within an organization. Identification of individuals within these role positions can be used to strategically improve social capital in the organization.

Boundary Spanner. A boundary spanner serves as a broker, connecting subgroups within an organization. Librarians fulfill this role naturally, operating on the boundary between teacher and library. Van Deusen (1996) observed in a case study that the librarian provided leadership as an "insider/outsider" suggesting a similar role. In this situation, the librarian added value through her knowledge of quality resources for instruction. However, since she was not a supervisor, she was a safe source for assistance and information. Since librarians are in a central and non-threatening position within a school, they are in a unique position to bridge the structural holes that might exist between departments and grade levels. Bridging structural holes is important to effective collaboration. A network with distributed expertise and many weak ties has little redundancy. Information within cliques is often redundant, since people closely connected to one another tend to have access to the same resources and research has shown that people rely on previously established communication channels (Hansen, 1999). When structural holes are brokered, the additional flow of information ensures that both groups have access to the information flows within the groups. The more structural holes spanned, the richer the information within the network.

Thus, it is important that brokers exist to bridge structural holes and enable new knowledge to flow into existing cliques. The broker, often referred to as a boundary spanner, spans the hole and serves in this role (Cross & Parker, 2004). Enabling cliques with purposeful information, boundary spanners can improve workflow, since each clique can focus on its own

work without the distractions of other needs but can also have consistent information regarding the other groups. In the academic library, the liaison librarian often serves this role. The liaison librarian is part of an academic department as well as the library itself. By engaging in both departments, they can broker information between the two groups ensuring that each group's needs are met. Although this is not as common within schools in the school setting, it does occur within departments in a single school or between a school and the district office. A teacher who is well connected to the district office might hear about new curriculum resources or reform initiatives in advance of other teachers and can thus spread the information to his or her department quickly. Librarians can make a point to become this individual by forming the necessary connections, and thus become more central to the information flow in the school building.

Central Connector. A central connector is highly sought after and therefore has greater access to information and social support from the network. In-degree and out-degree are two important ways that this is described. Others seek actors with a high in-degree out for resources and knowledge, whereas actors with a high out-degree seek resources from others (Burt, 1995; Wasserman & Faust, 1994). Those with a high in-degree, by nature of their position, have a disproportionate influence over others in the network as they have more relationships with which to access resources (Daly et al., 2010; Hanneman & Riddle, 2005). These individuals tend to be centrally located in the network and as such, have a greater ability to leverage resources compared to more peripheral individuals (Tsai, 2001). However, large numbers of direct ties can also drain an individual's resources because they require time and effort to maintain (Balkundi & Harrison, 2006). Furthermore, the social norms present within the group may constrain an individual's behavior defined by those ties (Burt, 1995). Therefore, a central connector may be

perceived as an expert in the system, but they may also be a bottleneck that is holding up the flow of resources and information.

Educational researchers often refer to the total or average number of relationships as a measure of closeness centrality. Another way this is expressed is as the total number of relationships in relation to the total number in the network (Burt, 2000; Cross & Parker, 2004; de Jong, Moolenaar, Osagie, & Phielix, 2016). In other words, how close is one person relative to others in the network. A teacher with a high closeness centrality will have few steps between the other actors in the network. Being centrally located means that the information a person distributes will reach the rest of the network more quickly (Freeman, 1978).

Information Broker. Information brokers sit on the shortest path between the remainder of the network. These individuals disproportionately affect information flow and can be leveraged to promote connectivity within the network (Cross & Parker, 2004). Since an information broker is likely to have a large number of ties in the network and also serve as a bridge between disconnected actors, potential information brokers can be identified using the broker and normalized broker measurements. Broker is the number of pairs that are not directly connected, but bridged by the given actor. Normalized broker (nBroker) is the broker divided by the total number of pairs, or the percentage of pairs for which the actor serves as broker. An individual with a high broker value has more influence in the network, as they are a pathway for information to flow amongst members of the network and thus can determine where and when information flows.

Because of their position in the network, information brokers, like boundary spanners, also bridge structural holes. However, unlike boundary spanners that link specific subgroups, where ties are likely to be strong, information brokers link a variety of actors within the network,

many of whom may have weak or non-existent ties. This allows them to receive and disseminate a large amount of information to and from different actors within the network. This combination of information from weakly connected actors contributes to innovation within the network by enabling information to flow in ways that it would not without the information broker (Burt, 1995).

Peripheral People. Peripheral people operate on the perimeter of the social network. They have few ties to the other actors in the network, measured by ego network size (Borgatti et al., 2002; Cross & Parker, 2004). These individuals may have underutilized skills, expertise, and unique perspectives that are not being leveraged by the school.

Individuals may be on the periphery because they wish to be there or because they are not sure how to work their way inside (Cross & Parker, 2004). Identifying these individuals can allow librarians to form mentoring relationships, introduce them to others, or get them involved in bigger projects. Identifying these individuals and pulling them into other projects helps the librarian become a boundary spanner or information broker, a bridge between individuals in the network, increasing his or her impact and perception of value.

Using social network analysis to identify periphery people is the first step. However, additional qualitative data is needed to determine why the individual is on the periphery (Cross & Parker, 2004). Some individuals are on the periphery by choice. Pushing them to be involved may reduce their morale or reduce their own work effectiveness. It is important to get to know people to understand these distinctions. For example, if a specialist is too busy helping others, they may not have the time to stay ahead in their field.

Regardless, enabling peripheral people to build more network ties increases the social capital of the entire organization, as their knowledge and resources become more easily accessible by other teachers.

Chapter Summary

Utilizing social networks in the form of teacher collaboration has the potential for improved academic achievement of students and transformative change in schools when effectively implemented (e.g., Brownell et al., 1997; Bryk & Schneider, 2003; Coburn et al., 2013; McNicholl, 2013; Moolenaar, 2012; Moore Johnson et al., 2016, 2016; Perry et al., 2006; Poulos et al., n.d.; Stoll et al., 2006). As a teacher that interacts with students and has the potential to interact with all other teachers, the librarian has a unique opportunity to impact the collaboration that occurs within a school.

Social network theory offers a lens through which to examine collaboration in schools. The school librarian can then use the information generated to improve collaboration at the individual and systemic level. To determine the effectiveness of this theoretical framework in the secondary school setting, this study employs techniques based on this theoretical foundation to identify a process for school librarians to evaluate and examine collaboration in their schools. This includes identifying and classifying individuals into specific network roles and visualizing their relationships within the network. With this information, the school librarian can think strategically about building relationships, leveraging existing opportunities, and building social capital throughout the school environment.

Chapter 4: Methods

The purpose of this research is to outline a process that school librarians can use to systematically evaluate and improve collaboration between teachers and librarians in their school by answering the question: *How can social network analysis be used by school librarians to evaluate and improve the collaborative networks in their school?* In order to achieve this, two schools were engaged in a mixed methods pilot study to test the usefulness of social network analysis to this purpose in a three phase process: Development of the Alaska Teacher Social Network Survey, Development of the Social Network Analysis for School Librarians (SNASL) Process, and pilot testing. This chapter reports on the methods and results of each phase of the research, and the rationale behind those methodological decisions.

Introduction to the Research Design

The University of Alaska Institutional Review Board approved the research project on April 11, 2017 titled "Social Network Analysis of Teacher & Librarian Collaboration AK Secondary Schools" [983929-2] (See Appendix A). As portrayed in Figure 4.1, this multi-phase mixed methods study made use of an explanatory sequential design using a quantitative survey followed by a qualitative participatory analysis before final interpretations (Creswell & Plano Clark, 2011). An explanation of each phase is provided in subsequent sections within this chapter.

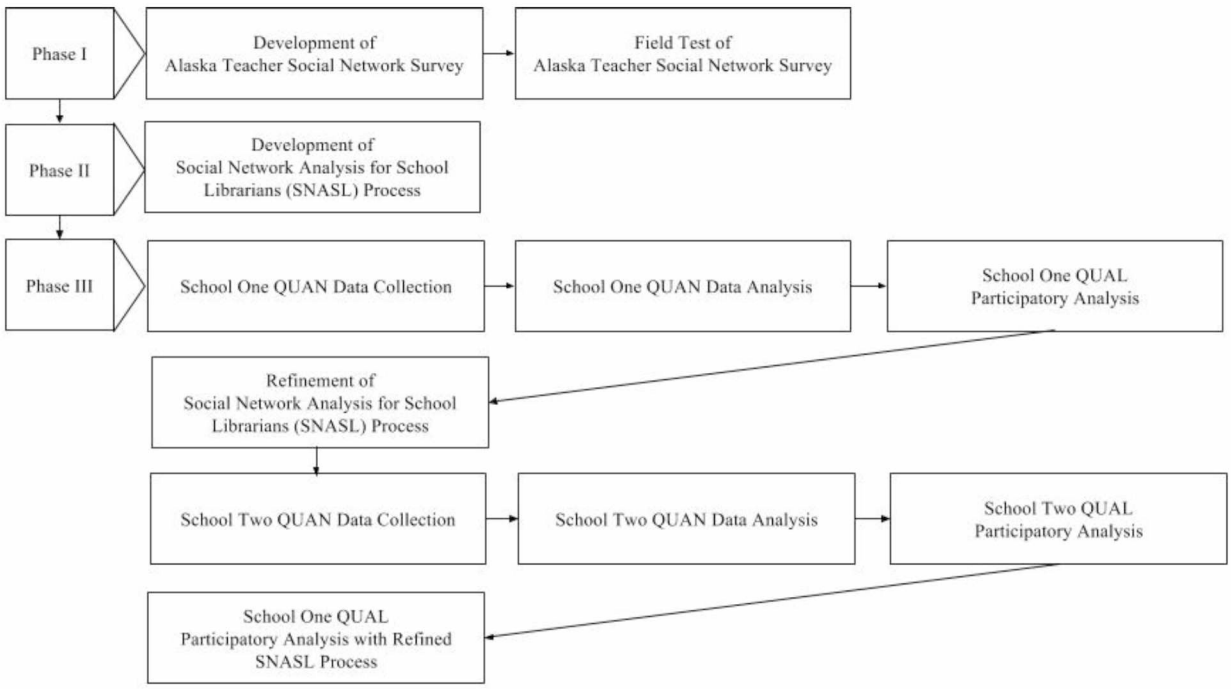

Figure 4.1: Research Design

Participants

The study was conducted in a mid-size suburban school district. After district permission was granted, all librarians and their principals in the district (9 in total) were invited to participate. Three schools agreed to participate. One of the three was used to field test the survey instrument. Thus, two sets of social networking data were collected and analyzed. In this particular district, all certified librarians are at the secondary level, so only middle schools and high schools were subject to the study.

The school used to field test the instrument is a high school with a student population of 960 ("School enrollment by grade as of October 1, 2016," 2017). There are 57 teaching staff, four counselors, and three administrators for a total of 64 certified and administrative positions. Amongst the pilot schools, School One is a middle school with a student population of 656 ("School enrollment by grade as of October 1, 2016," 2017). There are 38 teaching staff, three

counselors, and two administrative staff for a total of 43 certified and administrative positions. School Two is a high school with a student population of 977 ("School enrollment by grade as of October 1, 2016," 2017) and a teaching and administrative staff of 63. Both of the librarians in the study are certified librarians with more than 10 years of library experience, but less than two years of experience in their current school environment.

Since the purpose of the study is to outline a process that librarians and other school leaders can employ to assess and improve collaboration in their buildings, each school site was viewed as a pilot with the intention of refining the process to increase reliability, ease of use, and ability to analyze the data. For the Social Network Analysis for School Librarians to be implemented more widely and applied to other settings additional testing and analysis is necessary.

Demographics. Demographics were collected for those who participated in the Alaska Teacher Social Network Survey (ATSNS). Pilot School One chose to survey their certified and instructional support staff. They have 43 teaching, instructional support, and administrative staff. 93.02% (n=40) individuals chose to participate in the survey. Pilot School Two chose to survey their certified staff only. They have 62 teaching and administrative staff. 67.74% (n=42) of their staff chose to participate in the ATSNS survey.

Of the 40 participants in Pilot School One, a middle school with students in grades six through eight, 70% (n=28) taught 6th grade, 77.5% (n=31) taught 7th grade, and 62.5% (n=25) taught 8th grade. Of the 42 participants in Pilot School Two, a high school with students in grades nine through twelve, 80% (n=32) taught 9th grade, 85% (n=36) taught 10th grade, 85% (n=36) taught 11th grade, and 80.95% (n=34) taught twelfth grade.

Figure 4.2 and 4.3 depict the subject areas taught by teachers in Pilot School One and Two respectively.

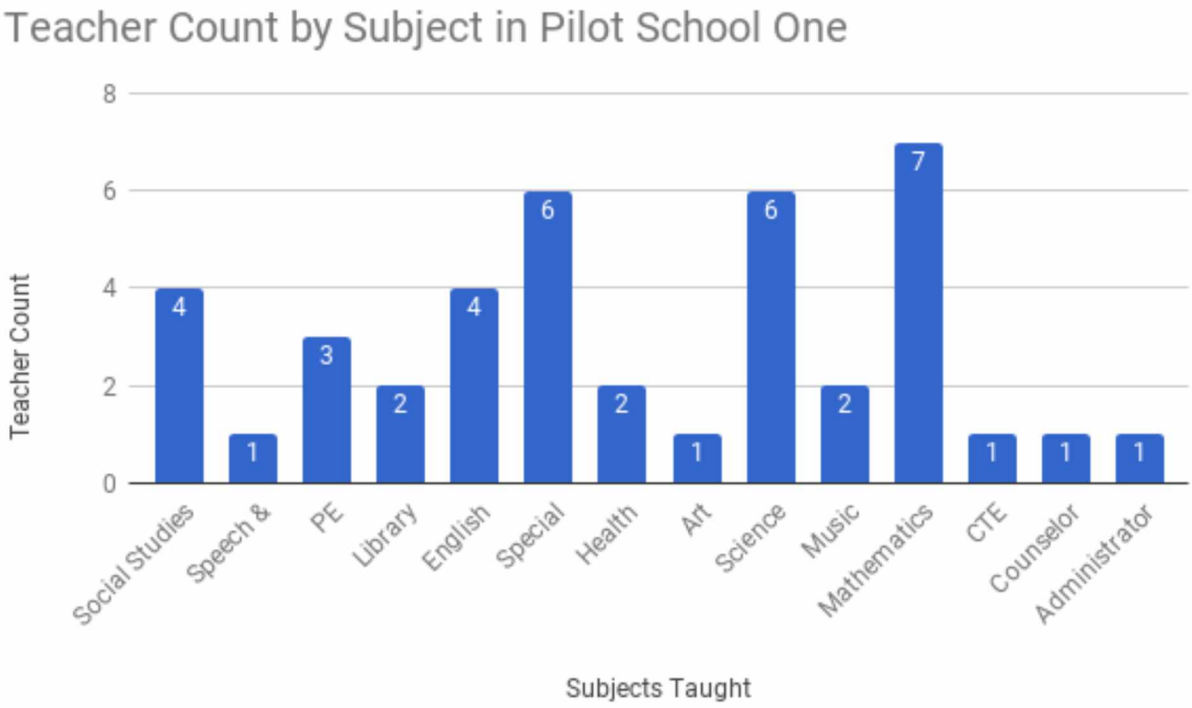

Figure 4.2: Teacher Count by Subject in Pilot School One.

Special Education includes both Intensive Resource classrooms and aides that follow individual students. Two teachers noted that they teach both science and math. One teacher taught both Health and PE.

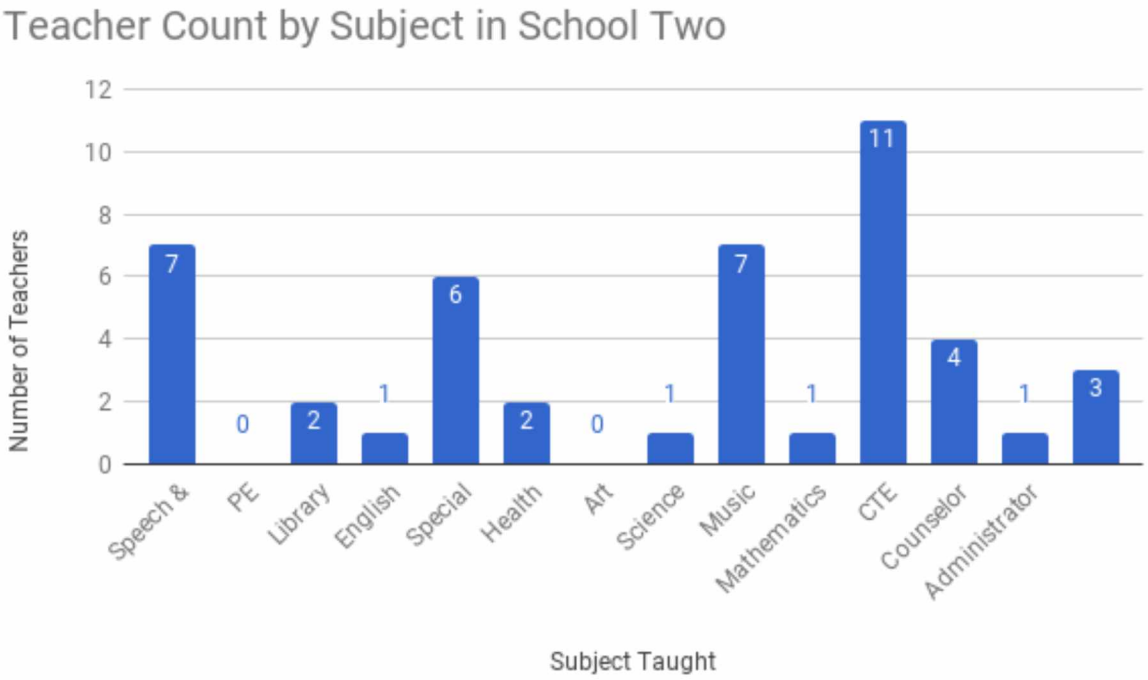

Figure 4.3: Teacher Count by Subject in Pilot School Two.

Special Education encompasses intensive resource as well as aides and subject-specific special education classes. CTE includes drafting, engineering, woodworking, etc. One teacher indicated they taught math and CTE classes. One teacher indicated they teach both social studies and CTE classes. Two teachers indicated they teach both science and mathematics.

As depicted in Figure 4.2, staff indicated their years of experience at Pilot School One as 30% (n=12) with 0-2 years of experience, 17.5% (n=7) with 3-5 years of experience, 19.05% (n=8) with 7-9 years of experience, and 27.5% (n=11) with 10 or more years of experience. In Pilot School Two, staff indicated their years of experience as 21.4% (n=9) with 0-2 years of experience, 11.9% (n=5) with 3-5 years of experience, 0.48% (n=2) with 7-9 years of experience, and 59.52% (n=25) with 10 or more years of experience.

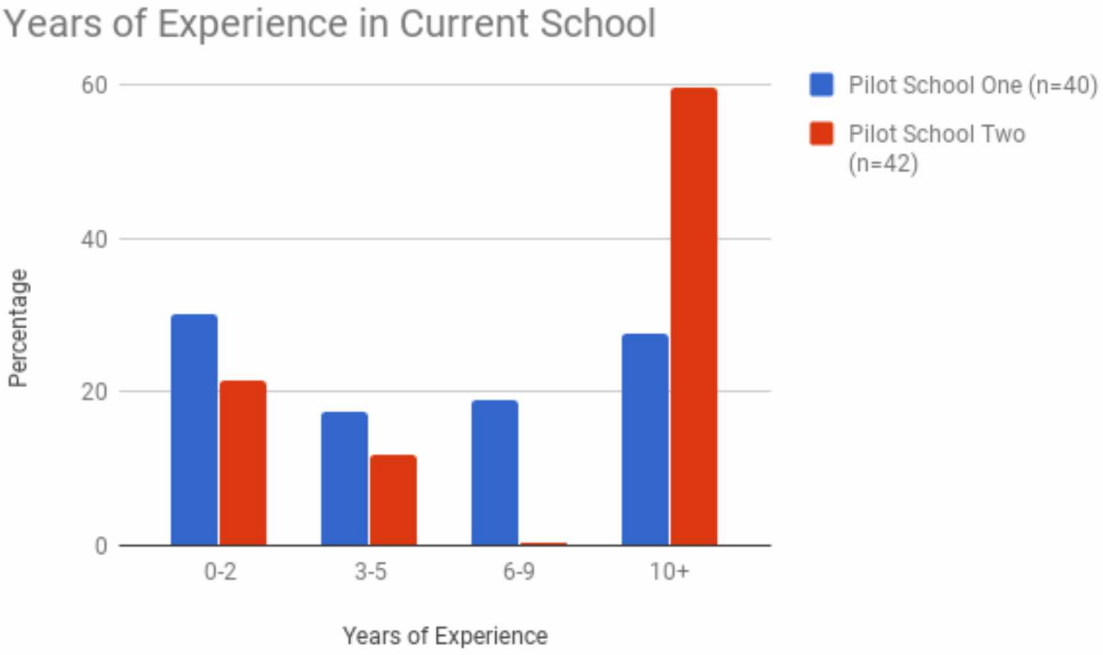

Figure 4.4: Frequency of Teachers based on Years of Experience in Current School of the Alaska Teacher Social Network Survey participants.

Although the intent of this research is not to compare the two schools, it can be noted that years of experience in a school are relevant to the social capital accessible within that school. As teachers continue to learn and practice within a school, the potential for social network ties increases (Coburn et al., 2013; Tschannen-Moran, 2001). Thus, schools with a higher percentage of teachers with less years of experience may have less access to social capital than those with a higher percentage of teachers with more years of experience in a particular school location.

Phase One: Alaska Teacher Social Network Survey

Phase One of the study involved the development of the Alaska Teacher Social Network Survey and field-testing of the survey instrument. In this study, a group network approach was used to explore the collaborative networks of two schools in a suburban setting. A group network

approach looks at the entire network bounded by a discrete unit, in this case the school itself. This level of analysis allows for examination of the whole structure as well as individual actors within the structure.

Another common method that was not selected for this study is an egocentric approach, whereby the network of one or more individuals is examined in isolation (Figure 4.5). This method would allow for understanding of the librarian's network but not the broader collaborative networks of the school as a whole. However, understanding the entire system is necessary if a librarian wishes to understand, and possibly alter the dynamic, of that system. If the librarian were to only examine his or her existing relationships, this would not reveal the cliques that exist in the school, which staff were central to the network, and who was serving as boundary spanners, among other things. Without this information, the librarian would be unable to improve collaboration beyond his or her existing social network. Thus, a group network approach was chosen for this study.

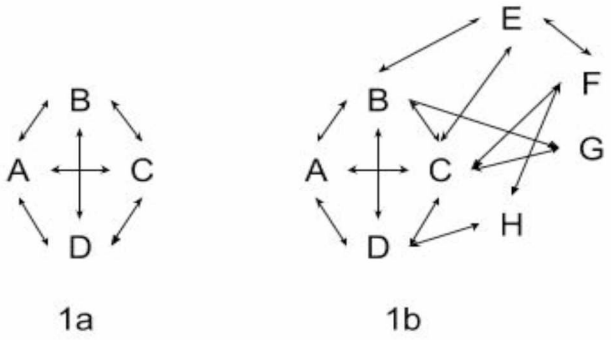

Figure 4.5: Ego versus Group analysis.

1a represents the egocentric network of actor A. 1b represents the group network of the organization of which actor A is a member.

The purpose of the research is to create a system that enables librarians to examine the patterns of relationships within a single school. Although it is possible to examine relationships across schools, or encompassing entire districts, school librarians are more likely to be concerned primarily with the collaboration that occurs within their own school and thus more directly impacts their students. Additionally, they are more likely to have access to the teachers and staff in their own building than at the district level. Librarians in both pilot schools later confirmed this assertion. During participatory analysis, one librarian indicated:

> We interact with our building so I would want to know our building. I can't imagine knowing who's interacting in the network of a curriculum coordinator would help me but it might. But I think it would be interesting to know how our classified people fit into that, especially your library assistants, your classroom aides, anyone who's on staff in a mentoring position, and even the safeties.

Thus, for the purposes of this study, the social network analysis process was designed to examine the collaboration that occurs within a single school.

Freeman, Romney, & Freeman (1987) found that individuals are much more likely to be accurate regarding the nature of relationships within their own subgroups, than they are regarding subgroups to which they do not belong or globally regarding the whole network, and that accuracy in social network perception also develops over time. Therefore, the survey was focused on more stable relationships, as opposed to those that might be bounded by a specific period of time. Bernard et al. (1979, 1982) found that respondents report inaccurate data more than half the time, regardless of the structure or time period questioned (with the exception of the most immediate past). As a result, they report, "cognitive data about communication can not be used as a proxy for the equivalent behavioral data" (Bernard et al., 1979, p. 208). However, they

did find that people tended to remember those they communicated with frequently and included them in their report regardless of whether or not they had communicated with that person during the time period in question. Therefore, to improve accuracy, the survey questions were not bounded by time but asked about relationships and interactions in a general sense.

Furthermore, the possible actors were preloaded into the survey so that participants were not forced to recall names, but instead chose them from a list. This reduces measurement errors and helps remind participants about relationships that otherwise might have been forgotten (Carolan, 2014).

Additionally, ratings of frequency were used in the survey. Ratings are generally the preferred method for capturing a relationship's intensity and are preferable over rankings (sorting relationships into an ordered list) and binary data (presence or absence of a tie) (Carolan, 2014). Therefore, a four-point frequency scale was included to add valued data. However, to enable a novice to easily use social network data in their occupational setting, this information was stripped in the analysis stage.

Finally, in order to effectively map information flow and build reliability, it was important to check both parties' perceptions of the relationship (Cross & Parker, 2004). To do this, two questions were asked in addition to demographic questions: 1) Within your school, whom do you go to for information or to discuss your work?, and 2) Within your school, who comes to you for information or to discuss your work?

Once school sites were chosen and permission granted, the Alaska Teacher Social Network Survey (AK TSNS) was drafted and field-tested. The survey was field tested at a large high school with 45 respondents (see Appendix B). The initial survey asked for teachers to list the frequency with which they interacted with each other teacher in the building and then to

select the most frequent reason for that collaboration. Reasons available in the survey included technology, instruction, resources, student specific, and other. These reasons were cited to attempt to include the breadth of reasons individuals might reach out to each other to increase student achievement in a K-12 environment, and to understand how the librarian fits into this system. Many teachers felt this system was too limiting and too comprehensive, and took too long to complete.

Feedback was given suggesting a change in design so that factors can be combined. In other words, teachers could indicate frequency with which they discussed each item (technology, instruction, students, etc.) separately rather than selecting the most frequent purpose. Additionally, teachers noted that they often engage in gossip or casual conversation. Communication networks that are broad or unspecific will naturally pick up jokes, gossip, and personal conversations (Cross & Parker, 2004). To increase precision, this was added as a category of communication so that it would be clear what activities involved seeking out others' expertise and what communications were more sociable. As a result of this field-testing, the survey was modified to separate the categories and add the category of "Casual Conversation" (see Appendix C for the final survey).

Reliability and Validity of Social Networking Analysis. Some of the weaknesses of survey-based social network analysis stem from the self-reporting nature of the survey respondents. People can often forget or misreport interactions; they can inflate their responses to make themselves look more central; and of course there is missing data from individuals who do not complete the survey at all, or only partially complete the survey (Cross & Parker, 2004; Freeman et al., 1987). This affects validity - whether a respondent's reported behavior reflects his

or her actual behavior - and reliability - whether the question(s) measure what they claim to measure.

These methodologies pose a limitation of the social network analysis component of this mixed methods study, since there is no measurable way within this method to demonstrate reliability and validity. However, general guidelines for the development of social network surveys as described in the "Alaska Teacher Social Network Survey" section of this chapter were used to help induce more valid responses. These include designing the survey to include a global list of actors, not bounded by time, with a four-point rating scale, and questions that allow for the determination of reciprocation of ties.

Previous studies lend evidence to the claim that reciprocated relations may be more valid (Carolan, 2014). To overcome participant recall shortcomings and develop reliability and validity, the survey was designed to ask both parties about an interaction. In this way, responses were cross-referenced. This helped fill in the gaps where a survey was incomplete or missing and also identified those individuals who inflated their responses. This method allowed for a more comprehensive understanding of the network and helped to mitigate missing data. If a teacher did not complete the survey, the researcher assumed reciprocity and manually coded the adjacency matrix to reflect this likelihood (Cross & Parker, 2004; Moolenaar, 2012).

Within the limitations that this poses, it is worth noting that cognitive data, regardless of reliability and validity, has something meaningful to tell. First of all, it demonstrates perceived communication. This alone can be valuable depending on the context and purpose of the investigation. In the case of the school librarian, the individual who acknowledges that they come to the librarian for information indicates that they value the information or resources that the librarian provides. On the other hand, the individual who does not indicate they routinely

visit the librarian, and yet the librarian knows they speak with that person quite often, may indicate that the person does not recognize the conversations they have with the librarian as accessing information and resources. Knowing this can help the librarian develop a plan of action to improve communication and collaboration between teachers, regardless of the accuracy of the responses.

Reciprocation was also used to help mitigate missing data. Different types of studies require different response rates to accurately calculate network measures. Measures of centrality are most sensitive to missing data (Borgatti, Carley, & Krackhardt, 2006; Costenbader & Valente, 2003), but most other characteristics remain fairly stable with a response rate of 75-85%. In this study, multiple attempts were made to get as close to 100% participation as possible with final numbers at 95.2% (n=40) for the middle school and 67.7% (n=42) for the high school. The low response rate for the high school is a limitation. However, dichotomizing the data by stripping frequency values, and enforcing symmetry by assuming reciprocated ties helps reduce analysis error (Carolan, 2014).

Phase Two: Development of the Social Network Analysis for School Librarians

The heart of this study is the development of the Social Network Analysis for School Librarians (SNASL) Process. Social network analysis is a complex methodology utilized by researchers in education, communication, and other social science fields. The power of social network analysis is the combination of statistical analysis and network visualizations. Librarians, like many teachers, are busy individuals. Analyzing the network of their school must be simplified so as to be manageable and useful. Of course, there are myriad ways to examine social network data and numerous means of quantitatively evaluating a social network. The goal here

was to simplify the process to enable use by non-trained personnel in a relatively short span of time. Thus, only a small subset of quantitative measurements was used.

The first step in developing the Social Network Analysis for School Librarians (SNASL) Process was to determine the most appropriate software program for network mapping and statistical analysis. After exploring several alternatives, UCINET 6 for Windows (Borgatti et al., 2002) was chosen due to its relative ease of installation, accessible help materials, free trial availability, and frequency of use in communication research.

After choosing UCINET, the next step was to determine which statistical measures and visual mapping strategies would be most useful to and easily understood by the school librarian. Social network diagrams can be difficult to understand, especially in a large organization; and often people will read into them what they want to see rather than what the information is actually suggesting (Cross & Parker, 2004). That is why the processes outlined here uses both diagrams and quantitative analysis. By examining quantitative analysis first, one can identify keys individuals to examine further in the network diagram. This can also help provide a layered approach that minimizes jumping to conclusions based on the diagram and permits a novice analyst to interpret the data.

Statistical Measures. In order to make the SNASL Process useful to the average school librarian, who has minimal time to spend and is unfamiliar with social network analysis, it was decided that measurements that are not immediately useful and easy to understand would not be included. After a review of the most common analysis in educational research, it was determined that measures at the ego-level would be most useful and easily understood by the school librarian and enable them to both understand the flow of information within the network and strategize

how to increase and improve collaboration. This type of analysis (ego-level) is possible even when the data collection is conducted within the group network and not the egocentric approach.

Network-level structural measures are calculated from the entire network and provide an excellent snapshot of the network's structure (Coleman, 1990). However, without a proper measure of comparison, these measurements are not immediately useful. For example, density is a common measurement used in social network analysis. Network density refers to the number of ties in the network reported as a fraction of the total possible number of ties. If all actors in the network had ties with every other member of the network, the density would be 1.0. Knowing that the density is 0.5 - and thus that about half the network has ties - is interesting, but it does not allow the librarian to know which actors have a large number of ties and which are not well connected within the school network. This type of ego-level information is necessary for the library to make the most use of the data.

Table 4.1: Social Network Analysis Employed in this Research

Statistical Analysis	**Definition**
Broker	The number of pairs that are not directly connected, but bridged by the given actor.
Normalized Broker	The broker divided by the total number of pairs.
Size of Ego Network	The size of the network for a given actor.
Constraint	The proportion of connections that actor has that are connected to one another.
Geodesic Distance	The number of steps between each set of actors in the network.
Point Connectivity	The number of nodes that would have to be removed in order for one actor to no longer be able to reach another.

In the initial development of the SNASL Process, the following statistical measures were used as defined in Table 4.1: broker, normalized broker, size of ego network, constraint,

geodesic distance, and point connectivity (Borgatti et al., 2002). These measures were used to identify and categorize the network position of individual members, including central connectors, those in the periphery, information brokers, and boundary spanners. This structure was used to make the SNASL Process accessible to the school librarian with little experience with social network analysis, and to enable the librarian to use the data for systematic improvement of the collaborative network. A worksheet was drafted to enable school librarians to walk through the analysis process and identify the actors in each network position. This was utilized during the participatory analysis steps in Phase Three.

Information Brokers. Information brokers facilitate the flow of information amongst others in the network (Cross & Parker, 2004). Potential information brokers can be indicated using the broker and normalized broker measurements. Broker is the number of pairs that are not directly connected, but bridged by the given actor. Normalized broker (nBroker) is the broker divided by the total number of pairs in the network, or the percentage of pairs for which the actor serves as broker. An individual with a high broker value has more influence in the network, as they are a pathway for information to flow amongst members of the network and thus can determine where and when information flows.

Central Connectors. Central connectors are those individuals who have the fewest number of steps between most other actors. Being centrally located means that the information a person distributes will reach the rest of the network more quickly (Freeman, 1978). They can link multiple members of the network to increase the flow of resources and information. Central connectors tend to have a high closeness centrality, measured here by geodesic distance. Geodesic distance displays how close is one person relative to others in the network. A teacher with a high closeness centrality will have few steps between themselves and the other actors in

the network. Central connectors are therefore most likely to be those individuals with the lowest geodesic distance values.

Boundary Spanners. In any given network there are likely to be subgroups. In a school, subgroups may take the form of academic departments, grade levels, or other commonalities. The spaces between those groups are called structural holes. Boundary spanners are those that connect multiple subgroups within a network and bridge the structural holes (Burt, 1997, 2000, p. 200; Cross & Parker, 2004).

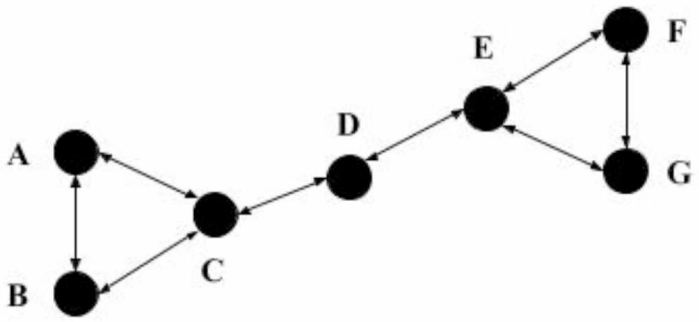

Figure 4.6: Boundary Spanner.

Node D is serving as a boundary spanner, connecting the two subgroups of A, B, C and E, F, G.

Within these subgroups actors have varying degrees of power based on the constraint imposed on them by the network (Burt, 2000). A group that is tightly knit has a higher potential to impose norms and sanctions then one that has looser connections. The statistical measure that reflects this is called constraint. Boundary spanners have low constraint, because they are connected to multiple groups as opposed to embedded within a closed group. Therefore,

constraint can be used to suggest individuals who might be boundary spanners. Network maps can be used to confirm whether an actor is indeed a boundary spanner.

Peripheral People. Those on the periphery exist on the edges of the network and have few connections (Cross & Parker, 2004). They may be on the periphery intentionally, needing space to operate effectively, or they may need help getting connected. Size of network is one of the most basic measures to determine those that are on the periphery. Those with the lowest network size are likely to be peripheral in the network. As with the other measures and network positions, network maps can be used to confirm the statistical analysis.

Point connectivity can also be used to determine which actors exist on the periphery of the network. Point connectivity calculates the number of nodes that would have to be removed in order for one actor to no longer be able to reach another (Borgatti et al., 2002). This shows the strength or tenuousness between a particular actor's connections to the network. If the number is higher the individual has many ways to get information to the other actor. If the number is low, there are few ways channels of information flow for that actor. Those on the periphery will have very low numbers in the point connectivity matrix.

Network Mapping. After determining which statistical measures to use, a decision needed to be made about how best to approach the visual mapping. NetDraw within UCINET (Borgatti et al., 2002) was used to draw the network maps. Within NetDraw, there are a variety of tools. To simplify the process and yet enable depth of analysis, it was decided that using attribute maps would be the most accessible to the librarian with minimal social network analysis training and exposure.

Attribute maps allow the researcher to apply filters to the map to gain differing perspectives on network connections (Hanneman & Riddle, 2005). Nodes can be altered by

shape, size, or color. For example, for years taught at this school, 0-2 might be brown, 3-5 red, 6-8 orange, and 9+ yellow. This color gradient allows for an easier visual representation of the network in relation to years taught in the school. Additionally, attributes can be used to cluster nodes within a map by a specific attribute, such as subject area. Applying these filters allows the researcher to visualize the impact of the attribute on network connections.

Research suggests that individuals tend to form relationships based on how similar they are; such as age, gender, or educational level (Cross & Parker, 2004; McPherson, Smith-Lovin, & Cook, 2001; Moolenaar, 2012). This is referred to as homophily. To enable librarians to visualize how homophily impacts network connections, subject area taught, location in the building, and years of practice were included in the pilot research. These factors were chosen due to the ease of access of the information to the school librarian. Subject area taught and location in the building may already be known or can be easily obtained. The total number of years taught as well as years taught within the particular school can be ascertained in demographic questions on the ATSNS. Other possible attributes that contribute to homophily include gender, race, hobbies, and general background. However, these factors were not included in this research due to privacy concerns.

To make the SNASL Process accessible to the school librarian, a worksheet was devised to walk through the process while teaching basic social network concepts. As a means of structuring the process and aiding librarians in linking social network concepts to daily practice, focus was placed on individual positions in the network and classifying individuals into four categories: central connectors, peripheral people, information brokers, and boundary spanners. The worksheet (Appendix D) also included instructions for how to use UCINET to generate statistical measures, manipulate network maps, and apply attribute maps to network

visualizations. The worksheet did not include instructions for how to collect network data, transfer data to an adjacency matrix for upload to UCINET, or install UCINET 6 for Windows. The researcher performed these steps for the librarians and has provided it here in Appendix E; although it is necessary for the school librarian that wishes to engage independently in the SNASL Process, it is procedural information and not something that was tested as part of the participatory analysis.

Phase Three: Pilot Testing

Pilot-testing of the School Network Analysis for School Librarians (SNASL) Process involved data collection and analysis in two pilot schools as detailed previously in the *Participants* section of this chapter.

Data Collection. For both Pilot School One and Pilot School Two, the Alaska Teacher Social Network Survey (ATSNS) was disseminated via SurveyMonkey by the researcher at a staff meeting, with follow up online for those staff members that were not present at the meeting due to illness or other commitments. Multiple attempts were made to get as close to 100% participation as possible with final numbers at 95.2% (n=40) for Pilot School One and 67.7% (n=42) for Pilot School Two.

Once participating teachers visited the SurveyMonkey link, they were informed of their rights via an informed consent page in the survey. Teachers who provided informed consent were granted access to the survey; those who did not were prevented from continuing the survey. No teachers choose this option. The survey was available until the close of the school year. Follow up emails were sent to teachers who did not complete the survey approximately one week and then one month after the presentation at the staff meeting.

All data were coded to maintain confidentiality but enable the researcher and librarian participants to identify subject area of the given teacher. Thus, each response was coded with their subject area and then a letter. For example, Math A, Social Studies B, etc. The master list of identification codes and teacher names was kept in a secure location.

Data Analysis. After data were collected, they were transferred to an adjacency matrix using Excel (Figure 4.7) and were visually analyzed using the NetDraw capability of UCINET (Borgatti et al., 2002).

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI	AJ	AK	AL	AM	AN	AO	AP	AQ	AR
1		Eng A	IR	Sci A	A-Admin	Sped A	Math A	PE/Health A	Eng B	Sci B	ELP	Sped B	Math B	Eng C	Sped C	PE/Health B	Soc A	Eng/Span	Eng/Soc	Sped D	Art	Sci C	Soc B	Math C	Music A	Soc C	Comp	Soc D	PE/Health C	Counselor A	Soc E	Sci D	Sci E	Math D	Sped E	Counselor B	Counselor C	CTE	Admin	Lib	Eng D	Math E	Music B	Sci F
2	Eng A								1			1		1					1																1			1		1	1	1			
3	IR			1	1			1		1		1		1	1			1		1		1			1		1		1	1	1	1			1	1	1	1	1	1			
4	Sci A		1				1																							1	1								1	1			
5	A-Admin		1				1	1	1		1									1														1	1				1	1	1			
6	Sped A								1											1												1		1	1				1	1				
7	Math A			1	1				1		1	1	1	1	1	1	1	1	1	1		1	1	1	1	1	1		1		1		1		1	1	1	1	1		1	1	
8	PE/Health A				1					1			1			1	1		1	1					1		1		1					1		1	1			1		1		
9	Eng B	1			1	1	1							1			1		1								1			1				1		1	1		1		1		
10	Sci B							1												1													1							1	1			1
11	ELP			1	1				1	1			1	1			1		1		1	1	1				1			1		1				1	1		1	1			
12	Sped B	1	1				1								1					1																		1	1	1			
13	Math B				1		1																1		1		1			1	1			1	1				1	1	1	1		
14	Eng C						1		1								1											1												1	1	1			
15	Sped C		1		1	1						1							1	1	1	1				1					1			1	1		1		1		1			
16	PE/Health B							1	1																		1		1	1							1	1		1				
17	Soc A				1				1					1	1	1		1	1				1			1			1	1				1			1		1	1	1			
18	Eng/Span						1													1			1																	1	1			
19	Eng/Soc						1	1	1											1											1			1						1	1			
20	Sped D	1	1	1	1	1	1	1	1	1		1	1	1	1	1	1	1	1			1	1	1		1	1	1	1	1	1		1		1	1	1	1	1	1	1	1	1	
21	Art														1	1														1	1	1											
22	Sci C				1		1		1	1				1	1			1												1			1		1			1	1	1	1		
23	Soc B								1						1		1			1						1	1	1		1	1	1				1			1				
24	Math C						1						1							1														1						1		1		
25	Music A				1									1																							1			1	1			1	
26	Soc C						1										1						1																	1				
27	Comp				1							1			1					1	1		1							1				1			1	1	1				
28	Soc D																1						1								1												
29	PE/Health C						1													1																			1				
30	Counselor A		1				1	1	1		1									1			1											1					1	1	1			
31	Soc E				1										1		1		1																		1	1		1	1				
32	Sci D			1	1	1		1	1	1	1				1	1			1		1	1	1			1			1	1	1		1	1	1	1	1	1	1	1			
33	Sci E				1					1																									1		1		1	1				
34	Math D	1		1	1	1	1	1	1					1	1		1		1			1	1	1	1		1			1	1		1		1	1	1		1	1	1	1		
35	Sped E				1							1			1					1																								
36	Counselor B		1				1	1			1									1							1													1	1	1			
37	Counselor C	1	1				1	1			1						1			1			1				1								1					1	1	1			1
38	CTE																										1													1				
39	Admin				1		1							1			1			1		1	1		1					1	1			1		1	1			1	1		
40	Lib	1	1	1	1		1		1	1	1			1					1						1	1	1		1	1	1					1	1		1		1		
41	Eng D	1		1	1		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		1		1			1	1	1	1	1		1	1	1	1	1	1	1	
42	Math E			1	1		1		1	1			1	1	1	1	1	1		1	1	1	1	1	1	1	1		1	1	1			1	1	1	1	1	1	1	1	1	
43	Music B																								1																			
44	Sci F		1	1					1	1																						1	1			1	1			1			

Figure 4.7: Screenshot of Adjacency Matrix in Excel for Pilot School One.

See Supplemental File: Pilot School One Adjacency Matrix and Supplemental File: Pilot School Two Adjacency Matrix for full data set.

This allowed the researcher to see relationships between actors in the network; the direction of those relationships; identify subgroups in the network; and identify individual actors that appear central, on the periphery, or bridging gaps between other actors in the network. For ease of analysis, all purposes listed on the survey were grouped together with the exception of casual conversation. This enabled the researcher and librarian participants to examine instrumental relationships only. Although expressive relationships are important to building trust in social networks, the intent of the research is to improve instrumental relationships between librarians and teachers through a process that is accessible to librarians and thus expressive ties were removed from analysis.

Participatory Analysis. After data collection and analysis, anonymized results were presented to the school librarian during a 60 to 90-minute conversation. During this time, the researcher examined the data alongside the school librarian from the pilot school using the SNASL Process Worksheet (Appendix D) in a semi-structured interview format. Both the researcher and librarian examined the data on the researcher's computer, which was preloaded with the UCINET software and school data sets. The role of the researcher during the semi-structured interview was as a technical guide, aiding the school librarian in understanding concepts and utilizing UCINET and NetDraw. Additionally, the researcher asked follow up questions as necessary to better understand the school librarian's interpretation of the data. The researcher's role was intentionally minimal to enable the school librarian to engage in the process without interference.

To avoid interruptions during the interviews and create a natural setting for an examination relating to one's work life, as well as for convenience of the participants, interviews

were conducted after school in the library of each librarian. Field notes were used to record immediate impressions during and following interviews.

Unfortunately, the researcher encountered technical difficulties with the attribute maps and was unable to explore these with the school librarian in Pilot School One during the first participatory analysis section. However, results from this section led to revision of the SNASL Process Worksheet and a follow up interview with the new worksheet was conducted with the Pilot School One Librarian.

Refinement of the SNASL Process. The goal of the participatory analysis process was to 1) determine librarian's understanding of network concepts and why they are relevant, 2) elicit librarian interpretation of the network map of their school, and 3) assess whether librarians were able to use the process to develop strategy for improving collaboration within their school.

Technical difficulties with the attribute maps during participatory analysis lead to further investigation on how to upload the maps to avoid these issues in the future and a revision in the procedural notes for the SNASL Process (Appendix E) regarding recommendations for how to create and upload attribute maps. The researcher initially used an attribute matrix developed using the UCINET spreadsheet editor. Although theoretically suitable, a more common approach is to use the text editor in Windows to create a tab delimited file. A new file was created and tested multiple times; no further technical issues were encountered.

A more substantial revision was of the SNASL Process Worksheet itself. In the first version of the SNASL Process Worksheet (Appendix D), the school librarian was led through two stages. The first was an analysis of the statistical data for each role position. The second was examination of the social network diagrams. During participatory analysis with Pilot School One it became clear that although the librarian understood each role position and its value, she was

having difficulty remembering the distinction between the different role positions during the social network diagram stage. Having just been introduced to the concepts, she was being asked to remember too much too quickly. Additionally, although she was able to identify individuals in each role position, she did not link the examination of the data with strategic plans for improving collaboration in her school.

As a result of the participatory analysis with Pilot School One the SNASL Process Worksheet was revised (Appendix F). In the first iteration (Appendix D), used with Pilot School One, the network position roles were identified and defined at the top of the worksheet and then not referred to again. The intention in this original design was to allow the librarian to use these roles as needed, but not force the librarian to use them. When used in Pilot School One, the librarian was able to identify individuals within these roles when prompted, but they did not voluntarily refer back to the role positions. Furthermore, the researcher noticed in the initial analysis of Pilot School One that the librarian was identifying individuals and providing some background, but for the most part was not indicating how the information could be used to improve collaboration in the school without additional prompting.

For example, when asked which actors have the most impact on the network, referring to boundary spanners, the librarian in Pilot School One said, "You can visualize constraint as power in their network. People with high constraint are most powerful in their network so I want to reach out to them when trying to get a new initiative started." This indicated that the librarian understood the role position and the value of the statistical analysis and its role for professional practice, but did not go so far as to strategize how that information would be used to improve collaboration.

To overcome these obstacles, in the revised iteration of the worksheet used with Pilot School Two (Appendix F), the researcher made these connections between role position and specific aspects of the social network analysis more overt. Instead of role positions being a separate section in the worksheet, it was thread throughout and made more explicit by creating subsections within the worksheet for each of the four role positions. Additionally, the question "How could you use this information to help improve collaboration?" was added to each subsection to help the librarian make the connection between the data and strategic improvement of collaboration in their school.

The response from the librarian in Pilot School Two to the corresponding statistical analysis in her school, demonstrates the improvement:

> This analysis shows how large a person's network is and how they fall in their network. [A] teacher talked about how different the library was from when she first came here, environmentally, tall shelves, but also technology differences. Books are being weeded because so much of the information is available online and has the most current information. As I do more and more of that, getting rid of nonfiction books, then you need to know who are the people that are going to have some influence. Win them over.

Her response provides a specific and actionable way that the data could be used to improve collaboration in the school. After referring to a common problem in librarianship - faculty response to the weeding of books - she demonstrates both an understanding of the role of the boundary spanner as an individual with influence over multiple subgroups and how this knowledge can improve her practice by indicating, "you need to know who are the people that are going to have some influence. Win them over;" suggesting that by understanding who the

boundary spanners are in the building you can help shift attitude throughout the building. In this instance, including the roles overtly in the worksheet and asking the librarian to connect the results to improving collaboration helped her connect the responses to her practice.

To further examine whether the revised worksheet would result in more generative insight and strategic responses from the librarian in Pilot School One, a second interview was conducted. In both interviews, the librarian was able to identify individuals in specific role positions, but in the second one she moved beyond identification to strategy for improving teacher collaboration. For example, when looking at the information brokers in the first interview, she remarked, "Looking at Broker and nBroker primarily, meshes with existing knowledge that sped works throughout the building and library." In the second interview, she expanded to say, "Those are the people I want to have stronger connections with because they are influential. Is that right? So, then I want to identify, so who is Sped D? Because I need to be in Sped D's business so I can say hey, do you know what's going on? Have you checked in over there?"

As a result of the participatory analysis with Pilot School One, the SNASL Process Worksheet was revised and restructured in three substantial ways: 1) The worksheet was reorganized by role position so that the librarian was examining the statistical analysis and then the social networking diagram for one role position before moving on to examine the next one. 2) Additional descriptions of each role position were added to clarify their value and purpose. 3) Additional questions were added to elicit school librarian's thinking regarding the strategic value of the social network data.

Once role positions were thread throughout the process, it became clear that identifying key players through defined roles enables the librarian engaged in the SNASL Process to

transition from identifying characteristics of their school's social network to strategic implementation of a plan to improve social capital throughout the school. Identifying individual actors in specific network positions enabled the librarians to move from noticing to strategizing.

Limitations. There are several limitations to any qualitative research. First, it must be noted that any report of research is a representation of the author (Creswell & Plano Clark, 2011). The researcher views data through a lens of his or her personal experience, which biases responses and interpretations of the data. To limit the effect of these biases, the planning and design of the research was conducted to increase data quality in the design of survey instruments, repeated testing of the SNASL Process, and transparency of reporting.

Additionally, this study only examined the potential of social network analysis as a tool for school librarians in secondary schools. Since the district involved in the research only has certified librarians at the secondary level, no data from elementary schools was included. Elementary schools often have different collaborative structures; they more likely to focus on grade level teams rather than subject area, and librarians are more likely to work with students on a fixed schedule. Therefore, additional research is needed to determine the impact of social network analysis, and specifically, the SNASL Process, in elementary schools.

In this study, all interviews were audio-recorded, transcribed verbatim, and checked for accuracy to increase credibility of data. During participatory analysis, each school librarian walked through the SNASL Process with guidance from the researcher in a 60- to 90-minute semi-structured interview using the structure of the SNASL Process Worksheet. Field notes were used to record immediate impressions during and following interviews. Additionally, interviews were initially read as a whole and then examined in sections for fuller examination. Interview transcriptions and field notes were gathered for initial coding. Using these initial categories,

transcripts were read again and analyzed to validate codes and identify supportive data for each identified theme.

To avoid interruptions during the interviews and create a natural setting for an examination relating to one's work life, as well as for convenience of the participants, interviews were conducted after school in the library of each librarian. The researcher's limited resources and the limited time of the participants, resulted in limitations to the scope of qualitative inquiry. Although a small grant of $1000 was received for this dissertation from the Frances Henne / VOYA Research Grant, this was not sufficient funding to enable further pilot testing of the SNASL Process.

The researcher facilitated the participatory analysis such that her role was minimal, however, she did offer explanations and technical assistance to the school librarians. Thus, without a facilitator's presence a school librarian may experience differing results when engaging in the SNASL Process. Further pilot testing and social network analysis research can incorporate additional school settings and levels of librarian experience to further validate these findings.

Final Analysis

As stated at the beginning of this chapter, the purpose of this research is to outline a process that school librarians can use to systematically evaluate and improve collaboration between teachers and librarians in their school. Since the outcome of this dissertation is the development of the Social Network Analysis for School Librarians (SNASL) Process, the final analysis of the data was designed to determine the effectiveness of the SNASL Process in enabling the school librarian to evaluate and improve the collaboration network of their school. During final analysis, interview transcriptions were read as a whole and then examined in

sections for fuller examination. Interview transcriptions and field notes were gathered for initial coding. Using these initial categories, transcripts were read again and analyzed to validate codes and identify supportive data for each identified theme. Three themes were identified during this analysis: identifying role positions, producing generative insight, and enabling the potential for strategic improvement of collaboration.

The results of the final analysis are presented in Chapter 5: Findings.

Chapter 5. Findings

The purpose of this chapter is to present the findings of the study to answer the question: *How can social network analysis be used by school librarians to evaluate the collaborative networks in their school?* To investigate this question, a process was developed for school librarians to evaluate and improve the collaboration network of their school, named the Social Network Analysis for School Librarians (SNASL) Process. This chapter reports on the themes that emerged during the final analysis: the role of network positions and the potential for strategic improvement of collaboration through generative insight.

Although a necessary part of the research design, the actual results of the social network analysis within each school are not the research findings. Therefore, the complete results of the social network analysis conducted within each pilot school are included in Appendix G.

Role of Network Positions

Definition of Terms. Recall from chapter III how a social network can be viewed as a set of actors and a set of links among these actors. When examining a social network analysis diagram, an actor is visualized as a node, which can represent an individual or an organization. In this case, each node represents a teacher or staff member at one of the pilot schools. The terms node and actor will be used interchangeably throughout this chapter.

The relationships between the actors are represented as links, or ties, between each node. Arrows represent the directionality of the ties. Ties that feature arrows going in both directions are reciprocal. In Figure 5.1, two nodes are presented with a reciprocal tie.

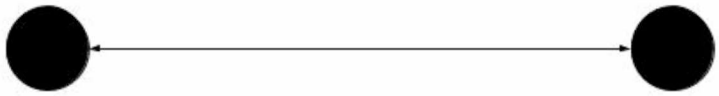

Figure 5.1: Illustration of network with two nodes and a reciprocal tie.

Information Brokers. Information brokers have a high out-degree (a large number of outgoing ties) and thus are hubs for information within the network. They also sit on a path between various pairs of individuals that would not otherwise be connected if the broker were not part of the network (see Figure 5.2).

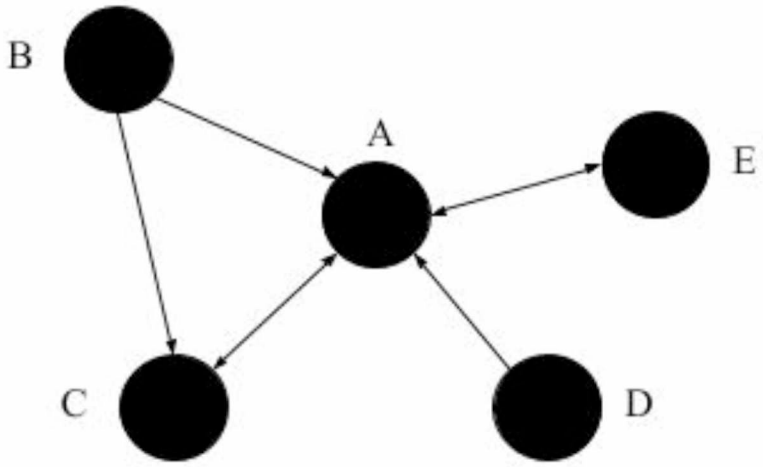

Figure 5.2: Diagram of Information Broker.

In this network, A is the information broker, ensuring that there is a path for information to flow between all members of the network.

In UCINET, the statistical measures broker and nbroker are used to identify information brokers. An individual with a high broker value has more influence in the network, as they are a pathway for information to flow amongst members of the network and thus have a greater influence on where and when information flows.

School librarian participants identified information brokers as "people I want to have stronger connections with because they are influential." In Pilot School One, after identifying Sped D as an information broker, the librarian noted "I need to be in Sped D's business so I can say hey, do you know what's going on?" confirming her understanding of the role of the information broker and its ability to increase social capital. By connecting with Sped D, she also gains access to his or her human capital, their knowledge, skills, and abilities.

In Pilot School Two, the librarian remarked that:

> Knowing who has the most influence, especially since I am still new - 2 years isn't long - it would help me to pinpoint the people I should be contacting and seeing if I can get them to collaborate with me, because they are going to have influence over the people with whom they are interacting. And there's that possibility that they'll say something about oh what a great lesson we had and another might pipe in and say oh, I'd like to try that. What's the possibility you and I can sit down together when you get a chance?

Her statement acknowledges that information brokers are connected to a diverse group of people in the network and that by working with them she is increasing her presence throughout the whole building. Since information brokers are well connected, there is a higher possibility that other teachers will see or hear about successful collaborations that occur with the information brokers. The librarian was able to take this information and apply it to a

collaborative strategy - focusing attention on collaborating with information brokers to take advantage of her role position.

Central Connectors. Central connectors tend to have a high closeness centrality, measured here by geodesic distance. Distance is a measure of how "far" apart actors are within the network (Hanneman & Riddle, 2005). In other words, how many steps does it take to get from one actor to another? When this value is small there is a relatively cohesive network; when it is high, it is difficult for information and resources to flow through the network. Geodesic distance, in particular, demonstrates the number of steps between each set of actors in the network. A teacher with a high closeness centrality will have few steps (a low geodesic distance) between the other actors in the network. For example, in Table 5.1, B is one step away from C, meaning that they are directly connected. In contrast, B is three steps away from D, meaning that for information to flow between B and D in that network, it must go through two other people before reaching D. This can be visualized in Figure 5.3.

Table 5.1: Example Geodesic Distance Matrix

	A	B	C	D
A	0	2	1	1
B	2	0	1	3
C	1	1	0	2
D	1	3	2	0

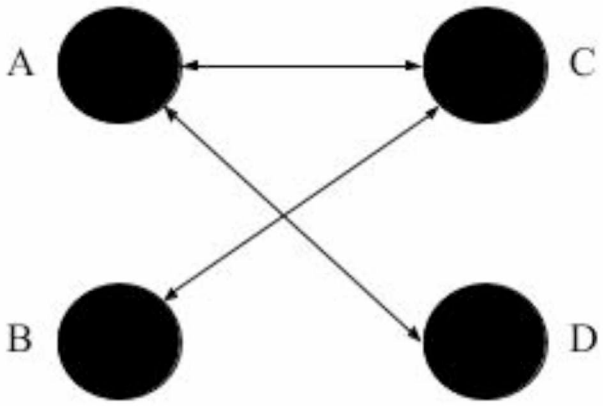

Figure 5.3: Example Network Diagram for Data in Table 5.1.

The librarian in Pilot School Two noted that she "Could also use this analysis to identify the people who are perceived experts / authority / bottlenecks because they could help route people to the library when appropriate. Identify who those individuals are could give insight into what they were doing to make them seen as attractive to other faculty and I could emulate or expand upon that." Again, she was able to identify the usefulness of the data to "identify the people who are perceived experts / authority / bottlenecks" and use this information to strategize her approaches to collaboration to "emulate or expand" on what the central connectors were doing to "make them seem as attractive to other faculty." Although this approach was different than the one taken by the librarian in Pilot School One, who identified individuals she could reach out to in order to benefit from their network connections, it is no better or worse. In both situations, the social network analysis enabled the librarian to move from a "build it and they will come" approach to a targeted and strategic approach.

This strategy also allowed the librarian from Pilot School Two to capitalize on the human capital of the central connector. To "emulate or expand" on what a central connector does is to engage with and learn from that individual, accessing their human capital and utilizing it to increase one's own.

The power of visualizing the network via a social network map was confirmed when using the graph theoretical layout to view central connectors in Pilot School One mapped by geodesic distance (Figure 5.4). The librarian made a statement that "the ones in the center, they are clustered that way because they have more stronger, more connections" and then noted that the map was "visually more reflective of what we were just talking about," referring to the geodesic distance matrix that was examined previously.

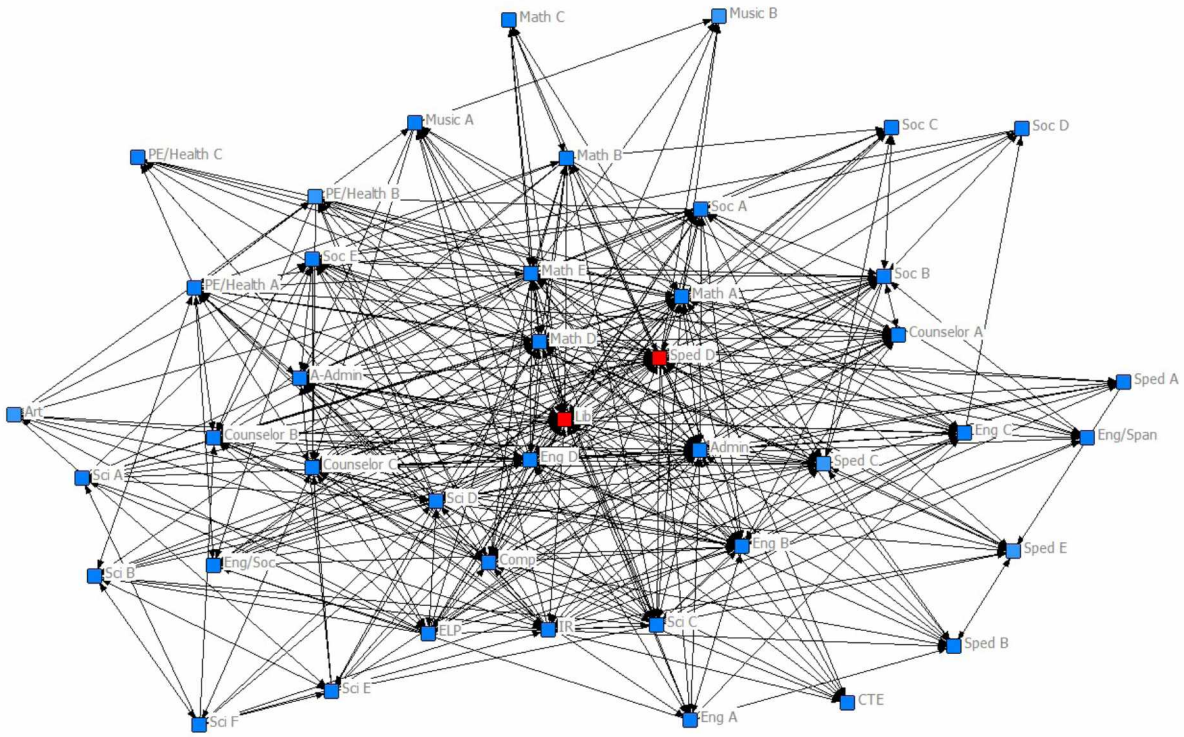

Figure 5.4: Social Network Diagram of Central Connectors in Pilot School One.

Nodes are organized by graph theoretical layout. Central connectors are coded in red.

By visualizing the centrality of individual network members in this way, the librarian was able to see the relative capacity of each member of the network to quickly and effectively communicate information:

> Sped D, which also has one of the lowest [geodesic averages]. It's interesting. Do you see… am I seeing right? English D. English D also was ranked as an information broker. But it's interesting because the librarian and English D have more influence than the admin does… That's cool. Not that it's influence, but it's more power in the structure. I think its just information not power… Like in the ability to share information and connect and collaborate there is a lot.

Visualizing the social network data in various configurations enabled her to see the actors with the most ability to share information throughout the network. As with the information brokers, she was initially surprised that the administration was not more central. The visualization shifted her preconceptions about the nature of power. She acknowledged that, although the principal was the authority in the building, he or she may not have the influence necessary to quickly disseminate information or connect people throughout the building.

Boundary Spanners. Boundary spanners connect subgroups within a network and bridge structural holes. Visualizing boundary spanners with a network map allows the analyst to see the connections between different subgroups in the network. Figure 5.5 depicts a network map that shows how Sped D has connections with various academic subunits within the school. For visual clarity, Sped D has been color-coded red and each subject area subgroup has been coded a different shape. Sped D, similar to central connectors and information brokers can help spread information across the network. However, unlike central connectors and information brokers,

boundary spanners have more control within the network, because they are not constrained by the norms of a particular subgroup. This means they are likely to have more influence than other members of the network.

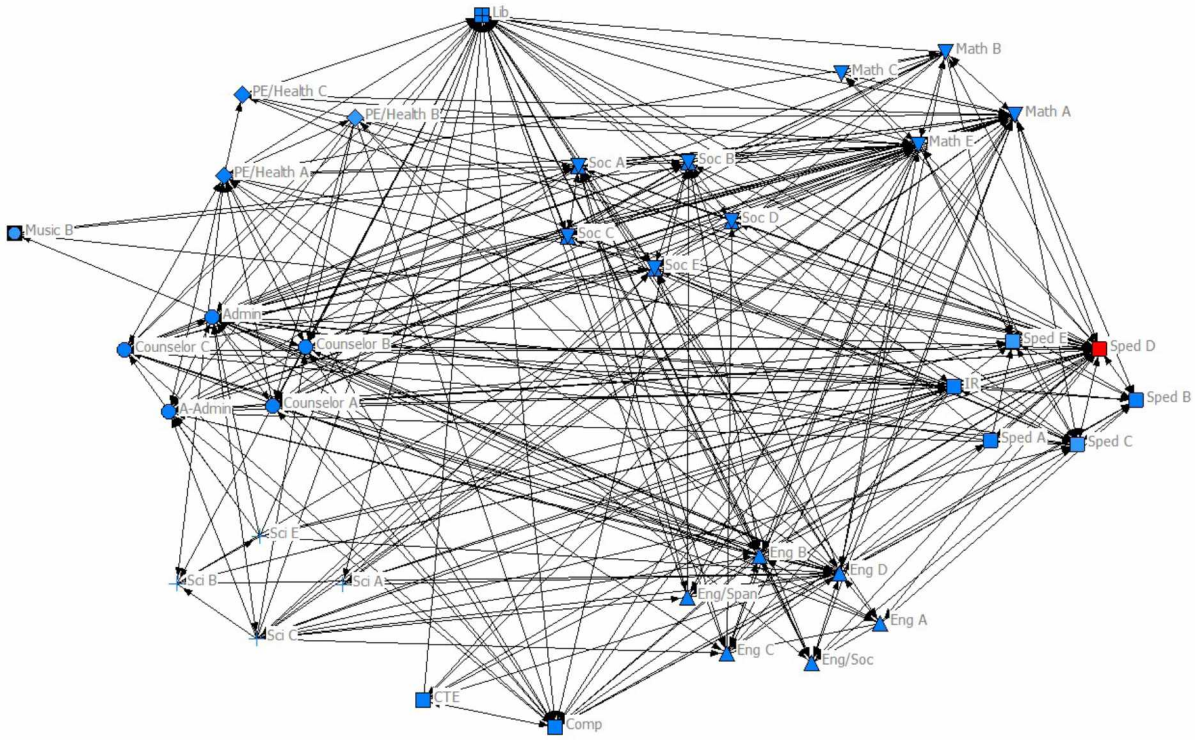

Figure 5.5: Ego Network of Sped D in Pilot School One.

The diagram is organized by subject area. Each subject area is coded a different shape. Sped D is red.

Upon examining the map in NetDraw depicted in Figure 5.5, the librarian in Pilot School One noted that Sped D and Library were potential boundary spanners and that although the Admin had connections with various departments they were not as robust as the connections present within the ego network of Sped D or Library. This triggered her to reflect on the role of the admin and why this might be the case:

> and I wonder if that's because in our building so many of us connect with each that we don't have to go through the admin to get to somebody. In other schools, you may have to run other networks, you may have to go through that power broker in order to get to others, but here people aren't afraid to just walk across the hall or go downstairs or go… reach out… because they are aware of who has information that they need. It's like, who knows how to use the printer, how to do this, I need to connect with the Z4 team, all these things. It's like the admin, are go-tos, but maybe not for all the day to day business. Where our boundary spanners are the day-to-day business of getting stuff done. We don't have to jump through hi to get to somebody else. We just go get it. I know who's gonna know…

She went on to differentiate the role of the information broker and the boundary spanner:

> I think you need like the information brokers. They get the information out. But these boundary spanners. These are the others you can get to those you are not collaborating with. It seems like those are the ones you want to target if you want to build more connections and stronger connections. Those are the people you want to connect with. Cause your information brokers are going to be able to share information and all that, but the boundary spanners are the ones that are going to have a better jump to other people, they'll get them, bring them in, you know. It's like get those outliers and bring them in.

These observations confirmed her understanding of the role boundary spanners play in the social network of the school and demonstrated her ability to use the information to improve collaboration by forming relevant strategy.

The librarian in Pilot School Two offered similar observations to the librarian in Pilot School One. In addition to identifying the boundary spanners, she noted a specific way in which she could use the information: "Teacher talked about how different the library was from when she first came here, environmentally (tall shelves) but also technology differences. Books are being weeded because so much of the information is available online and has the most current information. As I do more and more of that, getting rid of nonfiction books, then you need to know who are the people that are going to have some influence. Win them over." Here, she is referring to the regular practice of removing old, outdated material from the library. Often teachers do not understand the role this plays in maintaining a strong library collection and question the librarian. By identifying the boundary spanners who have influence within their network and "win them over," the librarian hopes to also win over the individuals in the network within those boundary spanners. Making connections with these boundary spanners and "win[ning] them over" allows her to transfer some of her human capital – knowledge of the role of the librarian in curating the library collection – to the boundary spanner, thereby increasing access to the social capital between both individuals through the new formation of a tie between them.

Periphery People. Since those on the periphery exist on the edges of the network and have few connections, they are likely to have the lowest ego network sizes and the lowest point connectivity values. Those with the lowest network size are likely to be peripheral in the network. Point connectivity, which calculates the number of nodes that would have to be removed in order for one actor to no longer be able to reach another, is also used to determine whether actors exist on the periphery of the network. If the number is higher the individual has many ways to get information to the other actor. If the number is low, there are few ways

channels of information flow for that actor. Therefore, those on the periphery will have very low numbers in the point connectivity matrix. As with the other measures and network positions, network maps can be used to confirm the statistical analysis.

The Density Measures report in UCINET calculates ego network size as one of its statistical measure; the number of individuals in an individual's social network. The Point Connectivity report in UCINET calculates point connectivity between each pair of actors in the entire social network. During participatory analysis, the school librarians used UCINET generated point connectivity report and density measures reports, which includes a measure of ego network size for each network member. They used this data to identify periphery individuals in the network, and then used UCINET's NetDraw to generate social network diagrams to better understand the role of these individuals in the network.

In both schools, librarians were able to identify those on the periphery. The visualization (Figure 5.7) in particular allowed them to see individuals that were on the edges of the network and had fewer connections.

> I want to see some of these… less of these outliers… see the one before where we saw that social studies… ugh… I feel like that's … I can see it in this one… when I look at all these arrows I like seeing like almost a black circle [referring to the arrows being so tightly connected that they form a black band around the node] around some of these people; you know, cause it means they are connecting everywhere, but then I see this and there's not a lot coming in and I don't see a lot coming out. You know, like, look at this right here. That's not cool. No. I was looking at Science F. That's what I was referring to when I said look right here, that's not cool.

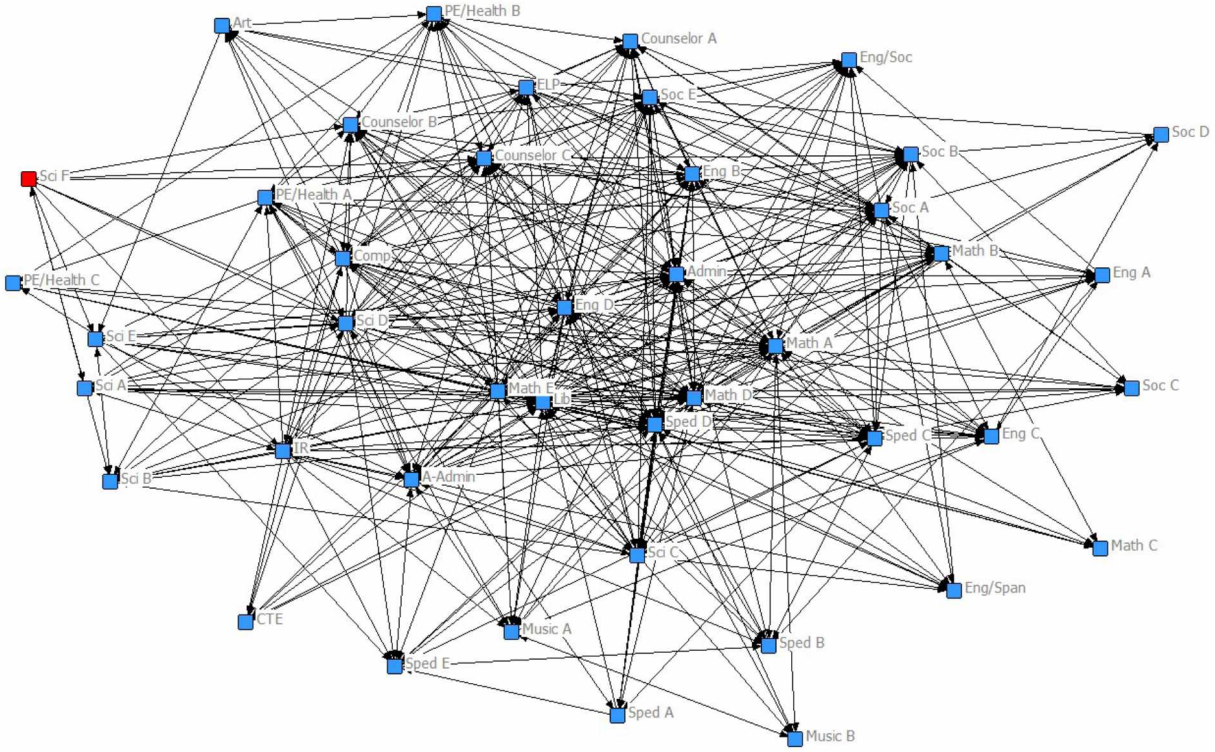

Figure 5.6: Social Network Map of Pilot School One.

Diagram is in graph theoretical layout by geodesic distance. Science F, a periphery person, is in red for visual clarity.

Both librarians noticed a connection between position on the network and subject taught. The librarian in Pilot School One connected this to the size of the department:

> a lot of times when you are a department of one or two, you don't have a lot of connections, because you don't have a team partner, you know, one door over who is teaching the same content or using the same materials. And that's what I see a lot of here. Those are the departments of one or two.

Whereas, the librarian in Pilot School Two related the phenomena to the subject matter itself:

> I think there's some people by virtue of their job are going to be automatically plugged into a network. And there are going to be others, their work is so esoteric perhaps, they are self-contained. For example, it's hard for me to make a connection where I can collaborate with the band teacher or the steel drums class. There is potential but there is more of a stretch to make myself essential to the success then there is for example the global studies department.

In both cases, the librarians recognized the value of identifying individuals on the edges of the network and the ability to use social network data to pull them in. In the case of Pilot School One, the librarian pointed to Soc D and shifted the network diagram to an egocentric view (Figure 5.8). She noted that seeing the data she would identify Soc A as the person to talk to in order to reach Soc D, saying "That would bridge that so you would have someone you could go to and say hey, how can I help, I'd like to help, and that would bridge that step. It's like, sometimes when you go straight to someone they aren't happy about it, but you can go around that and maybe get somewhere."

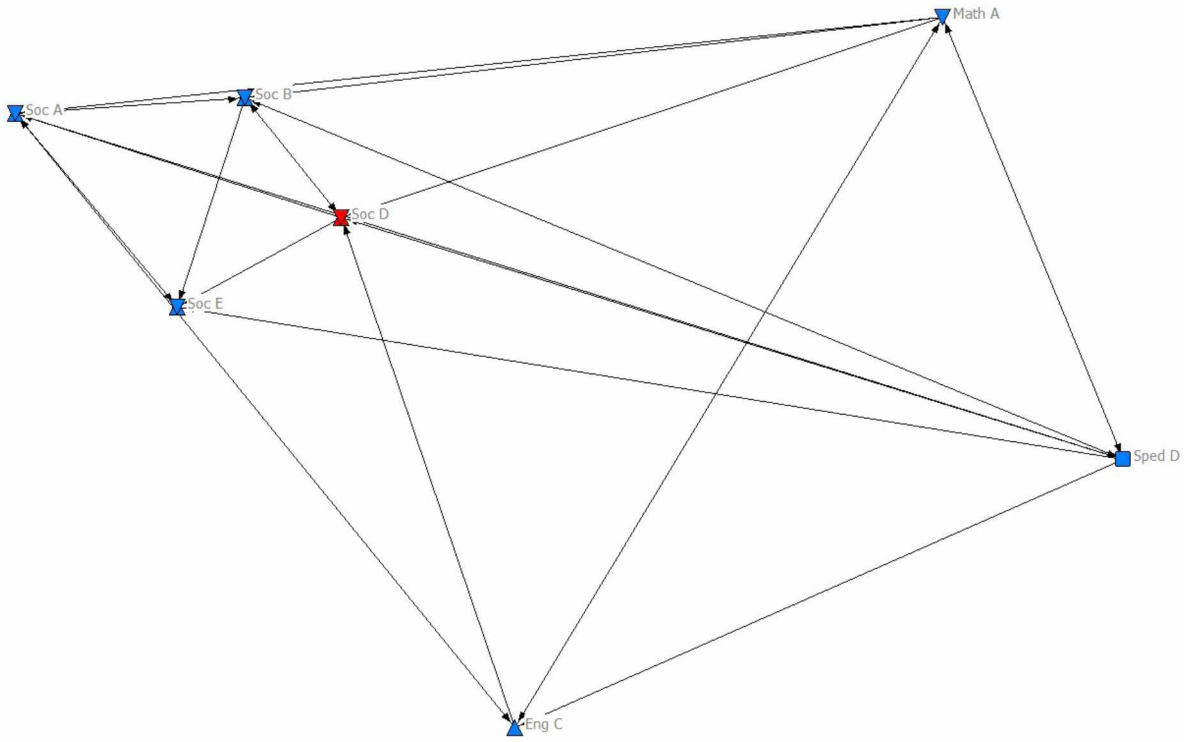

Figure 5.7: Ego network map of Soc D in Pilot School One.

Soc D a periphery person, is coded in red. The diagram shows connections to and from Soc D at a geodesic value of 1.

Both librarians also recognized that some people are on the periphery by choice and may not wish to be further involved in the network, or may need space to do their jobs effectively. "Well, if you look at the science, this music, with the ones and the twos, that these people don't feel ostracized, or don't feel I'm not getting everything I need, but it's more of a content specific I'm good, life's good, I'm playing my music and I'm happy..." Their observations indicated that the librarians recognized that some individuals, who possess a great deal of human capital, might still have limited access to social capital. Identification of individuals in these role positions allowed them to make a choice about how to proceed and where to focus their energies.

After using ego size and point connectivity values, ego-focused network diagrams provided information on how the individual is connected to the broader network. As the librarian for Pilot School One indicated, this enables the librarian to leverage existing connections to create a more robust collaborative network at the ego level for the peripheral individual.

> Look at each department to see where reciprocal connections exist and don't exist to know who to reach out to within a specific department. Add the librarian in to the analysis to see where the connections exist. By looking at the reciprocal relationships, there's the potential for inserting some kind of activity where two individuals are collaborating and I'm facilitating. That's really exciting.

For example, Figure 5.9 displays the ego network of Music B, the most peripheral individual in Pilot School One. From this visualization, the librarian was able to see that Music B has one reciprocal connection, with Music A. Adding the librarian to the visualization (Figure 5.10) so that the network diagram is showing all relationships that exist within one step of both the librarian and Music B, it's possible to see that the Librarian has an established connection to Music A. By leveraging her relationship with Music A, the Librarian has the potential to work collaboratively with both Music A and Music B, thus broadening Music B's ego network and drawing him or her more fully into not only access to social capital, but also increasing the overall school's collaborative structure.

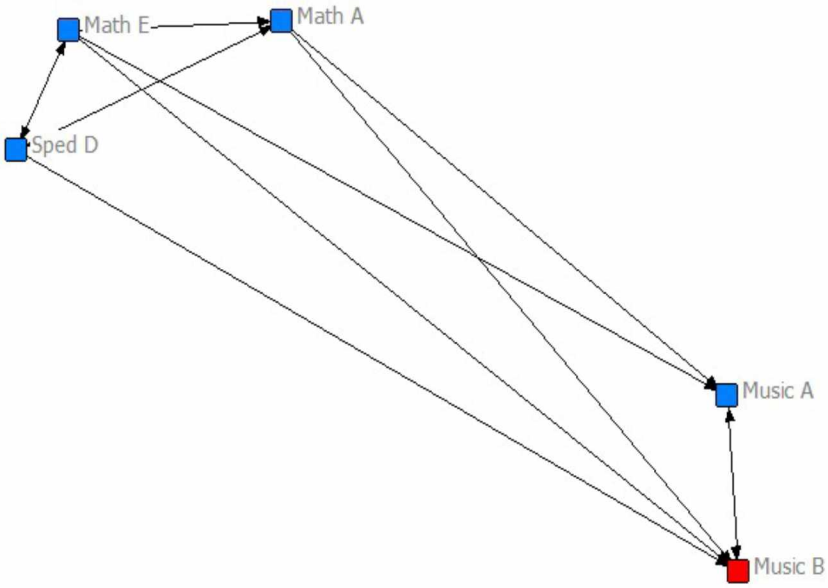

Figure 5.8: Ego Network of Music B, Pilot School One.

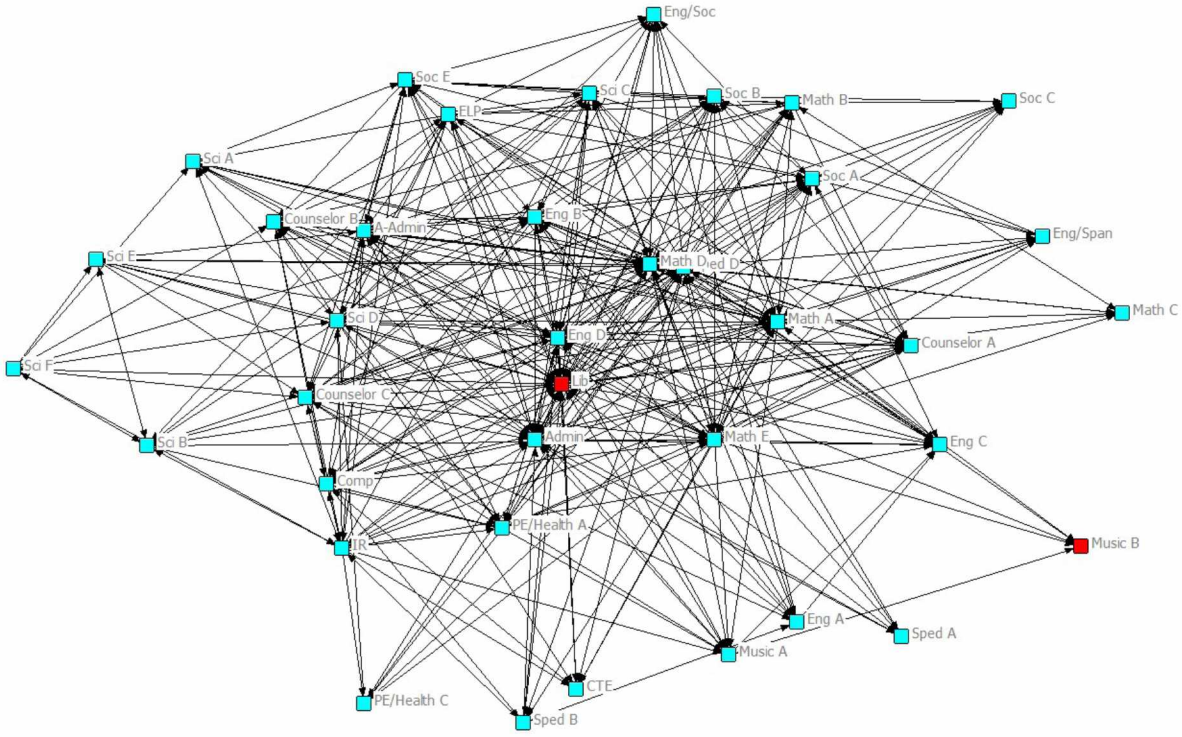

Figure 5.9: Ego Networks of Music B and Librarian, Pilot School One.

During the participatory analysis portion of each pilot, the librarians also indicated the importance of helping peripheral people become better connected to the greater school network and expressed frustration in not knowing how to make those connections:

> The one that said you can go now, there's no connection, there's no curricular connect, there's no personal connection. It's hard to come back time and again. I still do, but it's hard. There's no collaboration with that. I don't know what else I can do with this teacher to show that I'm worthy and that's really how I feel but I also see that that's how this teacher is with a lot of staff. I know it's not personal but it feels personal.
>
> [The district library coordinator] has said you need to be a librarian on the go, on the move. Get out of the library, get out of the office. I try that, that's what I'm aiming for, but I just haven't been successful at doing that.

These frustrations are common in school libraries and served as part of the impetus for this research, to provide school librarians with a tool to allow them to strategize their collaborative efforts. Although the SNASL Process does not provide guidance for how to form and maintain relationships, the ability to identify individuals that are disconnected from the rest of the social network is itself a powerful tool. Social network analysis via the SNASL Process allowed the librarians to identify individuals on the periphery so that strategies for integrating them into the broader collaborative network of the school could be identified.

It is important to note that people on the periphery may be on the fringes of the network intentionally, or they may be there because they do not know how to connect to the rest of the network. Participating librarians understood this concept indicating things such as "would have to talk to them to find out why they are there" and "I think there's some people by virtue of their

job are going to be automatically plugged in to a network. And there are going to be others, their work is so esoteric perhaps, they are self-contained."

The Potential for Strategic Improvement of Collaboration through Generative Insight

One of the school librarians described the differences between her current approach and using social network analysis to improve collaboration when she said "...you're just scatter plotting everywhere… build it and they will come; but this will be targeted. It's targeted and intentional when you have the data. You're like, okay, look at this. It's very clear that this is where I need to go, this is where I need to go."

Mapping the collaborative relationships of actors in the network and viewing and manipulating the social network maps enabled the school librarians in each pilot school to notice things of which they were not previously aware. Since each librarian was new to their school site (less than two years), they were still learning about the social relationships between the staff and their individual needs and preferences. The ability to see those relationships mapped into a diagram, and then connect that information to ideas about the flow of resources and influence, provided a tool that allowed the librarians to strategize to improve collaboration.

> Knowing who has the most influence, especially since I am still new - 2 years isn't long - it would help me to pinpoint the people I should be contacting and seeing if I can get them to collaborate with me, because they are going to have influence over the people with whom they are interacting. And there's that possibility that they'll say something about 'oh what a great lesson we had' and another might pipe in and say 'oh, I'd like to try that'. What's the possibility you and I can sit down together when you get a chance?

The librarian recognized that this data would allow her to "pinpoint" the people she should reach out to and see if she can "get them to collaborate." By working together with those that have the most influence in the network she gains access to their human capital and increases the potential for others to learn about her collaborative projects and want to replicate that experience with their own classes.

Similarly, she recognized that she "could also use this analysis to identify the people who are perceived experts / authority / bottlenecks because they could help route people to the library when appropriate." By targeting her efforts at those with the most capacity to reach others in the network, she could increase her chances of convincing others to collaborate with her and use the library.

These types of insights ranged from broad concepts about the nature of collaboration and how the SNASL Process could be used to improve collaboration overall to observations about specific individuals. In Pilot School Two, the librarian made an observation about one subgroup when she noted "counselors had low numbers but they are involved with every student, but you would think they are, would be involved with every teacher, but they are isolated." The visualization of the network enabled the librarian to see that the counselors were connected to each other but isolated from the rest of the network; they had few connections to other teachers.

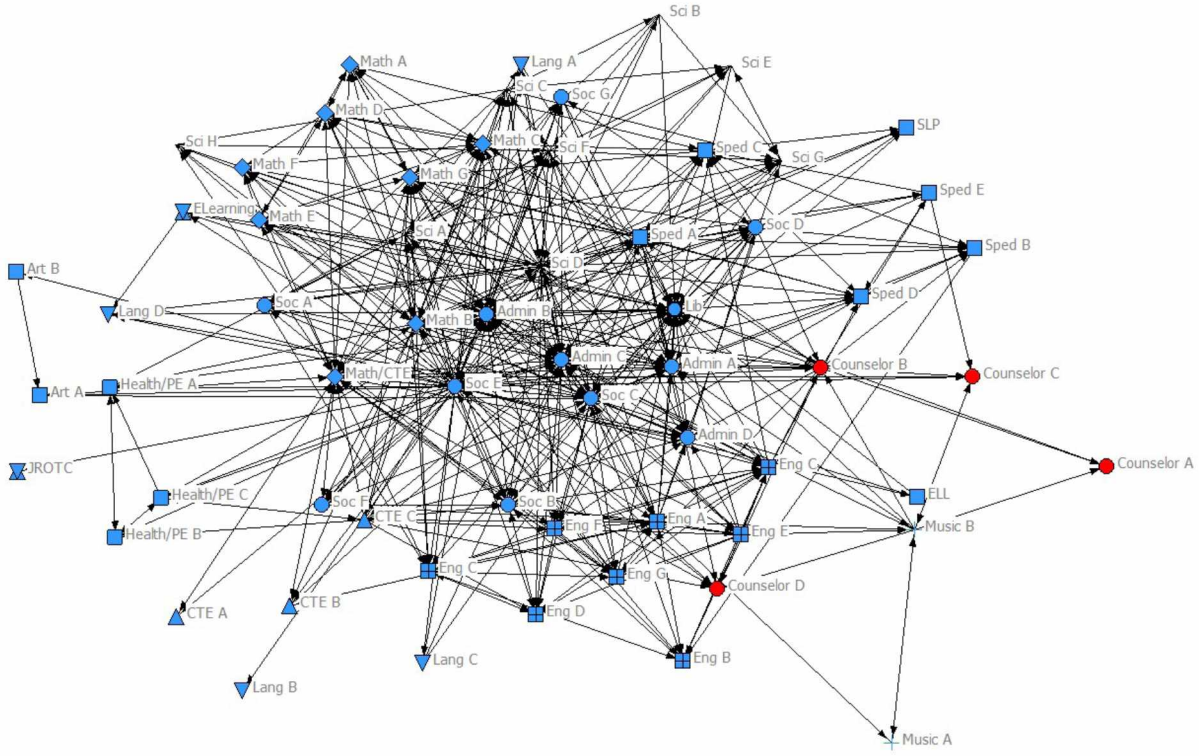

Figure 5.10: Social Network Map of Pilot School One with Counselors in Red.

Map is organized by graph theoretical layout by geodesic distance. For visual clarity, nodes are shaped by subject area and counselors are in red.

By identifying those in the periphery like the School Counselors, the librarians gained the ability to make a strategic choice. They can speak to the individual or individuals on the periphery to determine why they are there and if it is a matter of choice. They can then choose to aide the periphery people in becoming more collaborative and thus increase the social capital of the entire organization, or they may choose to spend their efforts elsewhere. Prior to the identification, however, the librarians were unable to make that choice because they did not have the information to do so. The SNASL Process enabled them to be in a position where strategic choices are possible.

In the examination of a social network diagram mapped by subject area (Figure 5.11), the school librarian in Pilot School One noted:

> It's interesting that I don't see social studies. Social studies are way out on the edges. That's interesting. So, when I look at social studies, I see that they are connecting with other social studies teachers and like one with math. You know? Interesting... And it would seem that Soc B is the one that connects to more because they have reciprocal here, not here, but they do here and here, so they would be the one, and Soc A. A and B. Those are the two you would target. Reach out to get here [Math A] and here [Sped D] and here [Library].

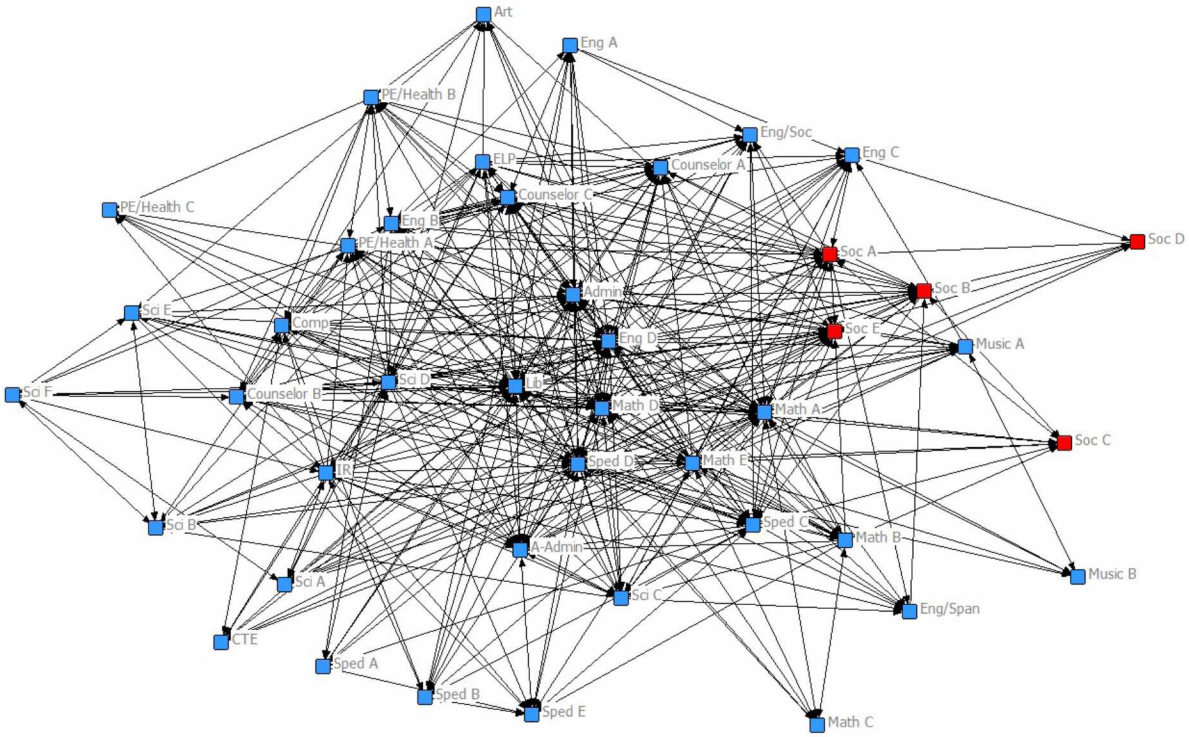

Figure 5.11: Social Network Map of Pilot School One with Social Studies in Red.

This network visualization is mapped by graph theoretical layout by geodesic values. Social Studies nodes are colored red.

Not only was she able to identify the fact that the social studies department was not well connected to the rest of the network, she was able to identify which teacher would be the best entry point to collaborating with the social studies department based on the number and types of connections each member possessed.

Confirming and Modifying Preconceptions. The examination of the social network diagrams resulted in confirmation or modification of librarians' preconceptions of their own practice. For example, one of the librarians mentioned, "I always feel too we have this disparity between upstairs downstairs. I feel like I connect more with people upstairs because they're upstairs where the library is and I have fewer connections with people downstairs because they're all the way downstairs, they are at the other end of the building." Based on this comment, the researcher and librarian generated an ego-level social network diagram for the librarian using a layout that mapped actors by location in the building (Figure 5.13). The librarian, who feared that she spent too much time with teachers that were physically closer to her in the building, noted, "it's not so bad. It's like okay… there's still some connections." By viewing the network map in this configuration she was able to see the proportion of connections she had with teachers upstairs (where the library is located) and downstairs. Her perception was that upstairs connections would be much more robust, but in reality the difference was less than she believed. Furthermore, by knowing who she is not connected to, and who indicates they are not connected to her, she can begin to build relationships with those individuals and change faculty perceptions of collaboration. The visualization of the social network changed her preconceptions.

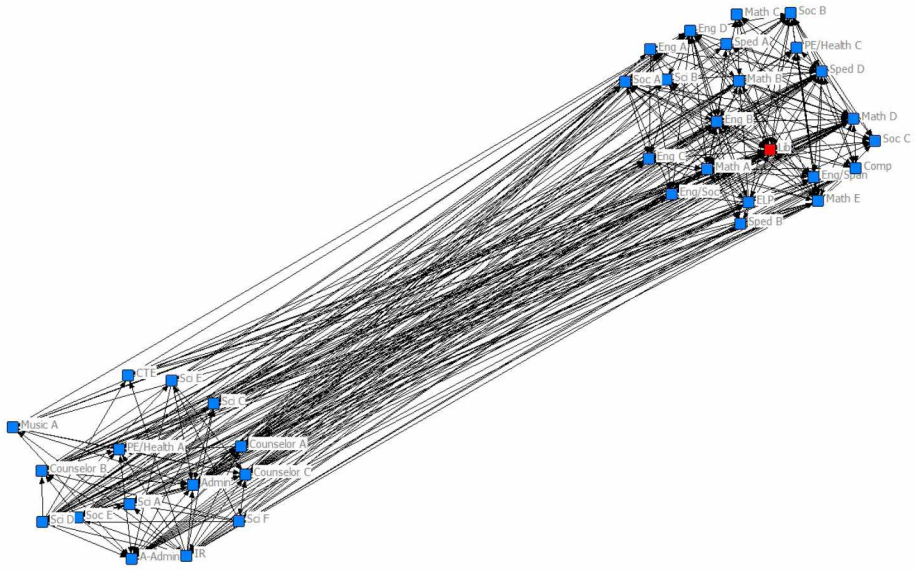

Figure 5.12: Ego Social Network Map of Librarian in Pilot School One.

Nodes are categorized by location in the building: the lower left are staff that work primarily downstairs, the upper right are staff that work primarily upstairs. The librarian node is red.

The other librarian also noted characteristics reflective of her own practice and remarked:

> I see low numbers for myself and I know part of that is that I'm new, I'm still learning the school, the personnel, the procedures, but I know it also reflects my personality as well. [The district library coordinator] has said you need to be a librarian on the go, on the move. Get out of the library, get out of the office. I try that, that's what I'm aiming for, but I just haven't been successful at doing that.

Her statement reflects recognition of the fact that the statistical data (Figure 5.14) and social networking maps (Figure 5.15) confirmed what she expected to see, that the connections she has formed are not as robust as she'd like to see. Although 30 members of the school (Figure 5.15) go to her for information and resources pertaining to their work, there are 32 others that do

not have direct ties with her. As a result, she does not have access to their human capital and they do not have access to her human capital.

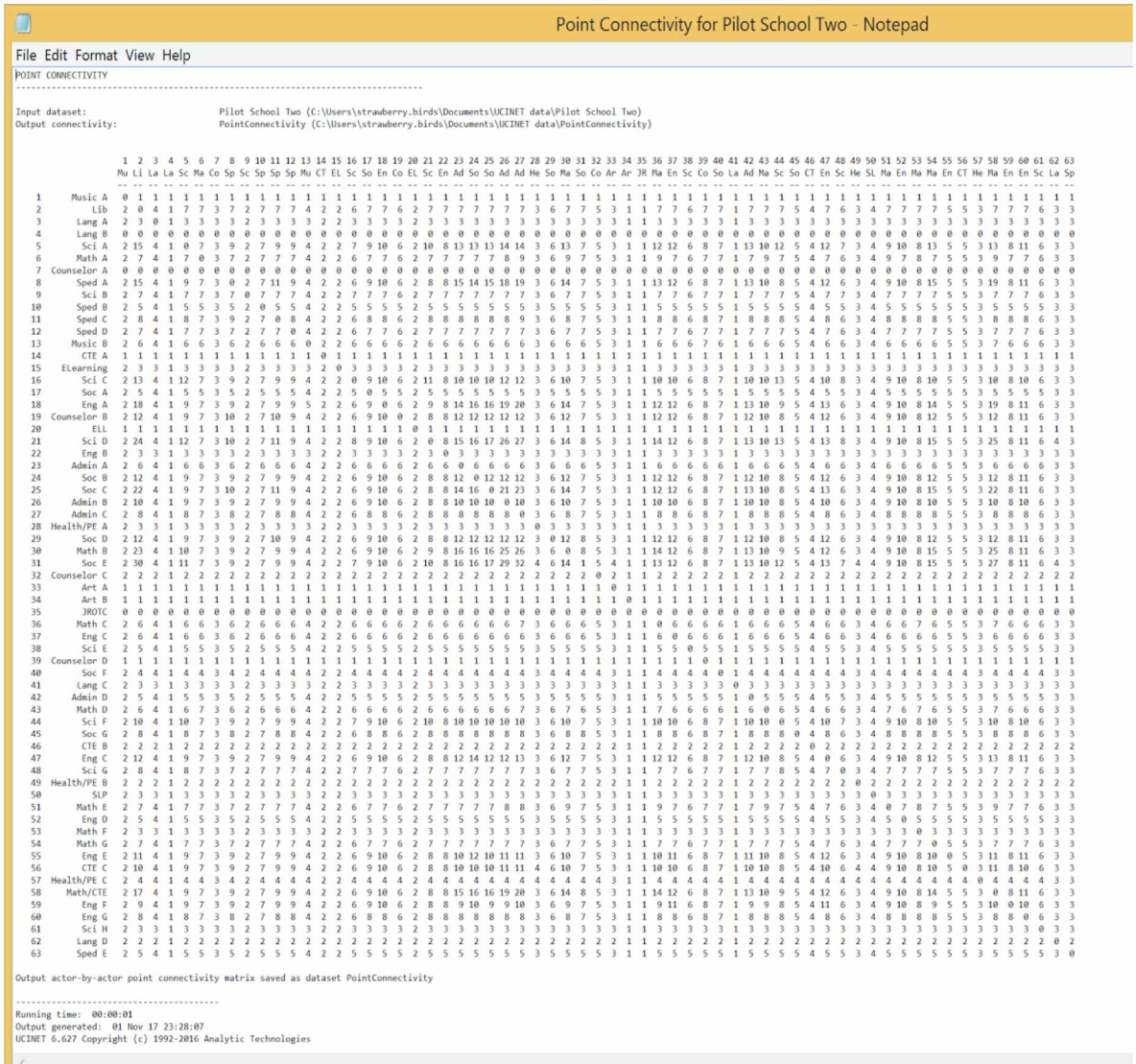

Figure 5.13: Screenshot of Point Connectivity Matrix for Pilot School Two.

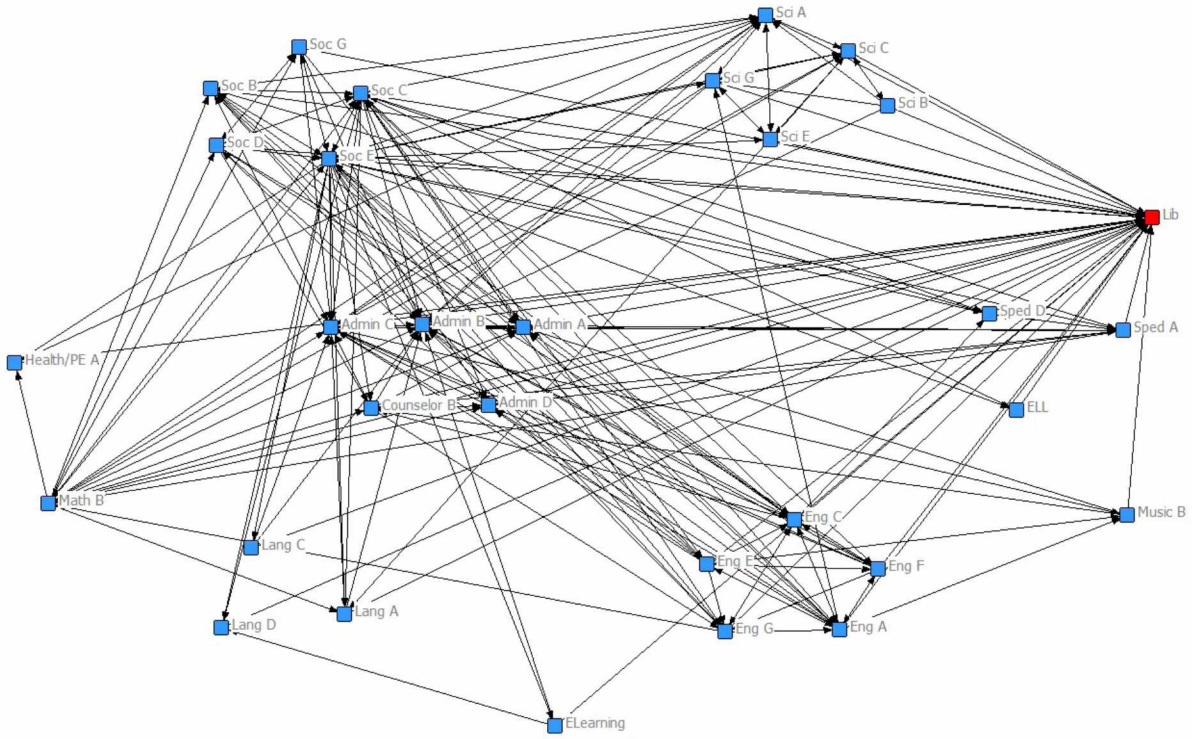

Figure 5.14: Ego Network Map of Librarian in Pilot School Two.

Nodes are organized by subject area and librarian is coded in red. The diagram depicts all of the librarian's incoming ties.

Having data that demonstrates the collaborative connections present in the building and visualizing that data with social networking maps enabled both librarians to move beyond "scatter plotting everywhere" and a "build it and they will come approach" to a more "targeted and intentional approach." By seeing the connections that existed and those that did not, they were able to strategize potential approaches to improve collaboration in a way they had not previously accomplished.

Unlike a report conducted by an external researcher, where the internal employee is looking only at predefined network diagrams, the librarians using the SNASL Process have full control of the social network analysis software. The librarians using SNASL are able to shift the

organization of the visualization, target specific individuals for examination using statistical analysis, or ask specific questions based on preconceptions or curiosity, and then use the social network visualizations to answer them.

While engaging in the process, the librarians recognized their own agency in manipulating the social network diagrams within UCINET. During the participatory analysis sections of the research, they often choose a specific individual or subject area whose ego or subgroup network they wished to explore. The ability to make these sorts of choices and see the various connections within and between departments was "exciting" to the participants who acknowledge the potential of this type of insight.

> Look at each department to see where reciprocal connections exist and don't exist to know who to reach out to within a specific department. Add the librarian in to the analysis to see where the connections exist. By looking at the reciprocal relationships, there's the potential for inserting some kind of activity where two individuals are collaborating and I'm facilitating. That's really exciting.

The themes that emerged during this research: the role of network positions and the potential for strategic improvement of collaboration through generative insight can be "exciting" not only to the school librarian who wishes to evaluate and improve collaboration in his or her school, but to school leaders who recognize the value of collaboration and its ability to lead to improved school achievement. In the final chapter, a summary of the study, a summary of findings, and implications for practice are presented. This information is provided not only for the school library research or practitioner, but also for all educational leaders who wish to strengthen collaborative practices in their schools.

Chapter 6: Discussion

Study Summary

Chapter I: Introduction defined the problem that was being studied and the need for the problem to be address, and explained the question that guided the research: *How can social network analysis be used by school librarians to evaluate and improve the collaborative networks in their school?* Chapter 2: Literature Review provided an examination of the literature on social capital and teacher collaboration in public schools. The value of teacher collaboration to student achievement, the role of trust in the collaborative relationship, and the role of professional learning communities in schools were discussed. In Chapter 3: Theoretical Foundation, social capital and social network theory were defined and discussed, as well as situated in the content of this study. On overview of common social network concepts in educational research were discussed. Additionally, social network role positions were defined and examined as a means of exploring social networks at the micro level. Since the outcome of this dissertation is the development of the Social Network Analysis for School Librarians (SNASL) Process, Chapter 4: Methods reported on the methods for each phase of the research design, and the rationale behind those methodological decisions. In Chapter 5: Findings, the findings of the pilot studies were presented and discussed. Chapter 6: Implications for Practice, opens with a summary of the dissertation, reviews the findings, and offers recommendations for both future research and implications for teacher collaboration in public schools.

Summary of Findings

The impetus for this research began with the effort to improve collaboration between the school librarian and teachers in PK-12 schools using social network analysis to evaluate and improve collaboration. The research design sought to answer the question: *How can social*

network analysis be used by school librarians to evaluate and improve the collaborative networks in their school? Through the research process, the School Network Analysis for School Librarians (SNASL) Process was developed to help provide school librarians with agency to evaluate collaboration in their schools and then use their findings to develop strategic plans to improve the collaborative network of their school. School network analysis has been used to study teacher collaboration and social capital in general educational settings, and in one instance was used to study school librarians (Schultz-Jones, 2009), but has yet to be studied as a mechanism for school librarians to engage in their own local participatory research.

This study tested the SNASL Process as a mechanism to evaluate collaboration in schools and create the potential for strategic improvement of existing collaborative structures in two mid-sized suburban pilot schools. School librarians engaged in participatory analysis using UCINET (Borgatti et al., 2002), examining the social network data compiled by the researcher and guided by the SNASL Process Worksheet.

The pilot studies revealed that the SNASL Process was effective in teaching basic social networking concepts, and creating the potential for generative insight and strategic planning to improve collaboration. In examining the data both statistically and through the use of social network visualizations, school librarians noticed patterns of relationships they were otherwise unaware of and confirm or modify existing preconceptions. Furthermore, school librarians in each pilot study demonstrated understanding of each network position (information brokers, central connectors, boundary spanners, and peripheral people) and were able to identify the individuals operating in each role within their school network. They were then able to identify strategic actions necessary to improve collaboration with individuals and subgroups.

Overall, the SNASL process enabled them to approach collaboration strategically. Instead of "just scatter plotting everywhere… build it and they will come," they could "be targeted." As one librarian expressed, "It's targeted and intentional when you have the data. You're like, okay, look at this. It's very clear that this is where I need to go, this is where I need to go."

In particular, they recognized the value of the SNASL Process to a librarian that is new in their building to use data to identify those with the most influence as a starting point for collaboration. "Knowing who has the most influence, especially since I am still new - 2 years isn't long - it would help me to pinpoint the people I should be contacting and seeing if I can get them to collaborate with me, because they are going to have influence over the people with whom they are interacting."

The ability to use data to see connections among and between departments within a school and understand how to use the data to make choices and foster new connections was "exciting" to the school librarians participating in the study. Understanding how to obtain and use this data provided them agency they did not previously possess to manage their collaborative networks and increase social capital in their schools.

Recommendations for Future Research

Applications of theory to new settings require a great deal of testing and refinement. Although this study was built upon theory in the education and communication fields, it is the first to apply these concepts to school libraries in this way. Therefore, other researchers can continue to examine the usefulness of social network analysis to teacher and librarian collaboration in K-12 schools; as well as test and refine the SNASL Process and increase its applicability to other educational settings.

In particular, this study did not test the SNASL Process in elementary schools due to the geographical lack of availability of certified librarians at the elementary level. Elementary schools often have different collaborative structures, based on grade level and often more insular (*The MetLife survey of the American teacher: Collaborating for student success*, 2010). Thus, research in elementary schools is warranted.

Further study of the specific combination of instruments used in this study is also needed. Testing with other survey instruments and other social network analysis software is needed to validate findings. Testing is also needed to determine successful of the SNASL process without the presence of a facilitator to collect and input data into the social network software, assisting with technical issues, and answer clarifying questions.

Additionally, although the study demonstrated the usefulness of social network analysis in producing generative insight and the potential for strategic improvement of collaboration, future research may wish to examine the steps needed for librarians to move from identification of strategy to implementation of that strategy.

Implications for Practice

A MetLife (*The MetLife survey of the American teacher: Collaborating for student success*, 2010) survey showed that on average, teachers spent 2.7 hours per week in collaboration. At the elementary school level, teachers are more likely to collaborate in grade level groups; at the secondary level, they are more likely to meet in subject specific teams. Teachers that spend more time in structured collaboration with other teachers are more likely to: (a) collaborate school-wide and across grade and subject areas; be more satisfied with teaching as a career; (b) be more likely to strongly agree that teachers trust each other; be more likely to strongly agree that other teachers contribute to their success; (c) believe students have a sense of

responsibility for their own learning; (d) believe most teachers in their school hold high standards for their students; and (e) be more likely to believe that collaboration has a major impact on student achievement (*The MetLife survey of the American teacher: Collaborating for student success*, 2010).

These beliefs and ideas on the impact of collaboration are not insubstantial. Teacher collaboration has the potential for transformative change in schools, but it must be more than a group of teachers given time to talk. Moore Johnson, Reinhorn, and Simon (2016) found that when teams had purpose, that not one teacher found the teamwork a waste of time. Accountability is also important for that time to be productive; critical to the success of collaboration are school leaders who establish early on that collaboration time is time to work toward team goals, not just "meeting" time (Poulos et al., n.d.). Focusing dialogue on instructional practice is also critical for collaboration to have an impact on student achievement. The literature reveals that professional development in schools is most effective when teachers conduct professional inquiries into their own practice via teacher teams or professional learning communities (McNicholl, 2013; Moore Johnson et al., 2016; Perry et al., 2006; Stoll et al., 2006).

However, just telling teachers to work together is not enough to create effective collaborative relationships. Teachers, especially those new to a school, may find it difficult to integrate into the existing relationships structure. Social network analysis can be particularly useful in this situation. Cross & Parker (2004) found that in the business world people learn the most about their colleagues within the first year. After that, they increasingly turn to the people they have come to trust, even if there are other people who might have more expertise. It is very likely this concept is true in all types of organizations. It is not uncommon to hear a school

librarian exclaim that it is difficult to integrate into the existing school culture, especially if the previous librarian was more isolated and collaborated less. Not only does one have to convince teachers to trust them, and get to know them, but they have to perceive the librarian as an expert worthy of consult and integrate him or her into their existing network of contacts (Christiansen et al., 2004). Entropy makes this very difficult. Librarians new to their school can benefit from understanding the structure of the school and therefore be more purposeful and efficient at directing their energies.

Drawing a social network map allows the school librarian to visualize the network of their school and see the interactions between colleagues. Once key players and structural holes have been identified, the librarian can think strategically about building relationships and increasing collaboration. This allows the librarian to think purposefully about where they fit into the social network of the building and how to make changes to that role if desired. By acknowledging the data, and devising a plan of action, the librarian can become an information broker and connect people and departments together, thereby placing themself in a position of influence and a bridge to greater collaborative networks. By examining one's position in the social network of the school, the librarian can uncover and then act to resolve many kinds of personal and system-wide weaknesses (Cross & Parker, 2004).

But this process does not need to be limited to the librarian alone. School administrators can benefit from utilizing social network analysis to examine the relationships between teachers in their schools (Abrams et al., 2003). By identifying information brokers, boundary spanners, central connectors, and peripheral people they too can leverage the influence these individuals have in the network. They can also identify subgroups that are disconnected from the rest of the network, peripheral individuals that should be more involved, or those that have too many

connections and may be suffering overload. This information, coupled with intimate knowledge of their staff, can be used to create a more effective and collaborative team.

Scheduling. In order for anyone to engage in this process, however, support in needed from the school administration (principal, superintendent, etc.). This support must not only include permission to engage in the internal research, but general and overarching support in developing a more collaborative culture within the school. One of the main ways that schools can support effective collaboration is scheduling. Scheduling can be a help or a hindrance when attempting to build up collaborative networks. A schedule that does not allow for organic discussions or the ability to reach out to the most relevant resource for the task at hand, is one that will result in poor and uninformed decision making (Cross & Parker, 2004). Schools that do not build in sufficient PLC or collaboration time will see isolation continue in buildings, and teachers continue to work alone, limiting the resources and knowledge at their disposal and hindering student growth.

Furthermore, administrators who are often in back to back meetings will never have the time to adequately hear from their teachers. Many schools have implemented leadership teams and principals seek guidance and feedback from these teams. However, if input is relegated to this subset of individuals, administrators will miss the potential insight that other qualified educators can provide. Librarians who wish to be heard will often seek out leadership roles, but these additional job responsibilities - if they become too great - can also result in the librarian having less time to perform his or her regular job duties, or may require extensive volunteer time outside of the school day.

Trust. School administrators would also be wise to develop and sustain trust amongst teachers and between teachers and principals. In Chicago, an examination of reform efforts

demonstrated that the level of trust among teachers was the distinguishing characteristic between schools that thrived under reform and those that did not (Bryk & Schneider, 2003), indicating that trust can be essential to effective change in schools. Trust between teachers, and between teachers and administrators, is critical to effective collaboration. Putnam (1993, 1995; 2001) refers to trust as "social capital" and describes it as an asset that can be accumulated and spent. Communities that rely on and use trust accumulate more social capital than those that do not use trust diminish social capital.

Collaboration for shared decision-making can result in greater trust within the school community. That trust can result in teachers being more willing to share ideas and resources, creating a spiral of improvement, which results in greater self-efficacy for teachers and greater student achievement. Unfortunately, shared decision making, as it has typically been enacted in schools, affords teachers little real influence; instead, it is designed to increase teacher satisfaction and acceptability of decisions by creating a mirage that teachers voices have weight in the decision making process. This has been described as contrived collaboration (Tschannen-Moran & Hoy, 2007).

In a nationwide survey (Bacharach, Bauer, & Shedd, 1988), teachers indicated that although they wanted to be involved in school and district decision making, their past experiences indicated that their participation was contrived and they had no real influence, reducing the likelihood of their future participation. Even though, as Conley, Schmiddle, and Shedd (1988)point out, "their pedagogical knowledge, skills, and information about students are arguably a school system's most valuable resource" (p. 266).

On the other hand, when teachers feel confident that their interests are being looked after; and when principals extend trust to teachers through true shared decision making, teachers are

much more likely to agree with and abide by decisions made by administrators (Tschannen-Moran & Hoy, 2007). These effects of trust in schools are not just theoretical. Indeed, studies have demonstrated that even after controlling for socioeconomic status, trust in schools is significantly related to student improvement in reading and mathematics (Tschannen-Moran & Hoy, 2007), but implementing collaboration and building trust requires not only buy-in from teachers, but guidance and support from principals.

For administrators attempting to implement effective collaborative teams or reforms, it is important to keep in mind that trust does not develop, nor is it based on, the same characteristics between supervisors and subordinates as it does between peers. Studies demonstrate that principals base their trust of teachers on the teachers' competence and commitment. Teachers, on the other hand, view principals as trustworthy when they are kind, friendly, and demonstrate integrity (Tschannen-Moran & Hoy, 2007).

Recognizing Human versus Social Capital. Additionally, understanding the difference between human and social capital can be beneficial to school administrators who are implementing new initiatives or curriculum. One way to distinguish between social capital and human capital is that human capital is a quality possessed *by* an individual; whereas, social capital is a quality created *between* people (Burt, 1997). In the world of education, as with many other fields, social capital can be more concretely defined as access to valuable resources (e.g., lesson materials, information) through one's social relationships with others; whereas human capital is typically expressed through one's academic degrees, training, and skills. Within a school each teacher possess human capital in their educational background, training, knowledge, skills, and abilities. When those teachers collaborate, they benefit from each other's human capital via social capital.

As explained in Chapter III, in the educational community, this concept can be seen in the work of Pil and Leana (2009), who found that teachers that work with more highly educated teachers will experience benefits in their own teaching practice and student academic achievement, regardless of their own level of education, or human capital. In other words, the human capital of the teacher has a higher benefit to the school when accessed via social capital than it does when the teacher works exclusively in isolation. However, schools often focus on developing human capital by sending teachers to trainings or providing professional development time.

Although these opportunities are important, they do not benefit the collective unless structures are in place to ensure that the information received by one individual can be accessed by others in the network. In other words, teachers need time to talk, share, and observe each other. School administrators can impact the frequency of this type of sharing by purposefully structuring communities of practice so that teachers who might not otherwise interact have the opportunity to do so.

In their examination of a failed mathematics reform effort in a public school district, Coburn et al. (2013) found that district policy influenced collaboration between teachers. In the first year of the initiative, when teachers discussed mathematics in their traditional grade-level groups, their collaborative ties were based on proximity and homophily (similarity with others based on gender, race, experience, etc.). In year 2, when the district changed the structure of the meetings, proximity and then expertise became the most important quality for new collaborations. Teachers sought out other teachers because they identified new experts in their social networks based on groups formulated by the district. Had the teachers not been asked to interact with new groupings, is it likely that homophily would have continued to be the

predominant method for social connections and teachers would have had less access to social capital.

Evaluating Communities of Practice. Finally, evaluating school-wide systems for communities of practice can increase school-wide supports for teachers increasing their self-efficacy and instructional resources, increase coherence across the school, improve collaborative practice, and directly and indirectly increase student achievement. Gajda and Koliba (2008) created a framework for evaluating and improving teacher collaboration within schools which includes raising collaboration literacy by training teachers and administrators on the purpose of communities of practice, identifying and inventorying communities of practice, reconfiguring teacher teams if necessary, assessing the quality of collaboration, making corrections if necessary, and recognizing accomplishments.

Raising collaboration literacy involves educating school leaders and shifting their mindset from one of hierarchical structures to one where teachers are engaged in communities of practice that form the building blocks for the larger professional learning community focused on shared purpose and inquiry. By identifying and inventorying communities of practice, school leaders can assess whether or not communities of practice are occurring in their schools and the strength of horizontal and vertical ties in those communities. Size of the community of practice (too big or too small) can also be assessed. Revisions can be made if necessary, based on the needs and philosophies of the particular school. Assessing collaboration quality is also critical, in that teacher teams must have verifiable goals, be focused in their communications, and be robust in their discussions. School leaders should model effective collaboration, provide structures when needed, and require agendas or minutes to ensure coherence if necessary. Enabling effective communities of practice also involves recognizing accomplishments when teams are

able to improve their practice. Recognizing accomplishments can simply be verbal acknowledgement at a staff meeting, to encouraging teams to share their process and results at conferences.

Administrators who implement these ideas will increase the likelihood of teachers working together and learning together. By working together in structured and efficient ways, teachers build social capital throughout the school, increasing their knowledge base and resource pool to directly and indirectly benefit their students. The School Network Anslysis for School Librarians (SNASL) Process developed through this mixed methods research study demonstrates how this can be done starting with the librarian as researcher and collaborator. Expanding the analysis and reflection process based on data to a school's entire staff may enable all members of school to understand how to develop social capital for improved teacher practice and student academic achievement, who to go to for assistance to improve workflow and efficiency, and how to most effectively structure teams to improve instructional practice.

Appendices A-H

Appendix A: Institutional Review Board Exemption Letter

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(907) 474-5444 fax
uaf-irb@alaska.edu
www.uaf.edu/irb

Institutional Review Board
909 N Koyukuk Dr. Suite 212, P.O. Box 757270, Fairbanks, Alaska 99775-7270

November 28, 2016

To:	Gary Jacobsen, PhD Principal Investigator
From:	University of Alaska Fairbanks IRB
Re:	[983929-1] Social Network Analysis of Teacher & Librarian Collaboration in AK Secondary Schools

Thank you for submitting the New Project referenced below. The submission was handled by Exempt Review. The Office of Research Integrity has determined that the proposed research qualifies for exemption from the requirements of 45 CFR 46. This exemption does not waive the researchers' responsibility to adhere to basic ethical principles for the responsible conduct of research and discipline specific professional standards.

Title:	Social Network Analysis of Teacher & Librarian Collaboration in AK Secondary Schools
Received:	November 16, 2016
Exemption Category:	*2*
Effective Date:	November 28, 2016

This action is included on the December 14, 2016 IRB Agenda.

Prior to making substantive changes to the scope of research, research tools, or personnel involved on the project, please contact the Office of Research Integrity to determine whether or not additional review is required. Additional review is not required for small editorial changes to improve the clarity or readability of the research tools or other documents.

Appendix B: Pilot Test Template of Alaska Teacher Social Network Survey (ATSNS)

The actual survey was conducted in SurveyMonkey and was customized (teacher names) for the specific school. The consent form preceded the survey on SurveyMonkey.

1. Select your name.
    a. Teacher A
    b. Teacher B
    c. Teacher C
    d. ...

2. Grade Level(s) you Teach
    - ☐ K
    - ☐ 1
    - ☐ 2
    - ☐ 3
    - ☐ 4
    - ☐ 5
    - ☐ 6
    - ☐ 7
    - ☐ 8
    - ☐ 9
    - ☐ 10
    - ☐ 11
    - ☐ 12

3. Subject(s) you Teach _____

4. # Years you have Taught at this School
    a. 0-2
    b. 3-5
    c. 6-8
    d. 9+

5. # Years you have Taught Total
    a. 0-2
    b. 3-5
    c. 6-8
    d. 9+

6. Within your school, **whom do you go to** for information or to discuss your work? For each person, list the purpose and frequency with which you seek out that person. [Within SurveyMonkey, drop-down menus were provided so frequency or purpose could be selected for each cell in the matrix. Choices for frequency: Never, Rarely, Occasionally, Frequently. Choices for Most Frequent Purpose: None, Technology, Instruction, Resources, Student Specific, Other.]

Name	Frequency	Most Frequent Purpose
Teacher A		
Teacher B		
Teacher C		
...		

7. Within your school, **who comes to you** for information or to discuss your work? For each person, list the purpose and frequency with which you seek out that person. [Within SurveyMonkey, drop-down menus were provided so frequency or purpose could be selected for each cell in the matrix. Choices for frequency: Never, Rarely, Occasionally, Frequently. Choices for Most Frequent Purpose: None, Technology, Instruction, Resources, Student Specific, Other.]

Name	Frequency	Most Frequent Purpose
Teacher A		
Teacher B		
Teacher C		
...		

Appendix C: Template of Alaska Teacher Social Network Survey (ATSNS), Final Version

The actual survey was conducted in SurveyMonkey and was customized (teacher names) for the specific school. The consent form preceded the survey on SurveyMonkey.

1. Select your name.
    a. Teacher A
    b. Teacher B
    c. Teacher C
    d. ...

2. Grade Level(s) you Teach
    - ☐ K
    - ☐ 1
    - ☐ 2
    - ☐ 3
    - ☐ 4
    - ☐ 5
    - ☐ 6
    - ☐ 7
    - ☐ 8
    - ☐ 9
    - ☐ 10
    - ☐ 11
    - ☐ 12

3. Subject(s) you Teach _____

4. # Years you have Taught at this School
    a. 0-2
    b. 3-5
    c. 6-8
    d. 9+

5. # Years you have Taught Total
    a. 0-2
    b. 3-5
    c. 6-8
    d. 9+

6. Within your school, **whom do you go to** for information or to discuss your work? For each person, list the frequency with which you seek out that person for each purpose listed. [Within SurveyMonkey, drop-down menus were provided so frequency could be selected for cell in the matrix.]

Name	Technology	Instruction	Resources	Student Specific	Causal Conversation
Teacher A					
Teacher B					
Teacher C					
...					

7. Within your school, **who comes to you** for information or to discuss your work? For each person, list the frequency with which that person seeks you out for each purpose listed. [Within SurveyMonkey, drop-down menus were provided so frequency could be selected for cell in the matrix.]

Name	Technology	Instruction	Resources	Student Specific	Causal Conversation
Teacher A					
Teacher B					
Teacher C					
...					

Appendix D: Social Network Analysis for School Librarians Worksheet, First Version

There are multiple ways to analyze a social network. This process uses some of the most common methods to get a broad picture of the network. This will by no means be comprehensive and will not look at all the possible tools, because some are not relevant to our purpose and some are overly complex for the time and goals of the examination.

Definitions:

Actor = A member of the social network

Tie = The connection between one actor and another

Reciprocal ties = When the ties between two actors go both directions; they give and receive information and resources from one another

There are four types of individuals in networks:

- Central Connectors - Are there any individuals who have a high in-degree and a low out-degree? This can be viewed in two ways. One is that they are perceived as an expert and the other is that they are a bottleneck of information that could be better diversified.
- Boundary Spanners - Connect one department with other departments. They have in-degree and out-degree with multiple departments and are usually the only individual connecting those departments.
- Information Brokers - People who sit on the shortest path between others. These people can help disseminate information throughout the network.
- Peripheral People - On the edges of the network with few connections; they might need help getting better connected or need space to operate on the fringes

Part I: Statistical Analyses

Before you look at the map of the data, you can run some statistical analyses to get a sense of the network.

Network > EgoNet > Basic Measures: This gives you statistics about the network of each individual actor. There are a few things to note here.

- The size is the number of actors that have a connection to this particular actor. Ties is the number of directed ties. Pairs is the number of ordered pairs; in other words how many potential pair connections are there in the network of this particular actor.
- Density is the number of ties divided by the total number of pairs. The higher the density the better the information flow within the individual's network.
- Broker is the number of pairs that are not directly connected. In other words, this actor bridges the gap between these pairs. Normalized broker (nbroker) is the broker divided by the number of pair; or the percent of pair where the actor serves as the broker. The higher the nbroker, the more influential the actor is in their network.

Q1: Who would you identify as the most influential actors in the network? Why? How could you use this information to help improve collaboration?

Network > EgoNetworks > Structural Holes: Use Whole Network Model.

- The *Effective size of the network* (EffSize) is the number of alters (connections) that ego has, minus the average number of ties that each alter has to other alters.
- *Efficiency* (Efficie) represents the proportion of the actor's ties that are non-redundant. The effective size of the ego network may tell us something about the actor's total

impact; efficiency tells us how much impact the actor is getting for each unit invested in using ties. An actor can be effective without being efficient; and an actor can be efficient without being effective.

- *Constraint* reflects how many the actor's connections are connected to one another. The principle is that if a network is tightly connected than the influence of an the individual member is constrained; they have less impact on the whole network if everyone has equal access to all members of the network. Thus, the lower the number here, the less constrained and the more potential impact an actor has on his or her network.

Q2. Which actors have the most impact on their network? Why? How could you use this information to help improve collaboration?

Network > Cohesion > Point Connectivity

- This calculates the number of nodes that would have to be removed in order for one actor to no longer be able to reach another. This should the strength or tenuousness between a particular actor's connection to the network. If the number is higher the individual has many ways to get information to the other actor. If the number is low, there are few ways channels of information flow for that actor.

Q3. Which individuals have the weakest connections to the network? How could you use this information to help improve collaboration?

Network > Cohesion > Geodesic Distance

- This calculates the number of steps between each set of actors in the network. A individual with small steps between lots of actors in the network can help disseminate information.

Q4. Which individuals have the shortest connections within the network? How could you use this information to help improve collaboration?

Part II: Network Mapping

Layout > Group by Attribute: Select "Subject."

- This allows you to visualize the network map by subject area. You can see where subject area groupings create subgroups within the network. On the right side pane you can control your view to look at specific nodes, specific sets of nodes, and nodes by attribute.

Ego

- The Ego Network Viewer allows you to view the network of a particular ego. This can be helpful to see the range or limitation of a particular actor in the whole network.

Helpful Tip: ~Node allows you to change nodes to active or inactive

Let's look at the networks of some of the people we identified before. What do you notice? If you remove people from the network (click off their node) what do you notice?

Appendix E: Social Network Analysis for School Librarians Process

Introduction to the Process

Social network theory is a mechanism for understanding the relationships between individuals in a particular system. Thus, it can be used to better understand how librarians and teachers collaborate. It is important, however, in order to get a full perspective, to examine both the whole system level and also the component parts within that system. To what level one descends within the system is predicated on the phenomena that is being explored. In the case of collaboration within a school, general guidelines can be used to guide the exploration so that it is efficient; educators do not have days and weeks to engage in extensive social network analysis. However, the ability to dig deeper is present and can be engaged in as necessary to support the questions that need answers in each particular case. The concepts and processes outlined in this chapter are designed to allow for guidance in what to look for without limiting the user's ability to skim the surface or dig deeper.

Gaining Permissions

Before beginning any research project, permission must be granted from the school and/or district. Each school and district will have its own policies. Some require an application for internal research to be submitted. Others require simply an email. The librarian should inquire with their principal, district research office, or consult their district school board regulations to determine the appropriate mechanism for gaining permissions to conduct research.

Developing the Survey

In order to collect the data necessary to conduct the social network analysis, a survey must be developed. Surveys can be physical or electronic, short or long. The format, length, and questions will depend on the goals of the project and the survey participants. Since each

population is different, each survey may be slightly different. However, it is important to be consistent within the same population. If the survey is repeated to track change over time, it is important that the survey questions and format be the same so as to maintain fidelity.

Defining Boundaries of the Survey Population. Social network analysis can be conducted at the ego level - centered around an individual person - or at the group level. The ego level may be simpler, because it only requires one person to respond to the survey. However, this data will be less accurate and will not show the networks that are disconnected from the individual in question. Figure E.1 is an example of the difference between an ego network and a bounded group network. In Figure E.1(a), A appears to have a dense network. However, in Figure E.1(b), it is clear that although A's subgroup is dense, that A has no connections to other members of the group. Thus, it is recommended that a bounded group approach be taken.

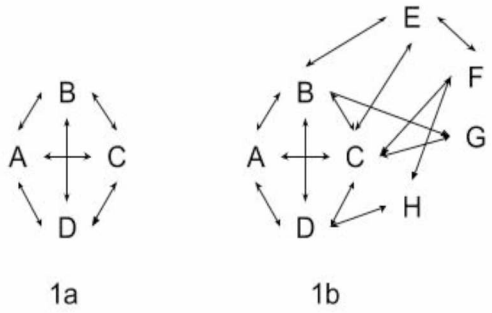


Figure E.1: Ego versus Group Network Analysis.

The researcher must next determine who is to be included in the group. Will survey participants consist of all staff members, instructional staff (teachers and paraprofessionals), teachers and administrators, or only teachers? Consider access to the survey population as well as prior knowledge of the school in making this decision. For example, if the office secretaries

play an important role in school-wide discussions, it is wise to include them the survey. However, if the goal is to improve teacher-specific collaboration, it may make sense to include only teachers. Administrators, although not teaching staff, play an important role in facilitating collaboration and may also provide valuable data as to their position in the network. An administrator is not necessarily central to the network if teachers do not consult him or her for instructional advice or resources. The smaller the population, the easier it will be to analyze the data, so this too may be a factor in making the determination.

Determining Survey Questions. The goal of this project is to analyze the collaboration networks that exist in a given school so that they can be increased and improved. Thus, the questions should reflect this goal. There are several ways to approach the question, but it is recommended to be both broad and specific. The survey will need to include a minimum of two questions that ascertain who is going to whom to collaborate. For example, "Within your school, ***whom do you go to*** for information, resources, or to discuss your work?" and "Within your school, ***who goes to you*** for information, resources, or to discuss your work?" A list of all the school staff would be provided. Participants would then place a checkmark next to the name of each staff member they consult for information, resources, or to discuss their work in the first question and the people who consult with them for the second question.

In this way, an attempt is made to focus specifically on work and not include friendships that lack a collaborative component. Additionally, asking both questions helps provide a more comprehensive view of the network and helps mitigate missing data where respondents choose not to complete the survey.

Although it is possible in social network analysis to map frequency of interactions or to ask participants to indicate who they talk to for each specific task in separate questions, this level

of detail lengthens the survey, reducing the change that participants will complete it. Furthermore, for the purposes of a research practitioner, it complicates the analysis to an unnecessary degree.

It is assumed that the researcher is familiar enough with the school staff to know what subjects and grade levels they teach, as well as their location in the building. However, if this is not the case, additional questions can be added to determine this information.

Determining Dissemination Method. After the survey population and questions are determined, the researcher will want to determine the dissemination method for the survey. Again, this depends on the survey population, their technical expertise, and access to participants. The survey can be as simple as a two-sided sheet of paper that is disseminated at a staff meeting, or may be taken online using software such as Google Forms or SurveyMonkey.

It is important in deciding what method to use to consider access to the population, technological expertise of the participants, and ease of use for the researcher. If participants are not familiar with online survey tools, it may be better to do the survey on paper; however, that means that the researcher will have to transfer the data to an electronic format for the purpose of analysis. If there is a large survey population, the researcher may wish to use an electronic survey to aid in data analysis. Furthermore, if staff meetings are rare, or not well attended, it may be easier to access the participant's electronic rather than by paper. On the other hand, if the participants are more likely to respond to something in their physical mailbox then email, a paper copy may make more sense.

Collecting Data

Once the survey has been disseminated and the data collected, it must be transferred to a format that is readable by social network analysis software. There are multiple types of software out there, but the most established and easy to use is UCINET 6 for Windows (Borgatti et al.,

2002). UCINET is downloadable software available for Windows, available for free for 90 days. Macintosh users can use UCINET if they are running BootCamp or other similar utilities. Although any social network analysis software can be used, the instructions throughout this document will be specific to UCINET.

Creating a Table for UCINET. There are several ways to upload data into UCINET, but the easiest method is to create a data matrix. This can be created in any spreadsheet software including Excel and Google Forms. To begin, create a list of all intended survey participants, including those that did not take the survey. It is wise to use alphabetical order, or another obvious organizational method, as it will make data transfer easier.

In the spreadsheet software, create an empty matrix with participant's names down column 1 and across row 1 as shown in Figure E.2. See Appendix B for a completed example matrix.

Table E.1: Empty Matrix

	Teacher A	Teacher B	Teacher C	Teacher D	...
Teacher A					
Teacher B					
Teacher C					
Teacher D					
...					

Next, begin reading the survey responses. Start by going through the first question "whom do you go to" for each participant, setting aside the second question for now. For each teacher, add a 1 to the cell if that teacher indicated they collaborate with the other teacher. For example, if Teacher A checked off that they go to Teacher C and Teacher D but not Teacher A,

their row in the matrix would look like Figure E.3. Cells that reflect no collaboration can be left blank, as pictured in Figure E.3, or can have a 0 placed in those cells.

Table E.2: Teacher A Example Row

	Teacher A	Teacher B	Teacher C	Teacher D	...
Teacher A			1	1	

After going through the first question for each respondent, it is time to go through the second: "who goes to you". Question 2 data is used to provide a more complex picture and also fill in the gaps where participants did not fill out the survey. Repeat the procedure for Question 1 with Question 2, ignoring a cell that already features a 1.

This type of analysis is non-directional, which means that it does not reflect a relationship that only flows in one direction. Although those types of relationships are not uncommon and can be studied, they require an additional level of analysis that is not recommended for the beginning researcher. This method of recording data will not depict directional relationships, but it is possible to do so with the original survey data, if the researcher desires to do so. UCINET features a great deal of help information to assist in data analysis that goes beyond the scope of this method.

Uploading the Data to UCINET. Once the data is collected and organized into a data matrix, it can be uploaded to UCINET. A basic method of transferring the data is to open the DL editor in UCINET; then copy and paste the data. Click Save and name your file.

Looking at Quantitative Data

The SNASL Process Worksheet is designed to help the researcher understand and interpret their data, notice things about their network, and develop strategy for improving

collaboration school-wide. To effectively examine the data, it is important to understand some terminology.

An individual or organization within a social network is referred to as an actor. A social network can be viewed as a set of actors and a set of links or ties among these actors. When examining a social network analysis diagram, an actor is visualized as a node, which can represent an individual or an organization. In the case of the school social network, each node represents a teacher or staff member within the network. The terms node and actor may be used interchangeably throughout this chapter.

The relationships between the actors are represented as links, or ties, between each node. Arrows represent the directionality of the ties. Ties that feature arrows going in both directions are reciprocal. In Figure E.4, two nodes are presented with a reciprocal tie.

Figure E.2: Illustration of network with two nodes and a reciprocal tie.

Within the SNASL Process worksheet, role positions within the network are used to guide the user through an examination of the network: boundary spanner, central connector, information broker, and peripheral people. Although the worksheet defines these terms, a deeper understanding of each position is provided here:

Boundary Spanner. A boundary spanner serves as a broker, connecting subgroups within an organization. Librarians fulfill this role naturally, operating on the boundary between the teacher and the library. Since librarians are in a central and non-threatening position within a

school, they are in a unique position to bridge the structural holes that might exist between departments and grade levels. Bridging structural holes is important to effective collaboration. A network with distributed expertise and many weak ties has little redundancy. Information within subgroups is often redundant, since people closely connected to one another tend to have access to the same resources and research has shown that people rely on established communication channels once established (Hansen, 1999). When structural holes are brokered, the additional flow of information ensures that both groups have access to the information flows within the groups. The more structural holes spanned, the richer the information within the network.

Thus, it is important that brokers exist to bridge structural holes and enable new knowledge to flow into existing subgroups. The broker, often referred to as a boundary spanner, who spans the hole, serves in this role. Enabling subgroups with purposeful information, boundary spanners can improve workflow, since each subgroup can focus on its own work without the distractions of other needs but can also have consistent information regarding the other groups. For example, a teacher who is well connected to the district office might hear about new curriculum resources or reform initiatives in advance of other teachers and can thus spread the information to his or her department quickly. Librarians can make a point to become this individual by forming the necessary connections, and thus become more central to the information flow in the school building.

Central Connector. A central connector is highly sought after and therefore has greater access to information and social support from the network. In-degree and out-degree are two important ways that this is described. Actors with a high in-degree are sought out by many others for resources and knowledge; whereas actors with a high out-degree seek resources from others (Burt, 1995; Wasserman & Faust, 1994). Those with a high in-degree, by nature of their position,

have a disproportionate influence over others in the network as they have more relationships with which to access resources (Daly et al., 2010; Hanneman & Riddle, 2005). These individuals tend to be centrally located in the network and as such, have a greater ability to leverage resources compared to more peripheral individuals (Tsai, 2001). However, large numbers of direct ties can also drain an individual's resources because they require time and effort to maintain (Balkundi & Harrison, 2006). Furthermore, the social norms present within the group may constrain an individual's behavior defined by those ties (Burt, 1995). Therefore, a central connector may be perceived as an expert in the system, but they may also be a bottleneck that is holding up the flow of resources and information. Either way, being centrally located means that the information a person distributes will reach the rest of the network more quickly (Freeman, 1978).

Information Broker. Information brokers sit on the shortest path between the rest of the network. These individuals disproportionately affect information flow and can be leveraged to promote connectivity within the network (Cross & Parker, 2004). Since an information broker is likely to have a large number of ties in the network and also serve as a bridge between disconnected others, potential information brokers can be identified using the broker and normalized broker measurements. Because of their position in the network, information brokers, like boundary spanners, also bridge structural holes. However, unlikely boundary spanners that link specific subgroups, where ties are likely to be strong, information brokers link a variety of actors within the network, many of whom may have weak or non-existent ties. This allows them to receive and disseminate a large amount of information to and from different actors within the network. This combination of information from weakly connected actors contributes to innovation within the network by enabling information to flow in ways that it would not without the information broker (Burt, 1995).

Peripheral People. Peripheral people operate on the perimeter of the social network. They have few ties to the other actors in the network, measured by ego network size. These individuals may possess underutilized skills, expertise, and unique perspectives that are not being leveraged by the school.

Individuals may be on the periphery because they wish to be there or because they are not sure how to work their way inside. Identifying these individuals can allow librarians to form mentoring relationships, introduce them to others, or get them involved in bigger projects. Identifying these individuals and pulling them into other projects helps the librarian become a boundary spanner or information broker, a bridge between individuals in the network, increasing his or her impact and perception of value.

Using social network analysis to identify periphery people is the first step. However, additional qualitative data is needed to determine why the individual is on the periphery. Some individuals are on the periphery by choice. Pushing them to be involved may reduce their morale or reduce their own work effectiveness. It is important to get to know people to understand these distinctions. For example, if a specialist is too busy helping others, they may not have the time to stay ahead in their field.

Regardless, enabling peripheral people to build more network ties increases the social capital of the entire organization, as their knowledge and resources become more easily accessible by other teachers.

Visualizing the Network

One of the powerful features of social network analysis is the ability to visualize the network using social networking maps or visualizations. These tools allow the user to see the connections between individuals and subgroups in the network. The SNASL Process Worksheet

provides some ideas and guidance for visualizing the network, however it is ultimately up to the user to decide which layouts, filters, and maps allow them to see the network best. Each network is different, and each question a user has about a network may require a different view of the map. This section reviews how to create and manipulate network maps.

In UCINET, NetDraw is used to draw network maps. Click the file folder icon to open an existing data set, and select the matrix data to open the file. The file format should be UCINET, the Type of Data 1-Mode Network. Under Options, all options should be checked. Leave ties have values as the default.

As you explore the network map, remember that if something appears awry, you can always close NetDraw and reopen the file. The data is saved in the matrix that was previously created. The map is just a visual representation of that; you can't delete a node or change it's value from NetDraw.

Applying Attributes. Attributes are a set of characteristics that apply to each actor in the network. For a school, common attributes are subject area, location in the building, years taught, and so on. Attributes are powerful filters that enable the user to change the shape or color of nodes based on attributes. For example, Figure E.3 presents a social network diagram organized by attribute - in this case subject area taught.

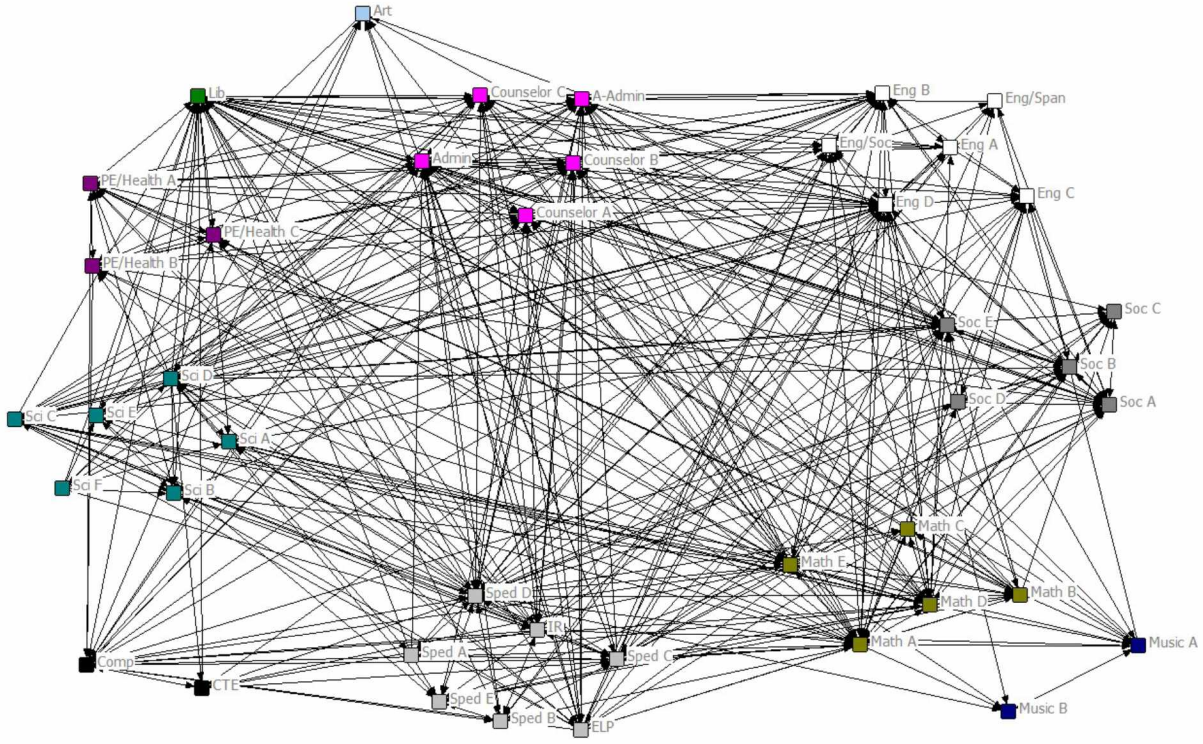


Figure E.3: Example of Social Network Map Sorted and Color Coded by Attribute

In order to use Attributes within NetDraw you must create an attribute file. To create your attribute file, open Notepad in Windows. The first line should read *node data. The next line should read ID and then the name of each attribute, separated by a tab (Figure E.3). If there is more than one word in a column, surround it with quotation marks. When done, save the file. See Figure E.5 for an example.

In NetDraw, click the file folder with an A icon to upload the file. Select the file, then under file format, select VNA. Type of file should read Node Attribute. Click OK.

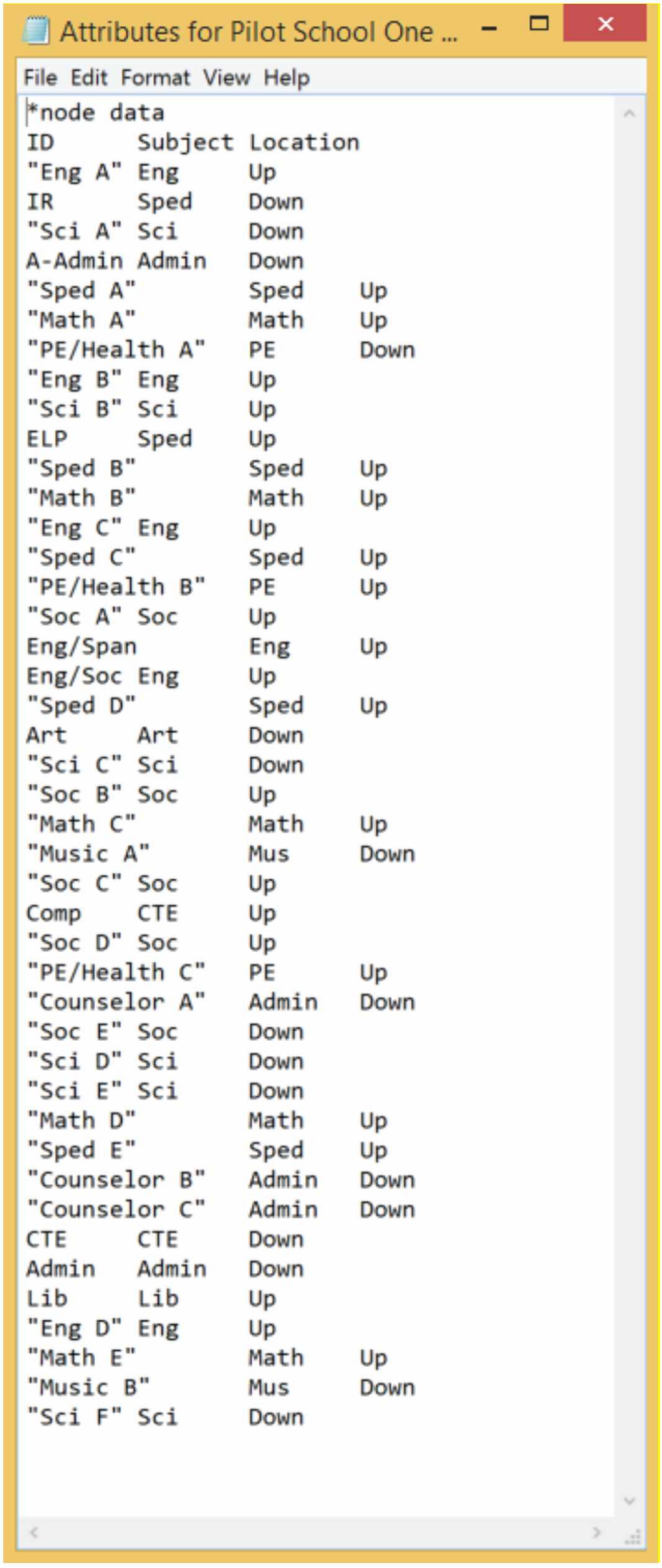


Figure E.4: Screenshot of Attribute Node Data

Once you have your data matrix opened in NetDraw and have uploaded the attribute file, you can change the layout of the map to more clearly see how the attribute impacts connections between actors. One way to do this is to click on Layout > Group by Attribute > Categorical Attribute and then select the appropriate attribute. Feel free to play around with settings until the map displays something meaningful.

Examining at the Ego Level. Examining the network map with all nodes displayed can be overwhelming and complex. A useful technique is to display a specific actor in the network or to display a subset of actors. To do this, click on Ego. Check the box next to each actor you wish to examine. You can clear all options, or select all actors using the buttons below the list of actors. This will show you the network of that actor, in other words, what direct connections does that actor possess. If you wish to see two-steps away from the actor - in other words, who is not directly connected but connected through another individual - you can change the geodesic distance from and/or to the ego.

For ease of viewing, it is possible to change the size and/or color of the ego(s) in question as well by using the size or color options in the Ego Network Viewer (Figure E.5). Click the checkbox next to size, color, or both and select your preferences. Click refresh to apply the changes.

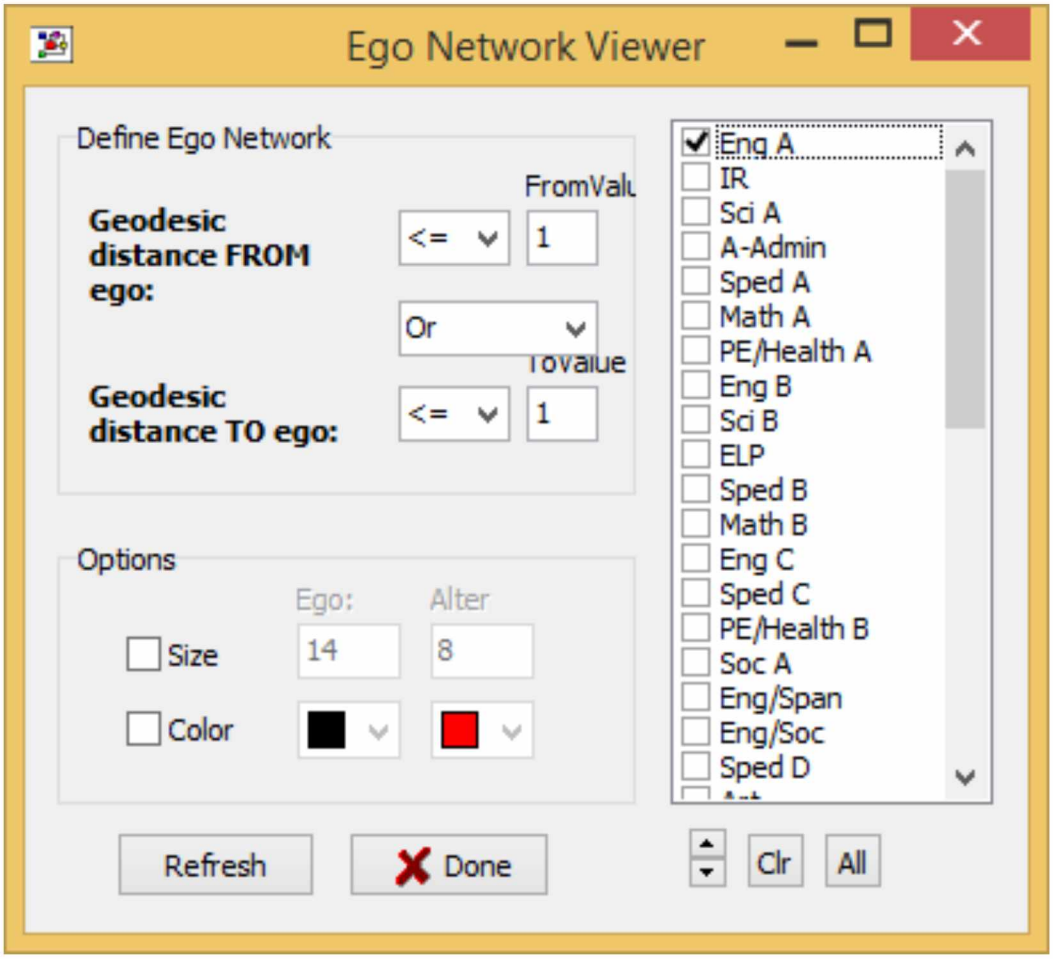


Figure E.5: Screenshot of Ego Network Viewer in UCINET

Creating a Plan of Action

Often recommended in the literature is the idea that librarians should increase their programs one unit at a time until their reputation grows to the point that other teacher seek out the librarian (Achterman & Loertscher, 2008). Although there is merit in this strategy, it is slow and unsystematic. Although the librarian should surely work with teachers who are willing and excited to work with him or her, more can be gained in the long run from integrating into other successful teacher teams. For example, Figure E.6 shows an example of a network in a high school. Teachers B and C are excited to work with the librarian. The librarian should work with them, but since these teachers are not well connected, they will be unable to spread the word

about the librarian effectively, minimizing the impact of Achterman & Loretscher's (2008) advice.

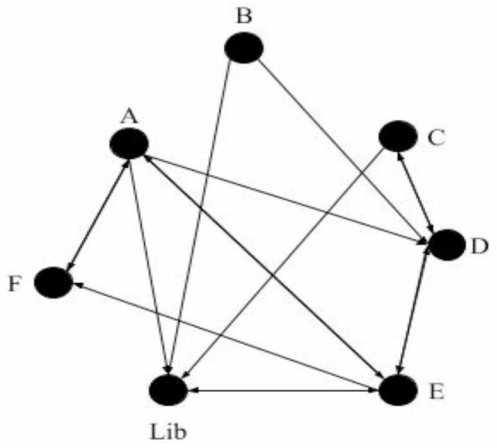


Figure E.6: Example Social Network Diagram

To effectively spread the word, the librarian should try to work with Teachers D or E. These individuals are central in the network and serve as boundary spanners between other teachers; for example, B and C are connected through D but not directly to each other. Getting D and E on board will result in greater dissemination of information about the benefits of working with the librarian. Without social network mapping, the librarian may never identify Teachers D or E in the first place, or it may take a year or more of casual observation to make an inference about the most well connected teachers. Social network mapping enables the librarian to have concrete data to support his or her collaboration strategies.

Repeating the Survey to Track Change Over Time. With a plan of action in place, it is important to know if that plan is working. Are more teachers collaborating with the librarian? Does the librarian have a more central position in the network or is he or she functioning as a

boundary spanner in a way that was not previously occurring? Are people who were once on the periphery more central now? To determine all this, it is important to repeat the survey and data analysis. Due to the time it takes to engage in this process and the time it takes to initiate change, it is recommended that it be repeated every two to three years. In a school with a higher turnover, it may be necessary to do the survey every two years to capture the impact of new staff. While a more stable teacher force may only need to be surveyed every three years.

It is important when repeating the survey to keep the questions and format the same. This will help ensure reliability in the research findings. It is also important to note that many factors, internal and external, impact shifting relationships among staff in a school. Change in leadership, new reform initiatives, schedule changes, and staffing changes can all play a role in the effectiveness of collaboration. Social network analysis will help the researcher determine what is going on, but it does not help with the why. Answering the why requires interviews and conversations with the school staff.

Appendix F: Social Network Analysis for School Librarians Worksheet, Final Version

Introduction

There are multiple ways to analyze a social network. This process uses some of the most common methods to get a broad picture of the network. This will by no means be comprehensive and will not look at all the possible tools, because some are not relevant to our purpose and some are overly complex for the time and goals of the examination.

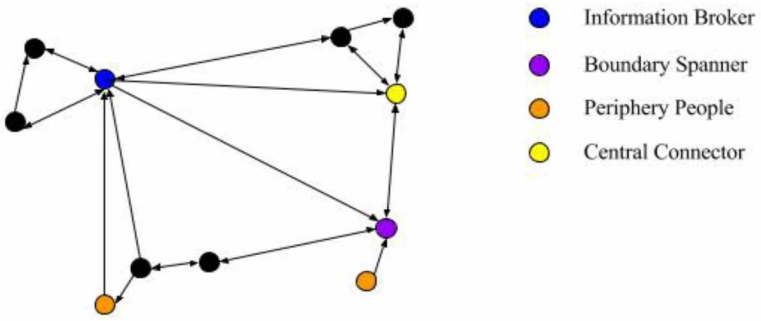


Figure F.1: Visualization of four types of individuals in networks

There are four types of individuals in networks:

- Information Brokers - People who sit on the shortest path between others. These people can help disseminate information throughout the network.
- Central Connectors - These people typically have a high in-degree and a low out-degree. This can be viewed in two ways. One is that they are perceived as an expert and the other is that they are a bottleneck of information that could be better diversified.

- Boundary Spanners - Connect one department with other departments. They have ties to and from multiple departments and are usually the only individual connecting those departments.
- Peripheral People - On the edges of the network with few connections; they might need help getting better connected or need space to operate on the fringes.

For each network position, it makes sense to examine the statistical data and then look at the social network diagrams. This will enable you to identify individuals to focus on when looking at the visualizations and also reduce bias, since decisions on who to examine are based on quantitative data.

Information Brokers

Information brokers have a large number of outgoing ties; they are always sharing information and resources. Unlike boundary spanners, that tie together specific subgroups, or central connectors, that have lots of authority, information brokers are just overall well connected. Librarians that wish to get information out quickly and to a wide audience would do well to target information brokers as part of their marketing strategy.

In UCINET, run the report Network > EgoNet > Basic Measures: This gives you statistics about the network of each individual actor. Look at the columns labeled broker and nbroker. Broker is the number of pairs that are not directly connected. In other words, this actor bridges the gap between these pairs. Normalized broker (nbroker) is the broker divided by the number of pair; or the percent of pair where the actor serves as the broker. The higher the nbroker, the more influential the actor is in their network.

Q1: Who would you identify as the most influential actors in the network? Why? How could you use this information to help improve collaboration?

In NetDraw, open the data matrix and load the attribute file. Once this is open, it can stay open throughout the remainder of the exploration. Click on Layout > Categorize by Attribute > Subject. This will organize the visualization by subject area so that teachers within the same subject area are clustered together. Find the information brokers you identified in Q1.

Q2. Who else do they connect to? Do they connect diverse individuals? Do their ties appear to be mostly one-way or mostly reciprocal? How could you use this information to help improve collaboration?

Boundary Spanners

Boundary spanners connect multiple subgroups within a school. The math department and art department may not work together very often, but if there is a teacher in the history department that works heavily with both math and art he is serving as a boundary spanner. The groups may not work together more frequently as a result of his presence, but he can transfer information between the groups easily. A librarian may wish to seek out a boundary spanner when he or she wants entry into a specific subgroup.

In UCINET, run the report Network > EgoNetworks > Structural Holes: Use Whole Network Model. Look at the column labeled Constraint. Constraint reflects how many of the actor's connections are connected to one another. Visualize constraint as power in their network. The principle is that if a network is tightly connected than the influence of an the individual member is constrained; they have less impact on the whole network if everyone has equal access

to all members of the network. Thus, the lower the number here, the less constrained and the more potential impact an actor has on his or her network.

Q1. Which actors have the most impact on their network? Why? How could you use this information to help improve collaboration?

In NetDraw, click on Ego and check one of the boundary spanners you wish to examine. This will show the ego network of this individual. In other words, who is seeking this person for information and who does this person go to for information within your school network. Repeat this for each boundary spanner.

Q2. Does this change your perceptions of the role of these individuals in the school's network? Who else do they connect to? Do they connect disparate subject areas? What subject areas do they How could you use this information to improve collaboration?

Central Connectors

Within a school, the principal is the authority. However, we all know other teachers and support staff we go to besides the principal when we need something done. Central connectors are often described as having a great deal of authority because many people go to them for information. Although they may not have the official authority of a principal, they often run day to day operations behind the scene, ensuring people have the resources and information they need to operate.

In UCINET, run the report Network > Cohesion > Point Connectivity. This calculates the number of nodes that would have to be removed in order for one actor to no longer be able to

reach another. This should the strength or tenuousness between a particular actor's connection to the network. If the number is higher the individual has many ways to get information to the other actor. If the number is low, there are few ways channels of information flow for that actor.

Q1. Who are the central connectors in their network? How could you use this information to help improve collaboration?

In NetDraw, look at the entire network. If you're still in Ego view, click on Node and select the radio buttons to turn all inactive nodes active. Click on Layout > Graph Theoretical Layout > Geodesic Distance. This diagram maps actors so that the ones that are most central are in the center of the diagram and the ones that are most peripheral are on the edges of the diagram.

Q2. Who is at the center of the visualization? Do you see the same individuals you identified in Q1? Are you surprised at any of the positions of individuals on the map? How might this help you improve collaboration?

Peripheral People

Peripheral people sit on the edges of the network. They have few connections within the network. This may be intentional - as they wish to operate independently - or it may be that they have difficulty getting involved. Librarians that wish to improve collaboration may wish to find out why an individual is peripheral in the network and if appropriate find a way to get them more involved.

In UCINET, run the report Network > Cohesion > Point Connectivity. This calculates the number of nodes that would have to be removed in order for one actor to no longer be able to reach another. This should the strength or tenuousness between a particular actor's connection to the network. If the number is higher the individual has many ways to get information to the other actor. If the number is low, there are few ways channels of information flow for that actor.

Q1. Which individuals have the weakest connections to the network? How could you use this information to help improve collaboration?

In NetDraw, examine the graph theoretical layout diagram again. Look for individuals on the edges of the network.

Q2. Who are on the edges of the network? Who are they connected to if anyone? How could you use this information to get them more involved?

Final Analysis

Q1. Based on this analysis are there particular people you might reach out to that you hadn't before? Why?

Q2. What's your overall impression of the usefulness of this data and analysis approach? Do you see yourself doing this again? How often? Who would you survey? All staff just certified, etc.?

Q3. Play around with the map by moving nodes around, changing the layout, or applying filters. What do you notice when you make these changes? Don't worry if something appears lost or awry; you can always close the NetDraw window and reopen the data set.

Appendix G: Social Network Analysis Quantitative Results

This appendix presents the quantitative results of the social network analysis conducted in Pilot School One and Pilot School Two. Results are organized by each network position that was examined: Information Broker, Central Connector, Boundary Spanner, and Peripheral People. Since tables generated by UCINET are often too large to be seen clearly, descriptions of tables reference supplemental files that contain the original text file outputs.

Information Brokers

Information brokers have a high out-degree (a large number of outgoing ties) and thus are hubs for information within the network. They also sit on a path between various pairs of individuals that would not otherwise be connected if the broker was not part of the network (see Figure G.1).

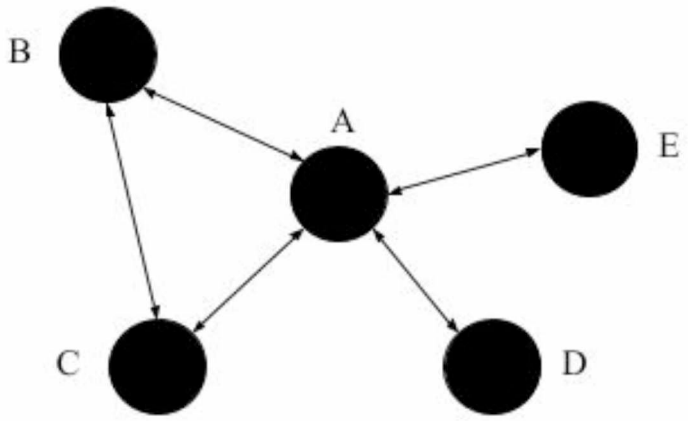


Figure G.1: Diagram of Information Broker.

In this network, A is the information broker, ensuring that there is a path for information to flow between all members of the network.

In UCINET, the statistical measures broker and nbroker are used to identify information brokers. An individual with a high broker value has more influence in the network, as they are a pathway for information to flow amongst members of the network can thus have a greater influence on where and when information flows.

Table G.1 shows the density measures report from UCINET. The original density measures output files from UCINET are available in Supplemental Files: Density Measures for Pilot School One and Density Measures for Pilot School Two. Columns 12 and 13 show broker and nbroker. Social network analysis takes into account each community as a separate entity with its own needs and norms. Therefore, there is no cut score or percentage value to indicate which individuals might be information brokers. The analyst uses statistical analysis as a indicator, but not a determinant, of network position. Network position must be confirmed through network maps and qualitative data, such as interviews with network members.

For the purposes of this research, the individuals with the three highest nBroker scores were chosen for further investigation. For Pilot School One: IR (nBroker = 0.70), Sped D (nBroker = 0.73), Lib (nBroker = 0.68), and Science D (nBroker = 0.70). For Pilot School Two: Soc E (nBroker = 0.85), Math/CTE (nBroker = 0.80), and Lib (nBroker = 0.80).

Table G.3: Density Measures Report from UCINET for Pilot School One

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
		Size	Ties	Pairs	Densit	AvgDis	Diamet	nWeakC	pWeakC	2StepR	2StepP	ReachE	Broker	nBroke	nClose	EgoBet	nEgoBe
1	Eng A	10.00	59.00	90.00	65.56	1.36	3.00	1.00	10.00	42.00	100.00	17.14	15.50	0.34	59.00	4.81	5.34
2	IR	23.00	152.00	506.00	30.04	1.80	3.00	1.00	4.35	42.00	100.00	10.22	177.00	0.70	152.00	67.05	13.25
3	Sci A	11.00	50.00	110.00	45.45			1.00	9.09	42.00	100.00	14.00	30.00	0.55	50.00	11.42	10.38
4	A-Admin	21.00	190.00	420.00	45.24	1.60	3.00	1.00	4.76	42.00	100.00	8.47	115.00	0.55	190.00	44.13	10.51
5	Sped A	8.00	29.00	56.00	51.79			1.00	12.50	42.00	100.00	19.81	13.50	0.48	29.00	9.92	17.71
6	Math A	32.00	323.00	992.00	32.56	1.76	4.00	1.00	3.13	42.00	100.00	7.11	334.50	0.67	323.00	134.44	13.55
7	PE/Health A	19.00	149.00	342.00	43.57	1.60	3.00	1.00	5.26	42.00	100.00	10.10	96.50	0.56	149.00	29.42	8.60
8	Eng B	23.00	241.00	506.00	47.63	1.55	3.00	1.00	4.35	42.00	100.00	8.32	132.50	0.52	241.00	30.43	6.01
9	Sci B	11.00	46.00	110.00	41.82			1.00	9.09	42.00	100.00	15.56	32.00	0.58	46.00	25.35	23.05
10	ELP	20.00	163.00	380.00	42.89	1.60	4.00	1.00	5.00	42.00	100.00	10.07	108.50	0.57	163.00	19.20	5.05
11	Sped B	10.00	50.00	90.00	55.56	1.46	3.00	1.00	10.00	42.00	100.00	16.67	20.00	0.44	50.00	9.87	10.96
12	Math B	17.00	144.00	272.00	52.94	1.49	3.00	1.00	5.88	42.00	100.00	10.85	64.00	0.47	144.00	7.95	2.92
13	Eng C	15.00	107.00	210.00	50.95	1.55	3.00	1.00	6.67	42.00	100.00	11.60	51.50	0.49	107.00	12.46	5.93
14	Sped C	21.00	184.00	420.00	43.81	1.60	3.00	1.00	4.76	42.00	100.00	9.40	118.00	0.56	184.00	41.42	9.86
15	PE/Health B	15.00	110.00	210.00	52.38	1.52	3.00	1.00	6.67	42.00	100.00	11.97	50.00	0.48	110.00	10.52	5.01
16	Soc A	22.00	219.00	462.00	47.40	1.57	3.00	1.00	4.55	42.00	100.00	8.82	121.50	0.53	219.00	36.64	7.93
17	Eng/Span	9.00	44.00	72.00	61.11	1.39	2.00	1.00	11.11	42.00	100.00	16.54	14.00	0.39	44.00	2.45	3.40
18	Eng/Soc	13.00	80.00	156.00	51.28	1.52	3.00	1.00	7.69	42.00	100.00	12.73	38.00	0.49	80.00	15.11	9.68
19	Sped D	36.00	346.00	1260.00	27.46			1.00	2.78	42.00	100.00	6.86	457.00	0.73	346.00	213.23	16.92
20	Art	9.00	25.00	72.00	34.72			1.00	11.11	42.00	100.00	20.49	23.50	0.65	25.00	13.50	18.75
21	Sci C	19.00	179.00	342.00	52.34	1.49	3.00	1.00	5.26	42.00	100.00	9.25	81.50	0.48	179.00	9.08	2.66
22	Soc B	19.00	175.00	342.00	51.17	1.53	3.00	1.00	5.26	42.00	100.00	9.42	83.50	0.49	175.00	27.31	7.98
23	Math C	6.00	23.00	30.00	76.67	1.23	2.00	1.00	16.67	42.00	100.00	23.08	3.50	0.23	23.00	1.25	4.17
24	Music A	12.00	80.00	132.00	60.61			1.00	8.33	42.00	100.00	14.19	26.00	0.39	80.00	13.75	10.42
25	Soc C	9.00	39.00	72.00	54.17	1.50	3.00	1.00	11.11	42.00	100.00	17.14	16.50	0.46	39.00	6.07	8.43
26	Comp	21.00	208.00	420.00	49.52	1.55	3.00	1.00	4.76	42.00	100.00	8.90	106.00	0.50	208.00	30.32	7.22
27	Soc D	6.00	18.00	30.00	60.00	1.47	3.00	1.00	16.67	41.00	97.62	28.47	6.00	0.40	18.00	1.08	3.61
28	PE/Health C	8.00	30.00	56.00	53.57	1.55	4.00	1.00	12.50	42.00	100.00	18.83	13.00	0.46	30.00	5.50	9.82
29	Counselor A	17.00	142.00	272.00	52.21	1.50	3.00	1.00	5.88	42.00	100.00	9.66	65.00	0.48	142.00	22.84	8.40
30	Soc E	20.00	175.00	380.00	46.05	1.58	3.00	1.00	5.00	42.00	100.00	9.44	102.50	0.54	175.00	15.68	4.13
31	Sci D	29.00	261.00	812.00	32.14	1.77	3.00	1.00	3.45	42.00	100.00	8.02	275.50	0.68	261.00	56.49	6.96
32	Sci E	12.00	63.00	132.00	47.73	1.59	3.00	1.00	8.33	42.00	100.00	15.33	34.50	0.52	63.00	7.26	5.50
33	Math D	28.00	276.00	756.00	36.51	1.71	3.00	1.00	3.57	42.00	100.00	7.65	240.00	0.63	276.00	91.47	12.10
34	Sped E	11.00	47.00	110.00	42.73	1.66	3.00	1.00	9.09	42.00	100.00	17.65	31.50	0.57	47.00	9.32	8.47
35	Counselor B	18.00	144.00	306.00	47.06			1.00	5.56	42.00	100.00	9.50	81.00	0.53	144.00	28.59	9.34
36	Counselor C	22.00	191.00	462.00	41.34			1.00	4.55	42.00	100.00	8.37	135.50	0.59	191.00	73.08	15.82
37	CTE	8.00	33.00	56.00	58.93	1.46	3.00	1.00	12.50	42.00	100.00	17.21	11.50	0.41	33.00	0.70	1.25
38	Admin	28.00	316.00	756.00	41.80	1.62	3.00	1.00	3.57	42.00	100.00	7.08	220.00	0.58	316.00	53.39	7.06
39	Lib	36.00	402.00	1260.00	31.90	1.76	4.00	1.00	2.78	42.00	100.00	6.44	429.00	0.68	402.00	157.89	12.53
40	Eng D	34.00	376.00	1122.00	33.51	1.76	4.00	1.00	2.94	42.00	100.00	6.55	373.00	0.66	376.00	140.73	12.54
41	Math E	32.00	323.00	992.00	32.56	1.75	4.00	1.00	3.13	42.00	100.00	7.22	334.50	0.67	323.00	37.25	3.75
42	Music B	5.00	14.00	20.00	70.00			1.00	20.00	41.00	97.62	27.89	3.00	0.30	14.00	0.25	1.25
43	Sci F	9.00	33.00	72.00	45.83	1.67	4.00	1.00	11.11	40.00	95.24	21.62	19.50	0.54	33.00	8.47	11.76

See Supplemental File: "Density Measures for Pilot School One" for original text file.

Table G.4: Density Measures Report from UCINET for Pilot School Two

		1 Size	2 Ties	3 Pairs	4 Densit	5 AvgDis	6 Diamet	7 nWeakC	8 pWeakC	9 2StepR	10 2StepP	11 ReachE	12 Broker	13 nBroke	14 nClose	15 EgoBet	16 nEgoBe
1	Music A	2.00	1.00	2.00	50.00			1.00	50.00	27.00	43.55	81.82	0.50	0.50	1.00	0.00	0.00
2	Lib	32.00	198.00	992.00	19.96			1.00	3.13	62.00	100.00	12.18	397.00	0.80	198.00	225.14	22.70
3	Lang A	7.00	27.00	42.00	64.29	1.45	3.00	1.00	14.29	61.00	98.39	26.41	7.50	0.36	27.00	0.25	0.60
4	Lang B	1.00	0.00	0.00		0.00	0.00	1.00	100.00	52.00	83.87	98.11	0.00		0.00	0.00	
5	Sci A	19.00	120.00	342.00	35.09			1.00	5.26	61.00	98.39	15.33	111.00	0.65	120.00	50.05	14.63
6	Math A	10.00	54.00	90.00	60.00	1.50	4.00	1.00	10.00	54.00	87.10	22.98	18.00	0.40	54.00	9.66	10.73
7	Counselor A	3.00	3.00	6.00	50.00			1.00	33.33	38.00	61.29	63.33	1.50	0.50	3.00	0.00	0.00
8	Sped A	21.00	127.00	420.00	30.24			1.00	4.76	61.00	98.39	14.49	146.50	0.70	127.00	96.35	22.94
9	Sci B	7.00	30.00	42.00	71.43	1.36	3.00	1.00	14.29	51.00	82.26	31.48	6.00	0.29	30.00	0.40	0.95
10	Sped B	8.00	24.00	56.00	42.86			1.00	12.50	51.00	82.26	32.48	16.00	0.57	24.00	6.53	11.67
11	Sped C	14.00	66.00	182.00	36.26	2.06	5.00	1.00	7.14	60.00	96.77	20.91	58.00	0.64	66.00	48.04	26.40
12	Sped D	11.00	49.00	110.00	44.55			1.00	9.09	61.00	98.39	23.37	30.50	0.55	49.00	18.65	16.96
13	Music B	10.00	20.00	90.00	22.22			1.00	10.00	54.00	87.10	33.96	35.00	0.78	20.00	47.33	52.59
14	CTE A	2.00	2.00	2.00	100.00	1.00	1.00	1.00	50.00	55.00	88.71	68.75	0.00	0.00	2.00	0.00	0.00
15	ELearning	5.00	10.00	20.00	50.00			1.00	20.00	61.00	98.39	38.13	5.00	0.50	10.00	0.25	1.25
16	Sci C	14.00	69.00	182.00	37.91	2.10	5.00	1.00	7.14	61.00	98.39	20.47	56.50	0.62	69.00	26.04	14.31
17	Soc A	10.00	43.00	90.00	47.78			1.00	10.00	60.00	96.77	23.26	23.50	0.52	43.00	13.30	14.78
18	Eng A	23.00	150.00	506.00	29.64	2.05	5.00	1.00	4.35	62.00	100.00	14.12	178.00	0.70	150.00	108.16	21.38
19	Counselor B	18.00	84.00	306.00	27.45			1.00	5.56	62.00	100.00	18.13	111.00	0.73	84.00	40.03	13.08
20	ELL	3.00	5.00	6.00	83.33	1.17	2.00	1.00	33.33	58.00	93.55	49.57	0.50	0.17	5.00	0.00	0.00
21	Sci D	38.00	313.00	1406.00	22.26	2.06	4.00	1.00	2.63	61.00	98.39	10.05	546.50	0.78	313.00	230.28	16.38
22	Eng B	9.00	39.00	72.00	54.17	1.51	3.00	1.00	11.11	58.00	93.55	29.44	16.50	0.46	39.00	2.17	3.01
23	Admin A	18.00	123.00	306.00	40.20	1.73	4.00	1.00	5.56	62.00	100.00	14.12	91.50	0.60	123.00	23.62	7.72
24	Soc B	19.00	136.00	342.00	39.77	1.65	3.00	1.00	5.26	62.00	100.00	14.22	103.00	0.60	136.00	42.39	12.39
25	Soc C	32.00	257.00	992.00	25.91	2.04	4.00	1.00	3.13	62.00	100.00	10.90	367.50	0.74	257.00	260.84	26.29
26	Admin B	32.00	240.00	992.00	24.19	2.09	5.00	1.00	3.13	62.00	100.00	10.82	376.00	0.76	240.00	146.48	14.77
27	Admin C	36.00	292.00	1260.00	23.17	2.05	4.00	1.00	2.78	62.00	100.00	9.98	484.00	0.77	292.00	148.02	11.75
28	Health/PE A	6.00	12.00	30.00	40.00			1.00	16.67	58.00	93.55	39.73	9.00	0.60	12.00	9.50	31.67
29	Soc D	14.00	63.00	182.00	34.62	1.92	4.00	1.00	7.14	61.00	98.39	19.87	59.50	0.65	63.00	29.87	16.41
30	Math B	32.00	256.00	992.00	25.81	1.91	4.00	1.00	3.13	61.00	98.39	10.66	368.00	0.74	256.00	178.09	17.95
31	Soc E	52.00	390.00	2652.00	14.71			3.00	5.77	62.00	100.00	8.90	1131.00	0.85	390.00	492.45	18.57
32	Counselor C	5.00	5.00	20.00	25.00			1.00	20.00	60.00	96.77	52.17	7.50	0.75	5.00	11.00	55.00
33	Art A	4.00	7.00	12.00	58.33			1.00	25.00	57.00	91.94	50.00	2.50	0.42	7.00	3.00	25.00
34	Art B	2.00	1.00	2.00	50.00			1.00	50.00	52.00	83.87	91.23	0.50	0.50	1.00	0.00	0.00
35	JROTC	1.00	0.00	0.00		0.00	0.00	1.00	100.00	52.00	83.87	98.11	0.00		0.00	0.00	
36	Math C	15.00	101.00	210.00	48.10	1.59	3.00	1.00	6.67	61.00	98.39	17.43	54.50	0.52	101.00	16.84	8.02
37	Eng C	13.00	72.00	156.00	46.15	1.61	3.00	1.00	7.69	61.00	98.39	20.27	42.00	0.54	72.00	12.82	8.22
38	Sci E	7.00	30.00	42.00	71.43			1.00	14.29	61.00	98.39	33.33	6.00	0.29	30.00	0.45	1.07
39	Counselor D	8.00	18.00	56.00	32.14			1.00	12.50	61.00	98.39	31.28	19.00	0.68	18.00	9.50	16.96
40	Soc F	9.00	48.00	72.00	66.67	1.39	3.00	1.00	11.11	61.00	98.39	22.02	12.00	0.33	48.00	1.37	1.90
41	Lang C	4.00	9.00	12.00	75.00			1.00	25.00	60.00	96.77	39.22	1.50	0.25	9.00	0.00	0.00
42	Admin D	15.00	90.00	210.00	42.86	1.70	3.00	1.00	6.67	62.00	100.00	16.02	60.00	0.57	90.00	16.30	7.76
43	Math D	11.00	64.00	110.00	58.18	1.45	3.00	1.00	9.09	59.00	95.16	22.26	23.00	0.42	64.00	6.39	5.81
44	Sci F	16.00	90.00	240.00	37.50			1.00	6.25	61.00	98.39	18.83	75.00	0.63	90.00	35.82	14.92
45	Soc G	9.00	45.00	72.00	62.50	1.44	3.00	1.00	11.11	61.00	98.39	21.63	13.50	0.38	45.00	2.57	3.56
46	CTE B	5.00	13.00	20.00	65.00	1.40	3.00	1.00	20.00	59.00	95.16	34.50	3.50	0.35	13.00	0.33	1.67
47	Eng C	19.00	126.00	342.00	36.84			1.00	5.26	62.00	100.00	15.09	108.00	0.63	126.00	70.57	20.64
48	Sci G	11.00	60.00	110.00	54.55	1.66	4.00	1.00	9.09	62.00	100.00	22.38	25.00	0.45	60.00	3.51	3.19
49	Health/PE B	4.00	5.00	12.00	41.67			1.00	25.00	54.00	87.10	67.50	3.50	0.58	5.00	2.50	20.83
50	SLP	5.00	14.00	20.00	70.00			1.00	20.00	53.00	85.48	37.59	3.00	0.30	14.00	0.33	1.67
51	Math E	12.00	73.00	132.00	55.30	1.48	3.00	1.00	8.33	61.00	98.39	20.68	29.50	0.45	73.00	6.11	4.63
52	Eng D	11.00	62.00	110.00	56.36	1.45	3.00	1.00	9.09	61.00	98.39	21.94	24.00	0.44	62.00	2.99	2.72
53	Math F	9.00	49.00	72.00	68.06	1.33	3.00	1.00	11.11	60.00	96.77	24.49	11.50	0.32	49.00	0.67	0.93
54	Math G	18.00	127.00	306.00	41.50	1.66	3.00	1.00	5.56	60.00	96.77	14.81	89.50	0.58	127.00	19.26	6.29
55	Eng E	14.00	89.00	182.00	48.90	1.62	4.00	1.00	7.14	62.00	100.00	19.31	46.50	0.51	89.00	12.08	6.64
56	CTE C	15.00	60.00	210.00	28.57			1.00	6.67	55.00	88.71	19.71	75.00	0.71	60.00	57.54	27.40
57	Health/PE C	6.00	12.00	30.00	40.00			1.00	16.67	59.00	95.16	40.41	9.00	0.60	12.00	8.00	26.67
58	Math/CTE	27.00	142.00	702.00	20.23			1.00	3.70	60.00	96.77	13.61	280.00	0.80	142.00	405.37	57.74
59	Eng F	16.00	103.00	240.00	42.92	1.64	3.00	1.00	6.25	59.00	95.16	17.15	68.50	0.57	103.00	11.29	4.70
60	Eng G	14.00	94.00	182.00	51.65	1.55	3.00	1.00	7.14	62.00	100.00	16.85	44.00	0.48	94.00	14.47	7.95
61	Sci H	7.00	33.00	42.00	78.57	1.21	2.00	1.00	14.29	59.00	95.16	29.65	4.50	0.21	33.00	1.17	2.78
62	Lang D	5.00	12.00	20.00	60.00	1.55	3.00	1.00	20.00	60.00	96.77	37.50	4.00	0.40	12.00	1.75	8.75
63	Sped E	7.00	16.00	42.00	38.10			1.00	14.29	52.00	83.87	36.36	13.00	0.62	16.00	4.17	9.92

See Supplemental File: "Density Measures for Pilot School Two" for original text file.

Network maps confirmed the role of the Information Brokers identified using density measures. Figure G.2 shows the ego networks of the three information brokers identified in Pilot School One in one network map: Lib, IR, and Sped D; Figure G.3 shows the results for Pilot

School Two. Unless otherwise specified, all ego network maps presented in this chapter consist of actors with ties that are 1 geodesic value to or from the specified ego. For clarity of visualization, the actors have been grouped by subject and the nodes of the information brokers have been colored red. In Pilot School One, when combined, these three individuals reach to 42 of the 43 nodes in the network. The only node not included in this network is Art, which has peripheral connections to the network. In Pilot School Two, the combined social network of the three information brokers reaches all members of the school network.

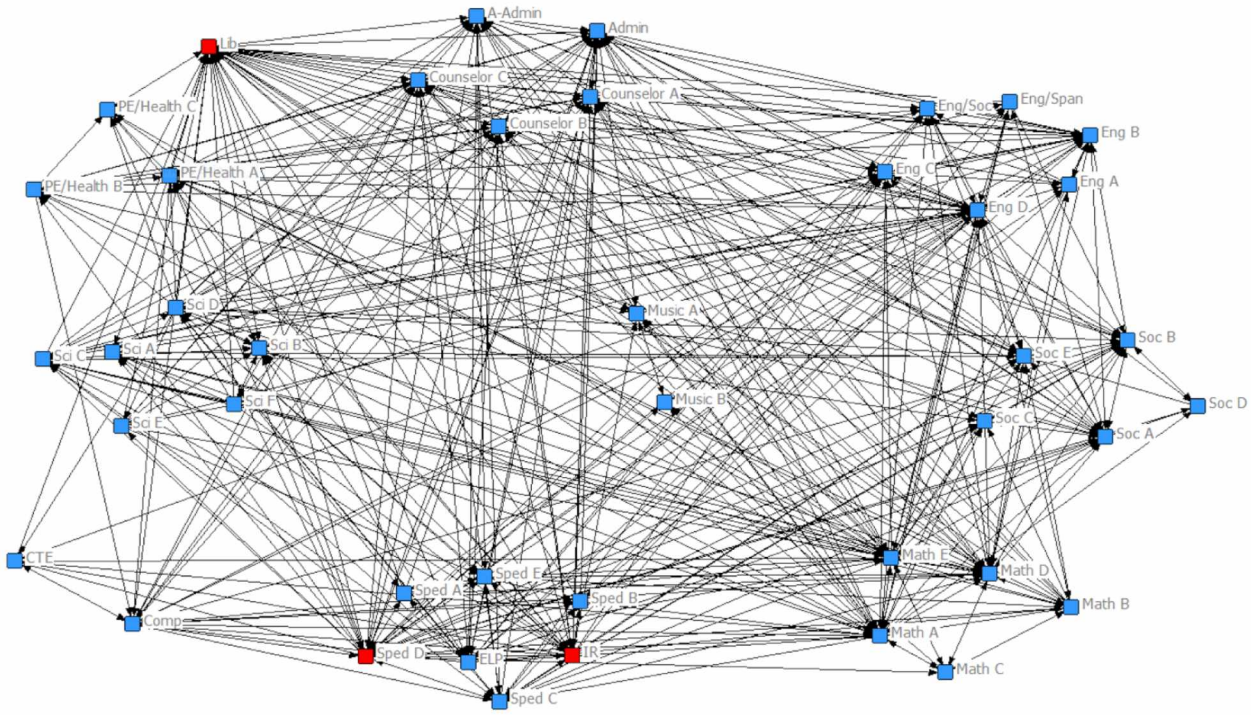


Figure G.2: Network map of information brokers from Pilot School One.

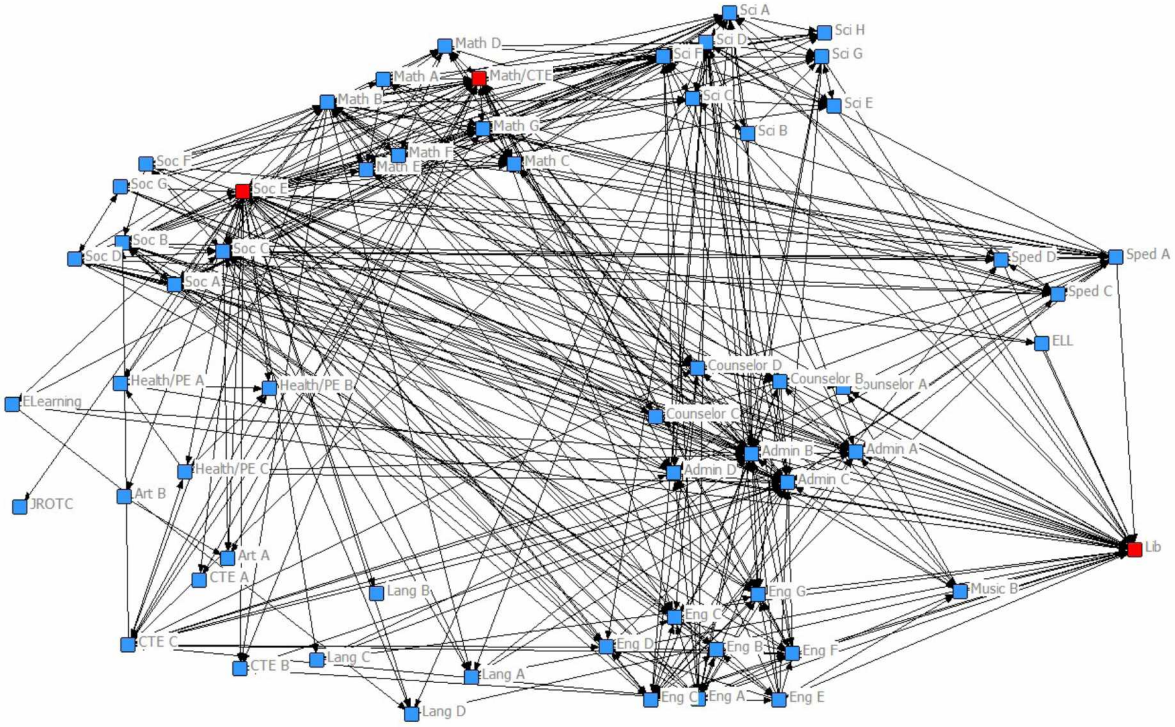


Figure G.3: Network map of information brokers from Pilot School Two.

Central Connectors

Central connectors tend to have a high closeness centrality, measured here by geodesic distance. Distance is a measure of how "far" apart actors are within the network. In other words, how many steps does it take to get from one actor to another? When this value is small there is a relatively cohesive network; when it is high, it is difficult for information and resources to flow through the network. Geodesic distance, in particular, demonstrates the number of steps between each set of actors in the network. A teacher with a high closeness centrality will have few steps between the other actors in the network. For example, in Figure G.1 IR is one step away from Sci A, meaning that they are directly connected. In contrast, Art is three steps from Math A, meaning that for information to flow between Art and Math A in the current network, it must go through two other people before reaching Math A.

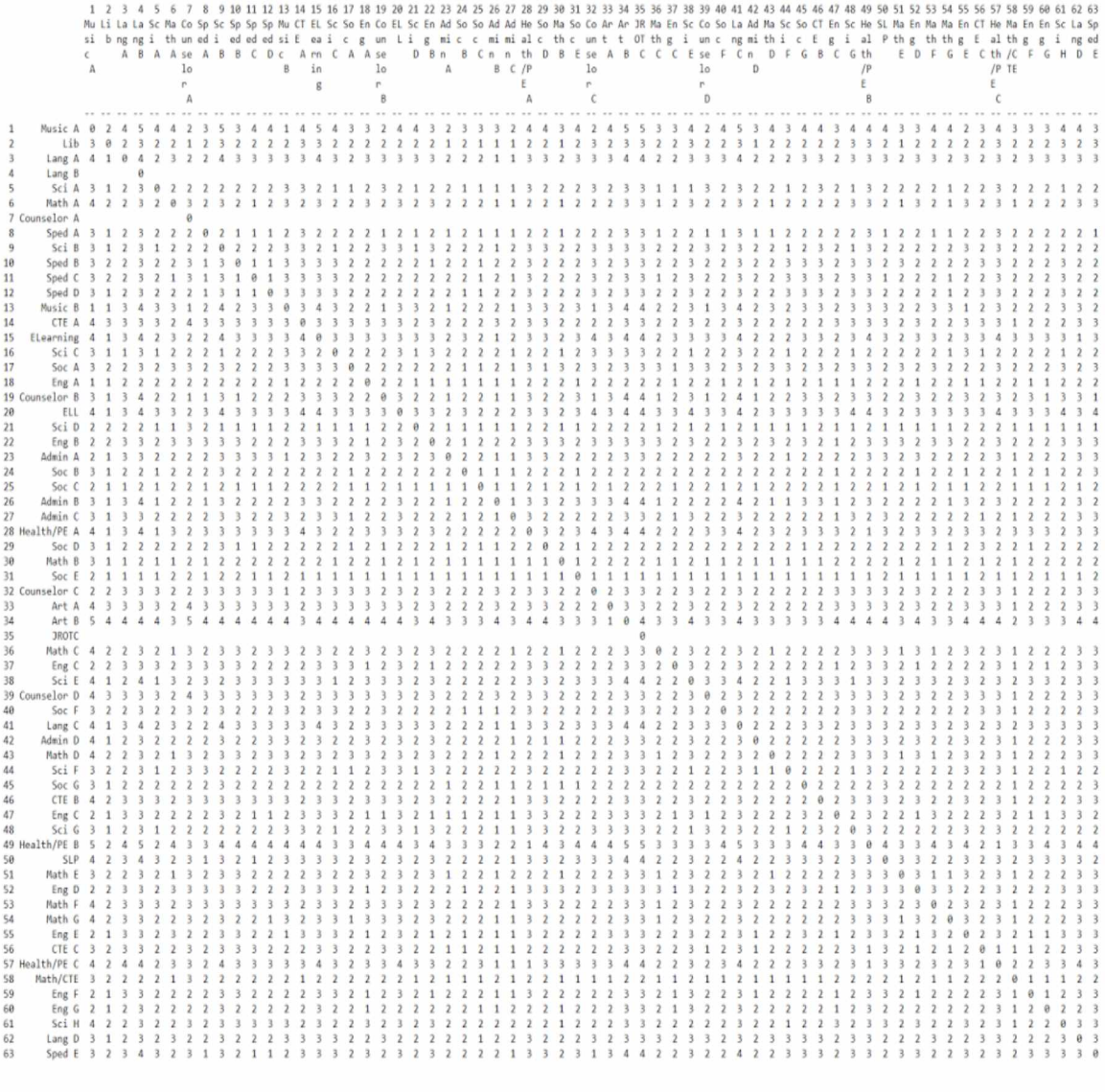
Identifying central connectors involves finding members of the network that have low geodesic values. Visual scans were used to locate individuals with a large percentage of one-step geodesic distances to other members of the network. These individuals were identified as potential central connectors: Sped D and Library for Pilot School One (Figure G.2), and Admin C for Pilot School Two (Figure G.3).

Table G.5: Geodesic Distances Matrix for Pilot School One

		1 Eng A	2 IR	3 Sci A	4 A-Admin	5 Sped A	6 Math A	7 PE/Health A	8 Eng B	9 Sci B	10 ELP	11 Sped B	12 Math B	13 Eng C	14 Sped C	15 PE/Health B	16 Soc A	17 Eng/Span	18 Eng/Soc	19 Sped D	20 Art	21 Sci C	22 Soc B	23 Math C	24 Music A	25 Soc C	26 Comp	27 Soc D	28 PE/Health C	29 Counselor A	30 Soc E	31 Sci D	32 Sci E	33 Math D	34 Sped E	35 Counselor B	36 Counselor C	37 CTE	38 Admin	39 Lib	40 Eng D	41 Math E	42 Music B	43 Sci F
1	Eng A	0	2	2	2	2	2	2	1	2	2	1	2	1	2	2	2	2	1	2	2	2	2	2	2	2	2	2	2	2	2	2	1	2	2	1	2	1	1	1	2	2	2
2	IR	2	0	1	1	2	2	1	2	1	2	1	2	1	1	2	2	2	1	2	1	2	1	2	2	1	2	1	2	1	1	1	1	2	2	1	1	1	1	1	1	2	2
3	Sci A	2	1	0	2	2	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1	1	2	2	2	2	2	2	1	1	2	2	3
4	A-Admin	2	1	2	0	2	1	1	1	2	1	2	2	2	2	2	2	2	2	1	2	2	2	2	2	2	2	2	2	2	2	2	1	1	2	2	2	1	1	1	2	2	3
5	Sped A	2	2	2	2	0	2	2	1	2	2	2	2	2	2	2	2	2	2	1	2	2	2	2	2	2	2	2	2	2	2	1	2	1	1	2	2	2	1	1	2	2	3
6	Math A	2	2	1	1	2	0	2	1	2	1	1	1	1	1	1	1	1	1	2	1	1	1	1	1	1	1	2	1	2	1	2	1	2	1	1	1	1	1	2	1	1	2
7	PE/Health A	2	2	2	1	2	2	0	2	1	2	2	1	2	2	1	1	2	1	1	2	2	2	2	1	2	1	2	1	2	2	3	2	1	2	1	1	2	2	1	2	1	2
8	Eng B	1	2	2	1	1	1	2	0	2	2	2	2	1	2	2	1	2	1	2	2	2	2	2	2	2	1	2	3	1	2	2	2	1	2	1	1	2	1	2	1	2	2
9	Sci B	2	2	2	2	2	2	1	2	0	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1	2	2	2	2	2	2	1	1	2	1
10	ELP	2	2	1	1	2	2	2	1	1	0	2	1	1	2	2	1	2	1	2	1	1	1	2	2	2	1	2	2	1	2	2	1	2	2	2	1	1	2	1	1	2	2
11	Sped B	1	1	2	2	2	1	2	2	2	2	0	2	2	1	2	2	2	2	1	2	2	2	2	2	2	2	2	2	2	2	2	1	2	2	2	1	1	1	2	2	3	3
12	Math B	2	2	2	1	2	1	2	2	2	2	2	0	2	2	2	2	2	2	2	1	2	1	2	1	2	2	2	1	1	2	2	1	1	1	2	2	1	1	1	1	2	3
13	Eng C	2	2	2	2	2	1	2	1	2	2	2	2	0	2	2	1	2	2	2	2	2	2	2	2	2	2	2	1	2	2	2	2	2	3	2	2	2	1	1	1	2	3
14	Sped C	2	1	2	1	1	2	2	2	2	2	1	2	2	0	2	2	2	1	1	1	2	2	2	1	2	2	2	2	1	2	2	1	1	2	1	2	1	2	1	2	2	2
15	PE/Health B	2	2	3	2	2	2	1	1	2	2	2	2	2	2	0	2	3	2	2	2	2	2	3	2	3	1	3	1	1	2	3	3	2	3	1	1	2	1	2	2	2	3
16	Soc A	2	2	2	1	2	2	2	1	2	2	2	2	1	1	1	0	1	1	2	2	2	1	2	2	1	2	2	2	1	1	2	2	1	2	2	1	2	1	1	1	2	2
17	Eng/Span	2	2	2	2	2	1	2	2	2	2	2	2	2	2	2	2	0	2	1	2	2	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1	1	2	2	3
18	Eng/Soc	2	2	2	2	2	1	1	1	2	2	2	2	2	2	2	2	2	0	1	2	2	2	2	2	2	2	2	2	2	1	2	2	1	2	2	2	2	2	1	1	2	3
19	Sped D	1	1	1	1	1	1	1	1	1	2	1	1	1	1	1	1	1	1	0	2	1	1	1	2	1	1	1	1	1	2	1	2	1	1	1	1	1	1	1	1	1	2
20	Art	3	2	2	2	2	3	2	2	2	2	3	3	1	1	2	3	2	2	2	0	2	2	3	3	2	2	3	2	2	1	1	1	2	2	2	2	2	2	2	3	3	3
21	Sci C	2	2	2	1	2	1	2	1	1	2	2	2	1	1	2	2	1	2	2	2	0	2	2	2	2	2	2	2	2	1	2	2	1	2	1	2	2	1	1	1	2	2
22	Soc B	2	2	2	2	2	2	2	1	2	2	2	2	2	1	2	1	2	1	2	2	2	0	2	2	1	1	1	2	1	1	1	2	2	2	2	1	1	2	2	2	1	2
23	Math C	2	2	2	2	2	1	2	2	2	2	2	1	2	2	2	2	2	2	1	2	2	2	0	2	2	2	2	2	2	2	2	1	2	2	2	2	2	1	2	1	2	3
24	Music A	2	2	2	1	3	2	2	2	2	2	3	3	1	3	3	2	3	2	2	3	2	2	3	0	2	2	2	2	2	2	3	3	2	2	2	1	3	1	1	2	2	1
25	Soc C	2	2	2	2	3	1	3	2	2	2	2	2	2	2	2	1	2	2	2	3	2	1	2	2	0	2	2	2	2	2	3	2	3	3	2	2	2	2	1	2	2	3
26	Comp	2	2	2	1	2	2	2	2	2	2	1	2	2	1	2	2	2	2	1	1	2	1	2	2	2	0	2	2	1	2	2	2	1	2	1	2	1	1	1	2	2	3
27	Soc D	3	3	3	2	3	3	3	2	3	3	3	3	2	2	2	1	2	2	2	3	3	1	3	3	2	2	0	3	2	1	2	3	2	3	2	2	3	2	2	2	3	3
28	PE/Health C	2	2	2	2	2	1	2	2	2	2	2	2	2	2	2	2	2	2	2	1	3	2	2	2	2	2	2	0	2	2	2	2	2	2	2	2	2	1	2	2	2	3
29	Counselor A	2	1	2	2	2	1	1	1	2	1	2	2	2	2	2	2	2	2	2	2	2	1	2	2	2	2	2	2	0	2	2	2	1	2	2	2	2	1	1	1	2	3
30	Soc E	2	2	2	1	2	2	2	2	2	2	2	3	2	1	2	1	2	1	2	2	2	1	2	2	3	2	2	2	3	0	2	3	3	2	2	1	1	3	1	1	2	2
31	Sci D	2	2	1	1	1	2	1	1	1	1	2	2	2	1	1	2	2	1	2	1	1	1	2	2	1	2	2	1	1	1	0	1	1	1	1	1	1	1	2	2	3	2
32	Sci E	2	2	2	1	3	2	2	2	1	2	2	3	2	2	3	2	3	2	2	3	2	2	3	2	2	2	3	2	2	2	3	0	2	1	2	1	3	1	1	2	2	3
33	Math D	1	2	1	1	1	1	1	1	2	2	2	2	1	1	2	1	2	1	2	2	1	1	1	1	2	1	2	2	1	1	2	1	0	1	1	1	2	1	1	1	2	2
34	Sped E	2	2	2	1	2	2	2	2	2	2	1	2	2	1	2	2	2	2	1	2	2	2	2	3	2	2	2	2	2	2	3	2	2	0	2	2	2	2	2	2	2	3
35	Counselor B	2	1	2	2	2	1	1	2	2	1	2	2	2	2	2	2	2	2	2	1	2	2	2	2	2	1	2	2	2	2	2	2	2	2	0	2	2	1	1	1	2	3
36	Counselor C	1	1	2	2	2	1	1	2	2	1	2	2	2	2	2	1	2	2	1	2	2	1	2	2	2	1	2	2	2	2	2	2	1	2	2	0	2	1	1	1	2	2
37	CTE	2	2	2	2	3	2	3	2	2	2	2	3	2	2	3	3	3	2	2	3	2	2	3	2	2	1	3	2	2	2	3	3	2	3	2	2	0	2	1	3	2	3
38	Admin	2	2	2	1	2	1	2	2	2	2	2	2	1	2	2	1	2	2	1	2	1	1	2	1	2	2	2	2	1	1	2	2	1	2	1	1	2	0	1	1	2	2
39	Lib	1	1	1	1	2	1	2	1	1	1	2	2	1	2	2	2	2	2	1	2	2	2	2	1	1	1	2	1	1	1	2	2	2	2	1	1	2	1	0	2	1	2
40	Eng D	1	2	1	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	1	2	1	2	2	1	2	2	1	1	1	1	1	2	1	1	1	2	0	1	2
41	Math E	2	2	2	1	2	1	2	1	1	2	2	1	1	1	1	1	1	2	1	1	1	1	1	1	1	1	2	1	1	1	2	2	1	1	1	1	1	1	1	0	1	2
42	Music B	3	3	3	2	4	3	3	3	3	4	4	2	4	4	3	4	3	3	4	3	3	4	3	3	4	1	3	3	3	3	3	4	4	3	3	3	2	4	2	2	3	3
43	Sci F	2	1	1	2	2	2	2	1	1	2	2	3	2	2	2	2	2	2	2	2	2	2	3	2	2	2	3	2	2	2	1	1	2	2	1	1	2	2	1	2	2	0

See Supplemental File: "Geodesic Distances for Pilot School One" for original output file.

Table G.6: Geodesic Distances Matrix for Pilot School Two



See Supplemental File: "Geodesic Distances for Pilot School One" for original output file.

Figure G.4 displays the social network map of Pilot School One using graph theoretical layout by geodesic distance. In a graph theoretical layout, the actors with the highest geodesic distance are in the center of the map and those with the lowest geodesic distance fall to the edges. For visual clarity, the nodes for Sped D and Lib have been colored red. The map confirms the centrality of Sped D and Lib, but also shows that there are several other notable central

connectors in the network; pilot School One has a dense network with several actors that demonstrate low geodesic values. Therefore, Sped D may be the most central but is by far the only central connector in the network.

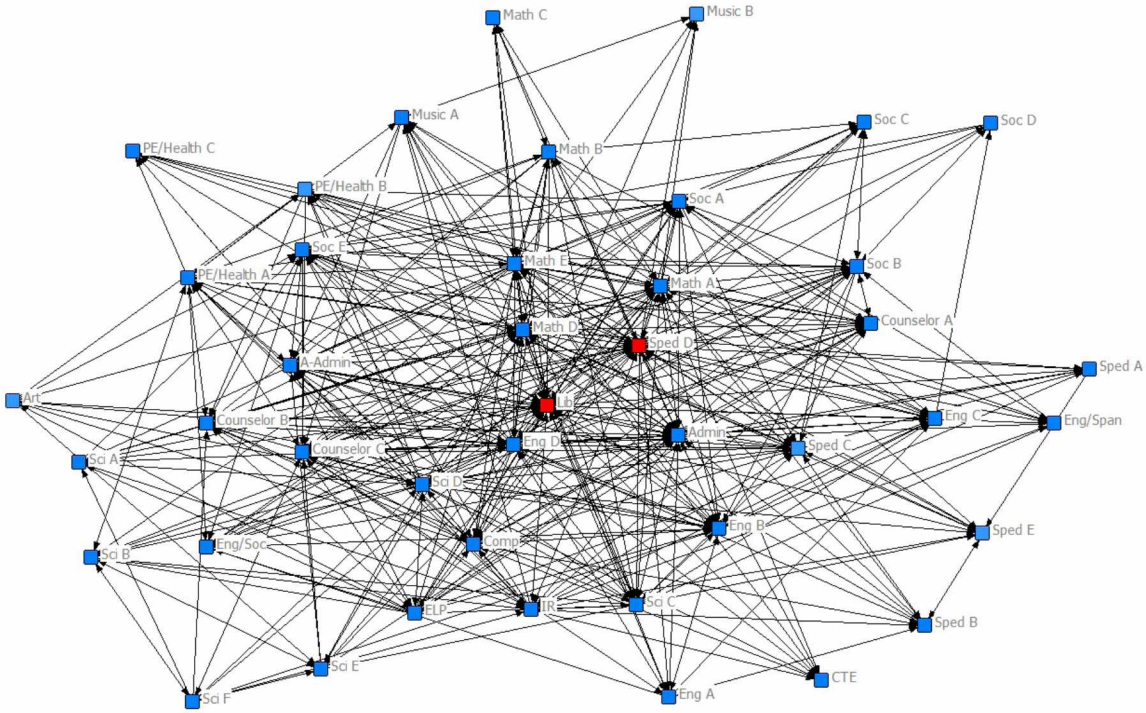


Figure G.4: Social Network Diagram of Central Connectors in Pilot School One.

Nodes are organized by graph theoretical layout. Central connectors are coded in red.

Figure G.5 depicts Pilot School Two organized by graph theoretical layout. For visual clarity, Admin C is in red. No other actor in Pilot School Two consistently has geodesic values of 1 or 2, so it is likely that Admin C is the central connector for the network and therefore has the greatest potential to quickly reach the entire network. However, the map demonstrates several other actors that are also central to the network, such as Soc C and may have similar potential to quickly reach the others in the school network.

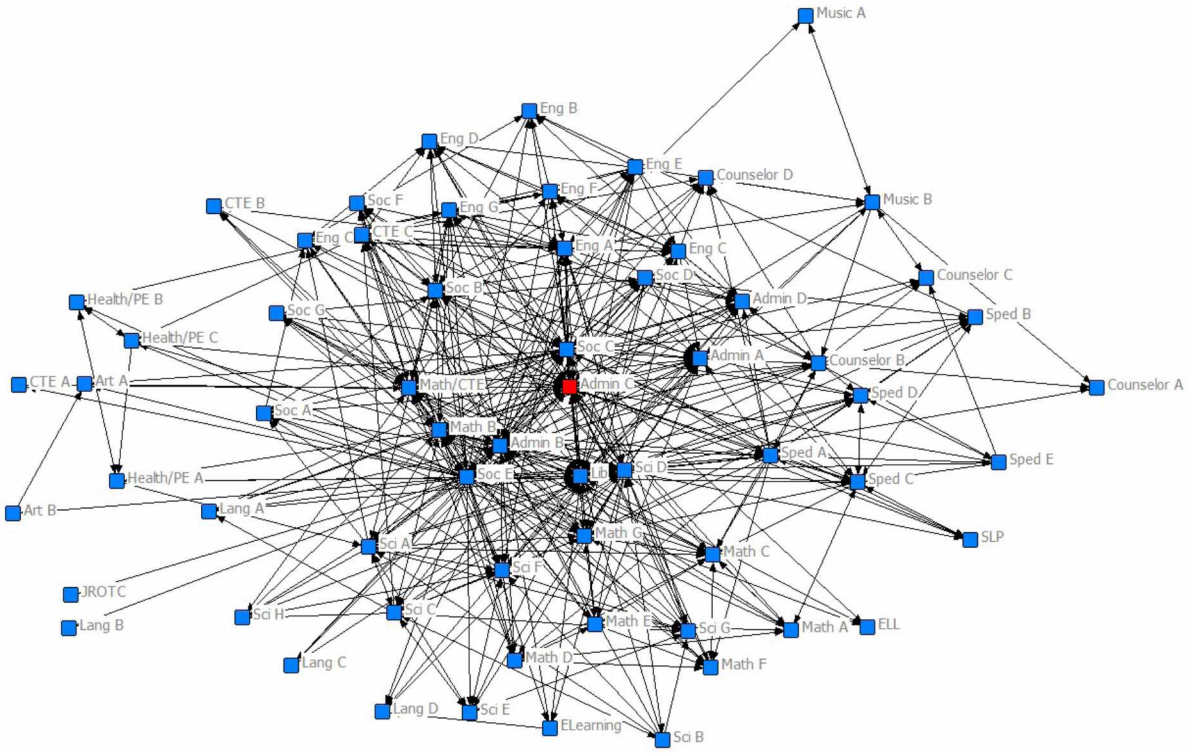


Figure G.5: Social Network Diagram of Central Connectors in Pilot School Two.

Nodes are organized by graph theoretical layout. Central connectors are coded in red.

Boundary Spanners

Boundary spanners connect subgroups within a network and bridge structural holes. Constraint is used to measure power held by individuals with a given network. Boundary spanners have low constraint, because they are connected to multiple groups as opposed to embedded within a closed group and therefore experience less closure in their social network. Therefore, constraint can be used to suggest individuals who might be boundary spanners. Network maps and qualitative interviews can be used to confirm whether an actor is indeed a boundary spanner.

In UCINET, the Structural Hole Measures report is run to calculate constraint. Tables G.5 and G.6 show the Structural Hole Measures report for Pilot School One and Pilot School Two

respectively. Column 4 indicates Constraint. As with Information Brokers, the individuals with the three lowest constraint scores were identified as potential boundary spanners: Lib (Constraint = 0.114), Sped D (Constraint = 0.117), and Math A (0.131) for Pilot School One; and Science D (Constraint = 0.115), Admin C (Constraint = 0.117), and Soc C (Constraint = 0.127) for Pilot School Two.

Table G.7: Structural Hole Measures for Pilot School One

		1	2	3	4	5	6	7	8	9	10
		Degree	EffSize	Efficienc	Constrain	Hierarchy	EgoBet	Ln(Constr	Indirects	Density	Numholes
1	Eng A	10.000	4.094	0.409	0.362	0.034	4.810	-1.017	0.864	0.656	31.000
2	IR	23.000	15.922	0.692	0.185	0.116	67.049	-1.689	0.883	0.300	354.000
3	Sci A	11.000	6.031	0.548	0.335	0.061	11.417	-1.094	0.848	0.455	60.000
4	A-Admin	21.000	11.406	0.543	0.186	0.044	44.135	-1.680	0.910	0.452	230.000
5	Sped A	8.000	4.375	0.547	0.423	0.028	9.917	-0.861	0.812	0.518	27.000
6	Math A	32.000	21.431	0.670	0.131	0.082	134.437	-2.031	0.903	0.326	669.000
7	PE/Health A	19.000	10.833	0.570	0.206	0.053	29.419	-1.582	0.897	0.436	193.000
8	Eng B	23.000	12.348	0.537	0.173	0.049	30.429	-1.754	0.916	0.476	265.000
9	Sci B	11.000	6.794	0.618	0.318	0.047	25.352	-1.146	0.817	0.418	64.000
10	ELP	20.000	11.673	0.584	0.206	0.077	19.202	-1.581	0.909	0.429	217.000
11	Sped B	10.000	5.088	0.509	0.350	0.040	9.867	-1.049	0.830	0.556	40.000
12	Math B	17.000	8.310	0.489	0.237	0.063	7.947	-1.438	0.916	0.529	128.000
13	Eng C	15.000	7.143	0.476	0.267	0.070	12.455	-1.320	0.900	0.510	103.000
14	Sped C	21.000	12.250	0.583	0.185	0.044	41.417	-1.689	0.903	0.438	236.000
15	PE/Health B	15.000	7.719	0.515	0.254	0.025	10.523	-1.369	0.919	0.524	100.000
16	Soc A	22.000	11.871	0.540	0.182	0.048	36.642	-1.706	0.919	0.474	243.000
17	Eng/Span	9.000	3.875	0.431	0.416	0.058	2.450	-0.877	0.872	0.611	28.000
18	Eng/Soc	13.000	6.619	0.509	0.286	0.041	15.107	-1.251	0.875	0.513	76.000
19	Sped D	36.000	25.982	0.722	0.117	0.084	213.227	-2.146	0.896	0.275	914.000
20	Art	9.000	5.455	0.606	0.398	0.087	13.500	-0.922	0.801	0.347	47.000
21	Sci C	19.000	9.080	0.478	0.213	0.057	9.084	-1.545	0.928	0.523	163.000
22	Soc B	19.000	10.093	0.531	0.199	0.033	27.306	-1.613	0.898	0.512	167.000
23	Math C	6.000	2.136	0.356	0.555	0.034	1.250	-0.589	0.797	0.767	7.000
24	Music A	12.000	5.433	0.453	0.306	0.033	13.750	-1.185	0.876	0.606	52.000
25	Soc C	9.000	4.538	0.504	0.403	0.055	6.067	-0.909	0.844	0.542	33.000
26	Comp	21.000	11.074	0.527	0.187	0.040	30.317	-1.678	0.919	0.495	212.000
27	Soc D	6.000	3.000	0.500	0.578	0.047	1.083	-0.549	0.822	0.600	12.000
28	PE/Health C	8.000	3.750	0.469	0.454	0.055	5.500	-0.791	0.852	0.536	26.000
29	Counselor A	17.000	8.407	0.495	0.224	0.035	22.837	-1.494	0.903	0.522	130.000
30	Soc E	20.000	11.060	0.553	0.199	0.051	15.678	-1.612	0.918	0.461	205.000
31	Sci D	29.000	20.353	0.702	0.136	0.045	56.489	-1.996	0.908	0.321	551.000
32	Sci E	12.000	6.808	0.567	0.309	0.032	7.261	-1.174	0.886	0.477	69.000
33	Math D	28.000	17.689	0.632	0.144	0.059	91.473	-1.936	0.907	0.365	480.000
34	Sped E	11.000	6.233	0.567	0.345	0.083	9.317	-1.065	0.850	0.427	63.000
35	Counselor B	18.000	9.611	0.534	0.215	0.045	28.592	-1.536	0.901	0.471	162.000
36	Counselor C	22.000	12.843	0.584	0.177	0.048	73.084	-1.733	0.897	0.413	271.000
37	CTE	8.000	3.667	0.458	0.451	0.035	0.700	-0.797	0.864	0.589	23.000
38	Admin	28.000	15.605	0.557	0.148	0.059	53.395	-1.913	0.928	0.418	440.000
39	Lib	36.000	24.855	0.690	0.114	0.060	157.886	-2.169	0.914	0.319	858.000
40	Eng D	34.000	22.778	0.670	0.120	0.059	140.735	-2.118	0.914	0.335	746.000
41	Math E	32.000	20.646	0.645	0.141	0.113	37.246	-1.957	0.925	0.326	669.000
42	Music B	5.000	2.417	0.483	0.635	0.011	0.250	-0.454	0.774	0.700	6.000
43	Sci F	9.000	5.182	0.576	0.397	0.055	8.467	-0.924	0.831	0.458	39.000

See Supplemental File: "Structural Hole Measures for Pilot School One" for the original output file.

Table G.8: Structural Hole Measures for Pilot School Two

		1 Degree	2 EffSize	3 Efficienc	4 Constrain	5 Hierarchy	6 EgoBet	7 Ln(Constr	8 Indirects	9 Density	10 Numholes
1	Music A	2.000	1.167	0.583	1.003	0.110	0.000	0.003	0.389	0.500	1.000
2	Lib	32.000	24.750	0.773	0.136	0.116	225.140	-1.998	0.881	0.200	794.000
3	Lang A	7.000	3.143	0.449	0.512	0.013	0.250	-0.669	0.881	0.643	15.000
4	Lang B	1.000	1.000	1.000	1.000	1.000	0.000	0.000	0.000		0.000
5	Sci A	19.000	12.204	0.642	0.208	0.065	50.048	-1.572	0.882	0.351	222.000
6	Math A	10.000	4.531	0.453	0.357	0.036	9.660	-1.030	0.850	0.600	36.000
7	Counselor A	3.000	1.000	0.333	0.926	0.000	0.000	-0.077	0.667	0.500	3.000
8	Sped A	21.000	14.783	0.704	0.184	0.065	96.347	-1.694	0.863	0.302	293.000
9	Sci B	7.000	2.667	0.381	0.515	0.044	0.400	-0.664	0.856	0.714	12.000
10	Sped B	8.000	4.458	0.557	0.468	0.141	6.533	-0.759	0.781	0.429	32.000
11	Sped C	14.000	9.175	0.655	0.266	0.070	48.043	-1.323	0.841	0.363	116.000
12	Sped D	11.000	6.344	0.577	0.344	0.088	18.652	-1.069	0.839	0.445	61.000
13	Music B	10.000	7.786	0.779	0.283	0.054	47.333	-1.263	0.623	0.222	70.000
14	CTE A	2.000	1.000	0.500	1.235	0.057	0.000	0.211	0.556	1.000	0.000
15	ELearning	5.000	2.700	0.540	0.650	0.009	0.250	-0.430	0.797	0.500	10.000
16	Sci C	14.000	8.381	0.599	0.274	0.075	26.042	-1.295	0.854	0.379	113.000
17	Soc A	10.000	5.143	0.514	0.366	0.068	13.300	-1.006	0.833	0.478	47.000
18	Eng A	23.000	16.030	0.697	0.173	0.069	108.165	-1.755	0.877	0.296	356.000
19	Counselor B	18.000	12.974	0.721	0.215	0.073	40.033	-1.536	0.870	0.275	222.000
20	ELL	3.000	1.333	0.444	1.049	0.016	0.000	0.048	0.767	0.833	1.000
21	Sci D	38.000	28.927	0.761	0.115	0.095	230.278	-2.166	0.909	0.223	1093.000
22	Eng B	9.000	4.364	0.485	0.422	0.082	2.167	-0.863	0.859	0.542	33.000
23	Admin A	18.000	11.114	0.617	0.214	0.050	23.624	-1.541	0.892	0.402	183.000
24	Soc B	19.000	11.625	0.612	0.208	0.066	42.388	-1.572	0.888	0.398	206.000
25	Soc C	32.000	23.583	0.737	0.127	0.073	260.840	-2.067	0.881	0.259	735.000
26	Admin B	32.000	24.013	0.750	0.130	0.079	146.477	-2.037	0.900	0.242	752.000
27	Admin C	36.000	27.326	0.759	0.117	0.077	148.022	-2.146	0.909	0.232	968.000
28	Health/PE A	6.000	3.857	0.643	0.524	0.040	9.500	-0.646	0.741	0.400	18.000
29	Soc D	14.000	9.000	0.643	0.272	0.087	29.867	-1.300	0.846	0.346	119.000
30	Math B	32.000	23.250	0.727	0.135	0.099	178.087	-2.004	0.901	0.258	736.000
31	Soc E	52.000	43.317	0.833	0.087	0.136	492.454	-2.445	0.864	0.147	2262.000
32	Counselor C	5.000	3.714	0.743	0.485	0.047	11.000	-0.723	0.524	0.250	15.000
33	Art A	4.000	2.100	0.525	0.777	0.101	3.000	-0.253	0.693	0.583	5.000
34	Art B	2.000	1.000	0.500	1.125	0.000	0.000	0.118	0.500	0.500	1.000
35	JROTC	1.000	1.000	1.000	1.000	1.000	0.000	0.000	0.000		0.000
36	Math C	15.000	8.071	0.538	0.259	0.055	16.842	-1.351	0.894	0.481	109.000
37	Eng C	13.000	7.333	0.564	0.292	0.056	12.817	-1.230	0.874	0.462	84.000
38	Sci E	7.000	2.182	0.312	0.514	0.058	0.450	-0.665	0.838	0.714	12.000
39	Counselor D	8.000	5.389	0.674	0.420	0.086	9.500	-0.867	0.746	0.321	38.000
40	Soc F	9.000	3.545	0.394	0.418	0.049	1.367	-0.873	0.888	0.667	24.000
41	Lang C	4.000	1.375	0.344	0.829	0.014	0.000	-0.187	0.813	0.750	3.000
42	Admin D	15.000	8.778	0.585	0.260	0.055	16.299	-1.349	0.899	0.429	120.000
43	Math D	11.000	4.941	0.449	0.342	0.054	6.386	-1.073	0.874	0.582	46.000
44	Sci F	16.000	9.957	0.622	0.248	0.087	35.819	-1.393	0.868	0.375	150.000
45	Soc G	9.000	4.000	0.444	0.401	0.041	2.567	-0.915	0.857	0.625	27.000
46	CTE B	5.000	2.333	0.467	0.683	0.065	0.333	-0.381	0.799	0.650	7.000
47	Eng C	19.000	11.982	0.631	0.203	0.055	70.574	-1.594	0.878	0.368	216.000
48	Sci G	11.000	5.281	0.480	0.346	0.061	3.511	-1.063	0.876	0.545	50.000
49	Health/PE B	4.000	2.333	0.583	0.708	0.122	2.500	-0.345	0.611	0.417	7.000
50	SLP	5.000	1.714	0.343	0.671	0.058	0.333	-0.400	0.787	0.700	6.000
51	Math E	12.000	5.639	0.470	0.319	0.060	6.108	-1.141	0.881	0.553	59.000
52	Eng D	11.000	5.133	0.467	0.346	0.059	2.993	-1.062	0.880	0.564	48.000
53	Math F	9.000	3.364	0.374	0.421	0.052	0.667	-0.865	0.892	0.681	23.000
54	Math G	18.000	11.068	0.615	0.211	0.034	19.259	-1.554	0.901	0.415	179.000
55	Eng E	14.000	7.647	0.546	0.271	0.056	12.083	-1.307	0.878	0.489	93.000
56	CTE C	15.000	10.912	0.727	0.251	0.080	57.536	-1.382	0.839	0.286	150.000
57	Health/PE C	6.000	3.688	0.615	0.521	0.046	8.000	-0.652	0.731	0.400	18.000
58	Math/CTE	27.000	21.726	0.805	0.137	0.106	405.369	-1.988	0.770	0.202	560.000
59	Eng F	16.000	9.211	0.576	0.246	0.056	11.292	-1.404	0.907	0.429	137.000
60	Eng G	14.000	6.921	0.494	0.274	0.046	14.473	-1.294	0.898	0.516	88.000
61	Sci H	7.000	2.333	0.333	0.514	0.035	1.167	-0.665	0.865	0.786	9.000
62	Lang D	5.000	2.250	0.450	0.676	0.066	1.750	-0.392	0.790	0.600	8.000
63	Sped E	7.000	3.813	0.545	0.494	0.099	4.167	-0.706	0.774	0.381	26.000

See Supplemental File: "Structural Hole Measures for Pilot School Two" for the original output file.

Visualizing boundary spanners with a network map allows the analyst to see the connections between different subgroups in the network. Since boundary spanner bridges subgroups, it makes the most sense to categorize the map using subject area. Figure G.6 depicts a network map organized by subject that shows how Sped C has connections with various academic subunits within the school. For visual clarity, Sped D has been color-coded red and each subject area subgroup has been coded a different shape. Sped D, similar to central connectors and information brokers, can help spread information across the network. However, unlike central connectors and information brokers, boundary spanners have more power within their ego network, because they are not constrained by the norms of a particular subgroup. This means they are likely to have more influence within their ego network than other members of the network.

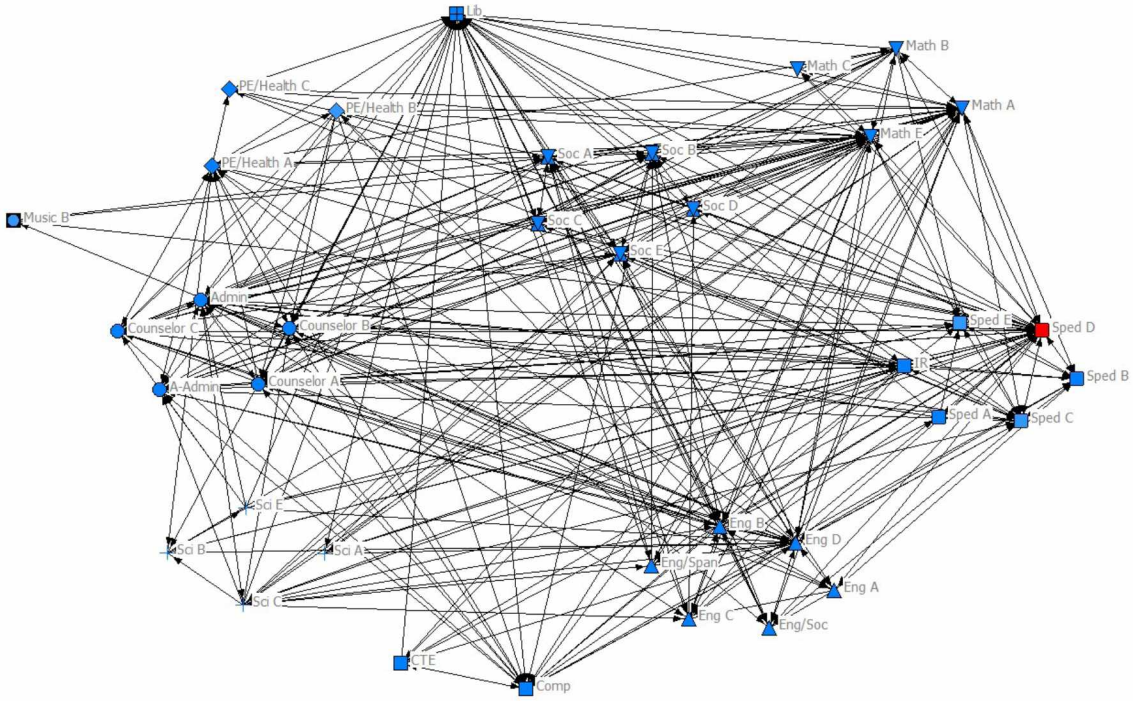
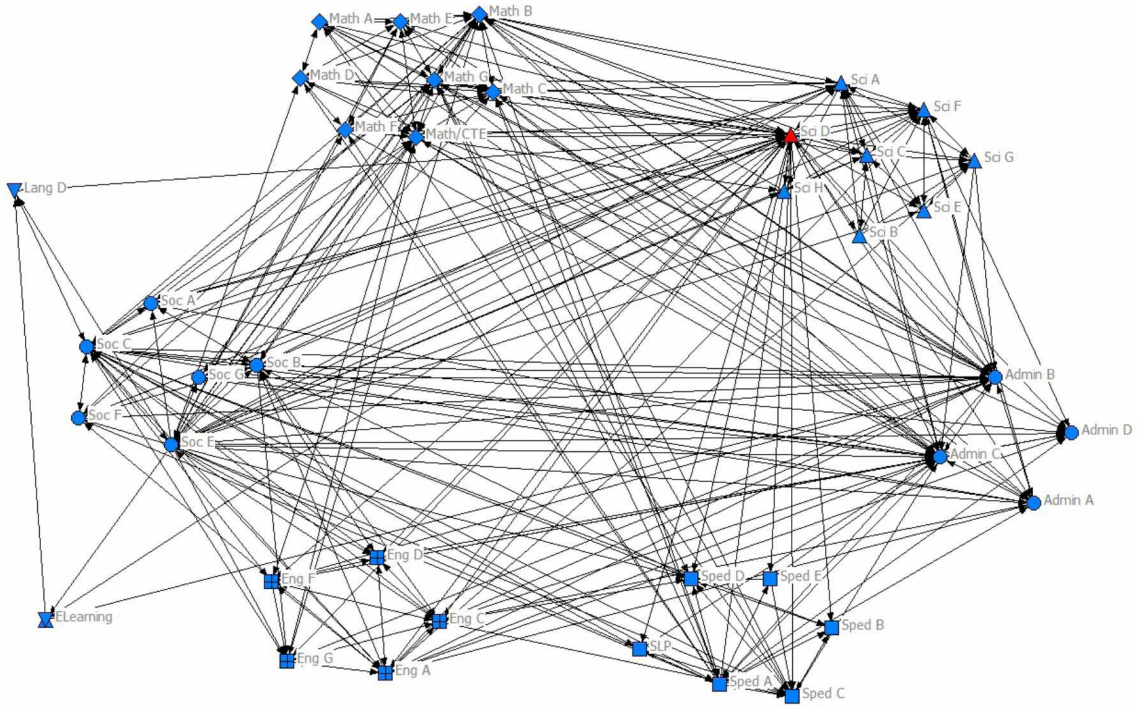
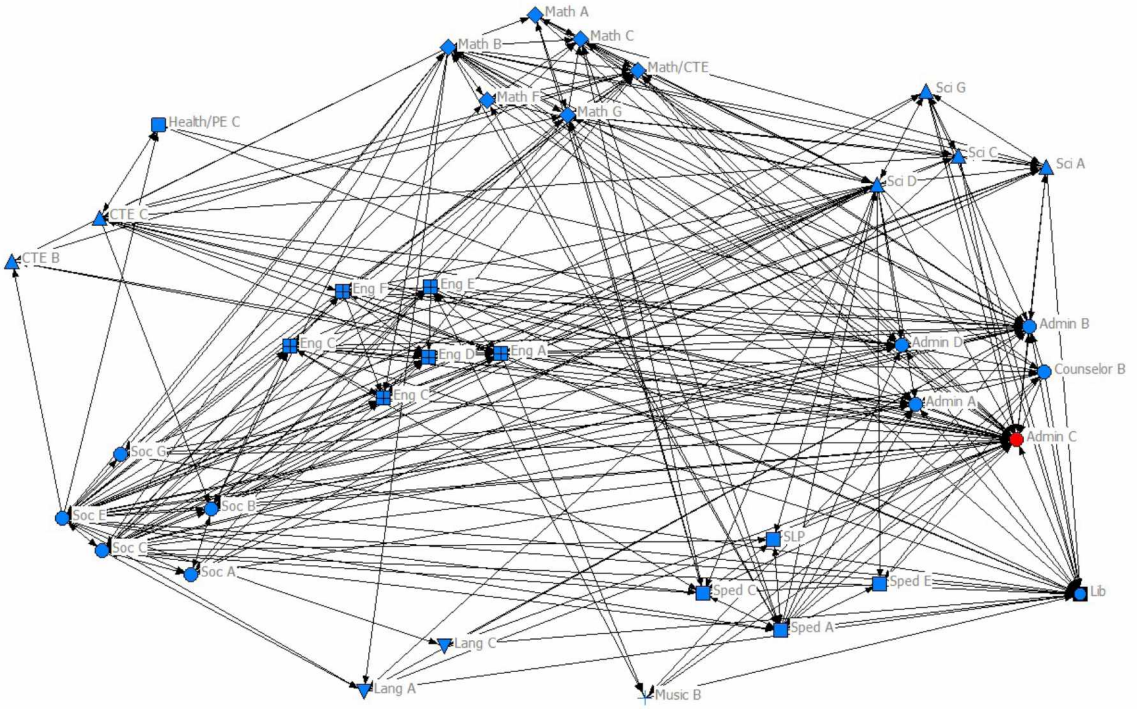


Figure G.6: Ego Network of Sped D in Pilot School One.

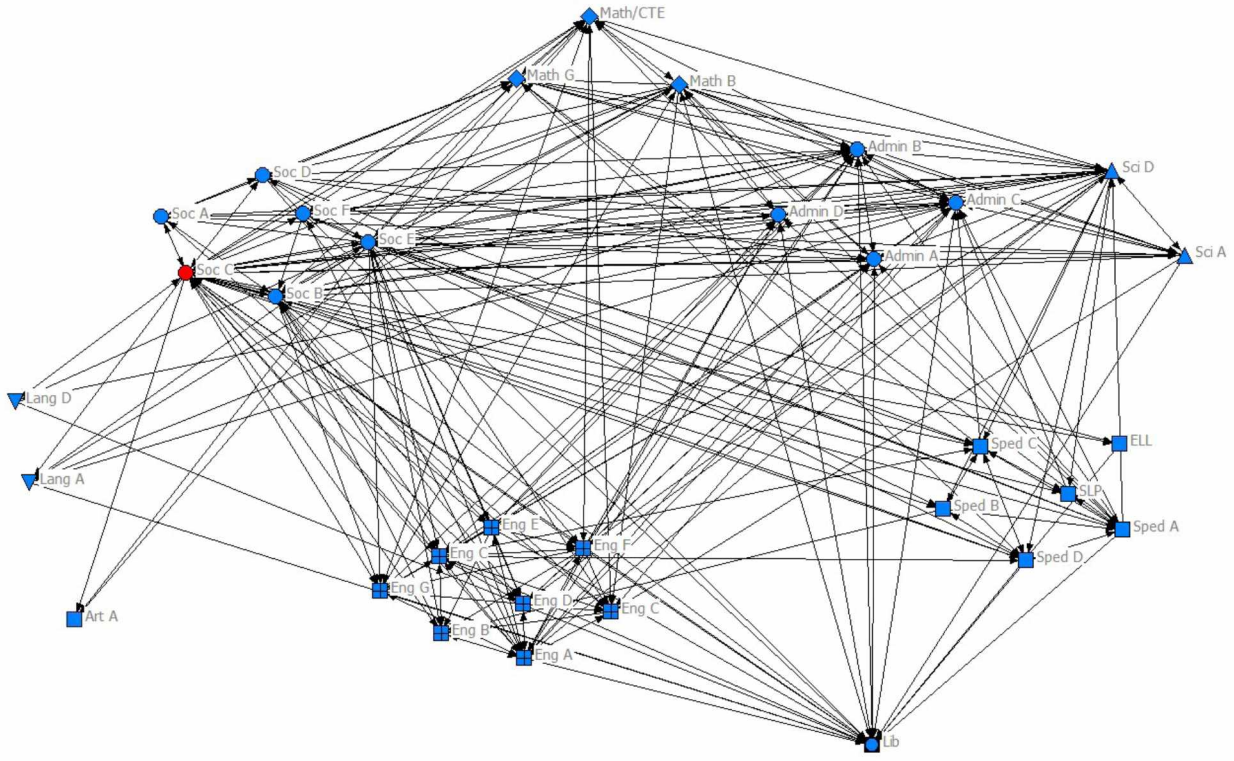
The diagram is organized by subject area. Each subject area is coded a different shape. Sped D is red.


Math A
Math E
Math B
Math D
Math G
Math C
Sci A
Sci F
Math F
Math/CTE
Sci D
Sci C
Sci G
Lang D
Sci H
Sci E
Sci B
Soc A
Soc C
Soc B
Admin B
Soc G
Soc F
Admin D
Soc E
Admin C
Admin A
Eng D
Eng F
Sped D
Sped E
ELearning
Eng C
Sped B
SLP
Eng G
Eng A
Sped A
Sped C

(A)


Math A
Math B
Math C
Math/CTE
Math F
Math G
Sci G
Health/PE C
Sci C
Sci A
Sci D
CTE C
CTE B
Eng F
Eng E
Admin B
Eng C
Eng D
Eng A
Admin D
Counselor B
Eng G
Admin A
Admin C
Soc G
Soc E
Soc B
SLP
Soc C
Soc A
Sped C
Sped E
Lb
Sped A
Lang C
Lang A
Music B

(B)



(C)

Figure G.7: Ego Networks of Science D (A), Admin C (B), and Soc C (C) from Pilot School Two.

For visual clarity, Math A has been color-coded red and each subject area subgroup has been coded a different shape.

Figure G.7 shows the ego networks of the three individuals identified as possible boundary spanners in Pilot School Two. The network diagrams show that each actor has ties to subject-specific subgroups. Sci D has ties with eight of the 13 subgroups identified with the school; Admin C with 11, and Soc C with eight. Which individual to leverage within the network to disseminate information to specific subgroups, depends on the subgroups one wishes to reach. Admin C has ties to the most subgroups, but is lacking ties to art and elearning. These ties are possessed by Soc C (art) and Sci D (elearning). Since each potential boundary spanner has ties to

different subgroups, it is unwise to choose only one. However, when all three are utilized, all unique subgroups within the school are reached.

Periphery People

Since those on the periphery exist on the edges of the network and have few connections, they are likely to have the lowest ego network sizes and the lowest point connectivity values. Those with the lowest network size are likely to be peripheral in the network. Point connectivity, which calculates the number of nodes that would have to be removed in order for one actor to no longer be able to reach another, is also used to determine whether actors exist on the periphery of the network. If the number is higher the individual has many ways to get information to the other actor. If the number is low, there are few ways channels of information flow for that actor. Therefore, those on the periphery will have very low numbers in the point connectivity matrix. As with the other measures and network positions, network maps can be used to confirm the statistical analysis.

The Density Measures report in UCINET calculates ego network size as one of its statistical measure; the number of individuals in an individual's social network. The Point Connectivity report in UCINET calculates point connectivity between each pair of actors in the entire social network. Table G.7 shows the size column from the Density Measures report and Table G.8 the Point Connectivity report for Pilot School One. This demonstrates that Music B has the lowest size value. When examining Music B's point connectivity, it is clear that one only contact is connecting Music B to the rest of the school network. Soc C and Math C also have relatively low ego network size values of 6. However, Soc C has point connectivity values of 4 and Math C has point connectivity values of 6, suggesting that they are not well connected but not fully peripheral.

Tables G.7 and G.8 show the size column from the Density Measures report and the Point Connectivity report for Pilot School Two respectively. Individuals with low ego network size values include Music A (size = 2), Lang B (size = 1), CTE A (size = 2), Art B (size = 2), and JROTC (size = 1). The point connectivity data corroborates the peripheral position of these actors in the network; their point connectivity values are 0 or 1 for all other actors. Furthermore, it indicates additional actors that may be peripheral on the network (Counselor A, ELL, Art A, and Counselor D) as their point connectivity values are 1 for all other actors, indicating that they are only able to access the rest of the school network through one other actor.

Table G.9: Ego Network Size for Pilot School One

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
	Size	Ties	Pairs	Densit	AvgDis	Diamet	nWeakC	pWeakC	2StepR	2StepP	ReachE	Broker	nBroke	nClose	EgoBet	nEgoBe
1	Eng A	10.00	59.00	90.00	65.56	1.36	3.00	1.00	10.00	42.00	100.00	17.14	15.50	0.34	59.00	4.81	5.34
2	IR	23.00	152.00	506.00	30.04	1.80	3.00	1.00	4.35	42.00	100.00	10.22	177.00	0.70	152.00	67.05	13.25
3	Sci A	11.00	50.00	110.00	45.45			1.00	9.09	42.00	100.00	14.00	30.00	0.55	50.00	11.42	10.38
4	A-Admin	21.00	190.00	420.00	45.24	1.60	3.00	1.00	4.76	42.00	100.00	8.47	115.00	0.55	190.00	44.13	10.51
5	Sped A	8.00	29.00	56.00	51.79			1.00	12.50	42.00	100.00	19.81	13.50	0.48	29.00	9.92	17.71
6	Math A	32.00	323.00	992.00	32.56	1.76	4.00	1.00	3.13	42.00	100.00	7.11	334.50	0.67	323.00	134.44	13.55
7	PE/Health A	19.00	149.00	342.00	43.57	1.60	3.00	1.00	5.26	42.00	100.00	10.10	96.50	0.56	149.00	29.42	8.60
8	Eng B	23.00	241.00	506.00	47.63	1.55	3.00	1.00	4.35	42.00	100.00	8.32	132.50	0.52	241.00	30.43	6.01
9	Sci B	11.00	46.00	110.00	41.82			1.00	9.09	42.00	100.00	15.56	32.00	0.58	46.00	25.35	23.05
10	ELP	20.00	163.00	380.00	42.89	1.60	4.00	1.00	5.00	42.00	100.00	10.07	108.50	0.57	163.00	19.20	5.05
11	Sped B	10.00	50.00	90.00	55.56	1.46	3.00	1.00	10.00	42.00	100.00	16.67	20.00	0.44	50.00	9.87	10.96
12	Math B	17.00	144.00	272.00	52.94	1.49	3.00	1.00	5.88	42.00	100.00	10.85	64.00	0.47	144.00	7.95	2.92
13	Eng C	15.00	107.00	210.00	50.95	1.55	3.00	1.00	6.67	42.00	100.00	11.60	51.50	0.49	107.00	12.46	5.93
14	Sped C	21.00	184.00	420.00	43.81	1.60	3.00	1.00	4.76	42.00	100.00	9.40	118.00	0.56	184.00	41.42	9.86
15	PE/Health B	15.00	110.00	210.00	52.38	1.52	3.00	1.00	6.67	42.00	100.00	11.97	50.00	0.48	110.00	10.52	5.01
16	Soc A	22.00	219.00	462.00	47.40	1.57	3.00	1.00	4.55	42.00	100.00	8.82	121.50	0.53	219.00	36.64	7.93
17	Eng/Span	9.00	44.00	72.00	61.11	1.39	2.00	1.00	11.11	42.00	100.00	16.54	14.00	0.39	44.00	2.45	3.40
18	Eng/Soc	13.00	80.00	156.00	51.28	1.52	3.00	1.00	7.69	42.00	100.00	12.73	38.00	0.49	80.00	15.11	9.68
19	Sped D	36.00	346.00	1260.00	27.46			1.00	2.78	42.00	100.00	6.86	457.00	0.73	346.00	213.23	16.92
20	Art	9.00	25.00	72.00	34.72			1.00	11.11	42.00	100.00	20.49	23.50	0.65	25.00	13.50	18.75
21	Sci C	19.00	179.00	342.00	52.34	1.49	3.00	1.00	5.26	42.00	100.00	9.25	81.50	0.48	179.00	9.08	2.66
22	Soc B	19.00	175.00	342.00	51.17	1.53	3.00	1.00	5.26	42.00	100.00	9.42	83.50	0.49	175.00	27.31	7.98
23	Math C	6.00	23.00	30.00	76.67	1.23	2.00	1.00	16.67	42.00	100.00	23.08	3.50	0.23	23.00	1.25	4.17
24	Music A	12.00	80.00	132.00	60.61			1.00	8.33	42.00	100.00	14.19	26.00	0.39	80.00	13.75	10.42
25	Soc C	9.00	39.00	72.00	54.17	1.50	3.00	1.00	11.11	42.00	100.00	17.14	16.50	0.46	39.00	6.07	8.43
26	Comp	21.00	208.00	420.00	49.52	1.55	3.00	1.00	4.76	42.00	100.00	8.90	106.00	0.50	208.00	30.32	7.22
27	Soc D	6.00	18.00	30.00	60.00	1.47	3.00	1.00	16.67	41.00	97.62	28.47	6.00	0.40	18.00	1.08	3.61
28	PE/Health C	8.00	30.00	56.00	53.57	1.55	4.00	1.00	12.50	42.00	100.00	18.83	13.00	0.46	30.00	5.50	9.82
29	Counselor A	17.00	142.00	272.00	52.21	1.50	3.00	1.00	5.88	42.00	100.00	9.66	65.00	0.48	142.00	22.84	8.40
30	Soc E	20.00	175.00	380.00	46.05	1.58	3.00	1.00	5.00	42.00	100.00	9.44	102.50	0.54	175.00	15.68	4.13
31	Sci D	29.00	261.00	812.00	32.14	1.77	3.00	1.00	3.45	42.00	100.00	8.02	275.50	0.68	261.00	56.49	6.96
32	Sci E	12.00	63.00	132.00	47.73	1.59	3.00	1.00	8.33	42.00	100.00	15.33	34.50	0.52	63.00	7.26	5.50
33	Math D	28.00	276.00	756.00	36.51	1.71	3.00	1.00	3.57	42.00	100.00	7.65	240.00	0.63	276.00	91.47	12.10
34	Sped E	11.00	47.00	110.00	42.73	1.66	3.00	1.00	9.09	42.00	100.00	17.65	31.50	0.57	47.00	9.32	8.47
35	Counselor B	18.00	144.00	306.00	47.06			1.00	5.56	42.00	100.00	9.50	81.00	0.53	144.00	28.59	9.34
36	Counselor C	22.00	191.00	462.00	41.34			1.00	4.55	42.00	100.00	8.37	135.50	0.59	191.00	73.08	15.82
37	CTE	8.00	33.00	56.00	58.93	1.46	3.00	1.00	12.50	42.00	100.00	17.21	11.50	0.41	33.00	0.70	1.25
38	Admin	28.00	316.00	756.00	41.80	1.62	3.00	1.00	3.57	42.00	100.00	7.08	220.00	0.58	316.00	53.39	7.06
39	Lib	36.00	402.00	1260.00	31.90	1.76	4.00	1.00	2.78	42.00	100.00	6.44	429.00	0.68	402.00	157.89	12.53
40	Eng D	34.00	376.00	1122.00	33.51	1.76	4.00	1.00	2.94	42.00	100.00	6.55	373.00	0.66	376.00	140.73	12.54
41	Math E	32.00	323.00	992.00	32.56	1.75	4.00	1.00	3.13	42.00	100.00	7.22	334.50	0.67	323.00	37.25	3.75
42	Music B	5.00	14.00	20.00	70.00			1.00	20.00	41.00	97.62	27.89	3.00	0.30	14.00	0.25	1.25
43	Sci F	9.00	33.00	72.00	45.83	1.67	4.00	1.00	11.11	40.00	95.24	21.62	19.50	0.54	33.00	8.47	11.76

See Supplemental File: "Egonet Density for Pilot School One" for original output file.

Table G.10: Point Connectivity for Pilot School One

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43
		En	IR	Sc	A-	Sp	Ma	PE	En	Sc	EL	Sp	Ma	En	Sp	PE	So	En	En	Sp	Ar	Sc	So	Ma	Mu	So	Co	So	PE	Co	So	Sc	Sc	Ma	Sp	Co	Co	CT	Ad	Li	En	Ma	Mu	Sc
1	Eng A	0	9	9	9	5	9	9	9	9	8	8	7	9	9	8	9	7	9	9	6	9	9	5	9	9	9	4	7	9	9	9	7	9	9	9	9	7	9	9	9	9	5	2
2	IR	7	0	10	19	5	19	12	19	11	8	8	7	14	15	8	14	7	13	20	6	11	15	5	9	9	15	4	7	16	17	9	7	18	11	16	20	7	20	21	19	9	5	2
3	Sci A	6	6	0	6	5	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	5	6	6	6	4	6	6	6	6	6	6	6	6	6	6	6	6	6	6	5	2
4	A-Admin	7	10	10	0	5	11	11	11	11	8	8	7	11	11	8	11	7	11	11	6	11	11	5	9	9	11	4	7	11	11	9	7	11	11	11	11	7	11	11	11	9	5	2
5	Sped A	7	7	7	7	0	7	7	7	7	7	7	7	7	7	7	7	7	7	7	6	7	7	5	7	7	7	4	7	7	7	7	7	7	7	7	7	7	7	7	7	7	5	2
6	Math A	7	10	10	21	5	0	12	19	11	8	8	7	14	15	8	15	7	13	21	6	11	15	5	9	9	15	4	7	16	17	9	7	19	11	18	21	7	25	29	20	10	5	2
7	PE/Health A	7	10	10	15	5	15	0	15	11	8	8	7	14	15	8	14	7	13	15	6	11	15	5	9	9	15	4	7	15	15	9	7	15	11	15	15	7	15	15	15	9	5	2
8	Eng B	7	10	10	14	5	14	12	0	11	8	8	7	13	14	8	14	7	13	14	6	11	14	5	9	9	14	4	7	14	14	9	7	14	11	14	14	7	14	14	14	9	5	2
9	Sci B	6	6	6	6	5	6	6	6	0	6	6	6	6	6	6	6	6	6	6	6	6	6	5	6	6	6	4	6	6	6	6	6	6	6	6	6	6	6	6	6	6	5	2
10	ELP	7	10	10	18	5	18	12	18	11	0	8	7	14	15	8	14	7	13	18	6	11	15	5	9	9	15	4	7	16	17	9	7	18	11	17	18	7	18	18	18	9	5	2
11	Sped B	7	9	9	9	5	9	9	9	9	8	0	7	9	9	8	9	7	9	9	6	9	9	5	9	9	9	4	7	9	9	9	7	9	9	9	9	7	9	9	9	9	5	2
12	Math B	7	10	10	14	5	14	12	14	11	8	8	0	14	14	8	14	7	13	14	6	11	14	5	9	9	14	4	7	14	14	9	7	14	11	14	14	7	14	14	14	10	5	2
13	Eng C	7	7	7	7	5	7	7	7	7	7	7	7	0	7	7	7	7	7	7	6	7	7	5	7	7	7	4	7	7	7	7	7	7	7	7	7	7	7	7	7	7	5	2
14	Sped C	7	10	10	15	5	14	12	14	11	8	8	7	13	0	8	14	7	13	15	6	11	14	5	9	9	14	4	7	14	14	9	7	14	11	14	14	7	14	14	14	9	5	2
15	PE/Health B	7	8	8	8	5	8	8	8	8	8	8	7	8	8	0	8	7	8	8	6	8	8	5	8	8	8	4	7	8	8	8	7	8	8	8	8	7	8	8	8	8	5	2
16	Soc A	7	10	10	15	5	16	12	16	11	8	8	7	13	15	8	0	7	13	15	6	11	15	5	9	9	15	4	7	15	16	9	7	15	11	15	15	7	16	16	16	9	5	2
17	Eng/Span	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	0	5	5	5	5	5	5	5	5	5	4	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	2
18	Eng/Soc	7	8	8	8	5	8	8	8	8	8	8	7	8	8	8	8	7	0	8	6	8	8	5	8	8	8	4	7	8	8	8	7	8	8	8	8	7	8	8	8	8	5	2
19	Sped D	7	10	10	21	5	21	12	19	11	8	8	7	14	15	8	15	7	13	0	6	11	15	5	9	9	15	4	7	16	17	9	7	19	11	18	21	7	26	33	20	10	5	2
20	Art	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	0	5	5	5	5	5	5	4	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	2
21	Sci C	7	10	10	14	5	14	12	14	11	8	8	7	14	14	8	14	7	13	14	6	0	14	5	9	9	14	4	7	14	14	9	7	14	11	14	14	7	14	14	14	9	5	2
22	Soc B	7	10	10	11	5	11	11	11	11	8	8	7	11	11	8	12	7	11	11	6	11	0	5	9	9	11	4	7	11	12	9	7	11	11	11	11	7	11	11	11	9	5	2
23	Math C	6	6	6	6	5	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	0	6	6	6	4	6	6	6	6	6	6	6	6	6	6	6	6	6	6	5	2
24	Music A	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	0	5	5	4	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	2
25	Soc C	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	0	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	2
26	Comp	7	10	10	11	5	11	11	11	11	8	8	7	11	11	8	11	7	11	11	6	11	11	5	9	9	0	4	7	11	11	9	7	11	11	11	11	7	11	12	11	9	5	2
27	Soc D	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	0	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2
28	PE/Health C	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	0	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2
29	Counselor A	7	10	10	11	5	11	11	11	11	8	8	7	11	11	8	11	7	11	11	6	11	11	5	9	9	11	4	7	0	11	9	7	11	11	11	11	7	11	11	11	9	5	2
30	Soc E	7	8	8	8	5	8	8	8	8	8	8	7	8	8	8	8	7	8	8	6	8	8	5	8	8	8	4	7	8	0	8	7	8	8	8	8	7	8	8	8	8	5	2
31	Sci D	7	10	10	18	5	20	12	19	11	8	8	7	13	15	8	14	7	13	21	6	11	15	5	9	9	15	4	7	16	17	0	7	19	11	16	20	7	23	24	19	9	5	2
32	Sci E	6	6	6	6	5	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	5	6	6	6	4	6	6	6	6	0	6	6	6	6	6	6	6	6	6	5	2
33	Math D	7	10	10	21	5	21	12	19	11	8	8	7	14	15	8	14	7	13	21	6	11	15	5	9	9	15	4	7	16	17	9	7	0	11	18	21	7	26	25	20	10	5	2
34	Sped E	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	0	4	4	4	4	4	4	4	4	2
35	Counselor B	7	9	9	9	5	9	9	9	9	8	8	7	9	9	8	9	7	9	9	6	9	9	5	9	9	9	4	7	9	9	9	7	9	9	0	9	7	9	9	9	9	5	2
36	Counselor C	7	10	10	14	5	14	12	14	11	8	8	7	13	14	8	14	7	13	14	6	11	14	5	9	9	14	4	7	14	14	9	7	14	11	14	0	7	14	14	14	9	5	2
37	CTE	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	0	2	2	2	2	2	2
38	Admin	7	10	10	16	5	15	12	15	11	8	8	7	14	15	8	14	7	13	15	6	11	15	5	9	9	15	4	7	15	15	9	7	15	11	15	16	7	0	16	15	9	5	2
39	Lib	7	10	10	19	5	19	12	19	11	8	8	7	14	15	8	14	7	13	19	6	11	15	5	9	9	15	4	7	16	17	9	7	18	11	17	20	7	20	0	19	9	5	2
40	Eng D	7	10	10	21	5	20	12	19	11	8	8	7	14	15	8	14	7	13	21	6	11	15	5	9	9	15	4	7	16	17	9	7	18	11	18	21	7	26	32	0	9	5	2
41	Math E	7	10	10	21	5	21	12	19	11	8	8	7	14	15	8	14	7	13	21	6	11	15	5	9	9	15	4	7	16	17	9	7	19	11	18	21	7	24	30	20	1	5	2
42	Music B	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1
43	Sci F	7	9	9	9	5	9	9	9	9	8	8	7	9	9	8	9	7	9	9	6	9	9	5	9	9	9	4	7	9	9	9	7	9	9	9	9	7	9	9	9	9	5	0

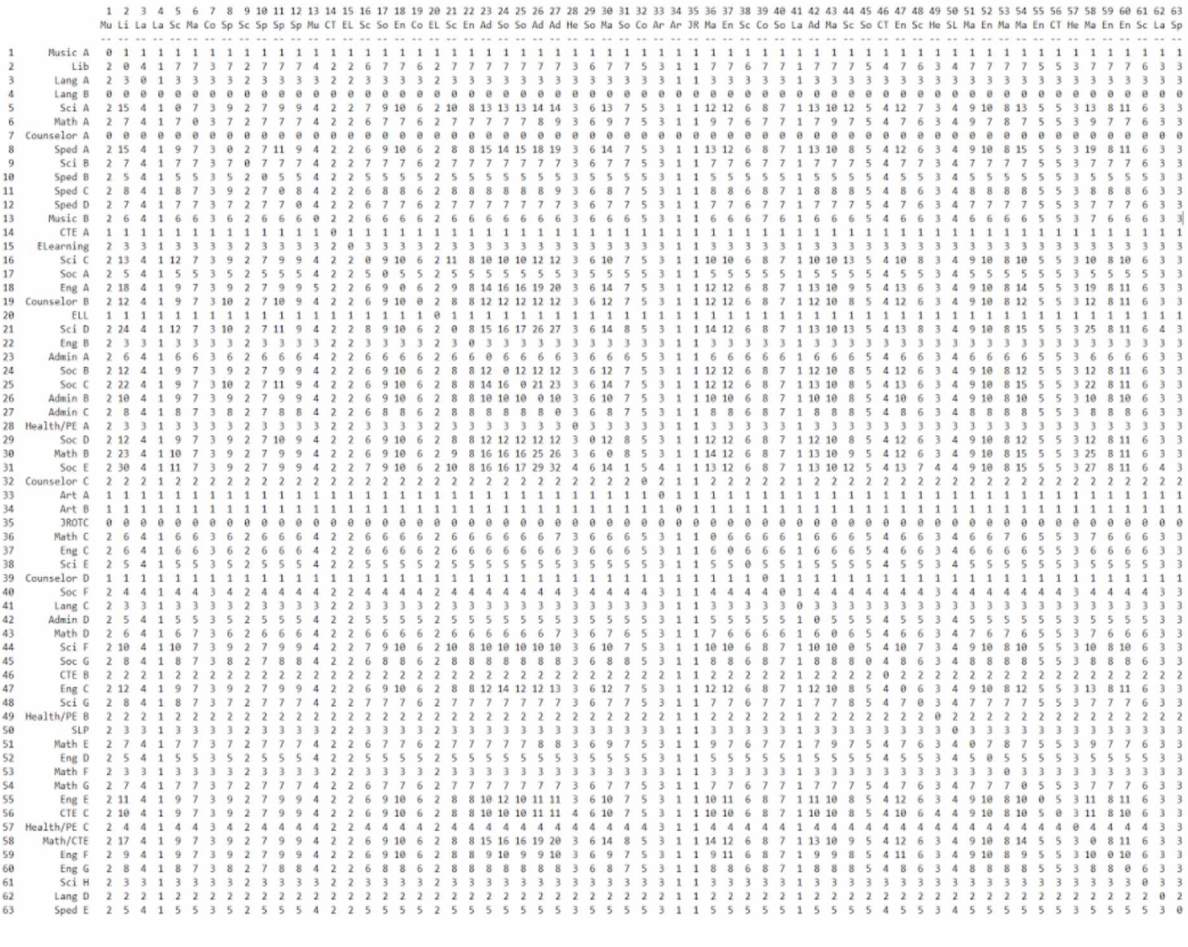
See Supplemental File: "Point Connectivity for Pilot School One" for original output file.

Table G.11: Ego Network Size for Pilot School Two

		1 Size	2 Avg Deg	3 Density
1	Music A	2.000	0.500	1.000
2	Lib	32.000	6.188	1.000
3	Lang A	7.000	3.857	1.000
4	Lang B	1.000	0.000	
5	Sci A	19.000	6.316	1.000
6	Math A	10.000	5.400	1.000
7	Counselor A	3.000	1.000	1.000
8	Sped A	21.000	6.048	1.000
9	Sci B	7.000	4.286	1.000
10	Sped B	8.000	3.000	1.000
11	Sped C	14.000	4.714	1.000
12	Sped D	11.000	4.455	1.000
13	Music B	10.000	2.000	1.000
14	CTE A	2.000	1.000	1.000
15	ELearning	5.000	2.000	1.000
16	Sci C	14.000	4.929	1.000
17	Soc A	10.000	4.300	1.000
18	Eng A	23.000	6.522	1.000
19	Counselor B	18.000	4.667	1.000
20	ELL	3.000	1.667	1.000
21	Sci D	38.000	8.237	1.000
22	Eng B	9.000	4.333	1.000
23	Admin A	18.000	6.833	1.000
24	Soc B	19.000	7.158	1.000
25	Soc C	32.000	8.031	1.000
26	Admin B	32.000	7.500	1.000
27	Admin C	36.000	8.111	1.000
28	Health/PE A	6.000	2.000	1.000
29	Soc D	14.000	4.500	1.000
30	Math B	32.000	8.000	1.000
31	Soc E	52.000	7.500	1.000
32	Counselor C	5.000	1.000	1.000
33	Art A	4.000	1.750	1.000
34	Art B	2.000	0.500	1.000
35	JROTC	1.000	0.000	
36	Math C	15.000	6.733	1.000
37	Eng C	13.000	5.538	1.000
38	Sci E	7.000	4.286	1.000
39	Counselor D	8.000	2.250	1.000
40	Soc F	9.000	5.333	1.000
41	Lang C	4.000	2.250	1.000
42	Admin D	15.000	6.000	1.000
43	Math D	11.000	5.818	1.000
44	Sci F	16.000	5.625	1.000
45	Soc G	9.000	5.000	1.000
46	CTE B	5.000	2.600	1.000
47	Eng C	19.000	6.632	1.000
48	Sci G	11.000	5.455	1.000
49	Health/PE B	4.000	1.250	1.000
50	SLP	5.000	2.800	1.000
51	Math E	12.000	6.083	1.000
52	Eng D	11.000	5.636	1.000
53	Math F	9.000	5.444	1.000
54	Math G	18.000	7.056	1.000
55	Eng E	14.000	6.357	1.000
56	CTE C	15.000	4.000	1.000
57	Health/PE C	6.000	2.000	1.000
58	Math/CTE	27.000	5.259	1.000
59	Eng F	16.000	6.438	1.000
60	Eng G	14.000	6.714	1.000
61	Sci H	7.000	4.714	1.000
62	Lang D	5.000	2.400	1.000
63	Sped E	7.000	2.286	1.000

See Supplemental File: "Egonet Density for Pilot School Two" for original output file.

Table G.12: Point Connectivity for Pilot School Two



See Supplemental File: "Point Connectivity for Pilot School Two" for original output file.

Figure G.8 depicts the ego network map for Music B in Pilot School One. From the map, one can see that Music B has few connections to the whole network. Furthermore, he or she possess only one outgoing and one multi-directional tie: to Music A, the only other music teacher in the school. This indicates that although four individuals have reached out to Music B for information or resources, Music B has only sought out Music A for the same. Interviews with Music B would help provide additional data on the reasons for the connections he or she has made, and why he

or she has not made additional connections within the school network.

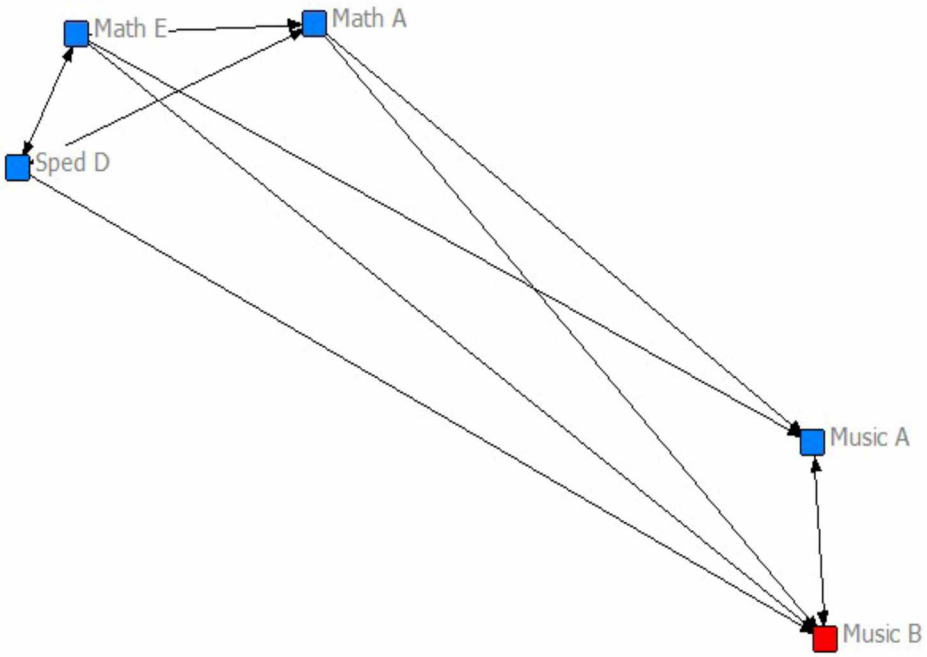


Figure G.8: Ego Network of Music B, Pilot School One.

Another way to visual peripheral individuals is the use of differing layouts within UCINET's NetDraw. Figure G.8 was drawn using the graph theoretical layout, which groups nodes according to similarity. In this instance, similar refers to geodesic distance, with nodes that have the shortest paths to all other nodes more central in the map. Thus, the analyst can see that there are other actors in the network that may be peripheral, such as CTE A, Lang B, or JROTC.

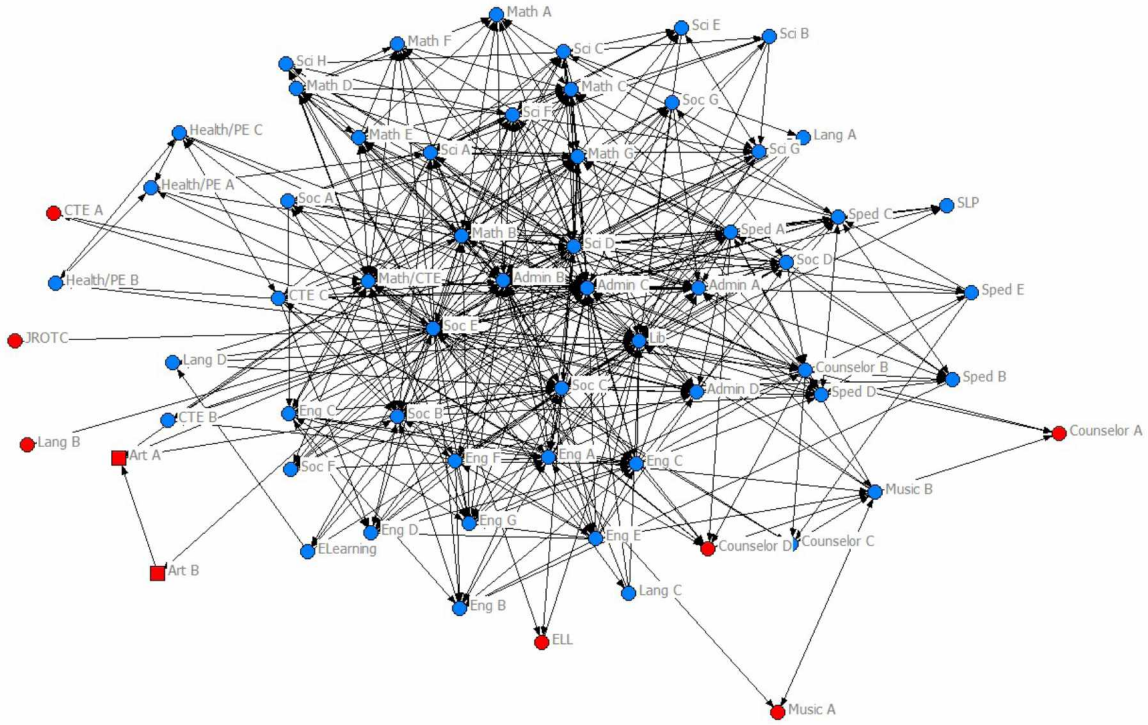


Figure G.9: Pilot School Two mapped using graph theoretical layout.

Peripheral people are coded in red.

Referring back to the network size (Table G.7) and point connectivity charts (Table G.8) for Pilot School One, confirms that these actors have relatively low network size and relatively high point connectivity values, verifying this interpretation of the network map. With the exception of Counselor D, all actors previously identified as peripheral fall on the outside edges of the network diagram and have few connections. Counselor D initial may seem confusing, but examination of the ego network for Counselor D (Figure G.10) reveals that he or she has only one outgoing connection. Although others seek out Counselor D for advice and information, he or she only seeks out one other person. Loss of that individual in the network would limit Counselor D's access to information and resources. An individual who is using this information to determine which individuals need stronger connections to the network, may choose to omit

Counselor D as a result of this data; those sorts of decisions must be based on the needs of the school.

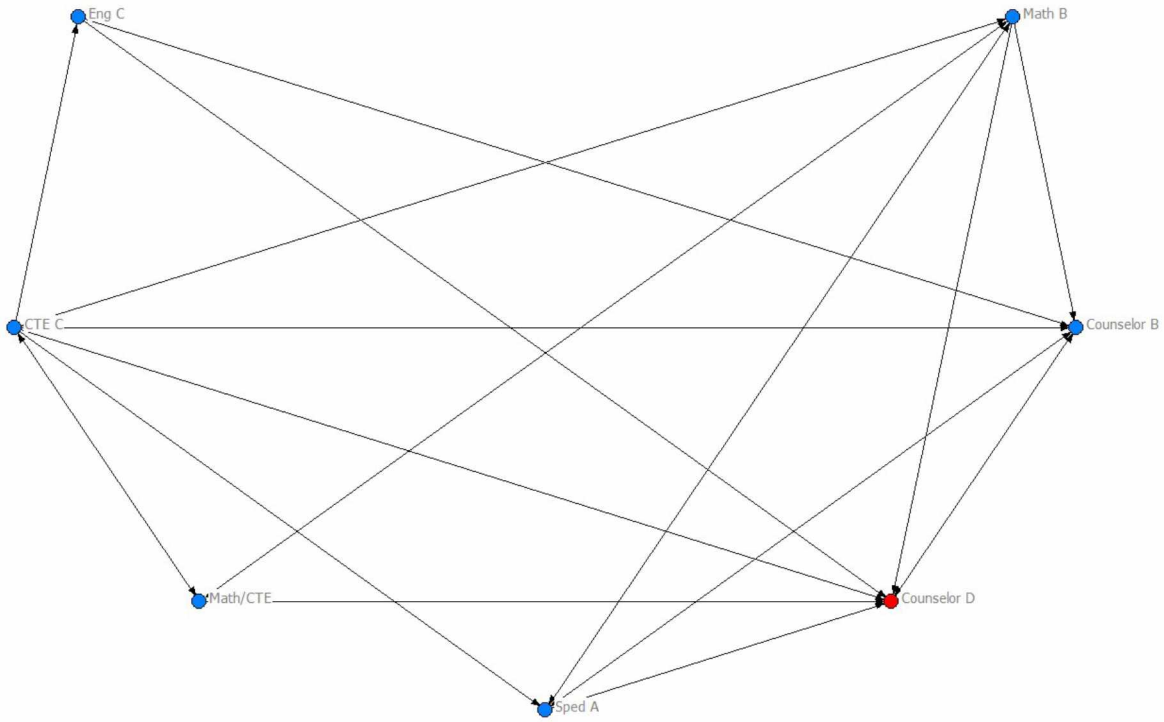


Figure G.10: Ego Network of Counselor D from Pilot School Two.

Appendix H: Consent Forms

Alaska Teacher Social Network Survey Consent Form

This study is intended to examine the effects of teacher and librarian collaboration in Alaska secondary schools and its impact on student learning through the lens of social network theory. Deborah Rinio, Librarian in the Fairbanks North Star Borough School District, and doctoral student at the University of Alaska Fairbanks, is conducting this study.

Deborah has contacted your school district and obtained any and all appropriate permissions to request your participation in this study. All permissions are filed with the UAF Institutional Review Board.

Your participation in this study is completely voluntary. Any contact information collected for the purpose of the study will be used only for communication between yourself and the researcher and will not be shared with anyone else.

The study will be conduced in three phases over the course of the semester. Your participation is needed for the second phase, a survey that will take approximately 20-30 minutes. Based on the results of this phase, a representative grouping of teachers will be selected to participate in interviews. Your participation may be requested again for the third phase. You are not obligated to participate in this or any future portions of the study. If you participate now, it does not obligate you to future participation. You may choose not to answer all questions or not to participate in one or more portions of the study, even after beginning the survey.

The results of the study will be used for scholarly purposes only. All responses will be stored in password-protected format for use by the researcher only. Results of the research will be published anonymously with no individual school, district, or person identified.

If you have any concerns or questions about the study, please contact: Deborah Rinio at djrinio@alaska.edu or 907-479-2261 x123; Dr. Gary Jacobsen, Doctoral Thesis Advisor, at gjacobs9@uaf.edu or 907-474-5924; or the University of Alaska Fairbanks (UAF) Institutional Review Board. The UAF Institutional Review Board (IRB) is a group that examines research

projects involving people. This review is done to protect the rights and welfare of people involved the research. If you have questions or concerns about your rights as a research participant, you can contact the UAF Office of Research Integrity at 474-7800 (Fairbanks area) or 1-866-876-7800 (toll-free outside the Fairbanks area) or uaf-irb@alaska.edu.

Electronic Consent

Clicking agree indicates that you: 1) have read the above information, 2) voluntarily agree to participate, 3) are at least 18 years of age. If you do not wish to participate, please decline by selecting disagree below.

Agree

Disagree

Participatory Analysis / Interview Consent Form

This study is intended to examine the effects of teacher and librarian collaboration in Alaska secondary schools and its impact on student learning through the lens of social network theory. Deborah Rinio, Librarian in the Fairbanks North Star Borough School District, and doctoral student at the University of Alaska Fairbanks, is conducting this study.

Deborah has contacted your school district and obtained any and all appropriate permissions to request your participation in this study. All permissions are filed with the UAF Institutional Review Board.

Your participation in this study is completely voluntary. Any contact information collected for the purpose of the study will be used only for communication between yourself and the researcher and will not be shared with anyone else.

The study will be conduced in three phases over the course of the semester. Your participation is needed for the third and final phase and involves a 45-60 minute interview to be conducted in person or by phone. You are not obligated to participate in this or any future portions of the study. You may choose not to answer all questions or not to participate in one or more portions of the study, even after beginning the interview.

The results of the study will be used for scholarly purposes only. All responses will be recorded, transcribed, and stored in password-protected format for use by the researcher only. Results of the research will be published anonymously with no individual school, district, or person identified.

If you have any concerns or questions about the study, please contact: Deborah Rinio at djrinio@alaska.edu or 907-479-2261 x123; Dr. Gary Jacobsen, Doctoral Thesis Advisor, at gjacobs9@uaf.edu or 907-474-5924; or the University of Alaska Fairbanks (UAF) Institutional Review Board. The UAF Institutional Review Board (IRB) is a group that examines research projects involving people. This review is done to protect the rights and welfare of people involved the research. If you have questions or concerns about your rights as a research

participant, you can contact the UAF Office of Research Integrity at 474-7800 (Fairbanks area) or 1-866-876-7800 (toll-free outside the Fairbanks area) or uaf-irb@alaska.edu.

Signing this consent form indicates that (1) you have read the above information, (2) you voluntarily agree to participation, and (3) you are at least 18 years of age.

_____

Printed Name

_____

Signature

_____

Date

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