FRIENDSHIP TIE FORMATION AMONG YOUTH WITH AND WITHOUT DISABILITIES IN HIGH SCHOOL: A SOCIAL NETWORK ANALYSIS

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DISSERTATION ABSTRACT

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This study evaluates dyadic, contextual, and network factors believed to contribute to the maintenance and formation of friendship ties among youth with and without disabilities in high school. The sample included 2,973 youth in ten high schools. Changes in friendship ties across one academic year were evaluated using stochastic-actor oriented models (SAOMs). Results from the SAOMs of each school indicated youth in large, but not small schools, were more likely to send ties to peers with similar disability status. Moderation analyses by ego disability status indicated the predictors of friendship ties did not differ significantly for youth with disabilities, except in two schools where youth with disabilities were less likely to send ties to peers in similar grades and from the same neighborhood, but more likely to send ties to peers of the same gender. Implications for research and practice are discussed, including the need for additional research to evaluate which combinations of peer characteristics are critical for network interventions.

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CHAPTER I

INTRODUCTION

Statement of the Problem

Youth with disabilities report lower levels of quality of life indicators than their peers without disabilities (Sacks & Kerns, 2008; Watson & Keith, 2002). These youth are less satisfied than their typically developing peers with their current circumstances, including their experiences within schools and in their personal relationships, which coincide with feeling less social belonging (Watson & Keith, 2002). Youth with disabilities are more likely than peers without disabilities to report feeling depressed, lonely, disliked, and experience suicidal ideation (Savage, McConnell, Emerson & Llewellyn, 2014; Wagner, Newman, Cameto, Levine, & Marder, 2007).

The differences in quality of life between youth with and without disabilities could be a result of insufficient access to material and social resources (Savage et al., 2014). Social resources in the form of meaningful social relationships decrease the likelihood of loneliness among youth and adults with disabilities (Eisenman, Freedman, & Kofke, 2017; Kersh, Corona & Siperstein, 2013; Mazurek, 2014; Renty & Royers, 2006; Tur-Kaspa, Margalit, & Most, 1999). Meaningful social relationships are a source of social support and social capital that influence mental health (Cohen & Willis, 1985; Mazurek, 2014), physical health (Wentzel, Barry, & Caldwell, 2004), and adaptive behavior (Parker, Rubin, Price, & De Rosier, 1995).

Youth with disabilities engage in a variety of relationships with individuals in different roles throughout development, including familial, romantic, friend, coworker, neighbor, mentor, and caregiver. For adolescents in high schools, a diverse array of

relationships serve important functions. Parental involvement and expectations influence the post-school outcomes of youth with disabilities (Test et al., 2009) and family members are at the center of adolescents' social networks (Eisenman, 2007; Eisenman, Farley-Ripple, Culnane, & Freedman, 2013). Beyond familial relationships, adult mentors who provide meaningful social support are also influential for adjustment (Pham & Murray, 2016).

During adolescence and young adulthood, peers are critically important to the experiences of youth with disabilities and provide unique support (Lafferty & McConkey, & Taggart, 2013; Mason, Timms, Hayburn, & Watters, 2013; Schuh, Sundar, & Hagner, 2015). Adolescents with disabilities identify friendships with peers as central to the transition to adulthood (Schuh et al., 2015) and the social support provided by peer friendships cannot be substituted by alternate relationships (i.e., family, adults; Lafferty et al., 2013; Mason et al., 2013). Unfortunately, friendships with peers occur less frequently (Kreider et al., 2016; Locke, Kasari, Rotheram-Fuller, Kretzmann, & Jacobs, 2013; Mendelson, Gates, & Lerner, 2016), are of lower quality (Locke, Ishijima, Kasari, & London, 2010; Mendelson et al., 2016; Whitehouse, Durkin, Jaquet, & Ziatas, 2009; Wiener & Schneider, 2002), are less stable (Estell, Jones, Pearl, & Van Acker, 2009; Marton, Wiener, Rogers, & Moore, 2015; Wiener & Schneider, 2002), and less diverse (Estell et al., 2009; Kreider et al., 2016; Kuo, Orsmond, Cohn, & Coster, 2013; Marton et al., 2015; Wiener & Schneider, 2002) for students with disabilities than for their typically developing peers.

Friendship dimensions (i.e., quantity, quality, stability, diversity) for youth with disabilities may be impacted by a variety of individual and contextual factors. The

quantity of reciprocated and total friendships appear to be influenced by individual characteristics. For example, younger students and female youth with disabilities have more reciprocated friendships than do older youth and males (Rotheram-Fuller, Kasari, Chamberlain, & Locke, 2010; Wiener & Schneider, 2002). Quantity and quality may also be influenced by contextual factors that limit access to peers. Adolescents with disabilities in self-contained classrooms have fewer friendships and are less likely to spend time with friends outside of the school day than are adolescents with disabilities in inclusive settings (Fisher & Shogren, 2016). The quality and stability of friendships of youth with disabilities is also influenced by characteristics of their friends. For example, youth with disabilities may form their most stable and highest quality friendships with other students with disabilities rather than with typically developing peers (Rossetti & Keenan, 2018) even when those peers have different types of disabilities (Estell et al., 2009; Kreider et al., 2016; Kuo et al., 2013; Locke et al., 2010; Marton et al., 2015; Wiener & Schneider, 2002). The tendency to form friendships on the basis of characteristics of their friends limits the diversity of friendship networks among youth with disabilities. Although various individual and contextual factors are related to the dimensions of friendship, no studies have empirically evaluated how these factors may uniquely contribute to friendship among youth with disabilities using a comprehensive model that includes multiple individual and contextual factors known to affect friendship.

Current practice. A variety of educational practices and interventions directly or indirectly address the friendships of youth with disabilities. However, these practices have not sufficiently addressed the disparities between youth with and without disabilities. For example, it appears that the inclusion of youth with disabilities in general

education classrooms can increase the quantity and quality of friendships, but shared time and shared space does not *ensure* meaningful friendships will develop with typically developing peers (Estell et al., 2008). Observational studies of inclusive classrooms have found that social interactions between adolescents with severe disabilities and peers without disabilities are infrequent without intervention (Carter, Hughes, Guth, & Copeland, 2005; Carter, Sisco, Brown, Brickham, & Al-Khabbaz, 2008) and friendship development often requires prompting and support from adults (Rossetti & Keenan, 2018). Other work suggests that the role of adults in inclusive classrooms can negatively affect friendship development by limiting peer interactions and increasing stigmatization of youth with disabilities in such classrooms (Bottema-Beutel, Mullins, Harvey, Gustafson, & Carter, 2016; Carter, Common et al., 2014; Carter, Biggs, & Blustein, 2016). Thus, although inclusive classrooms may increase *opportunities* for social engagement between youth with and without disabilities, the translation of this opportunity into meaningful friendships can be affected by other variables in the setting.

Group and individualized interventions that target social behavior and skills may indirectly influence friendships by decreasing inappropriate, and increasing appropriate, behaviors with peers. Socially inappropriate behavior can be intimidating to peers or result in social stigma (Carter, Bottema-Beutel, & Brock, 2014). Function-based interventions can be effective in reducing socially inappropriate, and increasing socially appropriate, replacement behaviors. Various social skills interventions delivered by teachers, parents, and peers directly teach specific social behaviors (e.g., initiating interactions, turn-taking) to increase the frequency and quality of social interactions (Carter, Bottema-Beutel et al., 2014; Carter, Common et al., 2014; Carter, Sisco, Chung,

& Stanton-Chapman, 2010; Hughes et al., 2012). Peer-mediated interventions for social, behavior, and academic skills increase social interactions for youth with disabilities (Carter et al, 2017; Carter, Asmus et al., 2016; Carter, Cushing, Clark, & Kennedy, 2005; Carter, Moss, Hoffman, Chung, & Sisco, 2011; Huber, Carter, Lopano, & Stankiewicz, 2018). Social behavior and skills are important to the social functioning of youth with and without disabilities, and interventions can build strengths and capabilities of youth to improve the quality and frequency of their peer interactions. However, there are times when individuals are excluded from social environments for reasons other than their social skills (Killen, Rutland, & Jampol, 2009). Moreover, the helping roles of peers may result in strain on existing or emerging friendships (Rossetti & Keenan, 2018).

In addition to this work, other researchers have developed peer support interventions as a means of expanding the social circles of adolescents with disabilities in high schools. These interventions range from peer partner programs designed as a form of reverse inclusion (Carter, 2018), to peer network interventions designed to build expanded social networks (Carter et al., 2013). Despite their widespread use in schools, peer partner programs have not been empirically validated (Carter, 2018). In one randomized trial of a peer network intervention, Asmus and colleagues (2017) did find, however, that adolescents with disabilities receiving the intervention increased in school contacts and friendships for one semester, but these effects were not maintained. Moreover, the increased contacts and friendships did not reach beyond the school context. Characteristics of the peer network members may be a critical component in the success of such interventions, but little research has evaluated which combinations of characteristics are most important (Carter, 2018). Furthermore, the ways in which initial

interactions lead to new friendships for youth with disabilities is still largely unknown (Carter, 2018).

Rationale for the Study

The friendship disparities between youth with and without disabilities is often attributed to individual skill deficits (e.g., social behaviors and communication) but these disparities may also be due to opportunity barriers (Asmus et al., 2017). Youth with disabilities may have fewer opportunities to engage with a variety of peers during school activities due to school placements, academic groupings, and exclusion from extracurricular activities. Even when youth with disabilities are included in general education classrooms, they are often segregated into different spaces within the classroom (Feldman, Carter, Asmus, & Brock, 2016; Tews & Lupart, 2008). Additional constraints may arise from the school context, such as peer preferences within social networks, structural tendencies of the network, or attitudes among members of the context. For example, typically developing adolescents in inclusive classrooms had positive attitudes toward youth with severe disabilities but identified a separate classroom as the most appropriate placement for them (Shalev, Asmus, Carter, & Moss, 2016). More nuanced attitudes and biases toward youth with disabilities likely impact the degree to which they are socially integrated in a school context. Additional research on social dynamics management suggests that a combination of individual and contextual factors influence relationships in a classroom or school which requires a multilevel approach for intervention (Farmer, Dawes et al., 2018; Farmer, Talbott et al., 2018).

The field of social network analysis has identified individual, dyadic, contextual, and network factors that predict friendship ties among youth. The proximity, or

propinquity, of two youth in activities, neighborhoods, and schools, for example, increases the likelihood of friendship formation since contact is often the base level requirement for friendship development (Cairns, Xie, & Leung, 1998; Kruse, Smith, van Tubergen, & Maas, 2016; McFarland, Moody, Diehl, Smith, & Thomas, 2014). Friendship ties between youth are also more likely to occur when youth are similar, or homophilous. This similarity between friends occurs on a variety of dimensions including individual characteristics, skills, behaviors, values, and interests (Gifford-Smith & Brownell, 2003; Kupersmidt, DeRosier, & Patterson, 1995; McFarland et al., 2014; McPherson, Smith-Lovin, & Cook, 2001). Youth are also more likely to reciprocate friendships with one another, endorse friendships with more popular youth, and become friends with their friends' friends (McFarland et al., 2014).

Despite a large body of evidence revealing the factors that contribute to friendship ties between youth in general, little is currently known about how these factors may affect friendship ties among youth with disabilities (Carter, 2018; Mendelson et al., 2016). Few studies have empirically evaluated dyadic factors that predict friendships among students with disabilities, the quantity of these relationships, or the presence of a best friend. Still fewer studies have evaluated the factors that predict the existence of a friendship tie between two youth, including a student with a disability, in a classroom or school network. Due to the importance of peer friendships, and the disparity between adolescents with and without disabilities on dimensions of friendship and quality of life, it is important to explore factors that may be associated with peer-relationship outcomes among this population. Such research has the potential to inform the development of effective peer relationship interventions for youth with disabilities. Therefore, the goal of

this study is to use social network analysis to examine how individual, dyadic, contextual, and network factors predict friendships ties within high schools among adolescents with and without disabilities.

CHAPTER II

LITERATURE REVIEW

Introduction

The following sections define key social network analysis terminology, detail the theoretical framework, and review the literature which inform the design of the study. Social network analysis is the primary theoretical framework used in this study due to the focus on understanding friendships between youth within a school context. In my description of social network analysis as a framework, I will also focus on exogenous and endogenous theories of networks used to conceptualize the key factors examined in the study. I include a review of key studies focused on the predictors of friendship ties for youth with disabilities and students in general due to the limited literature available on students with disabilities. The literature review is structured according to the type of predictor, including dyadic similarity on the basis of demographic characteristics, dyadic similarity on the basis of individual skills, behaviors, and interests, contextual factors, and network properties. The review includes studies focused on youth of all ages since a focus on adolescents in high schools would significantly limit the review for youth with disabilities.

Definition of Key Terminology

Social network analysis. The term social network analysis refers to the perspective or paradigm that relations and patterns of relations give rise to social life (Marin & Wellman, 2011). Social network analysis recognizes that patterns of relationships are dynamic—not static processes—where actors are constantly making and losing ties. As an interdisciplinary area of study, social network analysis has been used in

fields within the social, behavioral, and hard sciences (Freeman, 2004). It encompasses both theory and methods for investigating relations and their patterns, rather than the individual. Theory in social network analysis can be broadly categorized as theory of networks, or those based on the antecedents of networks, and network theories, or the consequences of networks (Borgatti & Lopez-Kidwell, 2011). Though both kinds of theory are critical to understanding the experiences of youth with disabilities, this study focuses exclusively on understanding factors that contribute to tie formation and maintenance, or theory of networks. Given the flexibility and breadth of the perspective, I will briefly clarify the key terms and theory of networks for this study and provide more detail throughout Chapters Two and Three.

Social network. A social network refers to a collection of socially-relevant actors connected by one or more relations (Marin & Wellman, 2011). Actors can refer to people, organizations, texts, countries, etc., and relations can refer to similarities, social relations, interactions, and flows (Borgatti, Mehra, Brass, & Labianca, 2009). Social networks can be whole or ego networks, and one- or two-mode networks. Whole networks are social relations between actors in a population of interest, often a bounded social group (e.g., single school), and ego networks are social relations between a focus actor and other actors they are connected to. One-mode networks are comprised of only one set of actors, while two-mode networks are comprised of two sets of actors or a set of actors and an event or group (Wasserman & Faust, 1994). Defining collections of actors requires addressing the boundary specification problem, which can be resolved by a position-based, events-based, or relations-based approach (Laumann, Marsden, & Prensky, 1983). In this study, a social network refers to a set of students (one-mode

network of actors) within a single school (position-based approach to whole networks) connected by friendship ties (relation).

Friendship tie. Relations within a social network can be directed or undirected. Undirected relations exist between two actors without any particular orientation, and directed relations are those sent from one actor to another. For example, a network of activity participation in a school where youth are connected to only the peers they share activities with is inherently undirected, but a network of peer support can be directed since support is provided from one youth to another. Directed relations are reciprocated when two actors endorse the same relation with one another, or they can be asymmetrical when only one actor endorses a relation with another actor. For example, in a network of peer support, one youth may endorse giving support to a peer, but the peer may not endorse providing support to the youth. In this case, the relation would be described as asymmetric rather than reciprocated. In the current study, friendship ties are directed to identify all forms of friendship, both asymmetric and reciprocated. Youth with disabilities are less likely to experience reciprocated friendship ties than are their peers without disabilities (Kasari et al., 2011; Kreider et al., 2016; Locke et al., 2013; Mendelson et al., 2016; Rotheram-Fuller et al., 2010; Wiener & Schneider, 2002). Differentiating between factors that impact these patterns is critical for understanding how to support reciprocated friendships.

Propinquity. Propinquity refers to the theory of networks that physical proximity to another actor increases the likelihood of a social relation. For social relations to form, opportunities for contact must be available (Blau, 1994). Thus, individuals can only form social relations with individuals with whom they have contact. People are more likely to

have contact with other actors who are geographically close than actors who are distant, even in modern society where technology can bring us into contact with others who are geographically distant (McPherson et al., 2001). However, as Blau (1994) notes, proximity resulting in contact or even repeated contact does not ensure that social relations will form between actors. Feld's (1981) attention to foci, or social, psychological, legal, or physical entities around which actors engage in joint activities, may be more valuable for conceptualizing propinquity. According to Feld (1981), actors who engage in joint activities with a shared focus are more likely to establish ties because their shared focus will lead to more valued interactions and, ultimately, greater positive sentiments toward one another. In this study, I will utilize the more general view of propinquity, as well as Feld's (1981) concept of foci to investigate how shared location and shared joint activity individually contribute to tie formation.

Homophily. Homophily refers to the theory of networks that contact occurs at a higher rate for two actors who are similar in comparison to two actors who are dissimilar (McPherson et al., 2001). The theory is most often traced back to the work of Lazarsfeld and Merton (1954) who defined homophily as the "tendency for friendships to form between those who are alike in some designated respect" (1954, p. 23). Homophily has been examined for a variety of dimensions including individual demographic characteristics, network positions, behaviors, skills, values, and attitudes (McPherson et al., 2001). Furthermore, dimensions that induce homophily in a network are those that are most salient in our social system. McPherson and colleagues (2001) also address the interplay of homophily and propinquity. They emphasize that social structures induce propinquity of similar others that impacts baseline levels of homophily. For example, a

majority Latinx school population would have higher rates of Latinx homophily because there are fewer non-Latinx students available in the population. Accordingly, it is critical to control for the characteristics of the school to identify homophily over and above that which would be expected from population proportions. Following McPherson and colleagues (2001) conception of homophily, I will examine a variety of dimensions that may induce homophily, including demographic characteristics, behaviors, and skills.

Theoretical Framework

Social network analysis is fundamentally focused on patterns of relationships because they give rise to society (Simmel, 1922/1955). Patterns of relationships have important consequences for actors embedded in those networks of relationships (Freeman, 2004). Relationships are not independent of all other relationships in a network, they are dependent on the existing network structure and the potential tie pool available (Cairns et al., 1998). Understanding the formation of patterns of relationships, or theory of networks, is a critical component of social network analysis. Social network researchers developed theories of networks based on empirical evidence that focus on endogenous network processes and those based on characteristics of actors exogenous to the network. The following sections describe the theories of networks that are most critical to friendship formation for adolescents in school contexts.

Endogenous network processes. Endogenous network processes arise out of networks themselves. Three in particular are critical to the study of adolescent friendships: reciprocity, transitivity, and preferential attachment. Reciprocity is a central theory to social network analysis evaluated since the 1930's and is the tendency for one actor to choose another if the second actor has already chosen the first (Wasserman &

Faust, 1994). This notion of reciprocal choice is a consistent finding in social network analysis literature (Snijders, van de Bunt, & Steglich, 2010). Moreover, the theory is consistent with developmental perspectives on adolescent friendship that underscore the importance of mutual attraction for friendship formation (Bukowski, Motzoi, Meyer, 2009).

Similar to reciprocity, transitivity is the tendency for friends of friends to become friends themselves. Models of transitivity developed by Davis, Leinhardt, and Holland are extensions of Heider's (1946; 1958) balance theory, which argues that positive and negative sentiment dichotomize groups (e.g., Davis, 1967; Davis & Leinhardt, 1971; Holland & Leinhardt, 1970; Holland & Leinhardt, 1971). Holland and Leinhard (1970) identified a more general model of transitivity where actors have a greater tendency to form ties with actors who are already connected to an existing tie. Davis and Leinhardt (1971) proposed that forms of triads (i.e., tie structures of three actors) will be more or less likely due to transitivity, but they rejected the notion that certain triads were impossible (i.e., forbidden triads). Current social network researchers have used a variety of measures to represent different theoretical and practical aspects of transitivity as conceptualized by this general model.

Barabási and Albert (1999) identified preferential attachment as a mechanism within large, complex networks ranging from genetic networks to the internet. In social science applications, preferential attachment refers to the tendency of new actors to form ties with actors who are already well-connected. Moreover, those who are already well-connected will increase their connections at a higher rate than those who are less well-connected. For example, a youth attending a new high school will have a greater

tendency to seek out connections with other youth who have many friends in the school. Likewise, youth with many friends in a school will gain more connections at a higher rate in comparison to a youth with relatively few friends. Preferential attachment is similar to cumulative advantage distribution (i.e., success breeds success) proposed by Price (1976) and is often referred to as the "Matthew Effect" (Merton, 1968; 1988).

Propinquity. Propinquity is the theory that geographic proximity is central to the formation of social relationships. Relationships between two actors can only form as a result of opportunities for contact (Blau, 1994). Opportunities for contact are more likely to arise when two actors are geographically close (McPherson et al., 2001). Although technology has reduced physical barriers to opportunities for contact, proximity continues to be a predictor of tie formation. Technology has reduced the difference between the effects of close proximity and intermediate distance on network ties, but both remain more influential than great distances (McPherson et al., 2001). For example, youth may be just as likely to develop friendships with other youth who live in their neighborhood or in their town, but less likely to develop a friendship with youth who live in a different town. Geographic proximity continues to be important for social relations because individuals often use technology to maintain existing social relations formed by face-to-face contact rather than as a tool to develop new relations (Wellman, 1996; Zhao & Elesh, 2008). However, shared location and repeated contact does not ensure tie formation. Within physical and online environments, co-presence (i.e., reciprocal orientation to one another, mutual availability, and accessibility) and being attuned to one another, may be more critical than simple colocation (Zhao & Elesh, 2008).

Feld's (1981) focus theory approach expands the concept of propinquity from co-location to joint activity within the social environment. Individuals organize their social relations around relevant aspects of the social environment where they engage in joint activity, which include social, psychological, legal, and physical entities. When individuals interact and engage in joint activities, their contact is more likely to develop into a social relation. Joint activity between individuals is often mutually rewarding and leads to positive sentiments that support tie formation. Although this argument points to shared attitudes, beliefs, group membership, and positions, those similarities must lead to focused interactions. Moreover, Feld (1981) argued that the greater the constraint in the focus (i.e., frequency of forced interaction), the more likely the focus will lead to tie formation. Thus, proximity is considered a critical component for foci to induce tie formation.

Propinquity is one theory of networks that explain tie formation within networks, and it may also influence characteristics of the network. Proximity contributes to shared attributes, or homophily, among network ties due to the institutional structures that sort neighborhoods, schools, and workplaces (McPherson et al., 2001). For example, a relatively homogenous neighborhood will likely also have homogenous public schools that lead to homogenous friendship networks of students. Furthermore, foci are often induced by social institutions such as schools and workplaces, which can intensify the effects of homophily on tie formation (McPherson et al., 2001). Due to the interplay between proximity or foci, and shared attributes, researchers should control for the effects of homophily when studying friendships to disentangle the effects of propinquity on tie formation.

Homophily. Homophily is a theory of networks that posits that people who are similar have connections at higher rates than those who are dissimilar (McPherson et al., 2001). Within social science literature, Lazarsfeld and Merton (1954) are often cited as the originators of this theory (McPherson et al., 2001). The proverbial expression "birds of a feather flock together," first used in their work, continues to represent this theory in the social network literature (e.g., Goodreau, Kitts, & Morris, 2009; Hamm, 2000; McPherson et al., 2001).

Social network researchers have identified homophily in friendships among school-age youth (Gifford-Smith & Brownell, 2003; Goodreau, 2009; Hallinan & Smith, 1989; Kupersmidt, et al., 1995; McFarland et al., 2014). Homophily occurs across a variety of dimensions (e.g., demographics, network positions, behaviors), however, dimensions that induce homophily are more salient in the social environment (McPherson et al., 2001). Dimensions that are less socially important will induce less homophily and individuals will form intergroup relations (Smith, McPherson, & Smith-Lovin, 2014). For example, in a school where academic performance is less salient, youth will be less likely to form relationships on the basis of similar grades and instead have friends with a range of grade point averages (GPAs). Moreover, since each individual has multiple attributes and affiliations, forming relations with only those who exactly match an individual's profile would significantly limit their potential tie pool (Smith et al., 2014). To maintain a wide enough potential tie pool, individuals only limit their pool on the dimensions that are most personally important (Blau, 1994).

Homophily is influenced by the tie pool available, institutional segregation that aids or limits propinquity, and out-group acceptance (Smith et al., 2014). Despite

theoretical expectations that increased baseline heterogeneity leads to decreased homophily (Blau, 1994), homophily on the basis of gender, race, religion, age, and education have remained relatively stable, even as demographics have shifted in the US from 1985 until 2004 (Smith et al., 2014). Thus, although the absolute levels of homophily appear to have changed as a result of population changes, the relative levels of homophily appear to have remained stable. According to Smith and colleagues (2014) this stability of homophily may have been due to slowly changing institutional structures, or a slow response in the social salience of dimensions when structures change. The slow response in social salience may also arise out of implicit social cognition, where past experience impacts social behavior even if those experiences are not introspectively available (Greenwald & Banaji, 1995). Actors' intergroup attitudes may be formed by a combination of explicit judgments and implicit beliefs (Killen, McGlothlin, & Henning, 2008). Intergroup contact may reduce implicit bias in friendship selection, but not eradicate it completely, leading to stable homophily despite demographic and institutional change.

Homophily may result from the belief that shared knowledge exists between those who are similar as well as a desire for ease of communication, shared cultural taste, and coordination of activities (Carley, 1991; McPherson et al., 2001). The desire to easily relate to others may lead actors to form ties with other actors they perceive to be most similar. Special education scholars suggest that sharing a common identity, particularly a common disability, can lead to a sense of equality in friendships (Eisenman et al., 2017; Rossetti & Keenan, 2018). Developmental perspectives on friendship also acknowledge a selection and socialization effect in friendships, where actors are more likely to choose

friendships with actors who have similar behaviors and may increase in similarity over time to ensure high rates of mutual responsivity (Bukowski et al., 2009; Kindermann, McCollam, & Gibson, 1996). Furthermore, social network research suggests that ties between two actors whose behaviors are dissimilar are more likely to dissolve than are ties between actors with similar behaviors (McPherson et al., 2001). Other researchers suggest "default selection" as an alternative mechanism for homophily on the basis of behavior. Youth with patterns of deviant behavior or social skill deficits may become friends by default if they are unable to form connections with other peers (Prinstein & Giletta, 2016). However, this explanation is not consistent with findings indicating that behavior and skill homophily across the entire range of a measure (e.g., Kupersmidt et al., 1995).

Summary. Social network analysis provides the theoretical framework for understanding the factors that may contribute to the formation of friendships among youth with disabilities in schools. This framework takes into account the interdependence of social relations within an entire network and accounts for contextual and network processes that impact friendship formation within a bounded setting. The key theories of networks for understanding friendship formation in schools include reciprocity, transitivity, preferential attachment, propinquity, and homophily. These theories serve as a basis for my review of literature on predictors of friendship for youth with disabilities in the sections that follow.

Predictors of Friendship Among Youth with Disabilities

The following sections describe the literature examining predictors of friendship for youth with disabilities in schools. I structure the review according to relevant theories

of networks and system levels (i.e., dyadic, context, network). First, I describe homophily on the basis of demographic characteristics, behaviors, skills, and interests. Second, I review contextual factors that affect the formation of friendship ties, including propinquity, inclusion, and other school-level factors that constrain the available tie pool. Third, I examine how network properties impact the development of friendship ties. I include research examining friendship for youth with disabilities of all ages to investigate predictors as thoroughly as possible. For theoretical predictors with limited research concerning youth with disabilities, especially in secondary settings, I include relevant research conducted with the total student population.

Homophily on the basis of demographic characteristics. Researchers have explored homophily for actor characteristics in the social networks of youth with disabilities ranging from early childhood settings to high schools. In the following section, I review the literature examining gender, age, race/ethnicity, and disability status homophily for youth across the education context. Additionally, I include research concerning all youth in high schools for gender, age, and race/ethnicity homophily due to the lack of available research concerning youth with disabilities in high schools in particular.

Youth with disabilities from early childhood through middle school are more likely to form ties with same-gendered rather than cross-gendered peers (Chen, Lin, Justice, & Sawyer, 2018; Farmer, Stuart, Lorch, & Fields, 1993; Kasari et al., 2011; Wiener & Schneider, 2002). Among a sample of children aged three to five years old in early childhood classrooms, children with disabilities were more likely to form play network ties with peers of the same gender (Chen et al., 2018). Chen and colleagues

(2018) identified the tendency toward gender homophily in play networks not only for children with disabilities, but also children without disabilities. Similarly, Kasari and colleagues (2011) found similar rates of gender homophily in the classroom friendship networks of youth with autism spectrum disorders (ASD) and their typically developing peers in grades 1-5. Weiner and Schneider (2002) also identified gender homophily at similar rates for the friendship networks of youth with and without learning disabilities (LD) in elementary and middle schools. Widening the focus of friendship networks to clusters of friendship ties, Farmer and colleagues (1993) identified gender homophily in the classroom social groups of 10-13 year old youth with emotional and behavioral disorders (EBD) in residential schools. Researchers consistently identify gender homophily in the social networks of youth with disabilities through middle school in both inclusive and self-contained settings. Youth with disabilities appear to be influenced by gender homophily at rates similar to their peers without disabilities. Unfortunately, no research has investigated gender homophily among adolescents with disabilities in high schools, but research concerning the total student population may apply.

Adolescents in high schools are also more likely to hold reciprocated friendships with same-gendered rather than cross-gendered peers (Goodreau, 2009). McFarland and colleagues (2014) identified gender homophily in the schoolwide friendship networks of adolescents in middle and high schools using data from the National Longitudinal Study of Adolescent Health (Add Health). In both their cross-sectional and longitudinal models of friendship ties, gender homophily was a significant predictor of friendship ties after controlling for homophily on other demographic characteristics and network processes indicating that adolescents are more likely to have friendships with other students of the

same gender and to form friendships with same gendered peers. McFarland and colleagues (2014) also acknowledged, however, that adolescents in high schools are often less impacted by gender homophily than are adolescents during middle school. This decrease in gender homophily may be due the increase in romantic relationships among adolescents during high school (Prinstein & Giletta, 2016). Similar patterns of gender homophily may also exist for adolescents with disabilities, but such patterns have yet to be studied.

Youth with disabilities have a tendency to form ties with peers of the same age (Farmer et al., 1993; Freeman & Kasari, 2002), but may form ties with younger students at higher rates than their peers without disabilities (Weiner & Schneider, 2002). Freeman and Kasari (2002) found that children aged 5-11 with Down Syndrome involved in a play date study were more likely to bring friends who were the same age to participate. Similarly, Farmer and colleagues (1993) examined the classroom social groups of youth aged 10-13 with EBD in residential schools and found that these youth were more likely to be a part of same-age than cross-age social groups even in age heterogenous classrooms. Weiner and Schneider (2002) found that youth with LD in elementary and middle schools largely had friends who were the same age, but also had significantly more friends who were younger in comparison to peers without disabilities. The friendship ties of youth with disabilities are likely affected by age homophily, but those effects may be weaker in comparison to peers without disabilities.

Research has yet to examine the effect of age homophily on the friendship ties of adolescents with disabilities in high schools. McFarland and colleagues (2014) also identified age homophily in their cross-sectional and longitudinal models. However, they

identified that the age homophily effect is significantly dampened in high schools. They suggest that, similar to gender homophily, the differences in age homophily for adolescents in middle schools and high schools can be attributed to the formation of romantic relationships that span age groups. Other explanations include the age-grouped nature of classes in earlier grades in comparison to high school classes (McPherson et al., 2001). Given previous findings that youth with disabilities in elementary and middle schools, and youth without disabilities in high schools, may be less affected by age homophily, evaluating the effect of age homophily on the friendship ties of youth with disabilities in high schools is a significant gap in the literature.

Little is known about the degree to which racial/ethnic homophily affects the friendship tie formation of youth with disabilities. For example, in the Freeman and Kasari (2002) study of the play networks of children with Down Syndrome, children in the study often brought friends who matched their race/ethnicity. In contrast, Chen and colleagues (2018) examined the play networks of children with disabilities aged 2-5 and found no significant effect of minority/majority homophily on tie formation. Results from McFarland and colleagues (2014) also suggested that racial/ethnic homophily significantly affected initial friendship ties as well as those that formed during the school year. The effect of racial/ethnic homophily was strongest for adolescents in high schools in comparison to middle schools. Thus, while research suggests that adolescents' friendship ties may be affected by racial/ethnic homophily, there is a significant gap in the literature concerning adolescents with disabilities.

Disability status, or category, may also play an important role in the formation of ties for youth with disabilities from early childhood through high school. In the Chen and

colleagues (2018) study of inclusive preschool classrooms with children with disabilities, the researchers found a significant effect of disability homophily on play network ties. Children in their sample were more likely to form play groups with other children with the same rather than a different disability status. Youth with learning disabilities in general education classrooms in elementary and middle schools have also been shown to have more friends with learning disabilities or learning challenges in comparison to peers without disabilities (Estell et al., 2009; Weiner & Schneider, 2002). Locke and colleagues (2010) examined the social ties of seven adolescents with ASD and 13 typically developing peers in an inclusive high school drama class and found that adolescents with ASD exclusively connected to peers with ASD.

Homophily on the basis of demographic characteristics are important components in a robust model of predictors of friendship for youth with disabilities. Gender, age, and race/ethnicity homophily appear to uniquely contribute to friendship ties in research on adolescents, even when controlling for propinquity, academic achievement homophily, and network processes. Each of these dimensions has important social salience. However their effects are not necessarily additive. Block and Grund (2014) found that having more than one attribute in common did not significantly increase the likelihood of forming a social relationship (i.e., individuals would significantly limit their available tie pool if they were to exclude all actors who were unlike them). Thus, each of these dimensions should be evaluated as singular effects in a comprehensive model for youth with disabilities in high school settings.

Homophily on the basis of skills, behaviors, and interests. Homophily also arises for a range of skills, behaviors, and interests that are most salient in a given

context. Among youth with disabilities, scholars have examined prosocial and antisocial behavior homophily, social and recreational interest homophily, and functional and communication skill homophily. However, these dimensions are not an exhaustive list of those that may induce homophily. Literature available on youth in schools suggests that academic achievement is an important dimension to consider when evaluating homophily, although the available evidence regarding academic achievement homophily among youth with disabilities is limited.

Pearl and colleagues (1998) examined the social groups and behavioral characteristics of children with disabilities in general education elementary classrooms. Their findings suggested that children with disabilities were more likely to associate with peers with similar prosocial or antisocial behavior ratings. These findings are consistent with other research in education which suggests similar rates of aggressive behavior among friends (Gifford-Smith & Brownell, 2003).

Shared social and recreational interests may support the development of friendship ties for adolescents with disabilities. One study of youth with EBD, aged 10-13, who were attending residential day schools indicated that students with disabilities were more likely to be a part of social groups with other youth who engage in similar activities (Farmer et al., 1993). These youth engaged in unstructured activities together during the school day, which may indicate a propinquity effect as conceptualized by Feld (1981). Additionally, qualitative research with adolescents with ASD suggests similar interests and activities are important dimensions for selecting peers for social interventions (Bottema-Beutel et al., 2016).

Functional and communication skills may support the initiation and maintenance of friendships, but sharing similar skill levels may not be a predictor of friendship ties. Research examining the social participation of adolescents with ASD using data from the National Longitudinal Transition Study 2 suggests that functional and communication skills are important predictors of social participation (Liptak, Kennedy, & Dosa, 2011; Orsmond, Shattuck, Cooper, Sterzing, & Anderson, 2013). However, this research examined the effect of these skills on the frequency of social participation (e.g., phone calls, getting together with friends) rather than on friendship networks. In contrast, Rossetti and Keenan (2018) have argued that friendships arise regardless of functional, social, or communication skill differences between youth with and without disabilities.

An additional predictor of friendship ties for youth with disabilities in schools may be academic achievement homophily. School-based research on the social networks of youth without disabilities indicates that students are more likely to form friendships with peers with similar levels of academic achievement (Gifford-Smith & Brownell, 2003; Kupersmidt et al., 1995; McFarland et al., 2014). For example, McFarland and colleagues' (2014) work has shown that GPA homophily significantly affects initial friendship formation among adolescents in both middle and high schools. Thus, although research on the relationship between academic achievement and friendship formation among students with disabilities is limited, it may be particularly important to study the degree to which academic achievement constrains friendship opportunities in this population.

Contextual factors. Dimensions of the school context can directly affect the formation of friendship ties for youth with disabilities. School context has also been

shown to moderate the effects of homophily, propinquity, and network processes on the friendships of youth with disabilities. For example, course scheduling may affect propinquity or wider potential tie pools that provide more opportunities for friendship ties. Contextual factors at the school level, including size, population, and climate of a school have also been shown to amplify or dampen the effects of dyadic or network factors on friendship ties (Goodreau, 2009; McFarland et al., 2014). As with other work, however, the bulk of these findings have been demonstrated with samples of youth without disabilities and little is known about how contextual factors affect tie formation among youth with disabilities. One exception is a literature review by Rossetti and Keenan (2018) which found that many friendships of youth with severe disabilities arose after these youth spent time together in inclusive and self-contained classrooms and/or engaging in shared activities. Similar findings were reported by Freeman and Kasari (2002) who found that reciprocated friendships of children with Down Syndrome were more likely to occur for friends who were in the same classroom. These findings suggest that engagement in joint activities may affect the formation of friendships among youth with disabilities.

Research with the general student population points to the same effect of propinquity for adolescents, though the effect may be strongest during elementary school where students often share the same classroom for most of the school day (Cairns et al., 1998). Among older students, the likelihood of friendship ties may be affected by repeated interactions in high school classrooms along with shared opportunities to spend time in other activities such as after-school programs and club participation (McFarland et al., 2014). Similarly, research conducted with German and Dutch adolescents suggests

that living in the same neighborhood increases the likelihood of friendship (Kruse et al., 2016). Together, these findings suggest that classroom, activity, and neighborhood propinquity all potentially influence friendship ties. Thus, an analysis of friendship ties among adolescents with disabilities should include similar constructs.

Inclusion, or spending the majority of the school day in a general education classroom, may be a particularly salient setting construct to study for youth with disabilities. Inclusion in a general education classroom offers an expanded tie pool of youth with and without disabilities in comparison to more restrictive settings (e.g., resource classroom, self-contained classroom). In their examination of the ego networks of adolescents with disabilities in high schools, Fisher and Shogren (2016) found that adolescents in more inclusive settings endorsed more friendships overall. However, Fisher and Shogren did not specifically test whether or not these friendships were the direct result of the inclusive setting. Despite this limitation, their findings did indicate that inclusion and friendship were associated, so additional research on inclusion and friendship formation is warranted.

An additional gap in the literature evaluating friendship ties for youth with disabilities is the use of contextual measures as moderators of effects. Education research suggests that school size, population diversity, the availability of school sponsored activities, and average academic achievement can all influence the effects of homophily, propinquity, and network processes (Goodreau, 2009; McFarland et al., 2014). Larger schools lead to an increased effect of homophily on the basis of demographic characteristics, propinquity from school sponsored activities, and network properties (McFarland et al., 2014). Due to a wider tie pool in larger schools, exclusionary behavior

does not have a high cost and actors are able to restrict their ties to those who are demographically similar and form tighter social groups. Schools that are more racially and ethnically diverse are more racially and ethnically homophilous, and form more clustered and more hierarchical social networks (Goodreau, 2009; McFarland et al., 2014). The larger available tie pool of same race/ethnicity actors allows for more exclusionary behavior and segregation in the network.

Although the effects of size and population diversity serve to magnify effects, the number of school sponsored activities and average academic achievement can magnify and dampen effects. For example, McFarland and colleagues (2014) found that as schools offered more activities, reciprocity and transitivity increased due to youth choosing more identity-related groups. An increase in school sponsored activities can also lead to an increase in age homophily, due to the age segmentation found in many activities (e.g., freshman basketball). In contrast, offering a greater number of school sponsored activities appears to reduce gender homophily due to the availability of cross-gender groups (e.g., band). Furthermore, in schools with higher average GPA, preferences for similarly achieving and age peers increases whereas racial homophily decreases. McFarland and colleagues (2014) suggest that climates of academic success may increase the salience of school group identity and thus decrease the focus on external identities. Although a climate of academic success appears to increase ties to demographically diverse peers, it may also serve to stifle ties between youth with and without disabilities if they differ significantly on academic skill levels. However, such interactions have not yet been empirically verified among adolescents with disabilities.

Network properties. There is some evidence to suggest that endogenous network processes, including reciprocity, transitivity, and preferential attachment, impact the friendship ties of youth with disabilities. Children with ASD in elementary schools are less likely than typically developing peers to have friendship ties reciprocated (Chamberlain, Kasari, & Rotheram-Fuller, 2007; Kasari et al., 2011; Rotheram-Fuller et al., 2010). The decreased likelihood to have friendship ties reciprocated may be an indicator that disability status may moderate the effects of reciprocity in schoolwide networks of youth with and without disabilities. Within schoolwide networks of adolescents, reciprocity significantly predicts current friendship ties, and those formed over the course of an academic year (McFarland et al., 2014). Interestingly, these effects were stronger for adolescents in high schools in comparison to middle schools. Even if significant differences exist between adolescents with and without disabilities, it is likely reciprocity plays a role in the overall network context.

Youth with disabilities may also be impacted by transitivity, or the increased likelihood for actors to become friends when they have a mutual friend in common. In the play networks of children aged 2-5 with and without disabilities in inclusive preschool classrooms, transitivity as measured by multiple two-paths (i.e., geometrically weighted dyad-wise shared partnerships, or GWDSP) and triad closure (geometrically weighted edgewise shared partnerships, or GWESP) significantly predicted ties between children (Chen et al., 2018). These results are consistent with research on the networks of adolescents, which indicates that transitivity, measured by triad closure (GWESP), significantly predicts friendship ties in a school network (McFarland et al., 2014).

Together, these results suggest that transitivity is an important predictor to investigate for friendship networks among adolescents with and without disabilities.

While preferential attachment affects friendship ties among adolescents in high school, there is a current gap in the literature regarding preferential attachment among adolescents with disabilities. McFarland and colleagues (2014) examined hierarchy, as measured by a hierarchical triad tau score, where triads with actors endorsing friendships "up" a hierarchy were measured. These triad configurations exhibited hierarchy because actors endorsed friendships with those who had higher status from received ties and only reciprocated ties with actors with similar patterns of ties. These results suggest that hierarchy predicts existing friendship ties and the formation of friendships across an academic year. McFarland and colleagues also observed that the effect of hierarchy was greater in high schools than in middle schools. Similar patterns of friendship ties may impact the networks of adolescents with disabilities, however, some adolescents with disabilities are acutely aware of power imbalances and may avoid potential ties that may lead to feeling vulnerable or fearing exploitation (Eisenman et al., 2017).

Summary & Research Questions

Social network analysis provides the theoretical framework for understanding the complex mechanism that influence patterns of friendship ties in schoolwide networks. This framework accounts for the interdependence of ties, the active influence of the total network, and recognizes networks as dynamic rather than static entities (Cairns et al., 1998). Theories of networks including reciprocity, transitivity, preferential attachment, homophily, and propinquity are particularly valuable for understanding the friendship ties of youth in schools. Evidence focused on youth with disabilities as well as research on all

youth in a school suggests that dyadic, contextual, and network factors affect schoolwide friendship ties. A comprehensive predictive model of friendship among adolescents with disabilities should examine demographic homophily (i.e., gender, age, race/ethnicity, disability), skill, behavior, and interest homophily (i.e., prosocial and antisocial behavior, recreational and social interest, academic achievement), contextual factors (i.e., propinquity, inclusion, school size, population diversity, number of school sponsored activities available, average academic achievement), and network processes (i.e., reciprocity, transitivity, hierarchy).

Based on the (a) strength of the research related to dyadic, contextual, and network factors that influence the maintenance and formation of friendship ties among youth in high schools as a whole and (b) lack of research on the predictors of friendship ties for youth with disabilities in high schools, this study examines the effects of dyadic, contextual, and network factors on the maintenance and formation of friendship ties among youth with and without disabilities in high school settings. This study will use stochastic-actor oriented models (SAOMs) to address the following research questions:

1. What are the effects of dyadic, contextual, and network factors on the maintenance and formation of friendships across one academic year among youth with and without disabilities during high school?
2. Does disability status moderate the relationship between friendship tie maintenance and formation and dyadic, contextual, and network factors?

CHAPTER III

METHODS

Overview of Methodology

There are several inherent challenges associated with the statistical analysis of social network generation including the interdependence of ties within a larger network. Several models have been developed to address these concerns including the exponential random graph model (ERGM; Lusher, Koskinen, & Robins, 2013) and the stochastic actor-oriented model (SAOM; Snijders, 2001; Snijders, 2005). The ERGM is a probability model for networks where dependence between ties is captured by local configurations (Robins, Snijders, Wang, Handcock, & Pattison, 2007). The SAOM is a probability model for network changes in continuous time where network data is available at discrete time points and dependence between ties is modeled by actors' choices to embed themselves in local configurations. Block, Stadfeld, and Snijders (2019) argue that SAOMs are more appropriate than ERGMs for the analysis of networks comprised of social actors who have agency in their friendship ties and likely evaluate the tradeoffs of making friendship selections. For the current study, which involves the analysis of networks comprised of youth in schools, I will use the SAOM.

The SAOM is a social network analytic method well-suited to explore the impact of individual, dyadic, contextual, and network factors as predictors of friendship tie formation because they take an actor-based approach to identifying network mechanisms, they are flexible enough to include a variety of mechanisms, and the estimation and testing procedures control for the simultaneous operation of mechanisms (Snijders et al., 2010). Mechanisms can be constant (e.g., race/ethnicity, gender) or time-varying (e.g.,

sport participation). The SAOM evaluates all relationships in a single network and provides estimations of the factors that impact the changes to the network conditioned on the first observed network. When models are consistent across multiple schools, parameters derived from single networks can be evaluated using meta-analytic methods to identify a generalized model and assess the effects of network level factors (An, 2015).

Assumptions. As reported by Snijders and colleagues (2010), there are key underlying assumptions for SAOMs. The first assumption is that network ties should be considered "states" that endure over time rather than brief events. Ties that reasonably meet this assumption include those which gradually change, including friendship, romantic relationships, collaboration, etc. In contrast, ties that represent brief events or discrete behaviors do not meet this assumption (e.g., telephone calls, observations of play behavior, social interaction, etc.).

A second assumption of SAOMs is that changes in the network are estimated as the outcome of a Markov process which means that the current *state* of the network determines its future changes probabilistically. To meet this assumption, all relevant information must be contained within the current state and independent variables that control for past influence should be included in the model (e.g., neighborhood, grade level).

A third assumption of SAOMs is that *time* is continuous despite limited observations at discrete time points, called "network panel waves". The dependencies between ties are a result of processes where changes in the network occur one tie at a time and in reaction to the existence of other ties. For example, a triangle that exists at

time one, but not at time two, does not instantaneously disappear, but rather ties are removed step-by-step.

A fourth assumption is that only one probabilistically selected actor may change a single outgoing tie at any given time. Tie changes are uncoordinated and sequentially dependent based on the change to the whole network.

A fifth assumption of SAOMs is that actors have *agency* to send ties to other actors. Actors choose to change outgoing ties based on their attributes, other actors' attributes, their network position, and their perceptions about the network. Tie changes cannot be coordinated between actors but can change sequentially. Ties that represent joint action or coordination (e.g., group membership, co-attendance) do not meet this assumption.

Change process. According to Snijders and colleagues (2010), the process of change in the network is due to two distinct sub-processes that are stochastic, or random. The first process is the change opportunity process which models the frequency of actors' tie changes. Only one actor at a time has the opportunity to make a change to add or withdraw a sent tie, or do nothing and maintain all existing ties. The rates at which actors change is either random or depends on network positions and covariates (e.g., grade, disability status) of actors as specified by the researcher. The second process is the change determination process which models precise tie changes when actors have the opportunity to change ties. Probabilities depend on network positions and covariates of the actor making a change and all other actors in the network as specified in the objective function. The objective function expresses how probable it is for actors to change their networks in particular ways, or the "rules for network behavior". It is the core of the

model and should represent the research questions, and relevant theory and empirical knowledge.

Estimation. Parameters of the modeled effects in the objective function are estimated from the observed data. Method of moments (MoM) implemented by computer simulation is used for estimating parameters because stochastic models such as these, are too complex for other estimation methods (e.g., maximum likelihood; Snijders, 2001). Change between network panel waves is modeled, and no inferences can be made about the initial network structure (Snijders et al., 2010). However, recent research has used SAOMs to model cross-sectional data, though publication is rare (Block et al., 2019).

Extant Data Source

The National Longitudinal Study of Adolescent to Adult Health (Add Health) is a nationally representative longitudinal study of adolescents in grades 7 through 12 in the United States that was originally designed to examine how social environments and behaviors led to health and achievement outcomes. The original sampling frame included 80 high schools stratified by region, urbanicity, school type, ethnic diversity, and size. High schools were eligible for participation if they included an 11^{th} grade and had more than 30 students enrolled. Participating high schools that did not span grades 7-12 identified feeder schools with a 7^{th} grade who sent at least five graduates to the high school. Researchers selected one feeder school with probability proportional to the number of students who attended the high school. The final sample included a single school or pair of schools for 80 distinct communities.

In the current study, I used self-, parent-, and interviewer-reported data from Waves I and II collected via an in-school questionnaire and in-home interviews. During

Wave I, more than 90,000 students in the 80 communities completed the in-school questionnaire between September 1994 and April 1995. In-home interviews were conducted with approximately 20,000 students and 17,000 parents during Wave I between April and August 1995. Follow-up in-home interviews were conducted with approximately 15,000 students during Wave II between April and August 1996.

The Adolescent Health and Academic Achievement Study (AHAA) expands Add Health to include additional data on academic progress and high school course curriculum for Add Health participants during Wave III. Respondents were asked to sign a Transcript Release Form allowing Add Health researchers to request high school transcripts. Approximately 12,000 (91%) respondents at Wave III signed the release. In this study, I used transcript data for the 1994-1995 school year matching Wave I data. Transcript data were obtained for respondents from 78 of the original 80 Add Health schools. Two of the Add Health schools, which were separate special education schools, had no data derived from transcripts because they did not maintain transcript records.

Study Sample

The Add Health research team selected each youth enrolled in sixteen schools for in-home interviews at Waves I and II to enable the analysis of social networks. This "saturation sample" is a subset of the larger, more representative, sample and includes two large schools and fourteen smaller schools. Saturation sample schools completed the Wave I in-school questionnaire during October and November 1994, and youth and their parents participated in Wave I in-home interviews between April and August 1995. Consistent with previous longitudinal studies of social networks using Add Health data, I

used the saturation sample for the analyses in this study (e.g., Aronson, 2016; Haynie, Doogan, & Soller, 2014; McFarland et al., 2014).

The personal characteristics of respondents from the saturation sample are generally comparable to the full Add Health sample (Haynie, 2002). The saturation sample of high schools at Wave I includes 3,702 respondents, 113 (3.05%) respondents did not have valid identification numbers to combine their data or identify their longitudinal friendship ties and were excluded from the sample. I analyzed social network data at the high school level only to account for factors derived from transcript data that is only available for grades 9-12. A total of 616 respondents were in seventh or eighth grade and were removed from the sample. The final sample for the analyses includes 2,973 students across ten saturation schools with grades 9-12. The schools included two large public high schools often referred to as Sunshine high school and Jefferson high school in prior research, seven smaller private and public schools with grades 7-12, and one special education school serving grades beyond 7-12. Descriptive statistics for the sample are reported by school in Table 1. All missing network data during Wave I in-home interviews (n = 687, 23%) was handled using the MoM procedure, a model-based hybrid imputation procedure (Huisman & Steglich, 2008). Summaries of missing tie data are reported by school in Table 1.

Measures

Dependent variable. In-school friendship tie changes served as the dependent variable for all analyses. During Wave I, in-school questionnaires (!") and in-home interviews (!#) measured "ties" using friendship nominations for up to five closest male and five closest female friends. Each respondent listed up to ten friends in total. At !#, the

tie nomination procedure was changed for 313 (11%) respondents who were asked to nominate only one male and one female friend. An ego effect was included for one nomination to control for this change in procedures. Only friendship ties between youth in the same school and within grades 9-12 were included and friendship ties to individuals not on the same school roster or in seventh or eighth grade were removed. The number of friends nominated was consistent with friendship studies of best- or close-friends that often range from three to ten friends. A greater number of nominations ensures fewer individuals are excluded and the sample is more representative of the actual network (Berndt & McCandless, 2009). Additionally, the validity of self-reported peer interactions likely increases as age increases because peer interactions occur more often outside the view of adults as youth get older and youth and peers may be the best source of information about social interactions and their own friendships (Berndt & McCandless, 2009; Fabes, Martin, & Hanish, 2009).

Covariate effects. Covariate effects refer to explanatory variables included in SAOMs that are separate from endogenous network effects. In the current study, covariate effects for demographic characteristics, behaviors, skills, and contextual factors were included. All Add Health survey and interview items used and their respective response options from the Add Health codebooks are presented in the Appendix.

Table 1

Descriptive Statistics for Add Health Sample by School

	Sunshine	Jefferson	School 1	School 2	School 3	School 7	School 8	School 28	School 81	School 88
Sample characteristics										
n	1673	757	27	43	73	124	78	73	73	49
Female	800 (48%)	366 (48%)	14 (52%)	22 (51%)	34 (47%)	63 (51%)	39 (50%)	49 (67%)	38 (52%)	23 (47%)
Race/Ethnicity										
White	66 (4%)	656 (87%)	14 (52%)	37 (86%)	68 (93%)	116 (94%)	61 (78%)	32 (44%)	66 (90%)	40 (82%)
Black	313 (19%)	-	-	-	-	-	-	24 (33%)	-	-
Hispanic	667 (40%)	21 (3%)	10 (37%)	-	-	3 (2%)	3 (4%)	8 (11%)	-	-
Asian	488 (29%)	4 (<1%)	-	-	-	-	-	-	-	-
Other	117 (7%)	56 (7%)	-	4 (9%)	4 (5%)	-	6 (8%)	6 (8%)	6 (8%)	8 (16%)
Disability	86 (5%)	74 (10%)	27 (100%)	6 (14%)	6 (8%)	9 (7%)	12 (15%)	-	3 (4%)	5 (10%)
Grade	10.90 (0.80)	10.30 (1.08)	10.29 (1.19)	10.12 (1.03)	10.51 (1.19)	10.39 (1.19)	10.51 (1.14)	10.24 (1.22)	10.33 (1.07)	10.27 (1.08)
GPA	2.52 (0.84)	2.60 (0.83)	3.20 (0.87)	3.17 (0.77)	2.75 (0.79)	2.97 (0.76)	2.70 (0.73)	3.38 (0.52)	3.04 (0.72)	2.90 (0.68)
AHPVT	92.07 (13.66)	105.12 (11.79)	79.61 (17.76)	109.61 (10.75)	104.19 (12.24)	99.35 (12.71)	105.27 (11.64)	107.12 (10.42)	107.38 (11.72)	105.33 (10.79)
Soc. functioning teach	1.15 (1.41)	1.08 (1.20)	0.38 (0.90)	1.05 (1.17)	1.11 (1.09)	0.85 (1.23)	1.38 (1.32)	0.91 (1.09)	0.84 (1.00)	1.29 (1.37)
Soc. functioning peer	1.65 (1.63)	1.35 (1.37)	0.48 (1.09)	1.12 (1.12)	1.33 (1.32)	1.19 (1.36)	1.80 (1.48)	1.37 (1.30)	1.15 (1.17)	1.31 (1.34)
Av. activities	1.42 (2.31)	2.13 (2.05)	1.52 (2.91)	2.93 (2.04)	3.10 (2.97)	2.24 (1.54)	3.12 (2.72)	3.47 (2.13)	2.04 (2.09)	3.04 (2.30)
Context characteristics										
Size	2104	1024	121	85	178	181	133	193	135	102
Racial heterogeneity	0.70	0.23	0.59	0.27	0.14	0.14	0.31	0.68	0.32	0.31
Disability heterogeneity	0.10	0.18	0.00	0.24	0.15	0.13	0.26	0.05	0.08	0.18
Number of activities	40	40	24	27	29	28	27	27	26	22
Network characteristics										
Jaccard index	0.19	0.26	0.04	0.28	0.12	0.20	0.17	0.20	0.21	0.26
Average degree t_1	2.74	5.24	3.19	4.26	2.90	5.82	2.87	3.14	3.62	4.76
Average degree t_2	2.01	3.95	0.42	2.46	0.54	2.18	2.29	1.67	1.73	3.26
Missing network ties t_2	25%	18%	30%	23%	32%	21%	28%	14%	23%	14%
One nomination	70 (4%)	36 (5%)	8 (30%)	17 (40%)	50 (68%)	52 (42%)	26 (33%)	14 (19%)	29 (40%)	11 (22%)

Note. GPA = grade point average. AHPVT = Adolescent Health Picture Vocabulary Test.

Demographic characteristics were measured using self-reported race/ethnicity, gender, and grade via the in-school questionnaire at Wave I. Respondents were able to choose multiple racial and ethnic backgrounds. The Add Health Network Variables conventions for defining race/ethnicity categories were applied and included: white (i.e., only endorsed white), Black (i.e., only endorsed Black), Hispanic (i.e., endorsed Hispanic background regardless of additional categories), Asian (i.e., only endorsed Asian), and other (i.e., all other responses including multiple backgrounds except Hispanic).

Disability status represented a combination of indictors of disability from the in-home interview at Wave I and Wave II. These indicators helped identify youth with disabilities as comprehensively as possible. During Waves I and II, interviewers administering the in-home interview reported if the youth respondent appeared or indicated that they were blind, deaf, or had a physical disability. While the use of interviewer perceptions of disability may lead to misidentification, no other data were collected regarding deafness and blindness. Additionally, parents reported if their youth had an intellectual, learning, or physical disability and if the youth received special education services in the past 12 months during Wave I in-home interviews. In the current study, youth with disabilities included youth respondents who were either (a) identified by the interviewer as deaf, blind, or as having a physical disability, (b) identified by their parent as having an intellectual, learning, or physical disability, or (c) were reported to be receiving special education services during the past 12 months.

Measures of social functioning, verbal ability, and academic achievement were included to evaluate the effects of behavior and skill homophily. *School social functioning* served as an indicator for social behavior. On the Wave I in-school

questionnaire, respondents were asked how often they had trouble getting along with teachers and students since the school year began in two separate items. Respondents provided frequency ratings on a five-point scale from 0 "never" to 4 "everyday." In this study, the items remained separate indicators and multicollinearity for each model was evaluated by assessing the covariance matrices of estimates. *Verbal ability* was measured during the Wave I in-home interview using the Adolescent Health Picture Vocabulary Test (AHPVT), an adapted version of the Peabody Picture Vocabulary Test (PPVT). The AHPVT included half the items from the PPVT, including odd numbered items from items 1-87 and even numbered items from items 90-175. The Add Health research team standardized scores by age, with a mean of 100 and a standard deviation of 15. *Academic achievement* was measured using the average GPA derived from AHAA transcript data for the 1994-1995 school year that matched the time period of Wave I or self-reported grades on the Wave I in-school questionnaire when transcript data were unavailable.

To evaluate contextual factors, measures of neighborhood, shared activities, and shared courses were included. *Neighborhood* was measured using the neighborhood group determined by the Add Health research team. Add Health researchers identified each respondent's home address during the Wave I in-home interview and derived neighborhood groupings from the addresses. *Shared activities* were measured using a matrix of the number of shared school activities between each unique pair of respondents collected during the Wave I in-school questionnaire. For the current study, a matrix was created from a series of items which asked each respondent to identify the school clubs and activities they had participated in during the 1994-1995 academic year. *Shared course-taking* was measured by using a matrix of the number of shared courses between

each unique pair of respondents during the 1994-1995 school year. This matrix was derived from edgelists created by AHAA researchers from respondents' high school transcript data collected during Wave III.

Endogenous network effects. Endogenous network effects reflected the processes discussed in the literature review, as well as a basic effect that served as the intercept for extending friendship ties. *Outdegree* is the basic effect included in every SAOM to account for the probability that actors send ties (Snijders et al., 2010). Within SAOMs in particular, this effect represents the costs and benefits of sending a random tie. Outdegree was measured for each actor as the total number of sent ties, or the total number of in-school friends a respondent nominated. *Reciprocity* was calculated as the number of all reciprocated ties of a given actor i, where $i \rightarrow j$ and $j \rightarrow i$.

Transitivity was measured with the GWESP effect where $i \rightarrow j$ is also connected by a two path $i \rightarrow h \rightarrow j$, and is regarded as preferable to the transitive triplets effect (Ripley, Snijders, Boda, Vörös, & Preciado, 2019). The tendency to not reciprocate ties within a transitive triplet was measured by adding the transitive reciprocated triplets effect. Block (2015) suggests using this effect for adolescent friendship networks in place of the three-cycles effect commonly used to identify hierarchy. Block (2015) has argued that the ubiquitous significant negative effect of three-cycles is likely spurious. Furthermore, a significant transitivity effect along with a negative transitive reciprocated triplets effect signifies asymmetry, but it does not necessarily signify hierarchy. However, Aronson (2016) found a significant positive three-cycles effect even after adding the transitive reciprocated triplets effect in his analysis of Add Health data, suggesting that both should be included in models using Add Health data. When combined, the three-

cycles effect is akin to an increased tendency for actors to nominate intermediary ties, where ties between *i*, *j*, and *h* are cyclical.

Preferential attachment was measured using indegree popularity, or the square root of the sum of ties received (i.e., indegrees) by an actor *i*'s nominated ties. Indegree popularity measures whether actors with high indegree are more attractive for others in the network to send a tie to. Beyond the theoretical importance of including preferential attachment, Ripley and colleagues (2019) suggest including at least one effect that represents the dynamics of in- and out-degrees to provide some control for potential exogenous variables that may be omitted. Therefore, outdegree popularity, or the square root of the sum of ties sent (outdegree) by an actor *i*'s nominated ties was also included to help control for omitted variables. Outdegree popularity is a measure of how attractive actors with high outdegree are to others in the network.

School-level contextual factors. School-level factors were included to describe the potential contextual effects identified in social network analysis literature (reported in Table 1). *Size* was measured as the number of students enrolled in the school as reported on the school's roster. *The number of school activities offered* was measured by the total number of school-sponsored clubs, activities, and sports indicated by students on the Wave I in-school questionnaire. *School race and ethnicity heterogeneity* was measured as 1- (∑ squared proportions for each racial and ethnic category) where proportions were calculated from student reported race and ethnicity on the Wave I in-school questionnaire. *School disability heterogeneity* was measured as 1- (∑ squared proportions for each disability status). School proportions for each disability status were calculated from the disability status indicator variable across the school population. *Average GPA*

for each school was measured as the average of all student GPAs for the 1994-1995 school year collected from AHAA transcript data and self-report data from the in-school questionnaire at Wave I.

Data Analysis

I divided the analyses into two steps to identify the predictors and moderating factors of friendship ties across multiple schoolwide networks using the "RSiena" package (Ripley et al., 2019) in R. First, a stochastic actor-oriented model assessing endogenous network and covariate effects was fit (Snijders, 2001; Snijders, 2005) on the friendship network of each school. Second, interaction effects for significant predictors identified in each school SAOM were included to assess whether disability status moderates the predictors of friendship ties.

Modeling network dynamics through SAOM. To evaluate the appropriateness of using SAOM methods with the available data, the Jaccard index, or the stability between each school network at "# and "$ were calculated (Snijders et al., 2010), as measured by

$$\frac{\%_{\#\#}}{\%_{\#\#} + \%_{'\#} + \%_{\#'}}$$

where $\%_{\#\#}$ is the number of ties present at "# and "$, $\%_{'\#}$ is the number of ties created between time points, and $\%_{\#'}$ is the number of ties terminated between time points. Jaccard values of .3 and higher are good and indicate adequate stability for estimation, wheras values less than .2 may affect estimation. If Jaccard values are less than .2 but the values are lower due to either increasing or decreasing ties or the network is very sparse (i.e., average degree less than 2), estimation will not be negatively affected. Jaccard

indexes for schools in the sample ranged from .04 to .28 and are reported by school in Table 1.

Next, the objective, or evaluation, function was included (Snijders, 2001; Ripley et al., 2019). The objective function models the goal of actors when they make a tie change, where the change leads to a more rewarding configuration for themselves in the network

$$()(+, -) = \sum_{25\#}^{4} +_2 3_{)2}(-)$$

where $+_2$ are statistical parameters that indicate the strength of the corresponding effects $3_{)2}(-)$, controlling for all other effects in the model. The $3_{)2}(-)$ are all the relevant factors believed to play a role in the evolution of the network and represent essential aspects of the network from the viewpoint of actor *i* (Snijders, 2017). The objective function included a random component to account for actor drives that were not explicitly modeled.

In each SAOM, the endogenous network effects and covariate effects were modeled first to represent the processes impacting friendship ties identified in the literature review. The endogenous network effects included outdegree, reciprocity, GWESP, transitive reciprocated triplets, three-cycles, indegree popularity, and outdegree popularity. The covariate effects included ego and alter effects for disability status, ego effects for one nomination, covariate identity effects (i.e., homophily for categorical variables) for gender, race/ethnicity, and disability status, covariate-similarity effects (i.e., homophily for interval or ordinal variables) for grade, social functioning, verbal ability, and academic achievement, and selection effects (i.e., propinquity) for

neighborhoods, activities, and courses. The ego and alter effects for disability status measures if actors with disabilities send (ego) or receive (alter) more ties than those without disabilities.

After evaluating the complete model, convergence between the simulated and observed parameters was evaluated using the t-statistic for deviation from targets. Standards suggest convergence is only adequate when the t-statistic values for each parameter are smaller in absolute values than 0.10, and the overall maximum convergence ratio is less than 0.25 (Ripley et al., 2019). Model fit was evaluated using goodness of fit auxiliary statistics which assess the Mahalanobis distance across four statistics: outdegree, indegree, geodesic distance, and triad type.

Next, interaction effects between ego (i.e., focal actor) disability status and significant endogenous network effects and covariate effects were added to the final model. The interaction effects were added to determine whether predictors of friendship ties functioned differently for students with disabilities within each network. Convergence and goodness of fit was evaluated using the t-statistic for deviation from targets and goodness of fit auxiliary statistics.

CHAPTER IV

RESULTS

Descriptive Statistics

Table 1 provides descriptive statistics for network characteristics by school, including Jaccard indexes, average degree for "# and "$, and missing network data. Jaccard indexes for Jefferson, and schools 2, 7, 28, 81, and 88 were above .2 indicating sufficient stability for estimating SAOMs. Jaccard indexes for Sunshine and school 8 were below .2, but greater than .1. Values for these schools were lower largely due to decreasing ties and the networks at "$ were very sparse, or approximately 2 degrees, indicating negative consequences for estimation are unlikely (Ripley et al., 2019). Schools 1 and 3 had very low Jaccard indexes (i.e., .12 or less) indicating insufficient stability for estimating SAOMs. This was confirmed by testing simple models including only network effects that failed to converge (i.e., parameter t-statistic values > |0.10|, overall maximum convergence ratio > 0.25).

The network graphs in Figures 1, 2, and 3 represent the "# and "$ schoolwide friendship networks for Sunshine, Jefferson, and the smaller schools evaluated using SAOMs respectively. Youth with disabilities are represented as red nodes, youth without disabilities are represented as black nodes, and youth with missing disability status are represented as white nodes. Square nodes indicate youth with missing friendship nominations at "$ and circle nodes indicate youth with complete friendship nomination data.

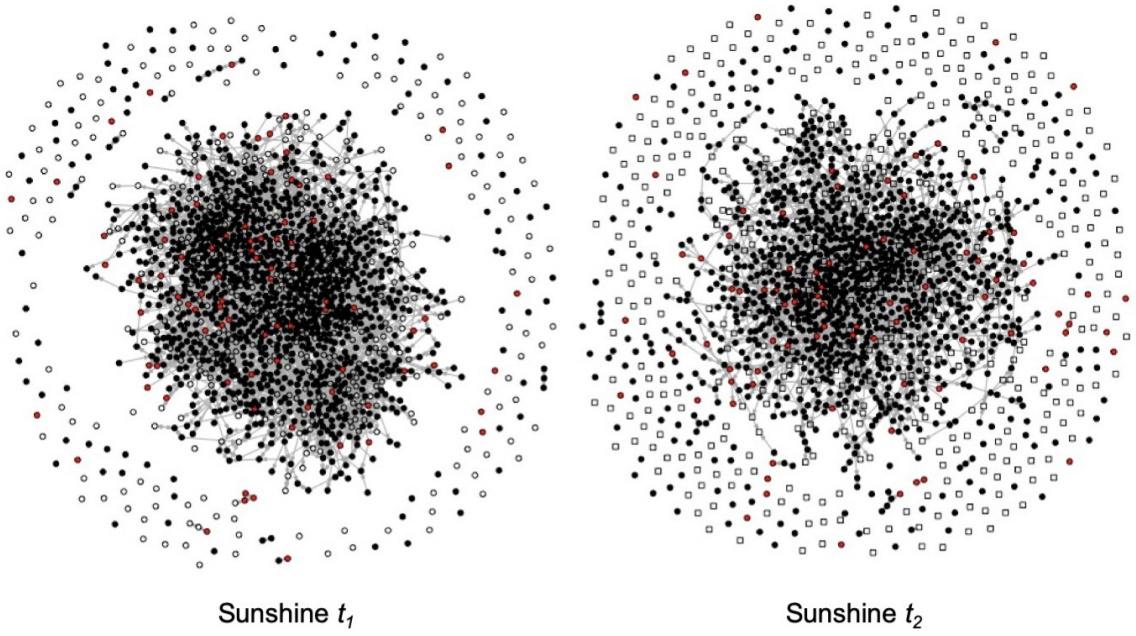

Figure 1. Network Graphs for Sunshine High School at "# and"$.

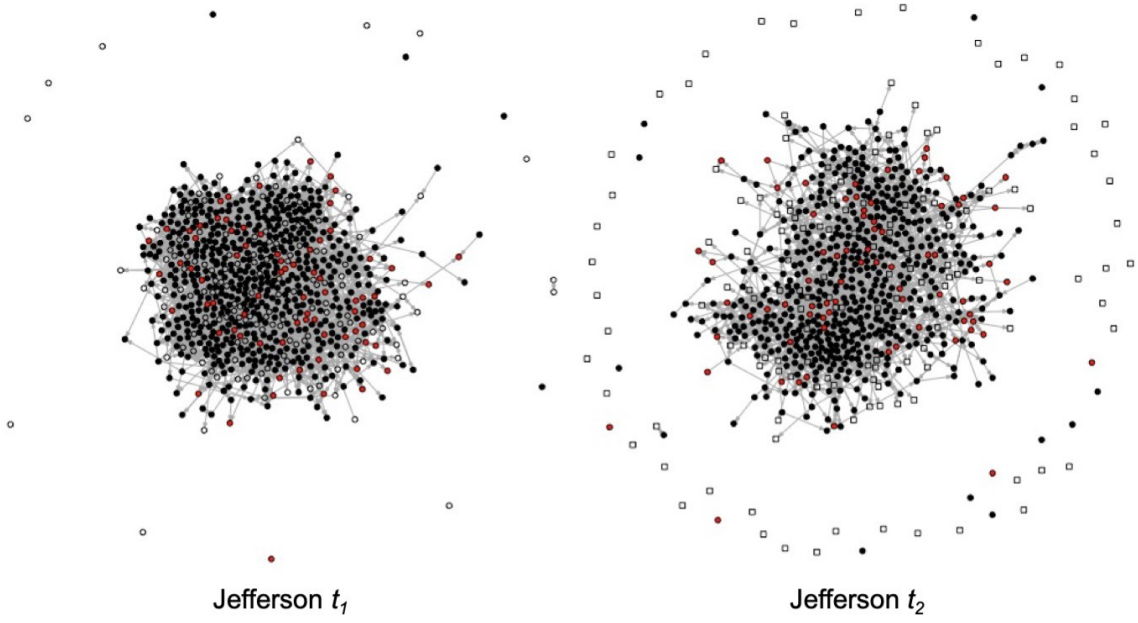

Figure 2. Network Graphs for Jefferson High School at "# and"$.

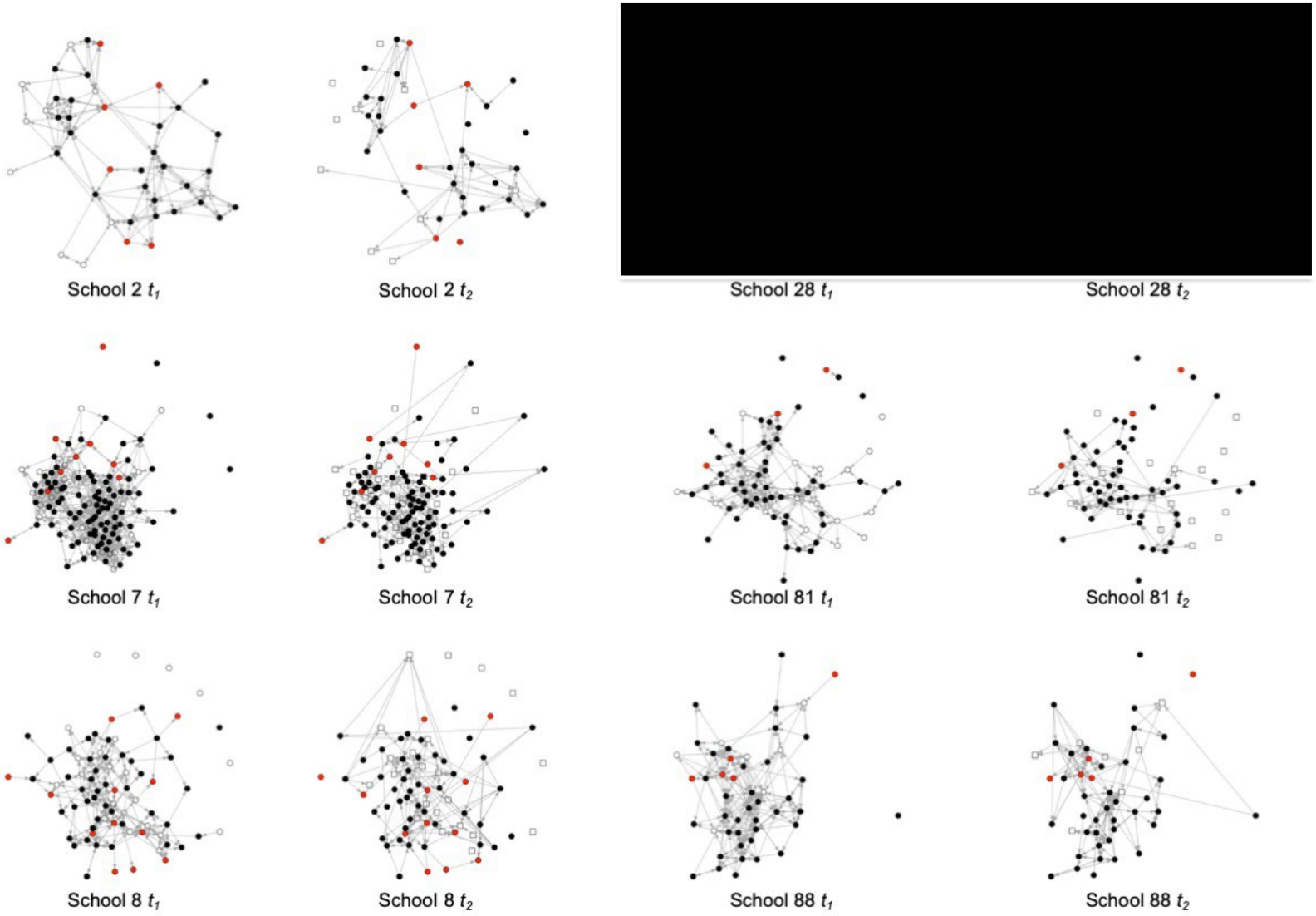

Figure 3. Network Graphs for Schools 2, 7, 8, 28, 81, and 88 at !" and !#.

Many of the youth with disabilities are connected to both youth with and without disabilities, have reciprocal ties, and are embedded in triads. Few youth with disabilities were isolates in their schoolwide friendship networks. Within school 28 all youth with disabilities had an outdegree of 0 at $!^{"}$, indicating they sent no ties. The lack of sent ties for youth with disabilities within school 28 at $!^{"}$ is problematic for SAOM estimation of the effect of ego disability status and ego disability interaction effects on tie maintenance and formation.

SAOM Results

To investigate the predictors of friendship tie maintenance and formation, I included network and covariate effects in the objective function for each school's SAOM. The results of the SAOMs in Sunshine, Jefferson, and schools 2, 7, 8, 28, 81, and 88 are presented in Tables 2 through 9, respectively. Convergence and goodness of fit statistics were assessed.

All parameters in the final model 1 SAOMs had a convergence ratio less than 0.10 in absolute value, and an overall maximum convergence ratio of less than 0.25, indicating adequate convergence. To ensure adequate convergence, some parameters could not be included in model 1 for schools 2, 8, 28, 81, and 88. The transitive reciprocated triplets could not be included for school 2 due to multicollinearity with multiple other effects ($r > .95$). The transitive reciprocated triplets and three-cycles effects could not be included for school 8 because the structures did not exist in the data at $!^{"}$. As previously described, youth with disabilities in School 28 sent no ties at $!^{"}$, which resulted in a high convergence ratio (i.e., $t > .10$) for the ego disability effect and lack of overall maximum convergence for the model (i.e., $t > .25$). I removed the

disability ego effect from the model to ensure convergence. For school 81, the neighborhood propinquity effect could not be included because there were no ties with the same neighborhood at !", and the disability alter effect could not be included due to collinearity with the disability homophily effect (r = .988). The course propinquity effect could not be included in school 88 since course data was only available for four students.

Goodness of fit tests revealed that model fit for indegree, outdegree, geodesic distance, and triad distributions were good for schools 2, 7, 8, 28, 81, and 88, $p > .01$. Jefferson had good model fit for indegree (p = .17), but poor fit for outdegree, geodesic distance, and triad census ($p < .01$). The addition of outdegree activity improved model fit, but no other theoretically important structural terms significantly improved fit. Inspection of the goodness of fit distribution plots and descriptive statistics revealed good fit for outdegrees of 1-5 and 7, outdegree of 0 was overrepresented and outdegrees of 6 and 8 were slightly underrepresented in some of the simulated networks. The observed values were not outside the range of the simulated networks and only slightly outside of the 90% frequency of representation interval. Fit was good for geodesic distances 1 through 3. Distances of 4 and 5 were overrepresented in some of the simulated networks. There were slightly too few triads of type 021D in the simulated networks, and triads of type 201 and 120D were slightly overrepresented in some of the simulated networks, but the number of each triad type in the observed networks was within the range of the simulated networks and only slightly above or below the 90% frequency of representation interval. While fit was not good for outdegree, geodesic distance, and triad type, the differences in the observed and simulated networks were not large and the parameter estimates and standard errors were relatively stable, even within models with worse fit.

Sunshine had poor model fit for indegree, outdegree, geodesic distance, and triad census ($p < .01$). However, inspection of the goodness of fit plots and descriptive statistics revealed good fit for indegrees 3-7, outdegrees 1 and 4-6, good fit for all geodesic distances despite the significant goodness of fit test ($p = .004$), and good fit for all triad types except 111D, 201, and 120D. There were too few indegrees of 0 and 8, and too many indegrees of 1 and 2 in the simulated networks. The observed values for indegrees of 1, 2, and 8 were only slightly outside of the 90% frequency interval and within the range of the simulated networks. There were too few outdegrees of 0, 7, and 8 and too many outdegrees of 2 and 3 in the simulated networks. Outdegrees of 7, 8, and 3 had observed values within the range of the simulated networks and were only slightly outside of the 90% frequency interval. There were slightly too few 111D triads and slightly too many 201 and 120D triads in the simulated networks. The addition of theoretically important structural terms did not yield significantly better fitting models, the differences between the observed and simulated networks were not large, and estimated parameters and standard errors were relatively stable.

Sunshine. The results of the SAOM testing the network and covariate effects for Sunshine high school are presented as model 1 in Table 2. The outdegree effect is akin to the intercept in the model, where the significant negative effect indicates the decreased odds of youth sending random ties within the school network and controls for the density of the network. The significant, positive effect of reciprocity indicates increased odds of youth sending ties to those who nominated the youth as a friend. The transitivity effects GWESP, transitive reciprocated triplets, and three-cycles were significant and indicate increased odds for youth to send ties to those who were friends with their friends,

decreased odds of youth reciprocating ties in triads, and increased odds of youth sending ties to intermediaries in cyclical triads. The significant negative effect of outdegree popularity and positive effect of indegree popularity indicate that youth within the school had decreased odds of sending ties to peers who sent many ties and increased odds of sending ties based on the popularity of their peers.

The covariate effects in model 1 indicate that youth in the school have increased odds of sending ties to peers who have similar grade levels, GPA, and verbal ability, are the same gender, race/ethnicity, are from the same neighborhood, and who they share activities and courses with. The non-significant disability status ego and alter effects indicate that youth with disabilities in the school were no more or less likely to send ties to or receive ties from peers respectively. Additionally, youth with and without disabilities were 1.23 (95% CI 1.10-1.39) times more likely to send ties to peers with the same disability status. Where youth with disabilities were more likely to send ties to peers with disabilities, and youth without disabilities were more likely to send ties to peers without disabilities.

Table 2

Stochastic Actor-Oriented Model of Friendship Ties for Sunshine

Variable	Model 1		Model 2	
	PE	*SE*	*PE*	*SE*
Network effects				
Outdegree	-4.86***	0.10	-4.88***	0.10
Reciprocity	3.13***	0.09	3.12***	0.11
GWESP	2.73***	0.09	2.73***	0.10
Transitive reciprocated triplets	-1.24***	0.10	-1.27***	0.11
Three-cycles	0.66***	0.11	0.73***	0.11
Indegree popularity (sqrt)	0.30***	0.04	0.31***	0.04
Outdegree popularity (sqrt)	-0.71***	0.06	-0.71***	0.07
Covariate effects				
Disability ego	0.16	0.11	-0.08	0.48
Disability alter	0.08	0.09	0.11	0.10
Same disability	0.21***	0.06	0.22***	0.06
Same gender	0.23***	0.04	0.23***	0.03
Same race/ethnicity	0.76***	0.04	0.76***	0.04
Grade similarity	1.12***	0.07	1.12***	0.07
GPA similarity	0.66***	0.11	0.66***	0.12
AHPVT similarity	0.57**	0.20	0.60**	0.21
Social functioning similarity (teacher)	0.04	0.06	0.04	0.06
Social functioning similarity (peer)	0.05	0.05	0.05	0.06
Same neighborhood	0.61***	0.07	0.61***	0.07
Shared activities	0.14***	0.02	0.15***	0.02
Shared courses	0.05***	0.01	0.05***	0.01
One nomination ego	-1.63***	0.32	-1.69***	0.34
Interaction effects				
Ego disability x reciprocity			-0.02	0.54
Ego disability x GWESP			0.26	0.58
Ego disability x trans. recip. triplets			-0.70	0.54
Ego disability x three-cycles			1.47	0.99
Ego disability x indegree popularity			0.22	0.18
Ego disability x outdegree popularity			-0.13	0.31
Ego disability x same gender			-0.04	0.17
Ego disability x same race/ethnicity			-0.11	0.17
Ego disability x grade similarity			-0.42	0.27
Ego disability x GPA similarity			-0.65	0.55
Ego disability x AHPVT similarity			1.64	1.07
Ego disability x same neighborhood			-0.16	0.35
Ego disability x shared activities			0.15	0.18
Ego disability x shared courses			-0.11	0.09

Note. *$p < .05$, **$p < .01$, ***$p < .001$. Parameter estimates are reported as log-odds ratios.

Jefferson. The results of the SAOM testing the network and covariate effects for Jefferson are presented as model 1 in Table 3. The significant, positive effect of reciprocity indicates increased odds of youth sending ties to those who nominated the youth as a friend. The significant transitivity effects of GWESP, transitive reciprocated triplets, and three-cycles indicate increased odds for youth to send ties to those who were friends with their friends, decreased odds of youth reciprocating ties in triplets, and increased odds of youth sending ties to intermediaries in cyclical triads. The significant negative effect of outdegree popularity and positive effect of indegree popularity indicate that youth within the school had decreased odds of sending ties to peers who sent many ties and increased odds of sending ties based on the popularity of their peers.

The covariate effects in model 1 indicate that youth in the school have increased odds of sending ties to peers who had similar grade levels, GPA, and verbal ability, were the same gender, were from the same neighborhood, and who they shared activities and courses with. The disability status degree effects indicate that youth with disabilities in the school were 1.16 (95% CI 1.01-1.33) times more likely to receive ties in comparison to peers without disabilities, but no more or less likely to send ties to peers. Additionally, youth with and without disabilities were 1.19 (95% CI 1.09-1.32) times more likely to send ties to peers with the same disability status.

Table 3

Stochastic Actor-Oriented Model of Friendship Ties for Jefferson

Variable	Model 1		Model 2	
	PE	*SE*	*PE*	*SE*
Network effects				
Outdegree	-3.19***	0.11	-3.21***	0.11
Reciprocity	2.53***	0.10	2.53***	0.08
GWESP	2.03***	0.07	2.04***	0.07
Transitive reciprocated triplets	-0.74***	0.07	-0.74***	0.06
Three-cycles	0.46***	0.06	0.45***	0.06
Indegree popularity (sqrt)	0.16***	0.03	0.16***	0.03
Outdegree popularity (sqrt)	-0.45***	0.05	-0.45***	0.05
Outdegree (activity)	-0.04***	0.01	-0.04***	0.01
Covariate effects				
Disability ego	0.11	0.07	-0.43	0.35
Disability alter	0.15*	0.07	0.15*	0.07
Same disability	0.18***	0.05	0.18**	0.06
Same gender	0.16***	0.04	0.16***	0.04
Same race/ethnicity	0.07	0.05	0.08	0.05
Grade similarity	1.24***	0.07	1.24***	0.08
GPA similarity	0.50***	0.11	0.51***	0.11
AHPVT similarity	0.67***	0.16	0.69***	0.16
Social functioning similarity (teacher)	0.04	0.07	0.04	0.07
Social functioning similarity (peer)	-0.08	0.06	-0.08	0.06
Same neighborhood	0.46***	0.05	0.44***	0.05
Shared activities	0.15***	0.03	0.15***	0.03
Shared courses	0.03**	0.01	0.02	0.01
One nomination ego	-1.68***	0.18	-1.69***	0.19
Interaction effects				
Ego disability x reciprocity			0.08	0.31
Ego disability x GWESP			0.38	0.28
Ego disability x trans. recip. triplets			0.02	0.28
Ego disability x three-cycles			-0.16	0.44
Ego disability x indegree popularity			-0.07	0.14
Ego disability x outdegree popularity			0.26	0.20
Ego disability x same gender			0.38**	0.13
Ego disability x grade similarity			-0.36	0.25
Ego disability x GPA similarity			-0.52	0.35
Ego disability x AHPVT similarity			0.70	0.51
Ego disability x same neighborhood			-0.59**	0.22
Ego disability x shared activities			-0.06	0.11
Ego disability x shared courses			-0.07	0.04

Note. *$p < .05$, **$p < .01$, ***$p < .001$. Parameter estimates are reported as log-odds ratios.

School 2. Model 1 in Table 4 presents the results of the SAOM testing the network and covariate effects in school 2. Within school 2, the reciprocity effect indicates youth had increased odds of sending ties to those who nominated them as a friend and the GWESP effect indicates youth had increased odds of sending ties to friends of friends. However, youth did not have increased or decreased odds of sending ties to peers based on any other network effects.

Table 4

Stochastic Actor-Oriented Model of Friendship Ties for School 2

	Model 1		Model 2	
Variable	*PE*	*SE*	*PE*	*SE*
Network effects				
Outdegree	-5.39***	1.36	-5.47**	1.74
Reciprocity	2.87***	1.07	2.85*	1.33
GWESP	1.87**	0.61	1.93*	0.94
Three-cycles	-1.11	0.61	-1.11	0.83
Indegree popularity (sqrt)	0.23	0.48	0.21	0.56
Outdegree popularity (sqrt)	0.26	0.52	0.30	0.58
Covariate effects				
Disability ego	0.80	0.54	1.26	2.23
Disability alter	0.02	0.57	0.06	0.68
Same disability	-0.04	0.57	0.00	0.63
Same gender	-0.97*	0.43	-1.00*	0.49
Same race/ethnicity	0.47	0.42	0.44	0.45
Grade similarity	3.25**	1.24	3.27*	1.40
GPA similarity	0.47	0.84	0.49	0.91
AHPVT similarity	-0.56	0.67	-0.58	0.76
Social functioning similarity (teacher)	0.47	0.70	0.37	0.73
Social functioning similarity (peer)	-1.47	0.75	-1.58	0.85
Same neighborhood	1.74	0.87	1.81	1.12
Shared activities	0.49	0.25	0.55	0.31
Shared courses	0.09	0.07	0.09	0.08
One nomination ego	-2.57*	1.23	-2.60	1.30
Interaction effects				
Ego disability x reciprocity			-0.27	4.27
Ego disability x GWESP			0.19	2.38
Ego disability x same gender			-1.08	0.92
Ego disability x grade similarity			0.00	3.66

Note. *$p < .05$, **$p < .01$, ***$p < .001$. Parameter estimates are reported as log-odds ratios.

The covariate effects in model 1 suggest youth in the school were only significantly affected by gender homophily and grade similarity. Youth in school 2 had decreased odds of sending ties to same-gendered than cross-gendered peers, and youth had increased odds of sending ties to peers who were similar in grade. All other covariate effects, including disability related effects were nonsignificant, indicating that youth did not have increased or decreased odds of nominating peers as friends based on these factors.

School 7. The results of the SAOM testing the network and covariate effects for school 7 are reported as model 1 in Table 5. The reciprocity effect indicates youth had a significant increase in odds to send ties to those who nominated them as a friend and the GWESP effect indicates youth had a significant increase in odds to send ties to friends of friends. All other network effects were nonsignificant which suggests youth in the school did not have increased or decreased odds of sending ties to peers due to these processes.

The results of the covariate effects in model 1 suggest youth in school 7 had a significant increase in odds to send ties to same-gendered than cross-gendered peers. All other covariate effects, including disability related effects, in the model were nonsignificant which suggests youth in the school had no increase or decrease in odds of sending ties to peers due to these factors.

Table 5

Stochastic Actor-Oriented Model of Friendship Ties for School 7

Variable	Model 1		Model 2	
	PE	*SE*	*PE*	*SE*
Network effects				
Outdegree	-3.76***	0.41	-3.83***	0.42
Reciprocity	2.01***	0.40	2.10***	0.43
GWESP	1.32***	0.34	1.27***	0.37
Transitive reciprocated triplets	0.03	0.40	0.05	0.39
Three-cycles	-0.44	0.51	-0.44	0.49
Indegree popularity (sqrt)	0.14	0.19	0.15	0.17
Outdegree popularity (sqrt)	-0.18	0.19	-0.17	0.20
Covariate effects				
Disability ego	-0.34	0.41	-1.65	1.67
Disability alter	-0.63	0.50	-0.83	0.73
Same disability	0.01	0.21	-0.02	0.24
Same gender	0.57***	0.13	0.61***	0.17
Same race/ethnicity	0.06	0.27	0.05	0.26
Grade similarity	0.33	0.24	0.33	0.22
GPA similarity	0.49	0.37	0.48	0.38
AHPVT similarity	-0.18	0.39	-0.16	0.42
Social functioning similarity (teacher)	0.17	0.26	0.16	0.26
Social functioning similarity (peer)	0.00	0.23	-0.01	0.25
Same neighborhood	-0.05	0.18	-0.03	0.17
Shared activities	0.11	0.08	0.10	0.08
Shared courses	0.03	0.05	0.03	0.05
One nomination ego	-1.36***	0.31	-1.34***	0.27
Interaction effects				
Ego disability x reciprocity			1.96	3.52
Ego disability x same gender			0.94	1.20

Note. *$p < .05$, **$p < .01$, ***$p < .001$. Parameter estimates are reported as log-odds ratios.

School 8. Table 6 model 1 presents the SAOM results testing the network and covariate effects in school 8. The significant positive effect of reciprocity and GWESP suggest youth in school 8 have increased odds of reciprocating ties to peers who nominated them and to friends of friends respectively. The significant negative effect of outdegree popularity suggests youth in school 8 have decreased odds of sending ties to peers who sent many ties. The indegree popularity effect was nonsignificant indicating this network process did not increase or decrease the odds of youth sending ties to peers.

Table 6

Stochastic Actor-Oriented Model of Friendship Ties for School 8

Variable	Model 1		Model 2	
	PE	*SE*	*PE*	*SE*
Network effects				
Outdegree	-2.73***	0.54	-2.71***	0.52
Reciprocity	1.80***	0.44	1.75**	0.67
GWESP	1.89***	0.44	1.94***	0.49
Indegree popularity (sqrt)	0.27	0.16	0.27	0.18
Outdegree popularity (sqrt)	-0.64*	0.28	-0.68	0.34
Covariate effects				
Disability ego	0.24	0.30	0.17	0.93
Disability alter	0.02	0.28	-0.01	0.33
Same disability	-0.12	0.26	-0.12	0.31
Same gender	-0.23	0.20	-0.23	0.21
Same race/ethnicity	0.10	0.19	0.09	0.21
Grade similarity	1.47***	0.32	1.53***	0.40
GPA similarity	0.92	0.56	0.97	0.60
AHPVT similarity	0.67	0.59	0.76	0.72
Social functioning similarity (teacher)	0.05	0.29	0.08	0.33
Social functioning similarity (peer)	0.09	0.26	0.11	0.29
Same neighborhood	-0.16	0.21	-0.15	0.24
Shared activities	0.22*	0.09	0.22*	0.09
Shared courses	0.10	0.08	0.08	0.08
One nomination ego	-1.52***	0.35	-1.49***	0.35
Interaction effects				
Ego disability x reciprocity			-1.26	2.41
Ego disability x GWESP			0.53	1.25
Ego disability x outdegree popularity			0.20	0.83
Ego disability x grade similarity			-0.82	1.12
Ego disability x shared activities			0.06	0.23

Note. *$p < .05$, **$p < .01$, ***$p < .001$. Parameter estimates are reported as log-odds ratios.

The covariate effect results in model 1 indicate that youth had increased odds of sending ties to peers in similar grades and with whom they shared activities with only. All other covariate effects in the model were nonsignificant, including the disability related effects. These nonsignificant effects suggest these factors were not more or less likely to impact youth friendship tie choices in school 8.

School 28. The SAOM results for model 1 testing the network and covariate effects for school 28 are presented in Table 7. The significant positive reciprocity and GWESP effects suggest youth had increased odds of sending a tie to peers who nominated them as a friend and to send ties to friends of friends. The significant negative transitive reciprocated triplets effect suggests youth in school 28 had decreased odds of sending ties to peers who nominated them in triplets. All other network effects were nonsignificant.

Table 7

Stochastic Actor-Oriented Model of Friendship Ties for School 28

	Model 1	
Variable	*PE*	*SE*
Network effects		
Outdegree	-4.31***	0.64
Reciprocity	2.29***	0.49
GWESP	2.37***	0.49
Transitive reciprocated triplets	-1.20*	0.60
Three-cycles	0.45	0.42
Indegree popularity (sqrt)	-0.20	0.32
Outdegree popularity (sqrt)	-0.44	0.31
Covariate effects		
Same disability	0.74	0.44
Same gender	0.34	0.23
Same race/ethnicity	0.58**	0.21
Grade similarity	1.74***	0.45
GPA similarity	0.51	0.54
AHPVT similarity	0.08	0.51
Social functioning similarity (teacher)	0.20	0.43
Social functioning similarity (peer)	0.47	0.38
Same neighborhood	1.05	0.61
Shared activities	0.11	0.10
Shared courses	0.11	0.06
One nomination ego	-2.01*	0.97

Note. *$p < .05$, **$p < .01$, ***$p < .001$. Parameter estimates are reported as log-odds ratios.

The significant positive effects for same race/ethnicity and grade similarity suggest youth in the school were influenced by racial/ethnic homophily and grade

homophily. Youth in the school had increased odds of sending ties to peers who matched their same racial/ethnic identity and peers who were close in grade level. All other covariate effects, including disability related effects, were nonsignificant and suggest these factors did not increase of decrease the odds of youth sending ties in the school.

School 81. Table 8 presents the SAOM results for model 1 testing the network and covariate effects for school 81. Of the network effects, only the reciprocity and GWESP effects were significant. Youth in school 81 had increased odds of sending ties to peers who nominated them as friends and increased odds of sending ties to friends of friends. All other network effects were nonsignificant indicating youth in the school did not have increased or decreased odds of sending ties to peers as a result of these processes.

According to the results of model 1, gender, grade, and GPA homophily each significantly contributed to the friendship tie choices of youth in school 81. Youth had increased odds of sending ties to same-gendered rather than cross-gendered peers, peers close in grade level than peers in more distant grade levels, and peers with similar GPAs than those with more disparate GPAs. All other covariate effects in the model were nonsignificant, including the disability related effects.

Table 8

Stochastic Actor-Oriented Model of Friendship Ties for School 81

Variable	Model 1		Model 2	
	PE	*SE*	*PE*	*SE*
Network effects				
Outdegree	-6.48***	1.46	-6.67***	1.33
Reciprocity	1.33*	0.54	1.34*	0.57
GWESP	1.35**	0.50	1.33*	0.52
Transitive reciprocated triplets	-0.92	0.77	-0.94	0.62
Three-cycles	0.11	0.42	0.11	0.40
Indegree popularity (sqrt)	0.16	0.28	0.20	0.29
Outdegree popularity (sqrt)	0.28	0.24	0.28	0.25
Covariate effects				
Disability ego	0.27	0.82	0.29	1.00
Same disability	-0.01	0.34	-0.02	0.33
Same gender	0.57*	0.24	0.55*	0.25
Same race/ethnicity	0.92	0.71	0.98	0.79
Grade similarity	1.67**	0.62	1.82*	0.76
GPA similarity	1.26*	0.60	1.10	0.63
AHPVT similarity	-0.09	0.72	-0.11	0.73
Social functioning similarity (teacher)	-0.01	0.53	0.00	0.56
Social functioning similarity (peer)	0.03	0.49	0.01	0.47
Shared activities	-0.31	0.19	-0.32	0.19
Shared courses	0.16	0.08	0.15*	0.07
One nomination ego	-4.64	2.94	-4.79	2.86
Interaction effects				
Ego disability x grade similarity			1.33	2.99
Ego disability x GPA similarity			-5.11	3.77

Note. *$p < .05$, **$p < .01$, ***$p < .001$. Parameter estimates are reported as log-odds ratios.

School 88. The results of the SAOM testing the network and covariate effects for school 88 are presented as model 1 in Table 9. All network effects in the model were significant except for indegree popularity. Youth in school 88 increased odds of sending ties to peers who nominated them, friends of friends, and intermediary ties in cyclical triads. Youth also had had decreased odds of reciprocating ties sent in triplets and of sending ties to peers who sent many ties. Youth did not have increased or decreased odds of sending ties to peers who received many ties.

Table 9

Stochastic Actor-Oriented Model of Friendship Ties for School 88

Variable	Model 1		Model 2	
	PE	*SE*	*PE*	*SE*
Network effects				
Outdegree	-2.76***	0.48	-2.97***	0.52
Reciprocity	2.05***	0.56	2.05***	0.54
GWESP	1.49***	0.41	1.47***	0.40
Transitive reciprocated triplets	-0.68*	0.29	-0.66*	0.31
Three-cycles	0.55*	0.25	0.56*	0.26
Indegree popularity (sqrt)	0.43	0.22	0.41*	0.20
Outdegree popularity (sqrt)	-0.84*	0.34	-0.86*	0.33
Covariate effects				
Disability ego	-0.43	0.43	-0.52	1.10
Disability alter	0.43	0.34	0.87	0.44
Same disability	0.03	0.34	0.33	0.37
Same gender	0.10	0.20	0.14	0.20
Same race/ethnicity	-0.26	0.25	-0.34	0.24
Grade similarity	1.55***	0.35	1.47***	0.36
GPA similarity	-0.52	0.59	-0.58	0.61
AHPVT similarity	0.30	0.52	0.22	0.56
Social functioning similarity (teacher)	-0.13	0.32	-0.10	0.35
Social functioning similarity (peer)	0.36	0.36	0.51	0.36
Same neighborhood	0.54**	0.19	0.60**	0.21
Shared activities	0.18	0.09	0.17	0.09
One nomination ego	-1.18**	0.41	-1.23**	0.42
Interaction effects				
Ego disability x reciprocity			0.60	1.75
Ego disability x GWESP			0.12	1.41
Ego disability x three-cycles			0.33	1.10
Ego disability x outdegree popularity			-0.44	0.96
Ego disability x grade similarity			-3.17*	1.57
Ego disability x same neighborhood			1.65	0.90

Note. *$p < .05$, **$p < .01$, ***$p < .001$. Parameter estimates are reported as log-odds ratios.

The covariate effects in model 1 suggest youth in school 88 were significantly impacted by grade homophily and neighborhood propinquity. Youth in the school had increased odds of sending ties to peers who were closer rather than more distant in grade level and peers from the same neighborhood rather than a different neighborhood. All other effects, including disability related effects, were nonsignificant and suggest youth

in the school did not have increased or decreased odds of sending ties to peers due to these factors.

Summary. Across Sunshine, Jefferson and each of the smaller schools, significant positive effects for reciprocity and GWESP were found in model 1. The results suggest youth in all of these schools had increased odds of sending ties to peers who nominated them as friends and to peers who were friends of their friends. Youth in Sunshine, Jefferson, and all of the smaller schools except for school 7 had increased odds of sending ties to peers who were close to them in grade level rather than in more distant grade levels. While this effect was consistent in most schools, the lack of grade homophily in school 7 suggests that the choices youth made differed by individual networks.

All other significant effects were shared by at most three of the smaller schools along with the two larger schools, which further suggests that unique patterns arose in individual schools. Gender homophily significantly increased the odds of youth sending ties to peers in Sunshine, Jefferson, and schools 7 and 81, but significantly decreased the odds of youth sending ties to peers in school 2. The significant negative transitive reciprocated triplets effect in Sunshine, Jefferson, and schools 88 and 28 indicates that youth in these schools had decreased odds of reciprocating ties to peers who nominated them when embedded in triads. Youth in Sunshine, Jefferson, and schools 88 and 8 had significantly decreased odds of sending ties to peers who sent many ties as indicated by the significant negative outdegree popularity effect. Only youth in Sunshine, Jefferson, and school 88 had increased odds of sending intermediary ties to peers within cyclical triads. The youth in Sunshine and Jefferson were the only youth with significantly

increased odds of sending ties to peers who received many ties and significantly decreased odds of sending ties to peers who sent many ties.

The covariate effects beyond grade and gender homophily were nonsignificant in most schools. Racial/ethnic homophily only significantly increased the odds of youth sending ties in Sunshine and school 28. GPA homophily significantly increased the odds of youth sending ties within Sunshine, Jefferson, and school 81 only. Neighborhood propinquity increased the odds of sending ties to peers in Sunshine, Jefferson, and school 88. Activity propinquity increased the odds of sending ties to peers in Sunshine, Jefferson, and schools 8. While same disability status, AHPVT similarity, and course propinquity significantly increased the odds of sending ties to peers in Sunshine and Jefferson, and the disability alter effect only increased the odds of youth with disabilities receiving ties from peers in Jefferson. The patterns of factors that contributed to the maintenance and formation of friendship ties within these school differ widely.

SAOM Moderation Results

To evaluate whether or not disability status moderated the relationship between friendship tie maintenance and formation and dyadic, contextual, and network factors, I included interactions between ego disability status and significant predictors in the objective function for each school's SAOM. The results of the SAOMs in Sunshine, Jefferson, and schools 2, 7, 8, 81, and 88 are presented as model 2 in Tables 2, 3, 4, 5, 6, 8, and 9 respectively. In school 28, no interaction effects could be tested due to !" outdegree of 0 for youth with disabilities. Convergence was adequate and goodness of fit statistics were good for schools 2, 8, and 88. Though convergence was adequate and fit was good for school 88, inspection of the covariance matrix of estimates following

testing of model 2 revealed collinearity between transitive reciprocal triplets and it's interaction effect with ego disability (r >.90) and the interaction effect was removed. The models for Jefferson had adequate convergence, but poor fit for outdegree, geodesic distance, and triad census. Goodness of fit was slightly better than model 1 but had similar issues. Outdegrees of 0 and 8 were slightly overrepresented and outdegree of 6 was slightly underrepresented in some of the simulated networks. Geodesic distance of 4 was slightly overrepresented, and distance of 5 was overrepresented in the simulated networks. Only triad types 021D and 201 had poor fit in model 2; there were slightly too few 021D and slightly too many 201 type triads. The models for Sunshine had adequate convergence, but poor fit for indegree, outdegree, geodesic distance, and triad census. Goodness of fit was slightly better than model 1 but had the same pattern of poor fit for all four goodness of fit auxiliary statistics.

Schools 7 and 81 did not have adequate convergence for models including interactions for all significant predictors. The interaction effect for GWESP was removed for school 7 due to near exact collinearity with the GWESP effect (r = .99). In school 81, interaction effects for transitive reciprocal triplets, GWESP, and the gender homophily effects were not possible due to multicollinearity (r > .95). Following removal of these effects, model 2 convergence was adequate and goodness of fit was good for both schools.

Sunshine. The results of the SAOM testing whether disability status moderated significant network and covariate effects for Sunshine are presented as model 2 in Table 2. None of the interactions between ego disability status and the network and covariate

effects were significant. Youth with disabilities did not significantly differ from their peers and instead were similarly affected by the same processes and factors.

Jefferson. The results of the SAOM testing whether disability status moderated significant network and covariate effects for Jefferson are presented as model 2 in Table 3. Only the interactions between ego disability status and gender homophily and neighborhood propinquity were significant. Youth with disabilities in Jefferson had significantly increased odds (1.46, 95% CI 1.13-1.89) of sending ties to same gendered peers in comparison to their peers without disabilities. Youth with disabilities also had significantly decreased odds (0.55, 95% CI 0.36-0.85) of sending ties to peers from the same neighborhood in comparison to their peers without disabilities. Youth with disabilities did not significantly differ from their peers on all other significant network and covariate effects.

Summary of smaller schools. In each of the smaller schools where moderation by ego disability status was evaluated for significant network and covariate effects, no significant interactions were found except for in school 88. Youth with disabilities in schools 2, 7, 8, and 81 did not have increased or decreased odds of sending friendship ties according to these factors in comparison to their peers without disabilities. These results suggest that youth with disabilities were impacted by these network processes and dyadic and contextual factors in similar ways as their peers without disabilities in these schoolwide networks. For school 88, only the interaction between ego disability status and grade homophily was significant. Youth with disabilities in this school had significantly decreased odds (.04, 95% CI .002-.91) of sending ties to peers who were close in grade level in comparison to peers in distant grades (e.g., ninth and twelfth

graders). Beyond this particular effect, the odds of sending ties to peers did not differ by the disability status of the sender.

CHAPTER V

DISCUSSION

This study sought to identify which dyadic, contextual, and network factors contribute to the maintenance and formation of friendship among youth with and without disabilities during high school. In particular, this study investigated how disability status may play a role in sending friendship ties while examining the factors commonly identified in the social network analysis literature. This was accomplished by investigating dyadic, contextual, and network effects in a comprehensive model and then including ego disability status as a moderator of significant effects from the first model. Results indicated that: (a) disability homophily was present in the large, but not small schools; (b) smaller schools had unique patterns of network and covariate effects; (c) youth with and without disabilities in most schools were similarly affected by network and covariate effects; and (d) youth with disabilities in only two schools significantly differed from their peers without disabilities on some, but not all, covariate effects.

Results from the SAOMs

Results from the SAOMs on smaller schools suggested that youth with disabilities were not more or less likely than their peers without disabilities to send or receive friendship ties within the schoolwide network, and that both youth with and without disabilities were not impacted by disability homophily. These results are surprising since previous research has identified that youth with disabilities are less likely to have the same number of ties as peers without disabilities (Kreider et al., 2016; Locke et al., 2013; Mendelson et al., 2016). Moreover, other researchers have reported that youth with disabilities are more likely to form friendships with other students with disabilities (Chen

et al., 2018; Estell et al., 2009; Locke et al., 2010; Wiener & Schneider, 2002). The smaller schools in the sample may not have been impacted by disability homophily due to the small number of youth with disabilities, where sending ties only to other youth with disabilities could have been too great a cost. For example, school 88 only had five youth with disabilities in the school and thus limiting their potential tie pool to only youth with disabilities would have severely restricted their networks. In contrast to the results in smaller schools, results from both Sunshine and Jefferson indicated that disability homophily impacted the maintenance and formation of friendships for both youth with and without disabilities. These differences between small and large schools may have been due to lack of power within the smaller schools to identify disability homophily effects, or to network differences between very large and very small schools. For example, large schools often exhibit greater homophily on demographic characteristics (McFarland et al., 2014). In large schools, exclusionary behavior does not have a high cost and actors are able to restrict their ties to those who are demographically similar and form tighter social groups.

The unique pattern of effects in the small schools may also be an indicator of the desire to retain greater tie options in small schools. Results indicated that few of the covariate effects representing different types of homophily and propinquity were significant within the small schools. Beyond grade homophily, most schools had only one to two significant covariate effects (e.g., activity propinquity in school 8). Youth in these schools may have sent ties to peers only on the basis of the most socially salient factors for their given context (Blau, 1994). For example, only youth in Sunshine and school 28 were influenced by racial/ethnic homophily and both schools had the highest racial/ethnic

heterogeneity within the sample. The results from Sunshine and school 28 are consistent with previous research showing the amplification of racial/ethnic homophily in more diverse settings (Goodreau, 2009; McFarland et al., 2014). These findings suggest it may be most appropriate to analyze the networks of schools individually, especially schools with few students, and to consider how size and demographic diversity could give rise to unique patterns.

Results from the SAOMs Evaluating Moderation

Results of the SAOMs evaluating whether ego disability status moderated the association between dyadic, contextual, and network effects and friendship tie maintenance and formation were mixed. Among the smaller schools, only grade homophily in school 88 was moderated by the disability status of youth sending ties to peers. Youth with disabilities in this school were significantly less likely to send ties to peers who were closer than more distant in grade level. Previous research suggests that youth with disabilities are more likely to form friendships with younger youth in comparison to their peers without disabilities (Weiner & Schneider, 2002). Some researchers have hypothesized that this difference in age selection of peers may be due to the fact that students with disabilities are more likely to attend courses that include peers from varied grade levels (McPherson et al., 2001). Unfortunately, course-taking data was not available for nearly all youth in school 88 making it impossible to determine if shared courses influenced this finding. Another possibility is that engagement in romantic relationships that span grade levels could have decreased the likelihood of youth with disabilities sending ties to same grade peers. In one prior study, McFarland and colleagues (2014) argued that the decreased effect of age homophily among youth in high

schools, in comparison to youth in middle schools, was due to romantic relationships between youth in different grades. A similar effect may have been operating here although I was unable to test for the influence of romantic relationships on friendship ties.

Results of the model evaluating moderation in Jefferson indicated that the effects of gender homophily and neighborhood propinquity differed for youth with and without disabilities. Youth with disabilities at Jefferson were more likely than their peers without disabilities to send ties to same-gendered peers. These effects differ from prior findings showing similar levels of gender homophily for youth with and without disabilities, but this earlier research was conducted with youth in pre-school through middle school (Chen et al., 2018; Farmer et al., 1993; Kasari et al., 2011; Wiener & Schneider, 2002). Thus, the pattern of effects observed here at the high school level may have been due to engagement of peers without disabilities in romantic relationships, thus increasing the occurrence of cross-gendered friendships (Prinstein & Giletta, 2016). The higher likelihood of same-gendered friendship ties could be an indicator that youth with disabilities in this school were less frequently engaged in romantic relationships with peers.

While disability status magnified the effect of gender homophily, it also dampened the effect of neighborhood propinquity. The increased exposure of living in the same neighborhood may lead to fewer friendship ties, particularly if experiences within the neighborhood have been negative. Prior research suggests that youth with disabilities are sometimes skeptical about developing friendships with peers in shared courses because they have not had positive experiences with these peers in the past

(Bottema-Beutel et al., 2016), and it is possible that the results from Jefferson could be a result of similar processes. It is also possible that the physical closeness of propinquity could be far less important than joint activity as conceptualized by Feld (1981). The effects of course and activity propinquity, indicators of joint activity, did not significantly differ for youth with and without disabilities.

Beyond these specific effects in Jefferson and school 88, all other significant effects within the original models were not moderated by disability status. These results suggest that youth with and without disabilities in high schools made choices to send ties to peers according to many of the same processes and factors within their schoolwide networks. This is especially the case for network processes, including reciprocity and transitivity, and to a more limited extent, preferential attachment. Youth with disabilities in large and small schools were just as likely as peers without disabilities to make friendship choices on the basis of reciprocating a friendship tie sent by a peer, being friends with friends of their own friends, and in some schools, of seeking friendship with popular peers. They were also just as likely to not reciprocate friendships within triadic structures, where becoming a friend of a friend or friendships among small clusters of youth weren't always mutual. These network processes are well-documented in social network literature and can serve as a foundation for structuring social network interventions for youth with disabilities.

Implications for Research

Previous researchers have argued that it is unclear what characteristics of peers are critical to the success of peer network interventions for youth with disabilities (Carter, 2018). The results of this study suggest that the factors that contribute to the maintenance

and formation of friendships among youth in general are similar to those that contribute to friendships among students with disabilities. This is an important finding because it provides direction for future researchers to investigate which combinations of network processes in particular, along with dyadic and contextual factors, can be leveraged to select peers to participate in social network interventions. Schoolwide networks may be uniquely affected by particular factors and processes and identifying them is a critical first step for intervention efforts. There may also be underlying social dynamics of a given school that influence how processes and factors lead to friendship ties. For example, in schools with higher average academic achievement, a greater degree of GPA homophily has been found (McFarland et al., 2014). Developing further understanding about how school and teacher practices contribute to social dynamics as well as using that information in coordinated social dynamics management efforts at the classroom and school levels may be fruitful (Farmer, Talbott et al., 2018).

The findings in the current study indicated that youth with disabilities may be more greatly impacted by disability homophily in larger schools. Although it is unclear if: (a) the results were unique to this particular sample; (b) the smaller schools were underpowered to detect effects; or (c) at what school population size or total number of youth with disabilities that disability homophily begins to emerge, future research should conduct power analyses to determine the sample size required to detect such effects. Future researchers should also account for design factors that may impact power (i.e., duration, waves, effect size, missing data, participant turnover) prior to data collection (Stadtfeld, Snijders, Steglich, & van Duijn, in press). Moreover, to begin to investigate differences based on network size, future researchers should investigate disability

homophily in schoolwide friendship networks for a range of school sizes and total populations of youth with disabilities. Finally, a larger sample of schools would allow for meta-analysis of the individual school results and the testing of school-level contextual factors as potential moderators of network and covariate effects (e.g., An, 2015). Such analyses could uncover if school size or population demographics magnify or dampen particular effects.

Future research should also investigate whether these processes and factors are still relevant within schools today. The proportion of youth with disabilities included in general education classrooms today differs from that of youth with disabilities contemporaneous to the study. Only 44.5% of youth with disabilities in schools during the 1994-1995 school year were included in general education at least 80 percent of their school day (US Department of Education, 1997). By contrast, 63.1% of youth with disabilities in schools during the 2016-2017 school year were included in general education classrooms (US Department of Education, 2018). Some research suggests that effects such as homophily on the basis of gender, race, religion, age, and education persist across decades of demographic and institutional change (Smith et al., 2014). It is important for future researchers to test how disability homophily may be affected by changes in school placement practices and how greater academic inclusion may impact social inclusion within networks and either magnify or dampen the effects of disability homophily. Given the similarity in course propinquity effects for youth with and without disabilities, it is possible that less inclusive placements for youth with disabilities could potentially exacerbate disability homophily but future research is needed to explore such effects.

Future researchers should also include more accurate measures of disability status and inclusion collected from student records to identify how effects may differ for specific populations of youth with disabilities. Although some previous research indicates that disability homophily may occur within and across different disability categories (Estell et al., 2009; Kreider et al., 2016; Kuo et al., 2013; Locke et al., 2010; Marton et al., 2015; Wiener & Schneider, 2002), the data used in the current study did not allow for an evaluation of potential similarities and differences between specific disability groups. Beyond disability homophily effects, other dyadic, contextual, and network effects may be moderated by both disability types and proportion of time spent in inclusive settings. Disentangling the effects of disability and inclusion is a critical next step in determining future network interventions that may be particularly beneficial for specific disability populations.

Implications for Practice

Recommendations for practice should be interpreted with caution since these data were correlational. However, preliminary evidence suggests that youth with disabilities did not differ greatly from their typically developing peers in how they made friendship choices. School staff interested in building positive friendships among youth with or without disabilities are likely to find success by managing the social dynamics at the school and classroom level (Farmer, Dawes et al., 2018). However, for youth with disabilities in particular, such an approach may require additional individualized interventions such as peer network interventions (e.g., Asmus et al., 2017; Carter et al., 2013).

Future research will likely identify a combination of characteristics that are critical for peers involved in peer support interventions. Preliminary evidence from the current study suggests that a focus on network processes could be valuable. Within all of the schoolwide networks analyzed, being friends with those who nominated a youth as a friend; and being friends with the friends of one's friends were consistent predictors of friendship. Thus, school staff interested in boosting or building youths' friendship networks could consider identifying other youth in the school interested in, or already endorsing, friendship with a targeted youth. Similarly, identifying peers connected to the target youth's current friends as potential participants in a peer network intervention may also provide opportunities to expand friendship networks.

Although youth with disabilities were often similarly affected by the same factors and processes as peers without disabilities, the results of this study suggest caution should be used for specific peer characteristics. In one of the schools in the current study, sharing a similar neighborhood led to decreased odds of youth with disabilities maintaining or forming friendships with their peers. Thus, peers who have many contact opportunities with a youth with a disability may not be the most appealing friendship partner for a youth with a disability, although this proposition should be studied further.

Limitations

It is important to consider the findings of the study in light of key limitations. First, the sample of two very large schools and eight small schools is not generalizable, especially if school context plays a role in the schoolwide friendship networks of youth. More analyses are needed for schools with a range of sizes and demographic characteristics to more accurately represent the range of school contexts. Additionally,

not all youth in the sample schools participated in Add Health data collection and the resulting samples and schoolwide networks may not be accurate representations of the total school populations.

Second, the analyses for small schools in the sample may have been underpowered. The results of these schools should be viewed with caution as they may not be an accurate representation of the factors and processes that contributed to these friendship networks. Future studies should conduct power analyses prior to design and data collection to ensure adequate power for uncovering effects (Stadtfeld et al., in press).

Third, moderation was only tested for significant predictors within each school's SAOM and was tested in a complete moderation model. It is possible that youth with and without disabilities significantly differed from one another on additional effects that were not included in the moderation model. Future research could evaluate disability status moderation for singular dyadic, contextual, and network effects to further explore how important social network effects differ for youth with disabilities.

Fourth, though model fit was good for the smaller schools, goodness of fit tests revealed poor fit in Sunshine and Jefferson for both model 1 and model 2. Inspection of goodness of fit plots and descriptive statistics revealed that the observed values were often within the range or just outside the range of the simulated networks. Though parameter estimates and standard errors were robust to changes in model specification, model specification could be improved to more accurately represent the observed networks.

Fifth, the Add Health data used in the analyses suffered from small to moderate amounts of missing data. Missing tie and covariate data likely bias the parameter

estimates, though small (i.e., less than 20%) to moderate (i.e., less than 40%) amounts of missing network data produces minimal bias and suitably large standard errors to represent the uncertainty due to missingness when using MoM (Huisman & Steglich, 2008). MoM procedures produce minimal bias in parameter estimates even for data that are missing at random (MAR) and not missing at random (MNAR; Huisman & Steglich, 2008). Multiple imputation procedures for longitudinal networks were developed to improve estimation of parameters when data are missing, however multiple imputation procedures were inappropriate for the planned analyses. Multiple imputation for longitudinal network data requires well-fitting models (Krause, Huisman, & Snijders, 2018). Though many of the models had good fit, the inclusion of many nonsignificant effects ensures these models are not the best fitting models to the observed data. Furthermore, including many parameters during multiple imputation for small networks can lead to insufficient power (Krause et al., 2018).

Sixth, the use of extant data in the study limited the effects that could be explored to the variables available in the data and treatment of the data could have introduced bias. Disability information was collected via parent interviews and by the interviewer, and a combination of these items was used to indicate disability status. These procedures could have led to inaccurate and under identification of youth with disabilities in the sample and resulted in moderate amounts of missing data. Furthermore, the use of a dichotomous indicator for disability status prevents exploration of any differences that exist based on disability category (e.g., learning disability, intellectual disability). Friendship nomination items allowed youth to identify any individual as a friend, even friends who did not attend the youth's school. All nominations to individuals without valid participant

identification numbers and attending the same school were removed prior to analyses. Additionally, since transcript data were only collected for youth in grades 9-12, all nominations to individuals in grades seven and eight were removed prior to analyses. Thus, the schoolwide networks and resulting effects only represent youth in the sample schools in grades 9-12. The Add Health data did not include information about the inclusivity of courses youth took. Inclusion likely influences the effect of disability homophily and course propinquity for youth with disabilities because those in more restrictive placements have access to a narrower available tie pool. Unfortunately, without placement information, these effects could not be explored or controlled for. Additionally, the social functioning items used to represent social behavior are likely not robust enough to adequately represent behavior homophily identified in prior research. Comprehensive measures of antisocial and prosocial behavior should be included in future research.

Seventh, Add Health data comes from the 1994-1995 school year and significant changes have occurred within schools and broader society that could influence schoolwide networks today. For example, youth with disabilities are included more often in general education classrooms today than at the time of data collection (US Department of Education, 1997; 2018) and technology developments influence how youth contact and engage with one another. Despite significant changes, it is unlikely that findings from the current study are irrelevant for youth today. Smith and colleagues (2014) found similar levels of age, race, gender, religion, and education homophily in 1985 and 2010 even with large demographic and institutional shifts. Even within online spaces, many of the same processes and factors appear to influence the likelihood of connections. For

example, Mazur and Richards (2011) found ethnicity and age homophily, as well as state propinquity within the online ego networks of adolescents and emerging adults. Future research should confirm whether the schoolwide networks of the current study and more recent populations are similarly affected by the same factors and processes.

Conclusion

Youth with disabilities in the sample were similarly affected by most of the predictors of friendship tie maintenance and formation as their peers without disabilities in schoolwide networks. Youth with disabilities in only two schools in the sample significantly differed from their peers without disabilities on grade homophily, gender homophily, and neighborhood propinquity. Youth in large schools were also more likely to choose friends on the basis of shared disability status, whereas youth in smaller schools were seemingly unaffected by such tendencies. These differences may be due, in part, to the fewer tie options available in small schools in comparison to large schools. When many tie options are available, individuals are able to restrict their friendship choices more without much risk of being isolated. In contrast, individuals with fewer tie options only restrict their choices according to the most important factors. However, more research is needed to understand if these differences exist across a range of school sizes and how statistical power may affect analyzing the networks of very small schools. Further research should also focus on how these predictors may be leveraged for interventions that boost or build the friendship networks of youth with disabilities.

APPENDIX

ADD HEALTH ITEMS AND RESPONSE OPTIONS FOR COVARIATE EFFECT MEASURES

Race/Ethnicity

Frequency	Code	Response	Variable Name	Type/ Length
4. Are you of Hispanic or Spanish origin?			**S4**	num 1
63664	0	no (skip to Q.6)		
15542	1	yes (go to Q.5)		
5751	8	I don't know. (skip to Q.6)		
10	9	multiple response		
5151	!	missing		
6. What is your race? If you are of more than one race, you may choose more than one.				
white (skip to Q.8)			**S6A**	num 1
35551	0	not marked		
54567	1	marked		
black or African American (skip to Q.8)			**S6B**	num 1
72956	0	not marked		
17162	1	marked		
Asian or Pacific Islander (go to Q.7)			**S6C**	num 1
83806	0	not marked		
6312	1	marked		
American Indian or Native American (skip to Q.8)			**S6D**	num 1
85212	0	not marked		
4906	1	marked		
other (skip to Q.8)			**S6E**	num 1
81333	0	not marked		
8785	1	marked		

Gender

Frequency	Code	Response	Variable Name	Type/ Length
2. What sex are you?			S2	num 1
44905	1	male		
44482	2	female		
51	9	multiple response		
680	!	missing		

Grade

Frequency	Code	Response	Variable Name	Type/ Length
3. What grade are you in?			S3	num 2
96	6	6		
12327	7	7		
11903	8	8		
18588	9	9		
17431	10	10		
15355	11	11		
13615	12	12		
207	13	My school doesn't have grade levels of this kind.		
55	99	multiple response		
541	!	missing		

Disability Status

Frequency	Code	Response	Variable Name	Type/ Length
C37. The next three questions are about disabilities {NAME} may or may not have.				
Is (he/ she) mentally retarded?			PC37	num 1
17436	0	no		
196	1	yes		
13	6	refused		
28	8	don't know		
42	•	missing		

Frequency	Code	Response	Variable Name	Type/ Length
C38. Does (he/ she) have a specific learning disability, such as difficulties with attention, dyslexia, or some other reading, spelling, writing, or math disability?			**PC38**	num 1
15205	0	no		
2276	1	yes		
20	6	refused		
180	8	don't know		
34	•	missing		
C39. During the past 12 months did (he/ she) receive any type of special education service?			**PC39**	num 1
15863	0	no		
1744	1	yes		
16	6	refused		
45	8	don't know		
47	•	missing		

Physical disability.

Frequency	Code	Response	Variable Name	Type/ Length
IF C50=NO AND C51=NO, THEN SKIP TO C63.				
C53. Do you consider {NAME} to have a disability?			**PC53**	num 1
226	0	no		
178	1	yes		
6	6	refused		
17197	7	legitimate skip		
108	•	missing		

Interviewer report.

Frequency	Code	Response	Variable Name	Type/ Length
26. Is the respondent blind?			**H1IR26**	num 1
20695	0	no		
22	1	yes, in 1 eye		
7	2	yes, in both eyes		
7	6	refused		
8	8	don't know		
7	!	missing—interviewer did not complete due to machine problems		
27. Is the respondent deaf?			**H1IR27**	num 1
20689	0	no		
34	1	yes		
7	6	refused		
9	8	don't know		
7	!	missing—interviewer did not complete due to machine problems		
26. Is the respondent blind?			**H2IR26**	num 1
14713	0	no		
6	1	yes, in 1 eye		
2	2	yes, in both eyes		
1	8	don't know		
16	!	missing		
27. Is the respondent deaf?			**H2IR27**	num 1
14704	0	no		
18	1	yes		
16	!	missing		
28. Is the respondent physically disabled?			**H2IR28**	num 1
14646	0	no		
75	1	yes		
1	8	don't know		
16	!	missing		

Social Functioning

Frequency	Code	Response	Variable Name	Type/ Length
46. Since school started this year, how often have you had trouble:				
a. getting along with your teachers?			**S46A**	num 1
30716	0	never		
30423	1	just a few times		
6151	2	about once a week		
9405	3	almost everyday		
7905	4	everyday		
120	9	multiple response		
5398	!	missing		
d. getting along with other students?			**S46D**	num 1
26063	0	never		
26665	1	just a few times		
5441	2	about once a week		
12157	3	almost everyday		
14042	4	everyday		
63	9	multiple response		
5687	!	missing		

Academic Achievement (Self-Report)

Frequency	Code	Response	Variable Name	Type/ Length
English/Language Arts			**S10A**	num 1
22106	1	A		
26612	2	B		
16706	3	C		
8839	4	D or lower		
1486	5	I didn't take this subject.		
5132	7	legitimate skip		
5055	8	I don't know.		
114	9	multiple response		
4068	!	missing		

Frequency	Code	Response	Variable Name	Type/ Length
Mathematics			**S10B**	num 1
20342	1	A		
24010	2	B		
17308	3	C		
10964	4	D or lower		
3584	5	I didn't take this subject.		
5132	7	legitimate skip		
4358	8	I don't know.		
101	9	multiple response		
4319	!	missing		
History/Social Studies			**S10C**	num 1
22170	1	A		
22436	2	B		
14594	3	C		
8206	4	D or lower		
8105	5	I didn't take this subject.		
5132	7	legitimate skip		
4661	8	I don't know.		
76	9	multiple response		
4738	!	missing		
Science			**S10D**	num 1
21396	1	A		
22661	2	B		
15183	3	C		
8769	4	D or lower		
7684	5	I didn't take this subject.		
5132	7	legitimate skip		
4593	8	I don't know.		
76	9	multiple response		
4624	!	missing		

Shared Activities

Frequency	Code	Response	Variable Name	Type/ Length
44. Here is a list of clubs, organizations, and teams found at many schools. Darken the oval next to any of them that you are participating in this year, or that you plan to participate in later in the school year.				
French club			**S44A1**	num 1
86664	0	not marked		
3454	1	marked		
German club			**S44A2**	num 1
88900	0	not marked		
1218	1	marked		
Latin club			**S44A3**	num 1
88634	0	not marked		
1484	1	marked		
Spanish club			**S44A4**	num 1
83459	0	not marked		
6659	1	marked		
Book club			**S44A5**	num 1
89074	0	not marked		
1044	1	marked		
Computer club			**S44A6**	num 1
87394	0	not marked		
2724	1	marked		
Debate team			**S44A7**	num 1
88057	0	not marked		
2061	1	marked		
Drama club			**S44A8**	num 1
84131	0	not marked		
5987	1	marked		
Future Farmers of America			**S44A9**	num 1
88455	0	not marked		
1663	1	marked		
History club			**S44A10**	num 1
89090	0	not marked		
1028	1	marked		

Frequency	Code	Response	Variable Name	Type/ Length
Math club			**S44A11**	num 1
87219	0	not marked		
2899	1	marked		
Science club			**S44A12**	num 1
87157	0	not marked		
2961	1	marked		
Band			**S44A13**	num 1
79587	0	not marked		
10531	1	marked		
Cheerleading/dance team			**S44A14**	num 1
82860	0	not marked		
7258	1	marked		
Chorus or choir			**S44A15**	num 1
81555	0	not marked		
8563	1	marked		
Orchestra			**S44A16**	num 1
88152	0	not marked		
1966	1	marked		
Other club or organization			**S44A17**	num 1
74409	0	not marked		
15709	1	marked		
Baseball/softball			**S44A18**	num 1
76079	0	not marked		
14039	1	marked		
Basketball			**S44A19**	num 1
73683	0	not marked		
16435	1	marked		
Field hockey			**S44A20**	num 1
89033	0	not marked		
1085	1	marked		
Football			**S44A21**	num 1
78722	0	not marked		
11396	1	marked		

Frequency	Code	Response	Variable Name	Type/ Length
Ice hockey			**S44A22**	num 1
88210	0	not marked		
1908	1	marked		
Soccer			**S44A23**	num 1
82678	0	not marked		
7440	1	marked		
Swimming			**S44A24**	num 1
85442	0	not marked		
4676	1	marked		
Tennis			**S44A25**	num 1
85749	0	not marked		
4369	1	marked		
Track			**S44A26**	num 1
79404	0	not marked		
10714	1	marked		
Volleyball			**S44A27**	num 1
83456	0	not marked		
6662	1	marked		
Wrestling			**S44A28**	num 1
86473	0	not marked		
3645	1	marked		
Other sport			**S44A29**	num 1
82097	0	not marked		
8021	1	marked		
Newspaper			**S44A30**	num 1
86191	0	not marked		
3927	1	marked		
Honor society			**S44A31**	num 1
81853	0	not marked		
8265	1	marked		
Student council			**S44A32**	num 1
83473	0	not marked		
6645	1	marked		

Frequency	Code	Response	Variable Name	Type/ Length
Yearbook			**S44A33**	num 1
83299	0	not marked		
6819	1	marked		

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