Individual Differences in Adolescent Social-Cognitive Development

by

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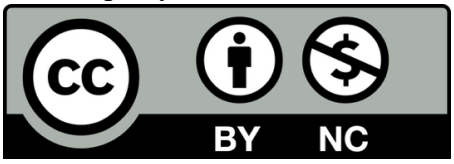
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DISSERTATION ABSTRACT

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During adolescence, continued development of social-cognitive processes coincides with dramatic changes to social structures and contexts. Forming close friendships is a major goal of this developmental period, and social-cognitive processes are theorized to play an important role in supporting the formation and maintenance of social connections. However, limited research has examined the relationship of social-cognitive processes with real-world social connections during adolescence.

The goal of this dissertation was to further investigate how social-cognitive processes support the formation and maintenance of social relationships, and how adolescents may adjust their engagement in social-cognitive processes to more closely align with their peers. In two studies, we used longitudinal complete social network data in conjunction with measures of individual differences in social-cognitive processes to examine how these processes relate to peer connections and close friendships over the first year of middle school. In Study 1, adolescents (N=324) were more likely to form and maintain both peer connections and close friendships with others that had similar engagement in perspective-taking. Notably, this result was found in one of the two included schools. In Study 2 (N = 324), adolescents in both schools who engaged in more co-rumination across their close friendships were more likely to send close friend nominations. We also found substantial inter-individual variability in co-rumination across close friendships. Overall, these findings suggest that social-cognitive processes relate to the formation and maintenance of peer relationships and close friendships in early adolescence, but additional

work is needed to investigate school-specific dynamics that could affect the utility of engaging in these processes in different ways. Additionally, the substantial variation found across friendships in measures such as co-rumination highlights a need to integrate social network approaches in investigations of adolescent social-cognitive development.

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CHAPTER I

INTRODUCTION

Adolescence is a time of tremendous physical, cognitive, and social development and has been identified as a potential sensitive period for sociocultural processing (Blakemore & Mills, 2014, see also Cheng, Mills, & Pfeifer, 2024). During this period, changes to the social environment may interact with changes in social sensitivity and cognitive processes, supported by development in social brain regions (Blakemore & Mills, 2014; Mills et al., 2014). Compared to childhood, adolescents gain more agency, begin to spend more time with their peers, and increasingly rely on peers for social support (Lam, McHale, & Crouter, 2014).

There are also dramatic changes to the social environments that adolescents spend most of their time in, most notably during the transition from primary school to secondary school, which typically coincides with early adolescence in the United States (around 10-12 years old). Notably, these changes are characterized by opportunities to form connections with a new, larger group of peers, in contrast to the smaller, more limited, social networks of primary school. While primary school students typically spend the majority of their time in the same classroom with the same peers and teacher, secondary school typically involves contact with different peers for different school subjects, and a larger pool of similarly-aged peers (Juvonen, 2007).

This transition presents new opportunities to form social connections and close friendships, which is a major developmental goal during adolescence (Bagwell et al., 1998). For students with negative peer experiences in primary school, this transition can also be a positive opportunity for a fresh start (Lorijn et al., 2024). However, successfully tackling these transitions requires engagement in social-cognitive processes that can support the navigation of increasingly

complex social networks, new social and emotional demands, and an increasingly important role for peers and friends.

In this review, I discuss the implications of continued social-cognitive development for real-world social goals.

Social-Cognitive Skills & Strategies

Theory of Mind and Mentalizing

One key social-cognitive process that continues to develop into and throughout adolescence is mentalizing, or the ability to represent or infer the mental states of others (Dumontheil et al., 2010; Devine, 2021). Mentalizing has most often been studied in terms of false belief understanding, usually conceptualized as "theory of mind" in younger children. However, mentalizing more broadly captures multiple dimensions and includes multiple components, including taking another's perspective, inhibiting one's own perspective, and understanding another's beliefs and knowledge. These dimensions can also be measured in various ways, including ability, propensity, and degree, though most studies only include a single dimension (Guazelli Williamson & Mills, 2023). While the bulk of the literature has focused on theory of mind in early childhood, research over the past two decades has found continued development across multiple domains and measures of mentalizing through adolescence. In adolescence, mentalizing is theorized to support the navigation of increasingly complicated social environments (Crone & Fuligni, 2020; Crone & Dahl, 2012).

Supporting the idea that mentalizing plays an important role in social cognition during adolescence, self-reported perspective taking propensity generally increases across adolescence, as does perspective taking propensity measured by a visual perspective taking task, the Director

Task (Davis & Franzoi, 1991; Van der Graaff et al., 2014; Pile et al., 2017). Mentalizing ability/accuracy seems to increase as well, though this research is limited by a lack of ecologically valid, developmentally appropriate tasks. Performance on the Movie for the Assessment of Social Cognition (MASC, Dziobek et al., 2006) suggests that older adolescents have greater accuracy than younger adolescents (Poznyak et al., 2019). Older adolescents also show improved performance on some story-based tasks compared to younger adolescents, though these tasks may themselves have low reliability (Białecka-Pikul et al., 2021).

Beyond developmental trends, past research has repeatedly demonstrated that inter-individual variability in mentalizing relates to social functioning in children. However, this research has primarily focused on childhood, using theory of mind measures that tap into the ability to take another's perspective. In a study of 3-year-olds, children with larger social networks showed better performance on a perspective-taking task (Burke et al., 2023). In two longitudinal studies, children with poorer theory of mind skills at age 5 were more likely to have no reciprocated friendships, both at age 5 and age 7 (Fink et al., 2015), and girls with more advanced theory of mind in 4th grade had greater gains in their number of friendships two years later (Gazelle et al., 2022). Additionally, children with better theory of mind performance are rated as more socially competent by their teachers and peers (Liddle & Nettle, 2007; Bosacki & Wilde Astington, 1999).

While investigations of mentalizing and social functioning in adolescent populations are less common, recent work has found relationships between mentalizing ability and friendship, including friendship style and quality (Białecka-Pikul et al., 2017; Smith & Rose, 2011). Perspective-taking in adolescence has been related to sharing with friends and prosocial behavior, and age-related increases in perspective-taking mediate age-related increases in

prosocial behavior towards friends (van de Groep et al., 2019; Tamnes et al., 2018; Güroğlu et al., 2014).

While mentalizing is theorized to play a crucial role in supporting navigating social environments, there have been several barriers to fully understanding its relationship to meeting social goals. A lack of reliable, ecologically valid measures that tap into various dimensions of mentalizing in adolescence has been a significant barrier. Additionally, many studies only measure one dimension, limiting our ability to create profiles of mentalizing and examine mentalizing strategies, as suggested by Guazelli Williamson & Mills (2023). Finally, mentalizing has not been directly connected to social outcomes in adolescence.

Co-Rumination

During adolescence, social support is an important function of peer relationships. Adolescents increasingly rely on their peers for social support, which can be an important positive factor for well-being (Schwartz-Mette et al., 2020). However, some forms of social support may have trade-offs. Specifically, co-rumination, or excessively talking about problems within a dyadic relationship, has been proposed to relate to both increased friendship quality as well as internalizing problems (Rose, 2002). Most of the literature on co-rumination has focused on adolescence, where engagement in co-rumination increases from late childhood through mid-adolescence (Rose 2021).

Co-rumination can be conceptualized as an ongoing process that supports social connection and provides a venue for adolescents to learn to manage and regulate their emotions in a peer context. Originally conceptualized as existing at the overlap of rumination and self-disclosure, co-rumination is an inherently social process (Rose, 2002). Notably, more recent work has emphasized that co-rumination extends beyond rumination and self-disclosure to

include additional social processes, such as social support, problem-solving, and responsiveness (DiGiovanni et al., 2026).

While co-rumination has typically been conceptualized as having both costs and benefits for adolescents, there appears to be considerable individual variation in how they experience those trade-offs. In a recent study using a within-subjects approach, some adolescents experienced only the costs or only the benefits of co-rumination (DiGiovanni et al., 2021). Additionally, when profiles of co-rumination, depressive symptoms, and social support were created, co-rumination was linked to depressive symptoms, but not all adolescents who co-ruminated exhibited depressive symptoms (Tilton-Weaver & Rose, 2023). Recent work has also suggested that the theorized trade-offs of co-rumination may only occur at the between-person level, as co-rumination was associated with friendship quality but not depressive symptoms at the within-person level (Bernasco et al., 2025).

The association between co-rumination and depression is also dependent on relationship quality, with depression linked to co-rumination in low-, but not high-quality relationships (Guassi Moreira et al., 2016). Co-rumination has also been found to moderate the relationship between emotional competencies and depressive symptoms, such that when girls engaged in high levels of co-rumination, poor emotional awareness was associated with depressive symptoms in their friend (Miller et al., 2020). Additionally, at high levels of co-rumination, adolescents who perceived their friend as having stronger anger regulation had fewer depressive symptoms, as did adolescents with stronger sadness regulation (Miller et al., 2020).

Together, these findings suggest that co-rumination does not always result in negative outcomes and may be impacted by numerous social-cognitive factors and friendship characteristics. However, further research considering co-rumination with the broader social-

cognitive context of adolescence is needed to understand how engagement in co-rumination may or may not be adaptive for meeting social goals. More varied measurements of co-rumination are also needed, including dyadic measurements and measures of variation across relationships.

Recent theories have also suggested that co-rumination may be most detrimental when an individual constantly relies on it as an emotion regulation strategy, instead of sometimes engaging in it, and sometimes using other strategies (DiGiovanni et al., 2026). Given that co-rumination is typically measured as a trait-level construct, it's difficult to untangle how it may be employed within and across friendships. Similarly, a lack of longitudinal approaches limits our understanding of how co-rumination may fluctuate across the course of a relationship to serve different purposes. At the beginning of a relationship, co-rumination may be more heavily employed to build connections. Conversely, co-rumination could become more common farther into a relationship, as the relationship becomes more interdependent and partners become more trusting and reliant on each other for support.

Social Reward Sensitivity and Motivation

Social reward sensitivity has also been hypothesized to play a role in adolescents' social-cognitive development and behavior. Heightened sensitivity to social reward has been proposed as one mechanism that could play a role in sensitivity to peer influences (Foulkes & Blakemore, 2016). In line with this, adolescents seem to have heightened social sensitivity to peer influences (Prinstein & Dodge, 2008; Somerville et al., 2013). However, most evidence for heightened social reward in adolescence has come from animal research, and human studies have been less conclusive (Foulkes & Blakemore, 2016). Additionally, there is an ongoing debate about whether heightened reward sensitivity is specific to social reward, and whether adolescents are sensitive to all social information, regardless of valence.

Social reward has been conceptualized as a motivator for adolescent social behavior, including as a motivator for conforming to peer groups, engaging in behaviors that gain social acceptance, and adjusting behaviors to gain acceptance (Laninga-Wijnen & Veenstra, 2021). In order to gain social rewards in peer contexts, adolescents may modify their behavior in the presence of their peers (Chein et al., 2011; van Hoorn et al., 2016)

Additionally, social reward could play a role in a wide range of social-cognitive processes and behaviors that are salient during adolescence. For example, co-rumination involves self-disclosure, which can be inherently rewarding (Tamir & Mitchell, 2012: Vijayakumar & Pfeifer, 2020; Vijayakumar et al., 2020). Evidence from neuroimaging has also found that in middle childhood/early adolescence, social interactions recruit both mentalizing and reward regions (Alkire et al., 2018). Furthermore, social-cognitive processes such as perspective-taking and co-rumination have been related to internalizing behaviors, which are also associated with reward processing in adolescence (Kwon et al., 2019).

Development and change in adolescent social networks

Reorientation towards peers

Importantly, adolescents are embedded within broader social networks, including classmates, peers, and friends. Bronfenbrenner's Ecological Systems Theory emphasizes the importance of proximal influences/the broader environment on development (Bronfenbrenner & Morris, 2007). These networks become a primary context that influences identity, decisions, and behavior (Laursen & Veenstra, 2021).

During adolescence, social networks undergo a series of important changes in both structure and function. In many Western cultures, the beginning of adolescence (around 10-12 years old) coincides with the transition from primary to secondary school. While the majority of

time in primary school is spent with smaller, more consistent groups of peers and monitored by a single familiar teacher, secondary school is characterized by larger, more diffuse groups of peers and more varied adult supervision (Eccles et al., 1996; Juvonen, 2007). Compared to childhood, adolescence is also characterized by increased agency and autonomy over how time is spent and who it is spent with. With a larger pool of potential peer connection and more autonomy, new factors become increasingly salient for choosing friends.

These friends also take on increasing importance during adolescence. Forming close friendships is an important developmental goal during this period (Bagwell et al., 1998), and these relationships become an increasingly important source of social support, as well as sources for socialization of emotion regulation (Borowski & Zeman, 2025), among other behaviors and skills.

Network Size and Dynamics

Social networks can be characterized by different types of ties and relationships, which have theoretical distinctions (Neal, 2020). In adolescence, commonly studied ties include study partners, friends, close friends, and best friends (Neal, 2020; Palacios et al., 2024). Networks based on various social ties have underlying theoretical differences and may differ on a number of features, but may also overlap. For example, networks based on interactions (i.e. time spent together) will likely differ from those based on reputation (e.g., "liking" networks, would like to spend time with). The same factors that make someone a sought-after academic study partner may not make them a desirable best friend. Additionally, there are a number of individual and network characteristics that can be measured, including indegree (incoming nominations), outdegree (outgoing nominations), betweenness (the extent to which an individual acts as a

broker between otherwise disconnected nodes), and closeness (distance from others in the network).

Developmental trajectories of network measures differ depending on the relationship measures. According to a meta-analysis of network changes across the lifespan, global, personal, and friendship network size increases throughout adolescence and into young adulthood (Wrzus et al., 2013). In a meta-analysis focused specifically on outdegree nominations in adolescence, younger adolescents (10-14 years) nominated significantly more close and best friends than older adolescents (15-18 years) (Neal, 2025). Nominations of friends did not significantly differ between younger adolescents and older adolescents, though younger adolescents did nominate more friends (Neal, 2025).

There are also several known endogenous network effects that drive social network structures. These include reciprocity, transitivity, and outdegree effects, reflecting that friendships tend to be reciprocated, friends of friends are likely to be friends themselves (transitivity effect), and the basic tendency to have ties at all (outdegree effect) (Snijders et al. 2010). Adolescents who are connected within a network are often more similar than those who are unconnected (Hartup, 1996). This similarity can be due to selection, where similar people are more likely to be chosen as friends, or influence, where members of a group/connected people become more similar over time.

Peer Selection Within Networks

As adolescents gain more agency and have more control over who they spend their time with, similarity seems to be a strong motivator for selecting potential social connections. The similarity-attraction model suggests that similarity reflects compatibility, which can foster cooperation and rewarding interactions (Byrne, 1971; Laursen, 2017). Therefore, selecting

similar friends could be a strategic choice for prioritizing friendships that are more likely to be successful.

Friends often share the same fixed/demographic characteristics such as gender, race and ethnicity, age, and socioeconomic status **(**Goodreau et al., 2009; Mehta & Strough, 2009). However, the strength of these homophily effects can differ depending on tie strength and over time (McMillan, 2022). Similarity can also be amplified by structural factors, such as nominations in network studies being limited to members of the same classroom, grade, or school. In line with similarity on demographic characteristics, similarity is typically stronger for behaviors than for internal characteristics (Laursen, 2017; Werner & Parmelee, 1979).

In addition to similarity, characteristics perceived as beneficial can increase the likelihood of being selected as a friend. In adolescence, popularity plays a large role in the selection of friends, with similarly popular peers preferred as friends and highly popular classmates more attractive as friends (Bravo et al., 2022). Prosocial behavior also plays a role in selection, with highly prosocial peers being more likely to be selected as someone other adolescents would like to spend time with (Chávez et al., 2025).

Social network studies have also looked at factors related to the selection of other types of social ties, such as academic study partners (Palacios et al., 2022) and helping relationships (van Rijsewijk et al., 2016). In these types of ties, factors such as high academic achievement, prosociality, and existing friendship (academic study partners) and academic achievement, mental health, and peer status (helping relationships) play a role.

Peer Influences Within Networks

While adolescents may choose to be friends with those that are similar to themselves, they can also become more similar to their connections over time. Specifically, they may become

more similar to others in their groups via peer influences, which have an increased importance during this period. The Influence-Compatibility Model suggests that the role of peer influence is to increase similarity to peers and friends, which in turn increases compatibility (Laursen & Veenstra, 2021). Conforming to group norms can have social benefits, and may help to prevent social rejection. In line with this, adolescents demonstrate an increased openness to peer influence (Braams et al., 2019; Chien et al., 2011).

Peer influences have been examined in relation to a number of behaviors and outcomes in adolescence, including depression (Van Zalk et al., 2010), delinquency (Burk et al., 2007), and alcohol use (Mercken et al., 2012). However, peer *influences* are distinct from peer *pressure* and are not inherently negative. While much of the literature has focused on risk factors related to peer influences, and there is more limited research on prosocial influences, friends can play an important role in influencing prosocial behavior (Barry & Wentzel, 2006).

Within the adolescent social network literature specifically, results for influence effects on prosocial behavior have been mixed. While there are a number of studies that have found prosocial influence effects, both positive and negative (Chávez et al., 2025; Laninga-Wijnen et al., 2020; Logis et al., 2013; Shin et al., 2019), others have found no effects (Dijkstra & Berger, 2018; Molano et al., 2013; Shin, 2017). Notably, prosocial behavior influence has often been examined in the context of passive behavior diffusion. However, social network-based interventions have also been designed to reduce antisocial behavior and substance use in adolescence (Paluk et al., 2016; Valente et al., 2007).

The dynamics of peer influences also depend on a number of factors. For example, adolescents' behavior can be influenced differently depending on characteristics of the social tie (Giletta et al., 2012). The peer influence literature has also focused on the role of specific

network members, such as students who are the most central to the network or popular students (Laninga-Wijnen et al., 2020). In particular, network interventions that have been used to address adolescent substance use and peer victimization/bullying often leverage the influence of network members with certain characteristics, such as those who are popular, highly connected, or can act as brokers or bridges between different peer groups that are not otherwise connected (Lakon et al., 2025; Wang et al., 2022).

Discussion and Unanswered Questions

Adolescence is a time of intertwined changes across multiple domains, where changes to social environments may interact with ongoing development of social-cognitive processes. However, while past research has examined both continued social-cognitive development and dynamics of social networks, it is not yet understood how social-cognitive processes may directly relate to successful navigation of new social contexts. Specifically, while theories suggest that some social-cognitive processes may confer social benefits and that peers and friends are important contexts for the socialization of these processes during adolescence, little existing work has connected social-cognitive processes to real-word social networks.

This dissertation is designed to directly connect measures of social-cognitive processes to complete social networks during the transition to middle school. The primary goals are to 1) examine how processes including perspective-taking and co-rumination relate to the formation and maintenance of social relationships during adolescence and 2) understand how adolescents may adapt their engagement in these processes to align with their peers and friends. In Chapters 2 and 3, I present empirical research connecting perspective-taking and co-rumination to social outcomes in adolescence. In Chapter 4, I discuss the overall findings and implications of this research.

CHAPTER II

THE ROLE OF PERSPECTIVE-TAKING IN THE FORMATION AND MAINTENANCE OF ADOLESCENT FRIENDSHIPS

Introduction

School Transitions and Peers

In the U.S., early adolescence (around 10-12 years old) typically coincides with the progression from primary school to secondary school. The transition to secondary school represents a time of great change in the social networks of adolescents, for whom establishing close friendships is a major developmental task (Bagwell et al., 1998). Notably, these changes are characterized by opportunities to form connections with a new, larger group of peers, in contrast to the smaller, more limited, social networks of primary school. While primary school students typically spend the majority of their time in the same classroom with the same peers and teacher, secondary school typically involves contact with different peers for different school subjects, and a larger pool of similarly-aged peers (Juvonen, 2007).

For adolescents, this transition into a new schooling environment can provide both opportunities to shape their social world and form valuable friendships, and challenges as they must learn to navigate an unfamiliar and increasingly complicated social world. Learning to successfully navigate the social world is key to adolescent wellbeing, as individuals who struggle to form close friendships in early adolescence are more likely to develop negative health outcomes (Allen et al., 2024; Goosby et al., 2013; Schwartz-Mette et al., 2020), while adolescents who are accepted by their peers are more likely to be involved in school and have higher academic achievement (Kingery et al., 2011). Peer relationships have been identified as a fundamental influence on adolescents' positive or negative outcomes during primary-secondary

school transitions, and as a primary concern by both students and parents (Jindal-Snape et al., 2020). Across cultures, support from friends during the transition to secondary school is related to well-being and school satisfaction (Oriol et al., 2017). Additionally, having more friends and higher-quality friendships in adolescence has been associated with better social, behavioral, and emotional adjustment (Waldrip et al., 2008).

While school transitions present a number of salient concerns, such as academic difficulties and problems with peers, they may also be a positive opportunity for students, providing a fresh start for those with negative peer experiences in primary school (Lorijn et al., 2024). Peer connections, or a lack thereof, can influence adolescents' wellbeing at a crucial time in their socio-cognitive development, making the successful navigation of new social networks a priority.

Adolescent Social-Cognitive Development

Co-occurring with school transitions, adolescence is a time of tremendous physical, cognitive, and social development, and has been identified as a potential sensitive period for sociocultural processing, including mentalizing (Blakemore & Mills, 2014, see also Cheng, Mills & Pfeifer, 2024). Notably, social cognitive processes such as mentalizing—the ability to represent or infer the mental states of others—continue to develop into, and throughout, adolescence (Devine, 2021; Dumontheil et al., 2010). As the successful navigation of social networks is an important developmental task of adolescence, mentalizing may help to support adolescents in accomplishing this task. Specifically, mentalizing is a potential mechanism in the formation and maintenance of adolescents' peer relationships, which may help to support adolescents' social goals. One facet of mentalizing is perspective taking, defined by Davis (1983) as the tendency to spontaneously adopt the psychological points of view of others.

Perspective taking is one aspect of mentalizing that could facilitate peer connections, as it can increase the likelihood of social cohesion and understanding. In a recent study of early adolescents' perspectives on factors that influence friendship development during school transitions, adolescents valued peers who show supportive and empathetic actions, manage conflicts, and avoid negative behaviors, all of which could be supported by perspective-taking (Krammer et al., 2023). Supporting the idea that perspective-taking plays an important role in social cognition during adolescence, self-reported perspective taking propensity generally increases across adolescence, as does perspective taking propensity measured by a visual perspective taking task, the Director Task (Davis & Franzoi, 1991; Pile et al., 2017; Van der Graaff et al., 2014).

Past research has repeatedly demonstrated that inter-individual variability in mentalizing relates to social functioning in children, though this research has primarily focused on childhood, using theory of mind measures that tap into the ability to take another's perspective. In two longitudinal studies, children with poorer theory of mind skills at age 5 were more likely to have no reciprocated friendships, both at age 5 and age 7 (Fink et al., 2015), and girls with more advanced theory of mind in 4th grade had greater gains in their number of friendships two years later (Gazelle et al., 2022). Additionally, children with better theory of mind performance are rated as more socially competent by their teachers and peers (Liddle & Nettle, 2007; Bosacki & Wilde Astington, 1999). While investigations of mentalizing in adolescent populations are less common, recent work has found relationships between mentalizing and friendship, including friendship style and quality (Białecka-Pikul et al., 2017; Smith & Rose, 2011). Perspective-taking in adolescence has been related to sharing with friends and prosocial behavior, and age-

related increases in perspective-taking mediate age-related increases in prosocial behavior towards friends (Güroğlu et al., 2014; Tamnes et al., 2018; van de Groep et al., 2019).

Selection and Influence Processes in Adolescent Social Networks

While perspective-taking in adolescence has been related to social behaviors (such as prosocial behavior), very little existing work has directly connected perspective-taking to social relationship outcomes, such as peer connections and close friendships. Within reciprocated dyads of peers that spent time together in school, adolescents tend to select others that were similar on perspective-taking (Miklikowska et al., 2022). By measuring social ties in a real-world environment salient to adolescents, such as their school environment, it's possible to investigate how perspective-taking could benefit adolescents in navigating the social world.

Given the relationship between perspective-taking and friendship quality (Smith & Rose, 2011), perspective-taking may be beneficial for facilitating social connection(s). Specifically, adolescents may choose to spend more time with classmates who engage in more perspective-taking, and adolescents with a higher propensity for perspective-taking could form close friendships more quickly, or be more likely to maintain those connections. There may also be bidirectional associations between perspective-taking and peer relationships, where perspective-taking both facilitates peer connections and is in turn socialized by those relationships through the modeling of behaviors. In a study of reciprocated dyads, adolescents who had friends with higher perspective-taking propensity at the beginning of high school showed increased perspective-taking a year later (Miklikowska et al., 2022). The influence-compatibility model suggests that adolescents may change their behavior to become more similar to their peers and friends in order to increase compatibility and prevent rejection (Laursen & Veenstra, 2021). Given that perspective-taking is related to empathy, engaging in perspective-taking could be

helpful for being viewed as an empathetic, thoughtful, and responsive friend, especially in friendships where these qualities are valued/practiced by the other member. However, if a given peer or friend has a low propensity for perspective-taking, it may be beneficial to lower one's own engagement to avoid being perceived as different, and to reduce conflict.

Longitudinal social network methods present opportunities to untangle selection and influence processes (Veenstra et al., 2013). Using stochastic actor-oriented modeling (SAOM), variables such as perspective-taking can be examined in terms of how they relate to the selection of social ties, as well as how an adolescent's social ties may in turn influence their perspective-taking (Snijders et al., 2010). For example, SAOM can be used to understand whether an individual with a certain characteristic such as higher perspective-taking propensity selects more friends, is selected as a friend by more people, or tends to select others with similar perspective-taking propensity. In addition, SAOM can be used to look at whether an individual's behavior may change based on their social ties, as might be the case if an individual's perspective-taking propensity changed over time to more closely match that of their friends. This approach has most commonly been used to examine risk behaviors and maladaptive behaviors. It has been less commonly used to look at prosocial and adaptive behaviors, where findings on peer influences have been mixed (Laninga-Wijnen & Veenstra, 2021).

Some factors may be more relevant for choosing close friends than for choosing peers to "hang out with," which can be addressed by examining multiple social networks. A network of social ties that are defined by spending free time together could demonstrate different selection and influence effects as compared to a network of social ties defined by identified close friendships. For example, it is possible that some characteristics may increase the likelihood of choosing to spend more free time with a peer, but not the likelihood of forming a close friendship

with that peer. In addition, adolescents' behavior can be influenced differently depending on characteristics of the social tie (Giletta et al., 2012). Some behaviors could potentially be adopted more easily than others, which could be observed in a network defined by less strong social ties, or a behavior might require a stronger social tie (e.g. close friendship) in order to propagate through a network.

Given the proposed role of mentalizing as a fundamental support for social interactions in adolescence, we would expect greater engagement in perspective-taking to increase an adolescent's ability to form and maintain social connections in the transition to a new school environment. However, little is known about the role that individual differences in perspective-taking play in helping adolescents to successfully navigate new social networks. Understanding how perspective-taking is related to social connections would further our understanding of how to support adolescents in navigating their social world, especially during periods that may already challenge adolescents' social-cognitive skills.

Current Study

In the current study, we used a longitudinal social network approach (SAOM) to examine how perspective-taking propensity relates to the selection of peer connections and close friendships in sixth-grade students, as well as how a student's perspective-taking propensity is influenced by characteristics of their peer connections and close friendships. We expected that sixth-grade students with higher levels of perspective-taking propensity would have more peer connections and close friendships, and that a student's perspective-taking propensity would change over the course of the year to be more similar to the perspective-taking propensity of their close friends.

Materials & Methods

Procedures

The University of Oregon Institutional Review Board approved all instruments and procedures, as did the involved school district. Two middle schools participated in the present study. Data were collected at three timepoints: Fall 2022, Winter 2023, and Spring 2023. Questionnaires were administered in classrooms during school hours by teachers using electronic data collection methods. Schools were compensated $1000 per year for their participation, and students and families received no compensation. An opt-out consent procedure was used, where students were included in the study unless opted out by their parents or guardian (n=5 across both schools). Families of all sixth-grade students enrolled in participating schools received information about the study and a link to an online form where they could request that their student not be included in the study. Students who were opted out by their parents did not fill out the survey and could not be nominated by their peers. Additionally, each student assented to participate at the beginning of each survey. Students who did not assent to participate in the study did not fill out the survey, but could still be nominated by their peers. The survey included a social network survey and questionnaires, a subset of which are used in the current study.

Participants

A total of 324 sixth-grade students participated from two schools (School 1: $N = 180$, School 2: $N = 144$), both located in the Pacific Northwest of the United States. Both schools were located within the same school district and served sixth- through eighth-grade students. Similar proportions of students at both schools qualified for free or reduced-price lunch (School 1: 63.9%, School 2: 63.7%). Demographics for each school are shown in Table 2.1.

Table 2.1

Participant Demographics

Measure	School	
	School 1 (%)	School 2 (%)
Gender		
Male	41.7	52.8
Female	42.2	34.7
Nonbinary	3.4	6.25
Unknown/Refuse to answer	12.7	6.25
Race & Ethnicity		
White	57.2	70.1
Black	10.5	8.3
Hispanic/Latinx	29.4	22.2
Asian	3.9	2,1
Native Hawaiian/Pacific Islander	2.2	3.5
American Native or Alaskan Native	8.9	8.3
Middle Eastern	1.1	0
Multiracial/Multiethnic	23.3	10.1
Unknown/Refuse to Answer	15	9.7
Language spoken at home		
English only	51.7	61.8
Multiple	32.2	19.4
Unknown/Refuse to answer	16.1	18.8

Note: Race and ethnicity categories are not mutually exclusive. Individuals may be included in more than one category, resulting in percentages that may not add up to 100 percent.

Measures

Peer Connections & Friendships

Students were first asked to nominate up to fifteen peers that they spent free time with in the prior month from a roster of all participating students in their grade. Participants were then asked to endorse whether each nominated peer was a close friend. These two measures were then used to construct two different directed networks—one "peer connection network" where each tie is defined by a student selecting a classmate as someone they spent free time with in the

previous month, and one "close friendship network" where each tie is defined by a student identifying a classmate as one of their close friends.

Perspective-taking Propensity

Perspective-taking propensity was measured using the Interpersonal Reactivity Index perspective taking subscale (IRI-PT; Davis, 1980, 1983). The IRI-PT has been extensively used/validated in adolescent populations, where IRI-PT scores typically increase over the course of adolescence (Davis & Franzoi, 1991; Van der Graaf et al., 2014). Overall perspective taking propensity scores are calculated by averaging Likert-scale responses (5-point scale, ranging from "Does not describe me well" to "Describes me very well") across the 7 items, resulting in a score between 0-4. Higher scores indicate a self-reported higher propensity to take another person's perspective. As our modeling strategy required categorical data, IRI-PT scores were categorized into five bins of equal size. The same bins were used across both schools and all timepoints. Distribution plots of categorized scores are available in Appendix A.

Analytic Strategy

Analyses were conducted using longitudinal Stochastic Actor Oriented Modeling (SAOM, Snijders 1996, 2001), implemented using the RSiena package (version 1.4.7). SAOM simultaneously models the probabilities of changes in ties within one or more social networks, along with probabilities of changes in one or more individual behaviors (for example, perspective-taking propensity) of each actor who is a member of that network (Ripley et al., 2024; Snijders et al., 2010). Importantly, SAOM can be used to disentangle selection and influence effects while controlling for structural network effects such as reciprocity (Snijders et al., 2010; Veenstra et al., 2013). By controlling for structural network effects that are known to

play a role in the dynamics of social relationships, we can more accurately model the impact of our proposed effects on network dynamics.

Two n × n adjacency matrices were created for each school, where n is the total number of students participating in the study. These matrices represented our two networks of interest, the peer connection network and the close friend network, which each captured a different kind of social tie. One adjacency matrix represented peer connection ties, while the other represented close friend ties. Students who left or joined the school over the course of the study were indicated using a composition change vector, which allows for handling changes to the composition of the network separately from missing data (Huisman & Snijders, 2003). Missing data due to non-response were handled using the default missing data strategy in RSiena (Huisman & Steglich, 2008). Results are reported separately for each school and network.

Model Specification

To examine selection and influence effects, SAOMs were created for each school and network (peer and close friend), including both hypothesis-related effects and additional control effects that reflect known fundamental endogenous network effects. Control effects of outdegree (density), reciprocity, and transitive triplets were included to account for known fundamental endogenous network dynamics. A homophily effect for gender was included to account for the tendency of adolescents to spend time with/be friends with peers of the same gender (McMillan, 2022; Mehta & Strough, 2009).

IRI-PT scores were included/modeled as dependent behavior variables. Selection effects of ego effects (sending nominations), alter effects (receiving nominations), and same behavior (homophily) effects were included. For behavior dynamics/influence effects, an average similarity effect was included, defined by the average of centered similarity scores between an

actor and their ties. This effect allows us to test if a student's perspective taking propensity becomes more similar over sixth grade to the average perspective taking propensity of their social connections. Models also took into account rate and shape effects of perspective-taking propensity.

Network evolution was modeled with the evaluation function, which assumes that the creation and maintenance of a connection are equal. Models were estimated using the Method of Moments estimator with 3000 iterations in Phase 3. In Phase 3, the average statistics of many simulated networks (in this case, 3000) are compared to the observed values, and the overall maximum convergence ratio and t-statistics for deviations from observed values are calculated, along with standard errors.

Results

Descriptive Statistics

Descriptive statistics for each participating school are shown in Tables 2.2 and 2.3. Plots of IRI-PT scores over time are available in Appendix B, and correlations between IRI-PT scores and outdegree are available in Appendix C. Reliability of IRI-PT scores was measured using Cronbach's alpha, and values were above 0.7 for both schools. Notably, some change in IRI-PT scores is expected, as the study was designed to measure some degree of change in perspective-taking propensity. Both network density and average degree increased over the course of sixth grade for both peer connection and close friend networks. The Jaccard index, which represents the proportion of stable ties between timepoints, ranged from 0.271 to 0.357 (peer connection network) and 0.253 to 0.349 (close friend network), generally considered good for our modeling strategy. Participation exceeded 80% at all timepoints, generally considered the threshold for sufficient participation using a SAOM approach (Ripley et al., 2024).

Table 2.2

Descriptive statistics of networks and measures.

Measure	Timepoint	School	
		School 1	School 2
N Network Joiners	1-2	1	3
	2-3	4	0
N Network Leavers	1-2	1	7
	2-3	12	13
Peer Connection Network			
Network Density - Peer Connections	1	0.028	0.051
	2	0.040	0.057
	3	0.040	0.061
Average Degree - Peer Connections	1	5.046	7.315
	2	7.245	8.111
	3	7.167	8.707
Jaccard Index - Peer Connections	1-2	0.271	0.288
	2-3	0.320	0.357
# Ties Formed	1-2	616	551
	2-3	463	477
# Ties Disintegrated	1-2	321	452
	2-3	492	429
# Ties Maintained	1-2	350	406
	2-3	449	502
Close Friend Network			
Network Density - Close Friends	1	0.019	0.031
	2	0.026	0.038
	3	0.023	0.038
Average Degree - Close Friends	1	3.386	4.504
	2	4.741	5.405
	3	4.174	5.431
Jaccard Index - Close Friends	1-2	0.253	0.255
	2-3	0.276	0.349
# Ties Formed	1-2	405	394
	2-3	287	298
# Ties Disintegrated	1-2	235	292
	2-3	366	306
# Ties Maintained	1-2	217	235
	2-3	249	324

Table 2.3

Descriptive statistics of perspective-taking.

	Timepoint	School 1	School 2
		M (SD)	*M (SD)*
IRI-PT	1	1.91 (1.51)	1.84 (0.75)
	2	2.23 (0.79)	2.01 (0.68)
	3	2.15 (0.87)	1.93 (0.77)
IRI-PT α	Raw α	0.737	0.731
	Standardized α	0.785	0.738

Structural Network Effects/Behavior Dynamics

Results for the peer connection network are shown in Table 2,4, and results for the close friend networks are shown in Table 2.5. Results are presented separately for each school. All models showed excellent convergence, as shown by the overall maximum convergence ratios ≤ 0.2, and the t-ratios for convergence for individual parameters all less than 0.1 in absolute value.

Peer Connection Networks

Across both schools, control effects were significant, indicating that students with a greater number of peer selections were less likely to select more individuals as connections (negative outdegree); peer selections tended to be reciprocated (positive reciprocity), and individuals who share peer selections were more likely to be connected themselves (positive transitive triplets). There was a significant homophily effect for gender, indicating that close friendship ties were more likely to be created and maintained between students of the same gender.

School 1

A significant positive homophily ($b = 0.650 \pm 0.22$, $p<.01$) selection effect was identified, indicating that ties were more likely to be formed and maintained with peers with the same propensity for perspective-taking. There were no significant ego (sending nominations) or alter (receiving nominations) selection effects, meaning that students with a higher propensity for perspective-taking were not more likely to send or receive more nominations. Additionally, there was no identified average similarity behavior influence effect, indicating that students' perspective-taking propensity did not become more similar to the average perspective-taking propensity of their peer connections.

School 2

No significant effects were identified for ego (sending nominations), alter (receiving nominations), or homophily selection effects for perspective taking propensity (IRI-PT), meaning that students with a higher propensity for perspective-taking were not more likely to send or receive nominations, and ties were not more likely between students with the same propensity for perspective-taking. Additionally, the average similarity influence effect was not significant, indicating that students' perspective-taking propensity did not become more similar to the average perspective-taking propensity of their peer connections.

Table 2.4

RSiena estimation results for peer selection & influence effects on perspective-taking

Peer Selection and Influence

	School 1			School 2		
Effect	par.	(s.e.)	t stat.	par.	(s.e.)	t stat.
Network Dynamics						
constant friendship rate (period 1)	17.981	(1.214)	-	22.973	(1.628)	-
constant friendship rate (period 2)	14.716	(0.908)	-	16.571	(0.941)	-
outdegree (density)	–2.472***	(0.084)	–29.299	–2.111***	(0.064)	–33.224
reciprocity	1.596***	(0.073)	21.994	1.507***	(0.060)	25.014
transitive triplets (1)	0.358***	(0.024)	14.731	0.433***	(0.022)	19.522
same gender	0.456***	(0.041)	11.030	0.238***	(0.039)	6.043
IRI alter	0.025	(0.030)	0.846	–0.022	(0.037)	–0.593
IRI ego	0.022	(0.030)	0.734	–0.008	(0.036)	–0.212
same IRI	0.650**	(0.222)	2.924	–0.310	(0.236)	–1.312
Behaviour Dynamics						
rate IRI (period 1)	4.224	(1.909)	-	2.479	(0.538)	-
rate IRI (period 2)	1.610	(0.421)	-	1.825	(0.394)	-
IRI linear shape	0.188*	(0.075)	2.518	0.018	(0.078)	0.238
IRI quadratic shape	–0.089	(0.155)	–0.573	–0.231	(0.250)	–0.926
IRI average similarity	1.655	(2.405)	0.688	0.727	(2.970)	0.245

† $p < 0.1$; ∗ $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

Convergence t ratios all < 0.06 (School 1), < 0.04 (School 2).

Overall maximum convergence ratio: 0.1 (School 1), 0.09 (School 2).

Note: IRI: Interpersonal Reactivity Index - Perspective Taking subscale.

Close Friend Networks

Across both schools, control effects were significant, indicating that the same endogenous network features were present as in the peer network. There was a significant homophily effect for gender, indicating that close friendship ties were more likely to be created and maintained between students of the same gender.

School 1

A significant positive same behavior/homophily selection effect was identified (b = 0.635 ± 0.31, p<.05), indicating that students were more likely to form and maintain ties to close friends with the same propensity for perspective-taking. There were no significant ego (sending nominations) or alter (receiving nominations) selection effects, meaning that students with a

higher propensity for perspective-taking were not more likely to send or receive close friend nominations. Additionally, there was no average similarity behavior influence effect, indicating that students' perspective-taking propensity did not become more similar to the average perspective-taking of their close friends.

School 2

There were no significant ego (sending nominations), alter (receiving nominations), or homophily selection effects, meaning that students with a higher propensity for perspective-taking were not more likely to send or receive close friend nominations and were not more likely to form and maintain close friend connections with others that had the same propensity for perspective-taking. Additionally, there was no average similarity behavior influence effect, indicating that students' perspective-taking propensity did not become more similar to the average perspective-taking of their close friends.

Table 2.5

RSiena estimation results for close friend selection/influence effects for perspective-taking

Close Friend Selection and Influence

	School 1			School 2		
Effect	par.	(s.e.)	t stat.	par.	(s.e.)	t stat.
Network Dynamics						
constant closefriendship rate (period 1)	14.027	(1.325)	-	18.785	(1.816)	-
constant closefriendship rate (period 2)	11.770	(0.808)	-	11.391	(0.743)	-
outdegree (density)	–2.776***	(0.120)	–23.137	–2.288***	(0.068)	–33.829
reciprocity	1.814***	(0.087)	20.822	1.812***	(0.078)	23.132
transitive triplets (1)	0.510***	(0.046)	11.010	0.612***	(0.039)	15.843
same gender	0.507***	(0.049)	10.366	0.245***	(0.041)	5.034
IRI alter	–0.004	(0.040)	–0.109	–0.046	(0.041)	–1.128
IRI ego	0.061	(0.040)	1.515	0.056	(0.042)	1.355
same IRI	0.635*	(0.311)	2.044	–0.361	(0.254)	–1.418
Behaviour Dynamics						
rate IRI (period 1)	4.167	(1.134)	-	2.487	(0.577)	-
rate IRI (period 2)	1.596	(0.366)	-	1.817	(0.358)	-
IRI linear shape	0.190*	(0.090)	2.104	0.019	(0.079)	0.242
IRI quadratic shape	–0.122	(0.140)	–0.874	–0.213	(0.185)	–1.151
IRI average similarity	1.154	(2.470)	0.467	0.979	(2.387)	0.410

† $p < 0.1$; ∗ $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

Convergence t ratios all < 0.07 (School 1), < 0.06 (School 2).

Overall maximum convergence ratio: 0.11 (School 1), 0.09 (School 2).

Note: IRI: Interpersonal Reactivity Index - Perspective Taking subscale.

Discussion

The transition into secondary school is characterized by a number of shifts in early adolescents' social networks and coincides with changing social cognitive capacities (Smetana & Villalobos, 2009). Understanding how adolescents use socio-cognitive skills such as perspective-taking in order to navigate new environments to form connections with peers is crucial for understanding how best to support adolescents during this transition.

This study applied a longitudinal social network approach to identify the mechanisms by which perspective-taking propensity influences social connections within the school environment in 324 adolescents transitioning into and across the first year of middle school. Self-reported perspective-taking propensity at the beginning of sixth grade was related to forming and

maintaining both peer relationships and close friendships across sixth grade, for one of the two participating schools. There was no evidence that a student's perspective-taking propensity became more similar to their peers or close friends over time. These results provide a novel insight into the real-world impacts of perspective-taking on peer relationships during school transitions.

Notably, results differed between the two included schools. For School 1, homophily effects of perspective-taking were found for both peer connections and close friendships. In School 2, perspective-taking propensity was unrelated to both peer connections and close friendships. While both schools were located in the same school district, there were several differences in their demographics and network structures that could affect the utility of different socio-cognitive skills and strategies, including engagement in perspective-taking. In terms of network characteristics, School 1 had a lower average degree for both peer connections and close friends, as well as lower network density. Average perspective-taking propensity was also slightly higher in School 1. The lower average degree and density of School 1 indicates that the network is less inter-connected, and groups are more insular. It's possible that different perspective-taking strategies are beneficial in this context compared to more inter-connected networks where members may have additional ways to gain explicit knowledge about others. Additionally, the average degree of School 1 was particularly low compared to School 2 at the beginning of the year and increased more sharply between Fall and Winter. While we did not have access to information about students' knowledge of each other from primary school, it's possible that School 1 may have presented more opportunities for connections with previously unknown peers than School 2. In this case, different strategies could be adaptive for facilitating

connections with previously unknown peers versus peers that are familiar but have not previously connected.

Notably, there were variations in the gender and race/ethnicity demographics of the two schools. School 1 had a more even balance of male and female students and a lower proportion of non-binary students compared to School 2, as well as a higher proportion of multiracial participants. However, School 1 also had more missing data for both gender and race/ethnicity. Previous work has suggested that engagement in perspective-taking reflects previous experiences with social attunement, and is related to factors such as social status (Wu & Keysar, 2007; Dietze & Knowles, 2021). In line with this, recent work has found that Latine, Black, and multiracial youth who engage in earlier exploration of and feel more clarity about their ethnic-racial identity show higher levels of perspective-taking in early adolescence, and remain high in perspective-taking across adolescence (Jorgensen et al., 2025). While we did not collect information regarding identity development, differences in demographic contexts between the schools could affect students' opportunities for conversations about identity exploration. Additionally, students' perceived social status may be impacted by group dynamics, and whether they exist in a majority or minority group within their school. Intersectional work focused on perspective-taking and social class in adolescence has also found that Chilean adolescents who reported high levels of perspective-taking and low social class prejudice were more likely to form and maintain cross-ethnic friendships (Chávez et al., 2021). Perspective-taking may be utilized differently depending on how many others in the network have shared experiences, or whether someone is in the majority group of the school.

Due to a high number of multiracial and multiethnic students across both schools, we did not include race and ethnicity in the models. SAOMs typically include homophily effects for

race and ethnicity, reflecting the tendency to be more likely to form friendships with those that share the same identity. However, given that many students held multiple ethnic/racial identities, it was not feasible to model all combinations of identities, and including a multiracial/multiethnic category would have obscured nuances in individual identities. Similarly, while we included a homophily effect for gender, there were a substantial number of non-binary participants. Previous work using a SAOM framework has not considered the effect of non-binary identity on network dynamics, and more research is needed to understand how these effects may align with or differ from previously established gender dynamics.

The homophily effect observed in School 1 aligns with previous research which found that students tended to befriend peers with similar perspective-taking (Miklikowska et al., 2022). Importantly, the current study extends this finding by using SAOM, which can disentangle the selection and influence processes that lead to shared characteristics in relationships. Furthermore, the current study replicated these findings in a younger age range, across different types of social ties, and across multiple relationships, as opposed to the single reciprocated friendship examined in Miklikowska et al. (2022).

Our findings that adolescents tend to form and maintain connections with peers and close friends that engage in similar levels of perspective-taking propensity add to past research that has found relationships between perspective-taking and prosocial behavior, as well as friendship quality (Güroğlu et al., 2014; Smith & Rose, 2011; Tamnes et al., 2018). Specifically, prior work has found that found that perspective-taking is related to prosocial behavior in adolescence, both cross-sectionally (Tamnes et al., 2018) and longitudinally (Güroğlu et al., 2014), where age-related increases in perspective-taking mediate age-related increases in prosocial behavior towards friends. Additionally, Smith & Rose (2011) found that self-reported tendency to take a

specific friend's perspective was positively related to the friendship's quality. Importantly, this study builds on these prior findings by integrating longitudinal social network data with measurements of perspective-taking, providing a new perspective on the relationship between perspective-taking and peer connections/close friendship during an important educational transition.

While we expected that a higher propensity to take others' perspectives would be related to more peer connections and close friendships, other dimensions of mentalizing such as accuracy, or combinations such as high propensity and high accuracy may be more relevant. As most past research has focused on friendship quality and prosocial behavior towards friends, it may also be the case that perspective-taking is more strongly related to friendship quality and behavior within friendships than it is for overall ties.

In the current study, we found no evidence for peer or close friend influence effects in either school. While some previous work has found greater increases in perspective-taking among students with friends who have higher propensity for perspective-taking, there were several differences in our methodological approaches (Miklikowska et al., 2022). Notably, the current study considered multiple social ties instead of one reciprocated friendship, used an SAOM approach that accounts for both selection and influence processes, and focused on a younger age range (middle school, instead of high school). Any one of these differences, or a combination of all three could explain the differential findings. Adolescents may be differently susceptible to peer influences over the course of adolescence, and perspective-taking may also be utilized differently as social-cognitive abilities continue to improve. We also captured the cumulative influence effects across connected peers and friends, who may not be equally influential. Furthermore, the previous finding considered influence effects and selection effects

separately, in different types of friendships. Additionally, studies on prosocial influences within an SAOM framework have found mixed evidence for influence effects (Laninga-Wijnen & Veenstra, 2023).

The results of this study have a number of implications for opportunities to support adolescents during the transition to middle school, a time that is characterized by significant changes to their social networks, and coincides with the social, cognitive, and physical changes of adolescence. Social relationships are a major concern for students and parents during school transitions and are a significant influence on transition outcomes (Jindal-Snape et al., 2020). Despite this, many students report feeling unprepared to navigate their new social environments and receive limited instruction on how to navigate this transition (van Rens et al., 2018). Additionally, discussions and training in how to form friendships have been proposed as a potential improvement to school environments by early adolescents (Persson et al., 2015). Increasing perspective-taking propensity could be a potential target for intervention and education before students enter secondary school. Integrating perspective-taking into social-emotional learning modules during the last year of primary school could potentially boost perspective-taking skills in time for the middle school transition.

This study has several strengths, most notably the integration of social network methods with perspective-taking measures, allowing us to connect perspective-taking to real-world relationships. We were able to directly test how an individual's propensity for perspective-taking matters for forming social connections, using an ecologically valid measure of social functioning by measuring actual peer connections at multiple levels. By collecting network data, we were also able to investigate homophily effects related to perspective-taking. Additionally, the use of repeated measurements enabled longitudinal analyses of perspective-taking and peer connections

over the course of the first year of secondary school. Crucially, we were able to disentangle selection and influence processes using stochastic actor-oriented modelling, which is impossible without longitudinal network data.

The results of this study provide an important first connection between mentalizing and peer connections during the transition into middle school. However, as with most investigations of adolescent mentalizing, only one dimension (perspective-taking propensity) was measured. Future work should expand these initial findings to account for additional dimensions of mentalizing, such as accuracy and tendency, which would enable investigations of mentalizing profiles (Guazzelli Williamson & Mills, 2023). Mentalizing dimensions may interact in ways that change their utility — for example, high propensity for mentalizing may not be beneficial if an adolescent is low on accuracy, while high accuracy may not be helpful if propensity/tendency is low. By utilizing a profile approach, future work can better understand the specific dimensions of mentalizing that are most beneficial for supporting social development and peer relationships. Additionally, the relationship between perspective taking and peer connections differed between the two schools included in the study, and future work should explore to what extent these results vary across schools. It is possible that the utility of perspective-taking depends on characteristics of individual schools and social networks, and there may be other socio-cognitive strategies that are more adaptive for certain network characteristics. For example, secondary schools may differ in how many primary schools their students come from, changing the degree to which the secondary school presents opportunities for new peer connections. Future research could consider measuring social networks on both sides of the school transition or collecting data on how many peers and close friends were known to each student prior to secondary school. Additionally, collecting data from a wider variety of schools may help to clarify the extent to

which demographic differences play a role in the relationship between perspective-taking and network dynamics.

In the current study, no evidence was found for influence effects on perspective-taking propensity. While the three measurements over the course of a year used in the current study present a significant advance in our ability to untangle selection and influence effects, it is possible that social influence effects on perspective-taking take place on a longer timescale, such as across multiple years of secondary school, or across adolescence. Additionally, while the current study looked at the influence of two different types of social ties, peer connections and close friends, influence effects could be specific to additional contexts, such as best friends or reciprocated friendships. The peer influence literature has also focused on the role of specific network members, such as students who are the most central to the network or popular students (Laninga-Wijnen et al., 2020).

Conclusion

Our findings indicate that perspective-taking propensity is connected to real-world social connections during a crucial period for adolescents—the transition to secondary school. These findings build from previous research, which has connected perspective-taking in adolescence to friendship quality and prosocial behavior (Smith & Rose, 2011; Tamnes et al., 2018; van de Groep et al., 2019). However, past research has not connected perspective-taking directly to real-world social networks, which is crucial for understanding how perspective-taking may actually facilitate social connections. Furthermore, the current study used a longitudinal approach, which is key for understanding the development of social connections, especially during transitional periods.

In addition to advancing our understanding of how individual differences in perspective-taking relate to real-world social ties, this study also provides insights into one practical potential mechanism for supporting social connections during school transitions. Social relationships are a major concern during transition, as well as a significant influence on transition outcomes (Jindal-Snape et al., 2020), but many students report feeling unprepared for navigating their new social environments (van Rens et al., 2018). Discussion and training in how to form friendships have been proposed by early adolescents as a potential improvement to school environments (Persson et al., 2015), and this could include content focused on perspective-taking.

This study provides an important step forward in our understanding of individual differences in perspective-taking propensity measured within social networks. Connecting longitudinal social network data to measures of social cognition opens the door for future work that can advance our understanding of the dynamics of prosocial behavior and social cognitive development within social networks.

CHAPTER III

CORUMINATION ACROSS CLOSE FRIENDSHIPS

Introduction

The transition into early adolescence is characterized by extensive changes across physical, cognitive, and social domains. Changes to adolescents' social networks and social worlds are extensive, with adolescents spending an increasing amount of time with their peers (Lam, McHale, & Crouter, 2014). Adolescents may also increasingly rely on these peers for social support, an important positive factor for adolescent well-being (Schwartz-Mette et al., 2020). However, some forms of social support may have trade-offs. Specifically, co-rumination, or excessively talking about problems within a dyadic relationship, has been proposed to relate to both increased friendship quality as well as internalizing problems (Rose, 2002).

Co-Rumination in Adolescence

Co-rumination can be conceptualized as an ongoing process that supports social connection and provides a venue for adolescents to learn to manage and regulate their emotions in a peer context. Originally conceptualized as existing at the overlap of rumination and self-disclosure, co-rumination is an inherently social process (Rose, 2002). Notably, more recent work has emphasized that co-rumination extends beyond rumination and self-disclosure to include additional social processes, such as social support, problem-solving, and responsiveness (DiGiovanni et al., 2026).

Co-rumination has been related to both benefits, including social support and increased friendship quality, as well as potential costs, such as internalizing problems. Co-rumination increases from late childhood through mid-adolescence, with the majority of research focused on co-rumination during adolescence (Rose 2021). Co-rumination has consistently been related to

positive friendship quality (Felton et al., 2019; Rose 2002, 2007) as well as positive friendship provisions (Borowski & Rose, 2024). In terms of internalizing problems, co-rumination has been related to higher self-reported anxiety and depression and has been found to predict increasing anxiety and depression in girls (Rose et al., 2007; Tompkins et al., 2011).

While co-rumination has typically been conceptualized as having both costs and benefits for adolescents, there appears to be considerable individual variation in how adolescents experience those trade-offs. In a recent study using a within-subjects approach, some adolescents experienced only the costs or only the benefits of co-rumination (DiGiovanni et al., 2021). Additionally, when latent profiles of co-rumination, depressive symptoms, and social support were created, co-rumination was linked to depressive symptoms, but not all adolescents who co-ruminated exhibited depressive symptoms (Tilton-Weaver & Rose, 2023). Recent work has also suggested that the theorized trade-offs of co-rumination may only occur at the between-person level, as co-rumination was associated with friendship quality but not depressive symptoms at the within-person level (Bernasco et al., 2025).

The association between co-rumination and depression is also dependent on relationship quality, with depression linked to co-rumination in low-, but not high-quality relationships (Guassi Moreira et al., 2016). Co-rumination has also been found to moderate the relationship between emotional competencies and depressive symptoms, such that when girls engaged in high levels of co-rumination, poor emotional awareness was associated with depressive symptoms in their friend (Miller et al., 2020). Additionally, at high levels of co-rumination, adolescents who had stronger sadness regulation or perceived their friend as having stronger anger regulation demonstrated fewer depressive symptoms (Miller et al., 2020).

Furthermore, while co-rumination has been consistently linked to friendship quality, it's unclear how co-rumination is linked to adolescents' broader social networks. Across different studies, co-rumination has been related to network size in varying ways, and this relationship may be influenced by gender and time dynamics. Cross-sectionally, higher co-rumination has been related to a lower number of self-reported friends (Tompkins et al., 2011). In a sample of adolescent girls, higher co-rumination was cross-sectionally related to a higher number of male friends and longitudinally related to fewer female friends (Starr & Davila, 2009). Additionally, Jones & Heerey (2022) found no relationship between co-rumination and network size.

Together, these findings suggest that co-rumination does not always result in negative outcomes and may be impacted by numerous social cognitive factors and friendship characteristics. Additionally, it's unclear how co-rumination relates to broader network structures.

Peer Connections, Peer Influences, & Social Learning

For adolescents, establishing close friendships is a major developmental task (Bagwell et al., 1998). Adolescents begin to spend more time with peers and increasingly rely on peers for social support (Lam, McHale, & Crouter, 2014), an important contributor to adolescent wellbeing (Chu et al., 2010; Petersen et al., 2023).

Adolescence has also been theorized as a sensitive period for sociocultural processing, where changes to the social environment may interact with changes in social sensitivity and cognitive processes (Blakemore & Mills, 2014). In line with this, adolescents seem to have heightened social sensitivity to peer influences (Prinstein & Dodge, 2008; Somerville et al., 2013). Peer influences have been examined in relation to a number of behaviors and outcomes in

adolescence, including depression (Van Zalk et al., 2010), delinquency (Burk et al., 2007), and alcohol use (Mercken et al., 2012).

Peers/peer relationships can also be an important venue for the socialization of behaviors, including emotion regulation (Borowski & Zeman, 2025). Social learning theory suggests that individuals learn behaviors by observing others. In this way, adolescents may become more similar to their friends over time. The similarity-compatibility model suggests that similarity reflects compatibility, which can foster cooperation and rewarding interactions (Byrne, 1971; Laursen, 2017). However, similarity can be achieved either by forming ties with others who are already similar, or by changing one's behavior to become more similar. Specifically, the influence-compatibility model supports the idea that individuals may change their behavior to match the observed behavior of others, in order to increase compatibility and prevent rejection (Laursen & Veenstra, 2021).

Longitudinal social network methods present opportunities to disentangle selection and influence processes (Veenstra et al., 2013). Using stochastic actor-oriented modeling (SAOM), behaviors such as engagement in co-rumination can be examined in terms of how they relate to the selection of social ties, as well as how an adolescent's social ties may in turn influence their engagement in co-rumination (Snijders et al., 2010). For example, SAOM can be used to understand whether an individual with a certain characteristic such as higher engagement in co-rumination selects more friends, is selected as a friend by more people, or tends to select others with similar perspective-taking propensity. In addition, SAOM can be used to look at whether an individual's behavior may change based on their social ties, as might be the case if an individual's engagement in co-rumination changed over time to more closely match that of their close friends.

The direct influences of friends' co-rumination on an individual's co-rumination are yet to be investigated. However, co-rumination has been found to predict depression, which in turn predicts co-rumination (Rose et al., 2007). One difficulty for understanding influence effects of co-rumination is that most studies lack dyadic co-rumination measures, making it difficult to identify how someone is influenced by the co-rumination of others in their network. Additionally, co-rumination is typically reported in terms of overall co-rumination or co-rumination with one specific friend, often a best friend, at a single timepoint.

Measuring co-rumination as a trait-level construct limits our ability to understand how it may be employed/utilized within and across/between friendships. Similarly, a lack of longitudinal approaches limits our understanding of how co-rumination may fluctuate across the course of a relationship to serve different purposes/goals, or to more closely align with friends.

Social Reward

Heightened sensitivity to social reward has been proposed as one mechanism that could play a role in sensitivity to peer influences (Foulkes & Blakemore, 2016). Most evidence for heightened social reward in adolescence has come from animal research, and human studies have been less conclusive (Foulkes & Blakemore, 2016). Adolescence may be a time for heightened reward sensitivity in general, including social reward sensitivity (van Duijvenvoorde et al., 2016). In line with this, past work has found increases in sensitivity to both social and monetary rewards during adolescence (Kilford et al., 2016). Additionally, adolescents may be sensitive to all social information, regardless of valence.

Co-rumination is often described as a socially rewarding activity, as it provides social support and is linked to higher friendship-quality and closer friendships. Therefore, adolescents who have a higher enjoyment of social reward may be more likely to: 1) co-ruminate, and 2) be

sensitive to peer influences on co-rumination, such as changing their engagement in co-rumination to match that of their close friends.

Current Study

The current study uses a longitudinal social network approach with co-rumination data from individual friendships to investigate the relationship between co-rumination and social networks, as well as individual variation in co-rumination across friendships, and influence effects of co-rumination between close friends. As previous work in this area has been mixed, we did not have a priori hypotheses about co-rumination and network size. We did expect that students would become more similar to their close friends in their engagement in co-rumination.

Materials & Methods

Procedures

The University of Oregon Institutional Review Board approved all instruments and procedures, as did the involved school district. Two middle schools participated in the present study. Data were collected from both schools at three timepoints over the course of 6th grade: Fall 2022, Winter 2023, and Spring 2023. Additionally, data from School 2 were also collected in Fall 2023, Winter 2024, and Spring 2024, encompassing 7th grade. Questionnaires were administered during school hours during a time designated by the 6th grade teachers, using electronic data collection methods. Schools were compensated for their participation, and students and families received no compensation. An opt-out consent procedure was used, where students were included in the study unless opted out by their parents or guardian (n=11 across two schools). Families of all 6th grade students enrolled in participating schools received information about the study and a link to an online form where they could request that their student not be included in the study. Students who were opted out by their parents did not fill out

the survey and could not be nominated by their peers. Additionally, each student assented to participate at the beginning of each survey. Students who did not assent to participate in the study did not fill out the survey but could still be nominated by their peers.

The survey included a social network survey and questionnaires, a subset of which are used in the current study.

Participants

Participants were sixth grade students from two schools, both located in the Pacific Northwest of the United States. Participation differed by analysis, with 324 students included in the network analyses and 311 included in characterization analyses. Demographics for each school are shown in Table 1. In total, 11 students were opted out of the survey by their parents or guardians. From School 1, 1 student was opted out at the first timepoint of the study. From School 2, 4 students were opted out at the first timepoint, along with 3 at timepoint 4, 2 at timepoint 5, and 1 at timepoint 6. If a previously participating student was opted out of the study at a later time, they were removed from the roster at subsequent waves, but preceding data were retained.

Social Network Analyses

For the social network analyses, only data from the first year of data collection (6th grade, timepoints 1-3) were used. This approach allowed us to directly compare both schools over the same timeframe. Additionally, there was a higher amount of missing data in Year 2, limiting our ability to apply stochastic actor-oriented modeling, given the stringent missing data requirements. Across both schools, 324 students were included in the social network analyses.

Table 3.1

Participant Demographics

Participant Demographics

Measure	School	
	School 1 (%)	School 2 (%)
Gender		
Male	44.9	54.2
Female	46.7	36.8
Nonbinary	3	6.25
Unknown/Refuse to answer	5.4	2.8
Race & Ethnicity		
White	61.1	73
Black	12	8.3
Hispanic/Latinx	33	23.6
Asian	3.6	2.1
Native Hawaiian/Pacific Islander	2,4	3.5
American Native or Alaskan Native	8.9	8.3
Middle Eastern	1.2	0
Multiracial/Multiethnic	20.1	20.1
Unknown/Refuse to Answer	7.8	5.6

Note: Demographics shown represent all students who provided co-rumination data.
Race and ethnicity categories are not mutually exclusive. Individuals may be included in more than one category, resulting in percentages that may not add up to 100 percent.

Measures

Peer Connections & Close Friendships

Students were first asked to nominate up to fifteen peers that they spent free time with in the prior month from a roster of all participating students in their grade. Participants were then asked to endorse whether each nominated peer was a close friend, and which, if any, was their best friend.

Co-Rumination

Co-rumination was measured using the 9-item version of the Co-Rumination Questionnaire (Hankin et al., 2010; Rose, 2002), which covers nine content areas related to co-

rumination, and assesses the extent to which the respondent co-ruminates with friends. Participants filled out the nine items for each nominated close friend. An average score was created for each close friend, and a second average was calculated across all close friends.

Social Reward/Prosocial Interactions

Enjoyment of prosocial interactions was measured using the Prosocial Interactions subscale of the Social Reward Questionnaire - Adolescent Version (SRQ-A; Foulkes et al., 2017). The Prosocial Interactions subscale measures the extent to which adolescents enjoy having kind, reciprocal relationships. Items were measured using a 7-point likert scale, and responses for the subscale were averaged.

Analytic Strategy

Characterization of Co-Rumination

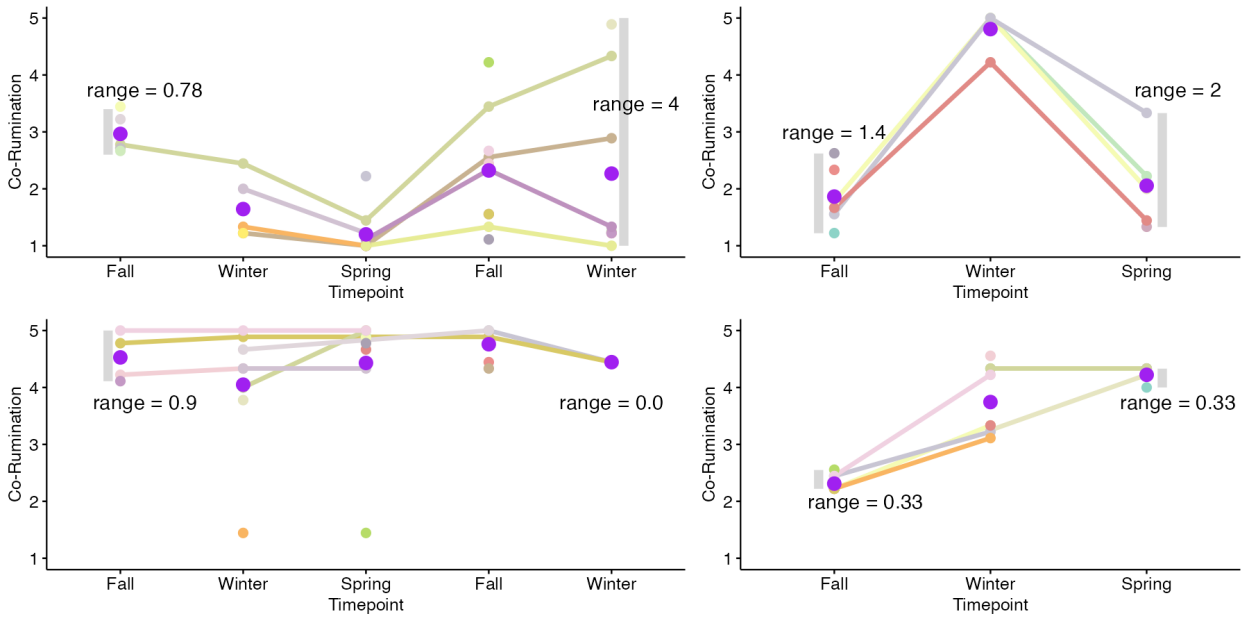
As a primary goal was to understand the relationship between co-rumination and network size, as well as to understand individual differences in co-rumination across friends and over time, correlations were calculated between variables related to co-rumination (including average co-rumination across close friends and range width) and network variables.

To account for the requirements of our analytic approach, which generally uses discrete ordinal categories, average co-rumination across close friends was broken into eight equal bins for analyses related to network and behavior dynamics. Plots of the categorized distributions are available in Appendix D.

Co-Rumination Variables. Co-rumination was calculated both as an average across close friends, and an average per close friend. Variation in co-rumination across close friends was described using the width of the range of average co-rumination across close friends, illustrated in Figure 3.1.

Figure 3.1

Descriptive plots of individual students' co-rumination. Purple dots represent average co-rumination across close friends at that timepoint. Each point represents co-rumination with a specific close friend, and lines connect the same close friends over time. Vertical light gray bars represent the range of co-rumination values, and labels indicate the width of the range.



Network Variables. Co-rumination was characterized in relation to network variables including indegree (number of incoming nominations) and outdegree (number of outgoing nominations). Indegree and outdegree were calculated for both peer connections (those the student had spent free time with in the last 30 days) and close friend (peer connections who were endorsed as a close friend). For an illustrative example of the network variables, see Figure 3.2.

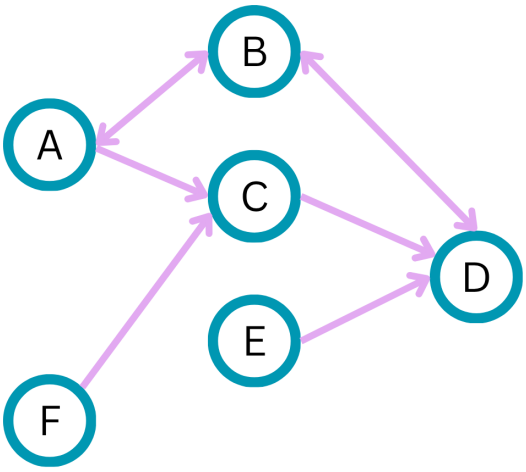


Figure 3.2

Network Example. In this network, A has an indegree of 1, and an outdegree of 2. B has an indegree of 2 and an outdegree of 2. C has an indegree of 1 and an outdegree of 1. D has an indegree of 3, and an outdegree of 1. E has an outdegree of 1 and an indegree of 0, as does F.

Network & Behavior Analyses/Stochastic Actor Oriented Modeling

Analyses were conducted using longitudinal Stochastic Actor Oriented Modeling (SAOM, Snijders 1996, 2001), implemented using the RSiena package (version 1.4.7). SAOM simultaneously models the probabilities of changes in ties within one or more social networks, along with probabilities of changes in one or more individual behaviors (for example, perspective-taking propensity) of each actor who is a member of that network (Ripley et al., 2024; Snijders et al., 2010). Importantly, SAOM can be used to disentangle selection and influence effects while controlling for structural network effects such as reciprocity (Snijders et al., 2010; Veenstra et al., 2013). By controlling for structural network effects that are known to play a role in the dynamics of social relationships, we can more accurately model the impact of our proposed effects on network dynamics.

An n × n adjacency matrix was created for each school, where n is the total number of students participating in the study. This matrix represented close friend ties, our network of interest. Students who left or joined the school over the course of the study were indicated using a composition change vector, which allows for handling changes to the composition of the

network separately from missing data (Huisman & Snijders, 2003). Missing data due to non-response were handled using the default missing data strategy in RSiena (Huisman & Steglich, 2008). Results are reported separately for each school.

Model Specification

SAOMs were created for each school, including both hypothesis-related effects and additional control effects that reflect known fundamental endogenous network effects. Control effects of outdegree (density), reciprocity, and transitive triplets were included to account for known fundamental endogenous network dynamics. A homophily effect of gender was included to account for the tendency of adolescents to spend time with and be friends with peers of the same gender (McMillan, 2022; Mehta & Strough, 2009). To examine selection effects, ego effects (sending nominations) and alter effects (receiving nominations) were included in the models. Ego and alter effects indicate that students with higher levels of a behavior give and receive more nominations.

For behavior dynamics/influence effects, an average similarity effect was included, defined by the average of centered similarity scores between the actor and their ties. This effect allows us to test if a student's engagement in co-rumination becomes more similar to their close friends' engagement in co-rumination. These models also took into account rate and shape effects of engagement in co-rumination.

Network evolution was modeled with the evaluation function, which assumes that the creation and maintenance of a connection are equal. Models were estimated using the Method of Moments estimator with 3000 iterations in Phase 3. In Phase 3, the average statistics of many simulated networks (in this case, 3000) are compared to the observed values, and the overall

maximum convergence ratio and t-statistics for deviations from observed values are calculated, along with standard errors.

Results

Descriptive Statistics for Co-Rumination

Table 3.2

Descriptive statistics of average co-rumination across close friends, as well as indegree (incoming nominations) and outdegree (outgoing nominations) for peer nominations.

	Wave 1		Wave 2		Wave 3		Wave 4	Wave 5	Wave 6
Characteristic	School 1[1]	School 2[1]	School 1[1]	School 2[1]	School 1[1]	School 2[1]	School 2[1]	School 2[1]	School 2[1]
avgCorumAll	2.63 (1.09)	2.51 (1.06)	2.59 (1.02)	2.58 (1.06)	2.80 (1.04)	2.53 (1.07)	2.45 (1.10)	2.55 (1.20)	2.71 (1.22)
indegree	5.07 (2.99)	7.14 (3.36)	6.6 (4.7)	7.9 (4.2)	6.6 (3.5)	8.4 (5.2)	6.3 (3.1)	6.7 (3.2)	6.02 (3.09)
outdegree	5.7 (2.9)	8.6 (4.0)	7.7 (4.3)	8.7 (4.5)	8.2 (4.0)	9.1 (4.5)	8.6 (4.2)	7.9 (4.1)	8.5 (4.0)

[1] Mean (SD)

Co-Rumination & Network Size

For peer connections, average co-rumination across close friendships was significantly positively correlated with peer network indegree at timepoint 1 for both schools, and with outdegree at timepoint 1 for School 1 (Tables 3.3-3.4). Co-rumination was not significantly related to indegree or outdegree at timepoints 2 and 3 (School 1) or 2 through 6 (School 2) (Tables 3.3-3.4).

Table 3.3

Peer Indegree & Average Co-Rumination

school	wave	cor	*p*	95% CI
1	1	0.22	.011*	[0.05, 0.38]
1	2	0.05	.553	[-0.12, 0.22]
1	3	-0.09	.374	[-0.27, 0.10]
2	1	0.19	.047*	[0.00, 0.37]
2	2	0.02	.837	[-0.17, 0.21]
2	3	0.13	.187	[-0.07, 0.32]
2	4	0.11	.338	[-0.12, 0.33]
2	5	-0.07	.530	[-0.29, 0.15]
2	6	0.10	.450	[-0.16, 0.34]

Table 3.4

Peer Outdegree & Average Co-Rumination

school	wave	cor	*p*	95% CI
1	1	0.25	.004**	[0.08, 0.41]
1	2	0.07	.399	[-0.10, 0.24]
1	3	0.15	.111	[-0.04, 0.33]
2	1	0.18	.069	[-0.01, 0.36]
2	2	0.13	.175	[-0.06, 0.31]
2	3	0.09	.355	[-0.10, 0.28]
2	4	-0.00	.993	[-0.23, 0.23]
2	5	-0.06	.591	[-0.28, 0.16]
2	6	-0.23	.067	[-0.46, 0.02]

For close friendship, average co-rumination was significantly positively correlated with indegree at timepoint 1 for both schools, and not significantly correlated with indegree at any other timepoint (Table 3.5). Average co-rumination had a significant positive correlation with close friend outdegree at timepoint 1 for School 1 and timepoint 2 for School 2, and was not significantly correlated with outdegree at all other timepoints (Table 3.6).

Table 3.5

Close Friend Indegree & Average Co-Rumination

school	wave	cor	*p*	95% CI
1	1	0.25	.006**	[0.07, 0.41]
1	2	0.06	.515	[-0.12, 0.23]
1	3	0.03	.786	[-0.17, 0.22]
2	1	0.26	.011*	[0.06, 0.43]
2	2	0.04	.696	[-0.15, 0.23]
2	3	0.11	.262	[-0.09, 0.31]
2	4	0.09	.451	[-0.15, 0.32]
2	5	0.01	.963	[-0.22, 0.23]
2	6	0.11	.406	[-0.15, 0.37]

Table 3.6

Close Friend Outdegree & Average Co-Rumination

school	wave	cor	*p*	95% CI
1	1	0.29	.001***	[0.13, 0.43]
1	2	0.08	.370	[-0.09, 0.24]
1	3	0.13	.145	[-0.05, 0.31]
2	1	0.14	.148	[-0.05, 0.33]
2	2	0.25	.006**	[0.07, 0.42]
2	3	0.09	.350	[-0.10, 0.28]
2	4	-0.07	.538	[-0.29, 0.16]
2	5	-0.18	.091	[-0.38, 0.03]
2	6	-0.22	.071	[-0.44, 0.02]

Variation in Co-Rumination Across Close Friendships

Descriptive statistics of the range of co-rumination scores across close friendships are available in Table 3.7.

Table 3.7

Descriptive Statistics of Ranges of Co-Rumination. Average width of the range of co-rumination scores across close friends.

Timepoint	School 1	School 2
	M (SD)	*M (SD)*
1	0.79 (0.8)	1.05 (0.98)
2	1.04 (1.1)	0.97 (0.94)
3	0.96 (0.96)	0.99 (0.97)
4	--	0.9 (0.89)
5	--	0.66 (0.81)
6	--	0.7 (0.71)

Wider ranges of co-rumination scores across close friends were related to higher average co-rumination scores at timepoint 1 for both schools, as well as timepoint 2 (School 1) and timepoints 3 and 6 (School 2) (Table 3.8).

Table 3.8

Range & Average Co-Rumination

school	wave	cor	*p*	95% CI
1	1	0.25	.005**	[0.08, 0.40]
1	2	0.19	.033*	[0.02, 0.35]
1	3	0.08	.414	[-0.11, 0.26]
2	1	0.25	.011*	[0.06, 0.42]
2	2	0.12	.216	[-0.07, 0.30]
2	3	0.31	.002**	[0.12, 0.48]
2	4	0.20	.093	[-0.03, 0.40]
2	5	0.15	.180	[-0.07, 0.36]
2	6	0.32	.011*	[0.08, 0.53]

Co-Rumination Across Time

Co-rumination appears to have substantial variation within individuals across time (Figures 3.3-3.5). At the school level, average co-rumination stayed relatively consistent over time (Table 3.2). Additionally, when looking at co-rumination by friendship type, co-rumination appears to be higher with best friends, compared to other close friends. Notably, overall co-rumination was calculated by averaging co-rumination across endorsed close friends, so some degree of individual variation may reflect changes in friendship composition.

Figure 3.3

Co-Rumination Across Close Friendships

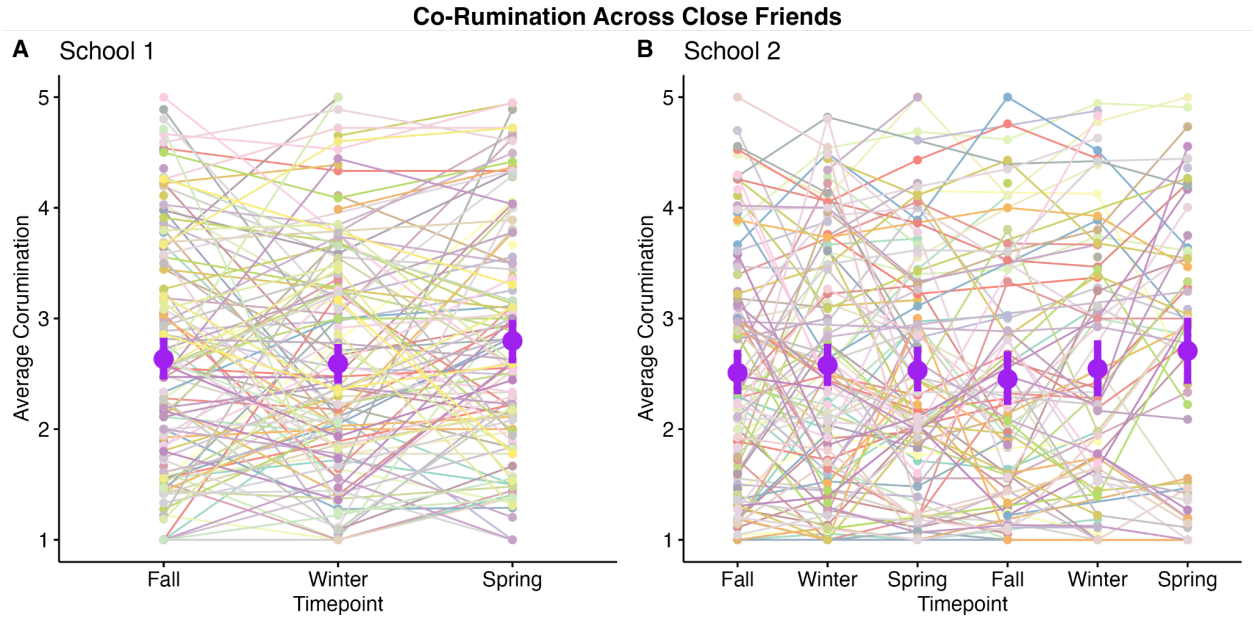


Figure 3.4

Co-Rumination With Best Friend

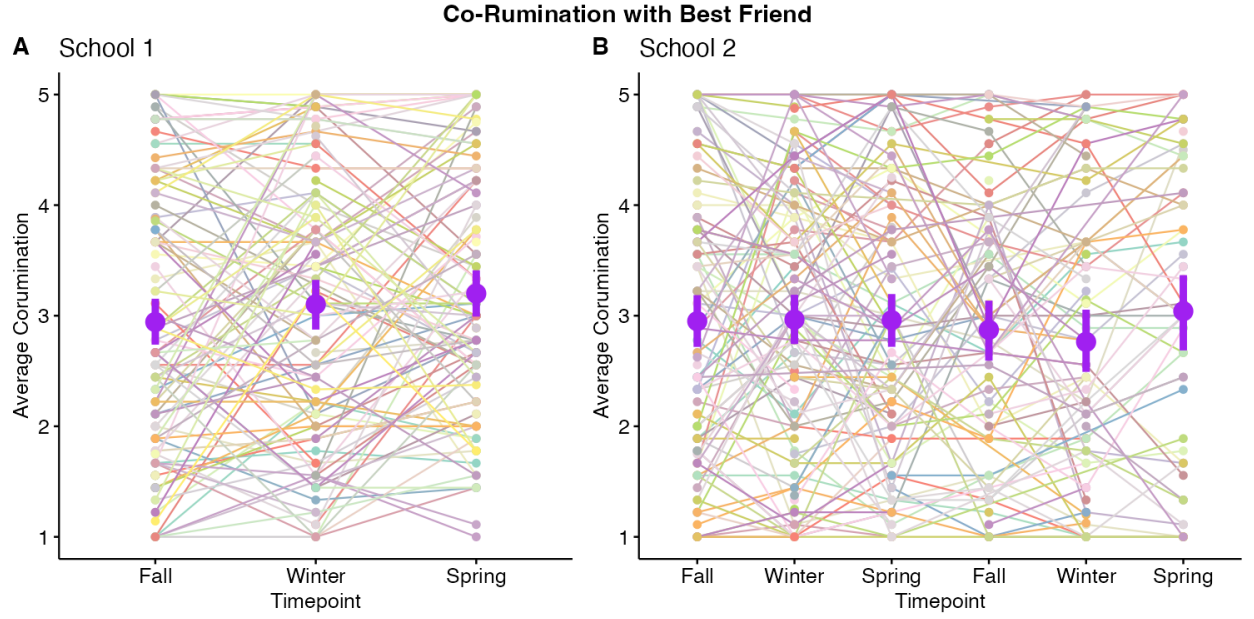
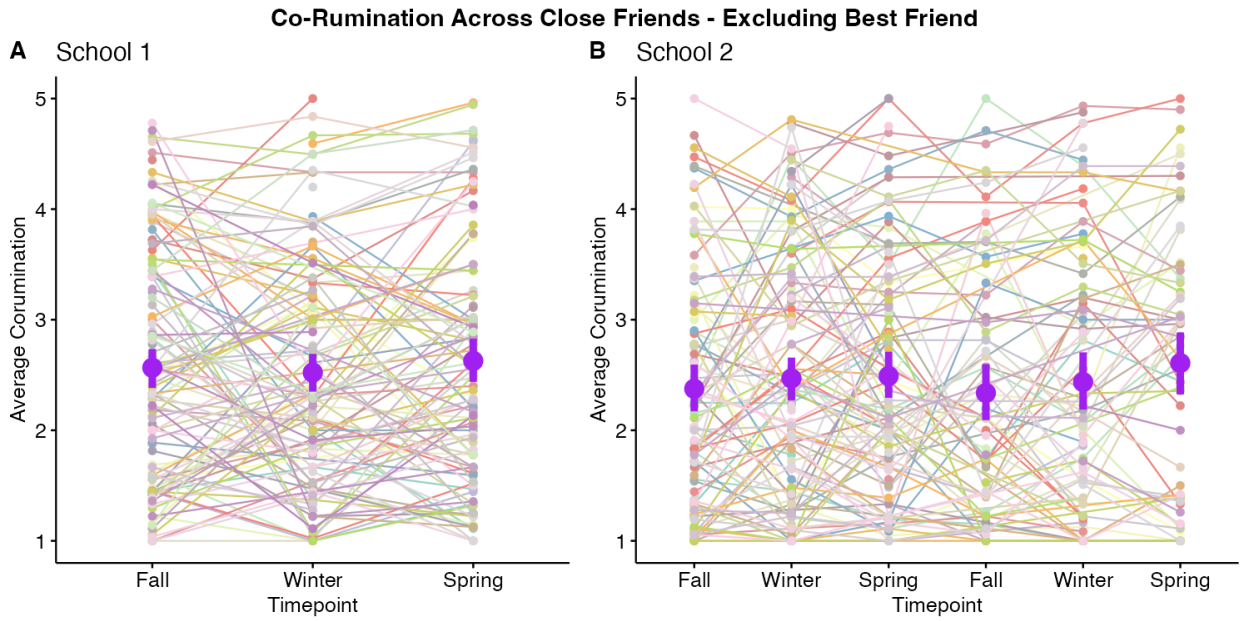


Figure 3.5

Co-Rumination Across Close Friendships - Excluding Best Friends



Descriptive Statistics of Network Variables

Descriptive statistics for each participating school are shown in Tables 3.9 and 3.10. Both network density and average degree increased over the course of sixth grade for the close friend networks. The Jaccard index, which represents the proportion of stable ties between timepoints, ranged from 0.253 to 0.349, generally considered good for our modeling strategy. Participation exceeded 80% at all timepoints, generally considered the threshold for sufficient participation using a SAOM approach (Ripley et al., 2024).

Table 3.9

Descriptive statistics of networks and measures.

Measure	Timepoint	School	
		School 1	School 2
N Network Joiners	1-2	1	3
	2-3	4	0
N Network Leavers	1-2	1	7
	2-3	12	13
Close Friend Network			
Network Density - Close Friends	1	0.019	0.031
	2	0.026	0.038
	3	0.023	0.038
Average Degree - Close Friends	1	3.386	4.504
	2	4.741	5.405
	3	4.174	5.431
Jaccard Index - Close Friends	1-2	0.253	0.255
	2-3	0.276	0.349
# Ties Formed	1-2	405	394
	2-3	287	298
# Ties Disintegrated	1-2	235	292
	2-3	366	306
# Ties Maintained	1-2	217	235
	2-3	249	324

Table 3.10

Descriptive statistics of co-rumination.

	Timepoint	School 1	School 2
		M (SD)	*M (SD)*
Co-rumination	1	2.63 (1.09)	2.51 (1.06)
	2	2.59 (1.02)	2.59 (1.06)
	3	2.80 (1.04)	2.53 (1.07)

Selection and Influence Effects (Network and Behavior Dynamics)

Results for the close friend networks are shown in Table 3.11. Results are presented separately for each school. All models showed excellent convergence, as shown by the overall maximum convergence ratios ≤ 0.2, and the t-ratios for convergence for individual parameters all less than 0.1 in absolute value.

Across both schools, control effects were significant, indicating that students with a greater number of close friends were less likely to select more individuals as connections (negative outdegree), close friendships tended to be reciprocated (positive reciprocity), and individuals who share close friends were more likely to be connected themselves (positive transitive triplets). Additionally, gender homophily selection effects were present in both schools.

School 1

For selection effects, there was a significant ego effect ($b = 0.034 \pm 0.017$, $p<0.05$), indicating that students who reported higher engagement in co-rumination across their close friendships were more likely to send close friend nominations. There was no significant alter effect ($b = 0.025 \pm 0.018$, $p>0.05$), indicating that engagement in co-rumination across close friendships was unrelated to receiving close friend nominations. For influence effects, there was no significant average similarity effect ($b = -0.367 \pm 1.933$, $p>0.05$), indicating that students' engagement in co-rumination did not become more similar to that of their close friends.

School 2

For selection effects, there was a significant ego effect ($b = 0.042 \pm 0.016$, $p<0.01$), indicating that students who reported higher engagement in co-rumination across their close friendships were more likely to send close friend nominations. There was no significant alter

effect (b = -0.004 ± 0.016, p>0.05), indicating that engagement in co-rumination across close friendships was unrelated to receiving close friend nominations. For influence effects, there was no significant average similarity effect (b = 0.459 ± 1.851, p>0.05), indicating that students' engagement in co-rumination did not become more similar to that of their close friends.

Table 3.11

RSiena estimation results for close friend selection/influence effects for co-rumination

Close Friend Network and Behavior Dynamics

	School 1			School 2		
Effect	par.	(s.e.)	t stat.	par.	(s.e.)	t stat.
Network Dynamics						
constant friendship rate (period 1)	17.091	(1.178)	-	18.941	(1.570)	-
constant friendship rate (period 2)	12.121	(0.878)	-	11.335	(0.725)	-
outdegree (density)	–2.548***	(0.042)	–60.685	–2.358***	(0.040)	–58.708
reciprocity	1.729***	(0.087)	19.888	1.681***	(0.082)	20.615
transitive triplets (1)	0.230***	(0.020)	11.386	0.303***	(0.020)	15.313
same gender	0.498***	(0.048)	10.330	0.264***	(0.047)	5.596
corumination alter	0.025	(0.018)	1.365	–0.004	(0.016)	–0.235
corumination ego	0.034*	(0.017)	2.036	0.042**	(0.016)	2.670
Behaviour Dynamics						
rate corumination (period 1)	8.322	(1.602)	-	5.648	(1.397)	-
rate corumination (period 2)	6.127	(1.476)	-	4.389	(0.889)	-
corumination linear shape	–0.061	(0.037)	–1.635	–0.132**	(0.048)	–2.726
corumination quadratic shape	–0.014	(0.040)	–0.353	0.004	(0.036)	0.103
corumination average similarity	–0.367	(1.933)	–0.190	0.459	(1.851)	0.248

† $p < 0.1$; ∗ $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

Convergence t ratios all < 0.07 (School 1), < 0.04 (School 2).

Overall maximum convergence ratio: 0.11 (School 1), 0.07 (School 2).

Co-Rumination & Social Reward

Cross-sectionally, co-rumination was positively associated with SRQ-Prosocial scores, indicating that higher average co-rumination was related to higher prosocial interactions, or the enjoyment of having kind and reciprocal relationships (Table 3.12). This relationship was significant at timepoint 2 for School 1, and for all timepoints for School 2. Visualizations of SRQ-Prosocial scores over time are available in Figure 3.6.

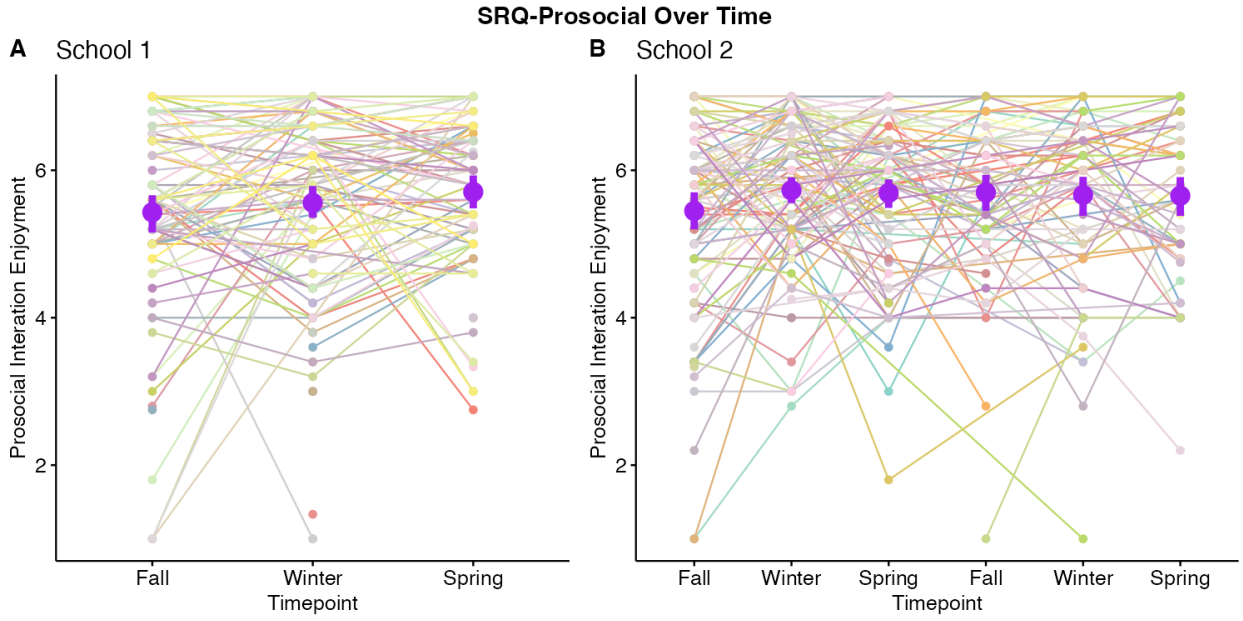
Table 3.12

Average Co-Rumination & SRQ - Prosocial

school	wave	cor	*p*	95% CI
1	1	0.17	.095	[-0.03, 0.36]
1	2	0.28	.002**	[0.10, 0.43]
1	3	0.17	.139	[-0.05, 0.37]
2	1	0.29	.004**	[0.10, 0.46]
2	2	0.41	< .001***	[0.24, 0.55]
2	3	0.24	.016*	[0.05, 0.42]
2	4	0.35	.002**	[0.13, 0.53]
2	5	0.37	.001**	[0.16, 0.55]
2	6	0.35	.007**	[0.10, 0.55]

Figure 3.6

SRQ-Prosocial Scores Over Time



Discussion

The current study characterized co-rumination across close friendships and over time, and examined close friend selection and influence processes related to co-rumination using a longitudinal social network approach. Additionally, co-rumination was related to a measure of social reward, specifically enjoyment of prosocial interactions.

Co-rumination was positively related to both peer and close friend network size during early timepoints, but this relationship varied based on network measure (indegree or outdegree), school, and when in the year the measurement was taken. Co-rumination was not significantly related to network size at all waves, and the directionality of the relationship wasn't consistent, as some waves showed a negative correlation. Previous work has found similarly mixed results, but has been primarily based on only egocentric reports of friendships (Jones & Heerey, 2022; Starr & Davila, 2009; Tompkins et al., 2011). In the current study, both indegree and outdegree were measured. Co-rumination was positively related to both peer and close friend indegree and outdegree at Timepoint 1, except for a non-significant relationship between co-rumination and peer outdegree for School 2. It's possible that students who had larger networks at the beginning of the year entered the network with more existing connections that they felt comfortable disclosing to, while larger networks later in the year may be comprised of more new friendships. Additionally, co-rumination may be more related to longitudinal or delayed changes in connections and less related to cross-sectional network measures. For example, friendship conflict or the loss of a tie could result in later co-rumination, or co-rumination could increase to support closeness in newly formed connections. In short, there may be nuanced relationships between co-rumination and network size that are not easily captured in cross-sectional analyses.

As findings on network size remain inconsistent, more work is needed to clarify the relationship between co-rumination and network size, including the factors that affect the relationship.

Generally, higher average co-rumination was related to a wider range of co-rumination scores. While this relationship was consistently positive, it was not significant at all timepoints. As previous work has typically measured co-rumination either as a report of general behavior or in terms of co-rumination with a specific friend, this effect can't be compared to previous findings. While this is an important characterization of the variation in co-rumination across friendships, future work could expand this to look at the differences between adolescents who are consistently high in co-rumination across friendships, versus those with more variability, or those whose high average co-rumination is driven by a specific friendship.

While no formal analyses were conducted to quantify stability and change in co-rumination over time, visual representations of co-rumination appear to show substantial individual differences in patterns of co-rumination. As suggested by DiGiovanni et al. (2026), co-rumination may fluctuate over the course of relationships to serve different goals. For example, co-rumination may be partially high at the start of a relationship to foster connection or increase over time as relationship partners become more interdependent and reliant on each other for support. Notably, co-rumination in this study was measured across close friendships, such that changes in co-rumination may also be driven by the formation or dissolution of specific friendships. This contrasts with previous research that has tended to measure co-rumination as a trait-level construct and has not considered how change in friendships may contribute to different patterns of co-rumination. In future work, it may be beneficial to consider profiles of co-rumination, such as differentiating between those who engage in high levels of co-rumination across all of their close relationships and those who engage in more variable co-rumination.

Similarly, there may be differences between those who consistently co-ruminate at high levels over time versus those who temporarily engage in high levels of co-rumination.

In terms of network effects, both schools showed a significant positive ego effect, indicating that higher engagement in co-rumination was related to a higher likelihood of nominating more close friends over the year. This indicates that higher engagement in co-rumination could confer some social benefits. However, higher co-rumination was not related to a higher likelihood of being endorsed as a close friend.

In terms of influence effects, adolescents did not become more similar to their close friends in engagement in co-rumination over the school year. Importantly, these influence effects can only be investigated using network data, as was done here. However, it's possible that specific friends are more relevant for peer influence, such as best friends or friends that spend the most time together. Additionally, influence effects were examined over the course of one year, but these processes may take longer to emerge.

In summary, our results indicate that co-rumination should be considered as a nuanced and evolving construct that depends on a variety of factors. When interpreting the results of the current study, attention should be paid to differences between the two included schools. While both schools were located in the same geographic area and school district, there were differences in both the demographic and network characteristics. In terms of demographics, School 1 had a more even gender balance between male and female students, while School 2 was more predominantly male. The trade-off model of co-rumination was originally proposed to account for/reconcile adolescent girls having both higher/more internalizing symptoms and higher-quality friendships, and past work has generally found that adolescent girls engage in co-rumination more frequently than boys (Rose, 2002). The current study accounted for gender in

our modeling approach, but it's also possible there could be more nuanced interactions, or that gender differences between the schools could affect the overall utility of co-ruminating as a mechanism for forming and maintaining relationships. Additionally, our sample included a number of non-binary adolescents, who have not been considered in previous work on co-rumination, or in a SAOM framework. Currently, it is unknown how non-binary gender identity may relate to co-rumination.

School 1 also had more racial and ethnic diversity. Limited work has examined the interaction between race and ethnicity and co-rumination, but preliminary analyses from a study of Black and White adolescents in same-race and cross-race friendships found no differences in co-rumination by friendship type (Stafford, 2023). Additionally, in a sample drawn from two single-gender high schools (one male, one female), Asian American/Pacific Islander girls engaged in more co-rumination than Black and Hispanic/Latin American girls (Lentz et al., 2016). Due to a high number of multiracial and multiethnic students in our sample, we did not include race and ethnicity in the models. Within an SAOM framework, these would be included as a homophily effect and would model outcomes based on whether students share a racial or ethnic identity. However, given that many students held multiple ethnic and racial identities, it was not feasible to model all combinations of identities, and including a multiracial/multiethnic category would have obscured nuances in individual identities.

Strengths & Limitations

This study has a number of strengths, most notably the measurement of co-rumination across adolescents' close friends within a longitudinal social network context. This approach expands our understanding of co-rumination within/across different relationships, and across

time. We were able to directly connect co-rumination to social outcomes and examine direct peer influences on co-rumination.

However, we were unable to connect co-rumination to measures of well-being or internalizing symptoms, which are key components of the trade-off model. While the current study was focused on characterizing individual differences in co-rumination and connecting these to social outcomes, future work should integrate measures of well-being and internalizing symptoms to better understand how variation in co-rumination across friendships and over time relates to the proposed trade-offs.

Additionally, some results differed between schools and timepoints, indicating a need for future work that digs into the specific factors within school networks and across time that may impact co-rumination. While social network data provides crucial insights, analyses are highly sensitive to missing data. Specifically, measures such as indegree are less reliable with lower participation, as students can only be nominated as a connection by other students that have participated in the study. While we achieved an overall high level of participation, some timepoints had lower participation, particularly in Year 2. Similarly, stochastic actor-oriented modeling could only be applied to the data from Year 1 due to missing data constraints.

Conclusion

Our findings indicate that co-rumination is related to real-world social relationships in adolescence, but that there are notable nuances in that relationship depending on a number of factors. These findings build on previous research that has found a link between co-rumination in adolescents and positive friendship quality and social support. However, existing research has typically measured co-rumination within a single relationship, at a single timepoint.

In addition to advancing our understanding of how co-rumination relates to selection and influence processes within social networks, this study also provides insight into/a proof of concept for measuring co-rumination across friendships and over time. Recent work has emphasized/suggested the importance of expanding measurement of co-rumination beyond a trait-level conceptualization (DiGiovanni et al., 2026). In the future, utilizing profile approaches that take into account variation across friendships and changes over time could help to better understand how co-rumination is related to social outcomes, could be influenced by/learned from friends, and for whom and when trade-offs occur.

This study provides an important foundation for future work aimed at broadening our understanding of co-rumination in adolescence. Linking co-rumination directly to data from real-world social networks provides insight into/a proof of concept for moving beyond a trait-level of co-rumination, which can better elucidate which factors contribute to previously investigated trade-offs between internalizing and friendship quality.

CHAPTER IV

DISCUSSION

Adolescence is a crucial period for continued social-cognitive development, which helps to support developmentally relevant goals such as the establishment of close friendships. Understanding social-cognitive processes within the context of ecologically valid and relevant settings is key to understanding how their development impacts social ties/health during key transitions for adolescents. This dissertation examines how social-cognitive processes including perspective-taking and co-rumination both impact social ties and are in turn influenced by those ties.

The first chapter of the dissertation presented an overview of prior research on adolescent social-cognitive development across domains, as well as the mechanisms within social networks that tie those processes to the selection of friends, as well as the mechanisms by which friends may influence social-cognitive processes. In the following two chapters, empirical work was presented examining social-cognitive processes within adolescent social networks. Using longitudinal social network data, we were able to disentangle selection and influence processes. Across both studies, we found/demonstrated that social-cognitive processes including perspective-taking and co-rumination can play a role in the formation and maintenance of both peer connections and close friendships during the transition to secondary school.

Overview of Results

In Chapter 2, we examined selection and influence processes related to perspective-taking propensity for both peer connections and close friendships over the course of sixth grade. In one of the two included schools, adolescents were more likely to select peers and close friends that

engaged in similar levels of perspective-taking. Across both schools, adolescents did not become more similar to their friends in perspective-taking.

In Chapter 3, we characterized individual differences in co-rumination across friendships, people, and over time. Additionally, we examined selection and influence processes related to co-rumination within close friendships. Within people, there was substantial variation in co-rumination across close friendships. Relationships between different measures of co-rumination, such as the average and range, differed over time and between schools. For both schools, higher engagement in co-rumination was related to sending more close friend nominations over the year, but not to receiving nominations. As in Chapter 2, no influence effects were identified in either school.

Summary

Across both studies, we found that social-cognitive processes can be directly connected to the formation and maintenance of social ties, including peer connections and close friendships, during the transition to middle school (Chapters 2 & 3). However, there were school, social tie type, and time-specific effects. Integrating complete social network data with measures of social-cognitive development provided a crucial opportunity to understand how social-cognitive processes support real-world social connections. Additionally, using longitudinal data enabled us to apply a modeling strategy (SAOM) that can disentangle selection and influence processes.

Across both studies, school-specific results were observed for some measures (e.g. the homophily effect of perspective-taking was only found in School 1, and relationships between co-rumination measures, as well as co-rumination and network variables differed between schools). The two included schools differed in their demographic and network characteristics in

ways that could potentially have downstream/broader effects on the utility and dynamics of social-cognitive processes, as well as on the dynamics of network changes.

Network Characteristics

In schools with a lower average degree and lower density, such as School 1, students have fewer connections overall and fewer connections relative to the number of possible connections. It is possible that in less-connected networks where groups are more insular and communication happens with fewer people, different strategies may be more helpful for forming and maintaining connections than in networks with more connection and communication between network members. Additionally, students in School 1 began the year with particularly few average connections compared to School 1 and gained more average connections between Fall and Winter than students in School 2. While information about students' relationships from before the beginning of secondary school were unavailable, it is possible that one school may have presented more new potential connections than the other. For example, one school may have had a larger proportion of students who knew each other from primary school, or primary schools may have funneled into these secondary schools in different ways.

In that case, different strategies may be more useful when forming connections with previously unknown peers versus previously known but unconnected peers, or maintaining connections. In the current studies, we modeled ties with the evaluation function, which models the presence of a tie but does not separate between the creation of a new tie or the maintenance of an existing tie. As the evaluation function assumes that the creation and maintenance effects are equal, it may be beneficial for future work to further explore whether these effects are in fact equal, and whether that relationship differs based on initial network composition. Existing work in the perspective-taking domain found that new friendships were likely to be formed between

those who were similar in perspective-taking, and that within existing friendships adolescents with friends who were higher on perspective-taking increased their own perspective-taking, controlling for existing similarity (Miklikowska et al., 2022). However, while this study separated effects related to new and existing friendships, it was at the cost of examining maintenance effects. Additionally, each person in a dyad was only represented once within each friendship type, limiting examination of network effects.

Recent work has also suggested that social-cognitive processes such as co-rumination may serve different purposes at different times (DiGiovanni et al., 2026). For example, engagement in co-rumination may be particularly beneficial for encouraging increased closeness in new friendships or may become more common farther into relationships as dyads become more interdependent and reliant on each other for social support. If the average length of relationships differed between networks, that may play a role in school-specific findings regarding co-rumination, and co-rumination may be serving different purposes in those networks.

Demographics

Beyond network characteristics, differences in the demographic makeup of the included schools could impact the relationship between engagement in social-cognitive processes and social outcomes/dynamics. Notably, School 1 had more multiracial participants than School 2. Additionally, School 1 had a more even balance of female and male students, while School 2 had more non-binary students.

While previous work has explored gender differences in social-cognitive processes and development, there have been several assumptions made that may not apply to the current studies. First, this work has examined overall gender differences in the development of and

engagement in social-cognitive processing, where girls are characterized as engaging in more perspective-taking and co-rumination that boys (Rose, 2002; Van der Graaff et al., 2014). However, social-cognitive development in nonbinary youth has not been characterized. Furthermore, work from the adult literature has suggested that perspective-taking is tied to social status, and gender interacts with social status such that gendered effects of perspective-taking can disappear when women are put in high-status positions, and men in lower-status positions (Love & Davis, 2014). Within schools, the gender composition of the cohort may impact the status that each group holds. In particular, School 1 had an even proportion of male and female students, while School 2 had a higher proportion of female students. In addition, School 2 had twice as high a proportion of non-binary students as School 1 (6.25% vs 3.4%). In this case, different gender groups could hold a different social status relative to other groups in each school, impacting the utility of their engagement in strategies such as perspective-taking.

Second, work in this area typically focuses on same-gender friendships. However, social-cognitive processes may operate differently in same-gender and cross-gender friendships. In particular, it's plausible that engagement in perspective-taking could be particularly beneficial for facilitating connections between those who have different experiences, socialization, social status, and more. The utility and benefits of engagement in these processes may differ depending on whether one is in the majority group, or how many others in the network have shared experiences and identities. Cross-cultural studies of perspective-taking have suggested that engagement in perspective-taking is related to the cumulative impacts of previous experiences and social attunement (Wu & Keysar, 2007). Previous work in adults has established that factors such as social status are related to inter-individual differences in social-cognitive processes including emotion perception and perspective-taking (Dietze & Knowles, 2021).

Relatedly, recent work has found positive relationships between ethnic-racial identity and perspective-taking in adolescence (Jorgensen et al., 2025). Specifically, Latine, Black, and multiracial youth who engage in earlier exploration of and feel more clarity about their ethnic-racial identity show higher initial levels of perspective-taking and remain high in perspective-taking across adolescence (Jorgensen et al., 2025). This may be related to ethnic-racial identity and related topics such as critical consciousness capturing how adolescents are navigating their sense of self in relation to others, and in relation to broader sociocultural history and contexts (Diemer et al., 2017). While we did not collect any data on ethnic-racial identity development in this sample, differences in school contexts could impact students' opportunities for conversations about their identity, as well as their interactions with other students of similar and different identities. Additionally, recent work connecting perspective-taking and social status found that Chilean adolescents who reported higher perspective-taking and lower social class prejudice were more likely to form and maintain cross-ethnic friendships (Chávez et al., 2021).

Similarly, we were unable to characterize the content of students' co-rumination, but differences in school climates could impact the potential social connections that students feel comfortable disclosing to, as well as the issues that they are experiencing and navigating. While reducing negative affect is commonly conceptualized as the primary goal of co-rumination, there may be other salient goals such as trying to make sense of an increasingly complex world, feeling supported, or creating a plan of action, which may be especially salient within conversations between minoritized individuals and in conversations where societally important topics are a focus (DiGiovanni et al., 2026). In line with this, recent work has found that co-rumination in the context of discussing societal stressors, co-rumination focused on gaining

understanding of stressors was related to greater intentions to engage in behaviors related to making positive change (Starr et al., 2021).

Co-rumination (both content and engagement) is related to multiple levels of adolescents' environments/the environments adolescents are situated in, including their individual contexts, friend contexts, and school contexts. While some features may be shared across schools, individuals and friend dyads/groups are nested within unique school contexts that may shape downstream behavior. For example, developmentally-relevant conversations centered on meaning-making, identity formation, and understanding stressors are likely to be shaped by the climate, demographics, and values of specific school environments.

Limitations

The studies contained in this dissertation examined how social-cognitive processes such as perspective-taking and co-rumination may support social connection in adolescence, and in turn be influenced by social connections. We found some evidence for selection effects related to these social-cognitive processes, and no influence effects. Notably, the selection effects differed between the two included schools. This section examines potential reasons for the observed discrepancy, as well as limitations that should be considered in discussion/interpretation of the results.

First, while both studies represent a significant advance in our ability to understand how social-cognitive processes support social connections over the first year of middle school, we were unable to collect data prior to the transition. This limits our ability to understand how stable the adolescents' social networks were, and how many new peers they encountered when entering sixth grade. Notably, in networks with more change between primary and secondary school, different strategies may be adaptive compared to networks with less change.

Additionally, due to the inherent limitations of collecting data in schools, where time is limited and the burden on teachers and students must be kept as low as possible, we were unable to collect the full breadth of measures that would be ideal to consider. Specifically, we collected one dimension of mentalizing (propensity) and were unable to collect data on well-being or internalizing symptoms. Social network methodologies/approaches such as stochastic actor-oriented modeling also require high participation rates, which are often only achievable via opt-out consent procedures. While the opt-out consent procedure enabled us to collect sufficient data for an SAOM approach, it also limited our ability to ask more sensitive questions, such as those about mental health. Additionally, we were unable to collect some demographic information, such as household income and socioeconomic status.

Within the SAOM approach, we also navigated some relatively uncharted territory with our demographic data and participant sample. As discussed in the introduction, adolescents tend to be similar to their friends on demographic characteristics such as gender, race, and ethnicity. Within an SAOM approach, effects are typically included to account for the likelihood towards homophily on these characteristics. However, the demographics of our participants differed from existing studies. Most notably, both schools contained a substantive number of non-binary adolescents, who have not been previously acknowledged within this framework. In both studies, a homophily effect of gender was included, but further work in both SAOM frameworks and adolescent friendship research more broadly is needed to understand how gender homophily operates within contexts that include non-binary adolescents. Furthermore, prior work has found gender differences between female and male adolescents in the development of and engagement in social-cognitive processes (Rose 2002, Van der Graaf et al., 2014). However, there is not yet a strong base of evidence for how these processes develop and differ for non-binary adolescents.

Similarly, our sample included a substantial number of multiracial youth. When modeling homophily effects, it's unclear how best to represent multiracial youth, who may share some, but not all, identities with their peers and friends. Due to a lack of a clear theoretical basis for how to model race and ethnicity within our sample, we did not include it in the model. However, this may have resulted in some homophily effects being unaccounted for.

A number of the factors mentioned above could have contributed to the discrepancy in results observed between the two included schools in Chapter 2. While we were unable to identify the exact mechanisms that differed between the two schools, this is a promising avenue for future work.

Future Directions

Future work can expand on the work detailed in this dissertation in a variety of ways. First, there are a number of additional measures that could be connected to the constructs explored here, such as additional dimensions of mentalizing and outcomes that may be related to co-rumination, such as friendship quality and wellbeing. As discussed earlier, profile approaches could also help to integrate multiple measures. Given the inherent constraints imposed by collecting data within school settings, future research could combine approaches to link in-school social network data to additional measures collected outside of school. In particular, collecting additional data could enable exploration of mentalizing dimensions such as accuracy, which are typically evaluated using computer-based tasks.

Second, replicating the methodology of the current studies in additional schools would both help to resolve discrepancies in the findings across the two schools included here, and would help to illuminate the specific characteristics within a school or network that determine

which social-cognitive strategies are adaptive. Identifying when and for whom different strategies are adaptive is crucial for translating these findings into practice and creating frameworks that can support adolescents through difficult social transitions.

As discussed above, there are many opportunities for extending this work once best practices for including gender diverse and multiracial participants within SAOM frameworks have been established. Similarly, further research into gender differences related to social-cognitive development can support future studies looking at those processes in relation to peer and friend selection and influence effects.

Finally, this framework could be expanded to other school transitions, such as the transition to high school. Social-cognitive processes continue to develop over the course of adolescence, and these processes may operate differently farther into adolescence. Furthermore, later adolescence is characterized by even more autonomy over friendships, and there are additional types of relationships that may shape behavior, such as romantic relationships, that may shape behavior.

Conclusion

In summary, we found relationships/links between social-cognitive processes and real-world social connections during early adolescence, supporting the idea that continued development of social-cognitive processes can support real-world social and developmental goals. Additionally, we found that constructs such as co-rumination have substantial individual differences that are often overlooked in traditional studies. Overall, these studies support the idea that bringing together approaches from network science and social-cognitive development, along with a greater focus on individual differences in engagement in social-cognitive processes within

and between friendships, can further our understanding of how to support adolescents in successfully navigating novel social contexts.

APPENDIX A

Figure A.1

Binned IRI-PT Scores – School 1

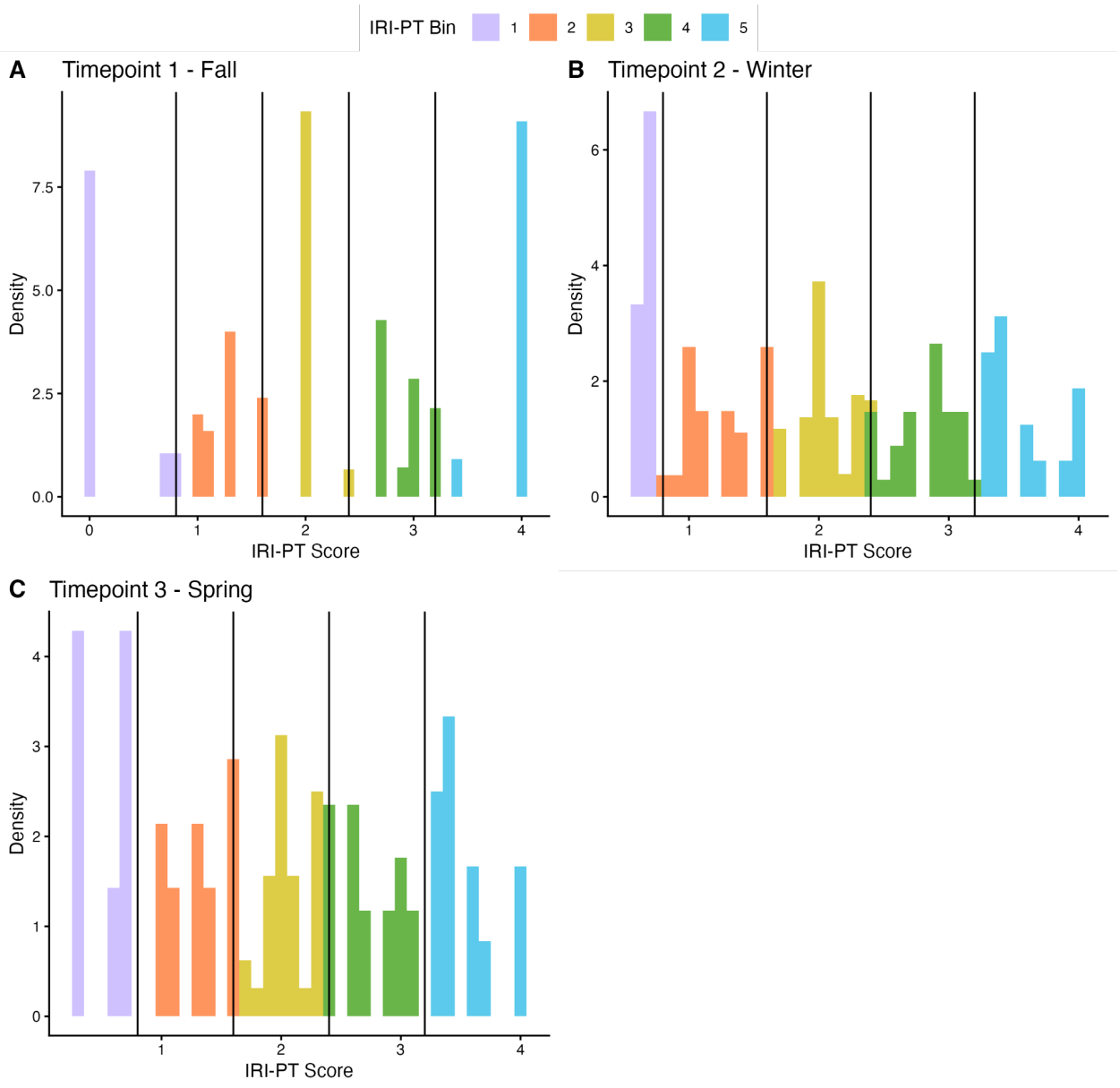
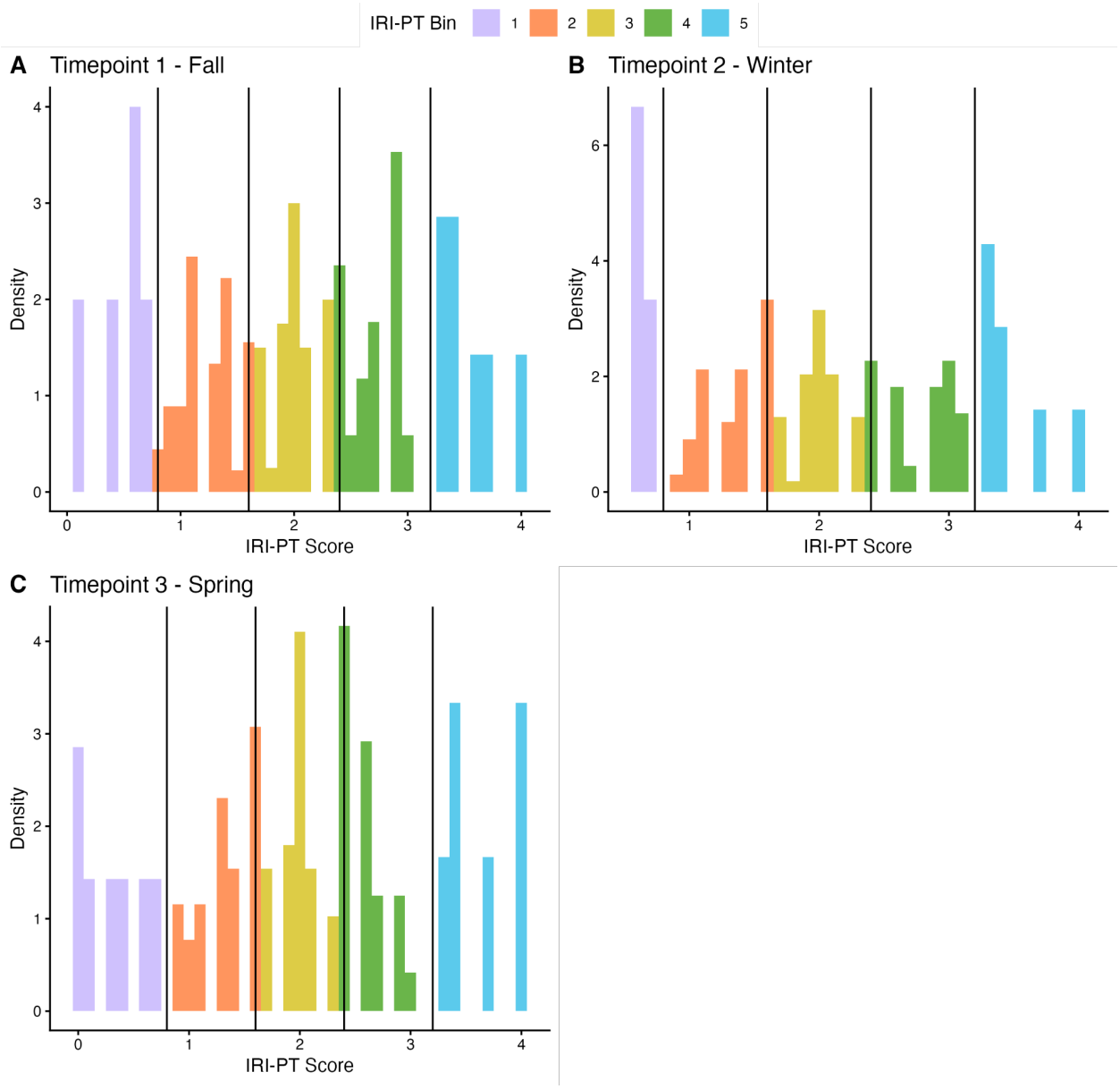


Figure A.2

Binned IRI-PT Scores – School 2



APPENDIX B

Figure B.1

IRI-PT Scores Across Time – School 1

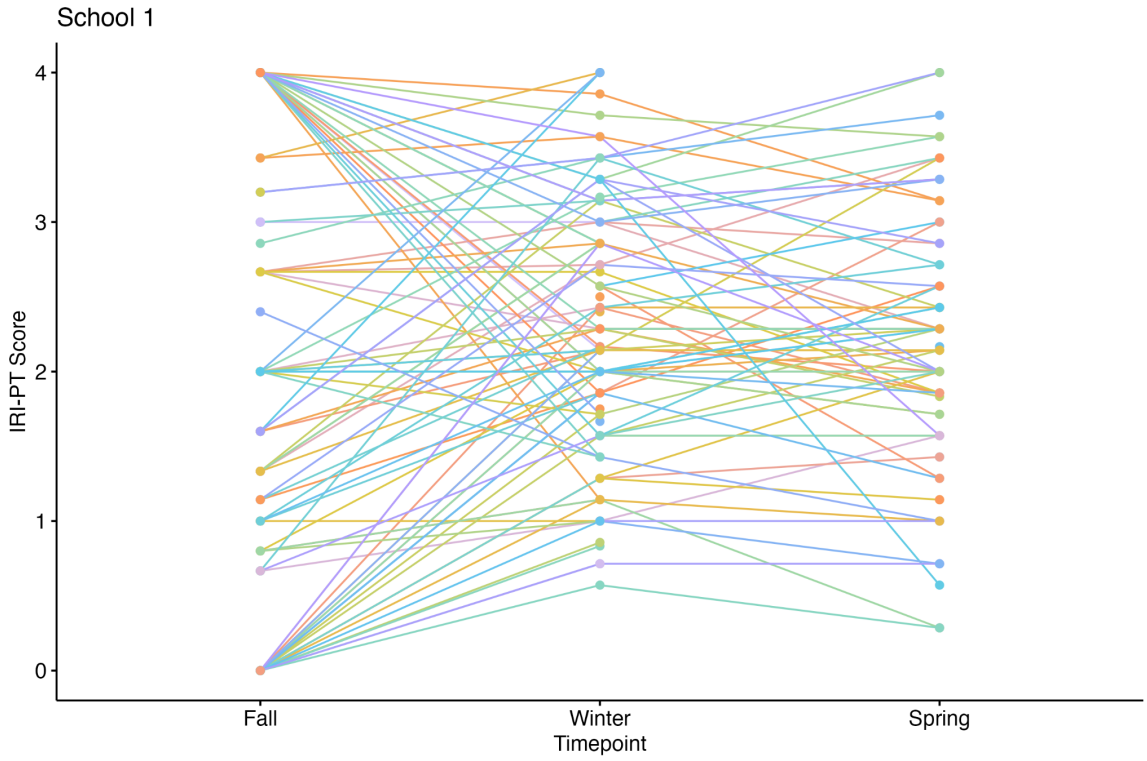
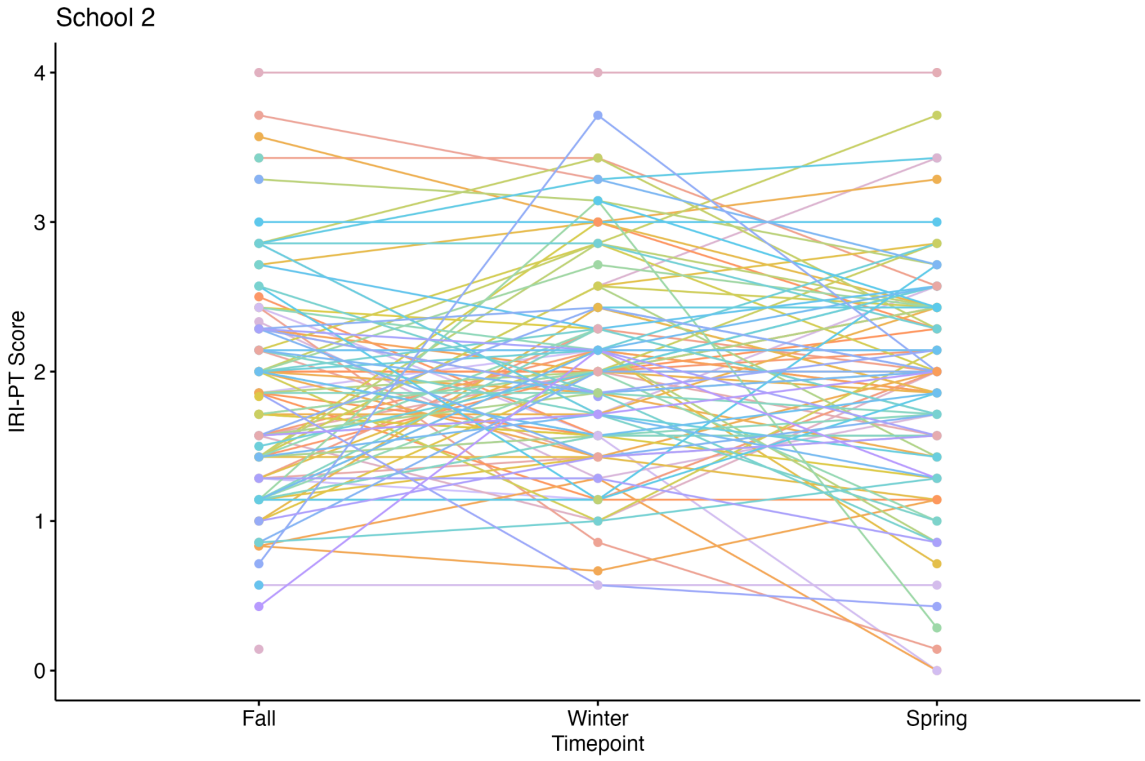


Figure B.2

IRI-PT Scores Across Time – School 2



APPENDIX C

Table C.1

Peer Indegree & IRI-PT

school	wave	cor	*p*	95% CI
1	1	0.02	.813	[-0.15, 0.20]
1	2	-0.17	.059	[-0.33, 0.01]
1	3	-0.09	.443	[-0.30, 0.13]
2	1	0.08	.402	[-0.11, 0.26]
2	2	0.18	.045*	[0.00, 0.35]
2	3	0.01	.935	[-0.19, 0.20]

Table C.2

Peer Outdegree & IRI-PT

school	wave	cor	*p*	95% CI
1	1	-0.11	.227	[-0.28, 0.07]
1	2	0.01	.946	[-0.17, 0.18]
1	3	-0.15	.167	[-0.36, 0.07]
2	1	0.16	.094	[-0.03, 0.33]
2	2	0.12	.193	[-0.06, 0.29]
2	3	0.16	.102	[-0.03, 0.35]

Table C.3

Close Indegree & IRI-PT

school	wave	cor	*p*	95% CI
1	1	0.00	.992	[-0.17, 0.18]
1	2	-0.14	.105	[-0.31, 0.03]
1	3	-0.11	.330	[-0.32, 0.11]
2	1	0.06	.523	[-0.12, 0.24]
2	2	0.15	.102	[-0.03, 0.32]
2	3	-0.04	.683	[-0.23, 0.15]

Table C.4

Close Outdegree & IRI-PT

school	wave	cor	*p*	95% CI
1	1	-0.08	.396	[-0.25, 0.10]
1	2	0.04	.670	[-0.13, 0.21]
1	3	-0.04	.743	[-0.25, 0.18]
2	1	0.11	.230	[-0.07, 0.29]
2	2	0.23	.010*	[0.06, 0.40]
2	3	0.16	.117	[-0.04, 0.34]

Table C.5

Peer Indegree Change (T3-T1) & T1 IRI-PT

school	cor	*p*	95% CI
1	0.17	.064	[-0.01, 0.33]
2	0.04	.675	[-0.15, 0.22]

Table C.6

Peer Outdegree Change (T3-T1) & T1 IRI-PT

school	cor	*p*	95% CI
1	0.15	.104	[-0.03, 0.31]
2	0.04	.655	[-0.14, 0.22]

Table C.7

Close Friend Indegree Change (T3-T1) & T1 IRI-PT

school	cor	*p*	95% CI
1	0.15	.101	[-0.03, 0.31]
2	0.02	.843	[-0.17, 0.20]

Table C.8

Close Friend Outdegree Change (T3-T1) & T1 IRI-PT

school	cor	*p*	95% CI
1	0.15	.092	[-0.02, 0.32]
2	0.07	.452	[-0.11, 0.25]

APPENDIX D

Figure D.1

Binned Average Co-Rumination Scores – School 1

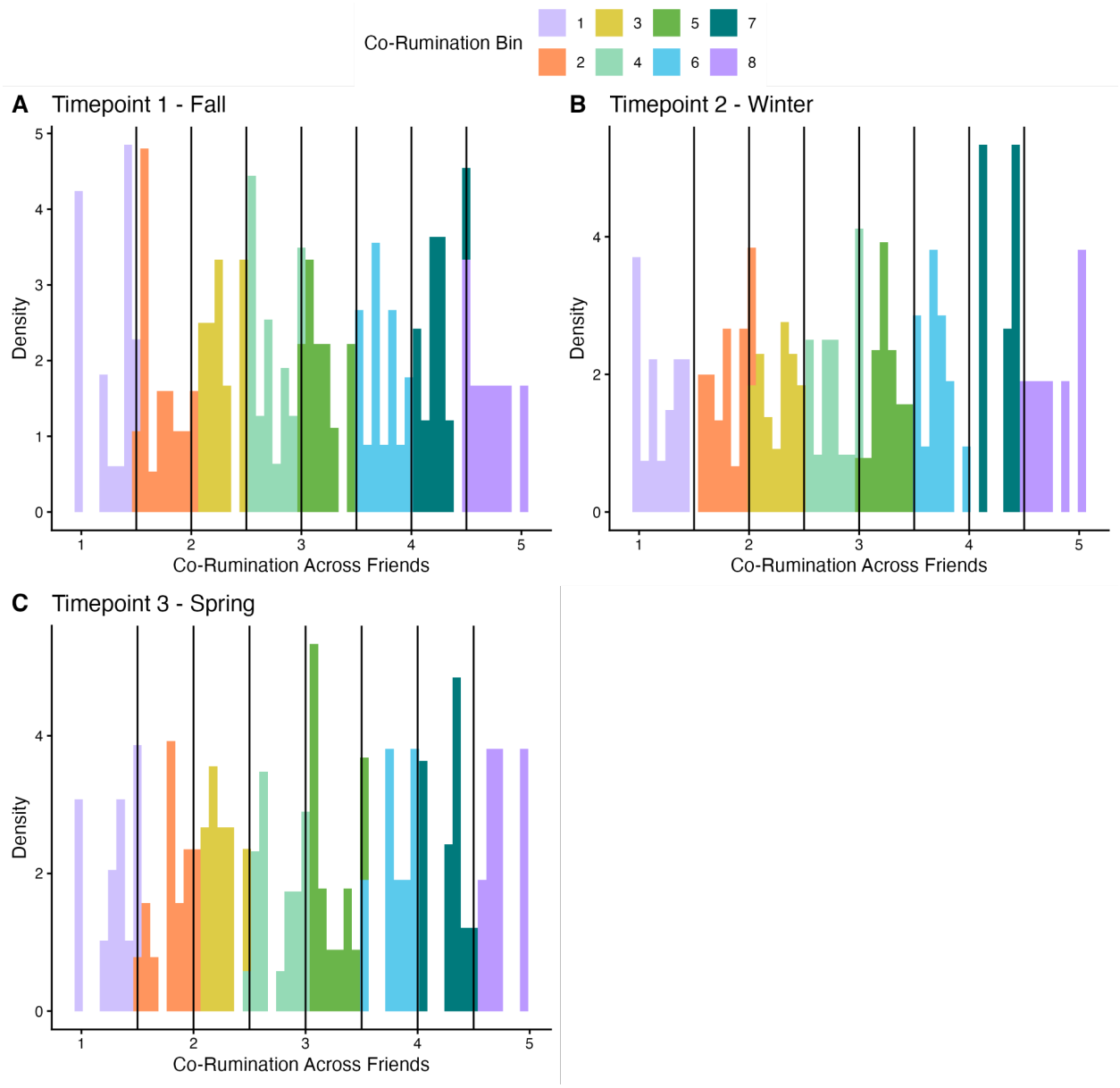
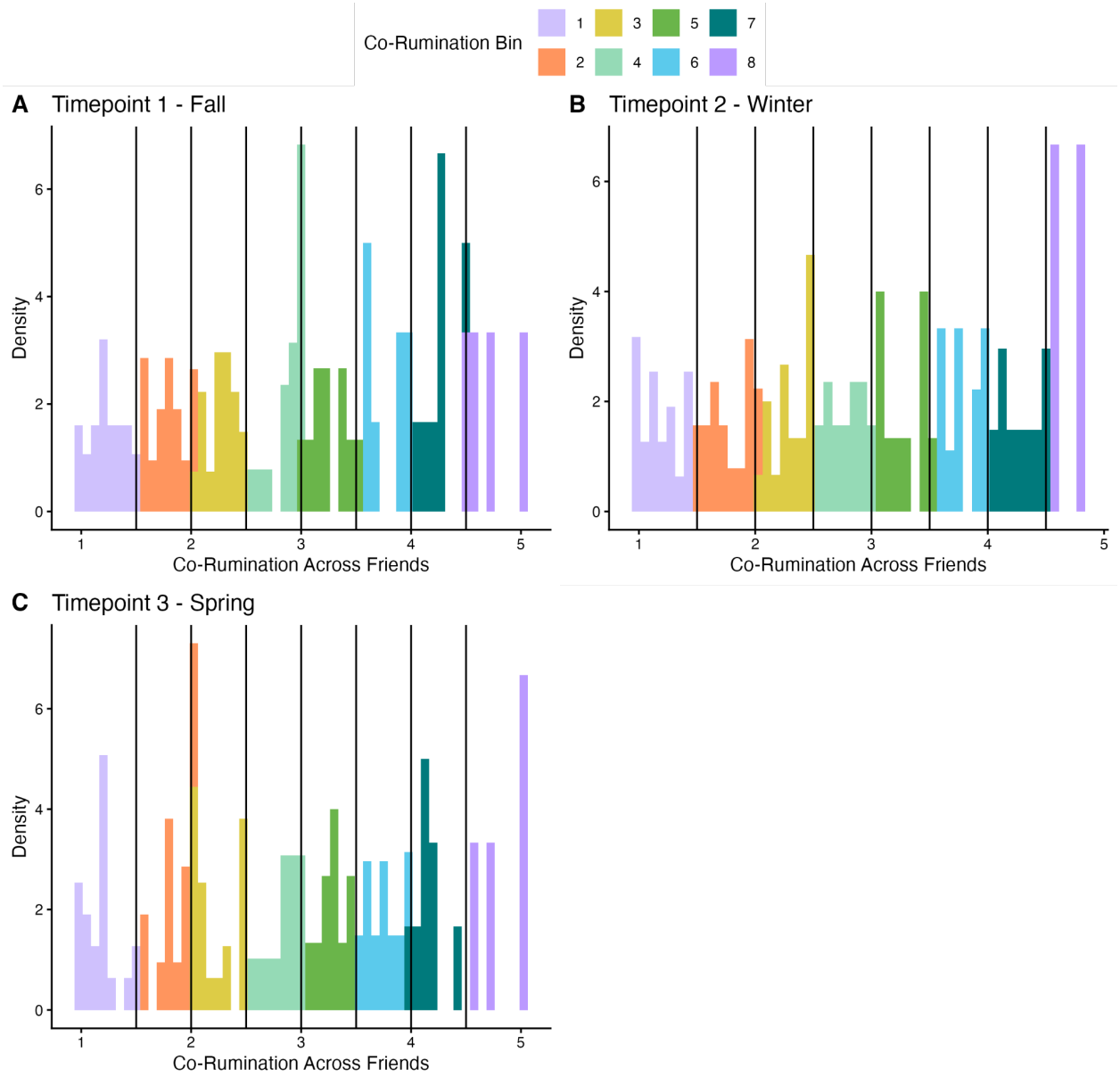


Figure D.2

Binned Average Co-Rumination Scores – School 2



APPENDIX E

Figure E.1

School 1 - Peer Network

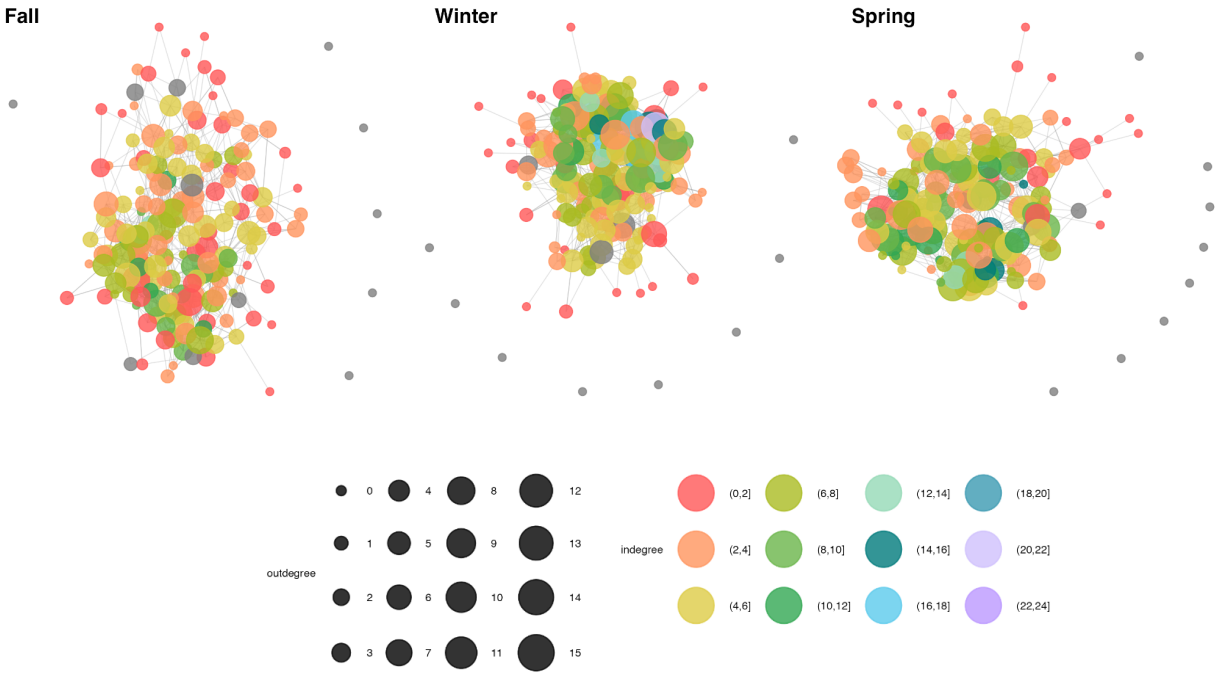


Figure E.2

School 2 - Peer Network

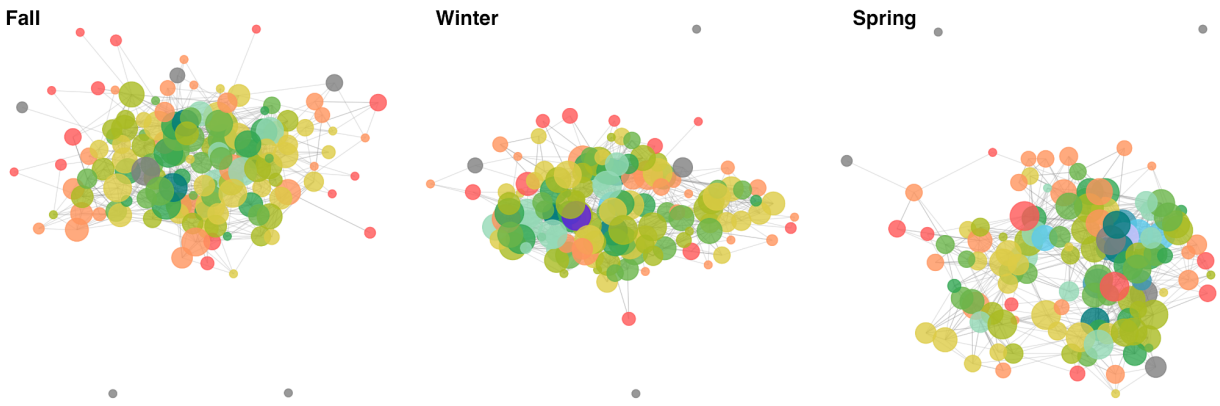


Figure E.3

School 1 - Close Friend Network

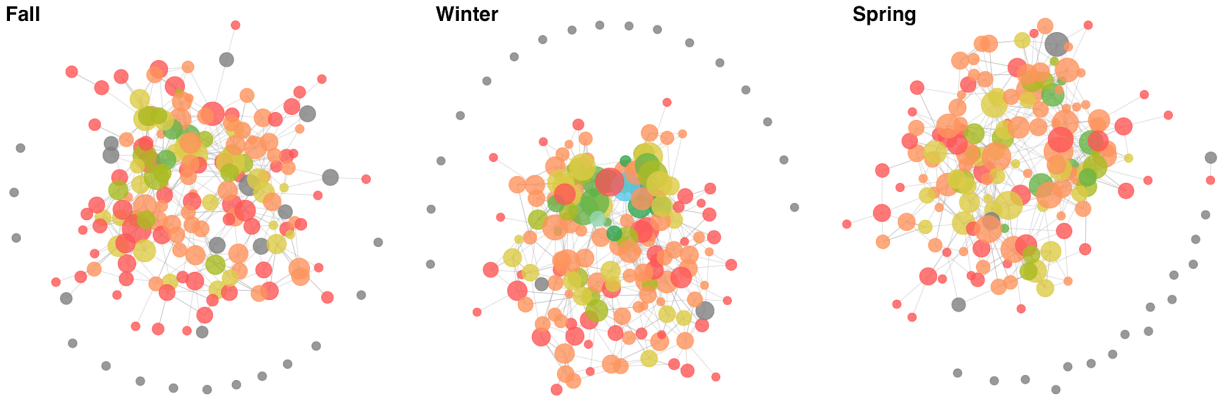
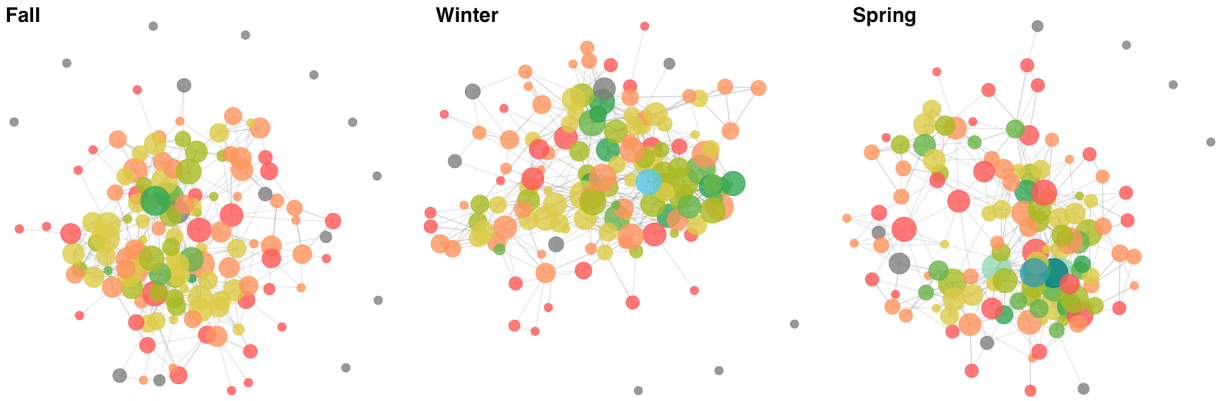


Figure E.4

School 2 - Close Friend Network



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