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Bully-victim network perceptions of bullies, victims, and peer observers

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ABSTRACT

Bullying is a complex social construct, and informants (e.g., bullies, victims, and peer observers) may have differing perceptions about bully-victim relationships. This study examines how informant perspectives differ using network data obtained from 438 fifth-grade students (M_{age} = 11.19 years old, 46 % girls) in 13 Indonesian elementary school classrooms. Using a cross-informant framework, we investigated how self- and peer-reported bully-victim relationships overlapped as a function of the sex of bullies and victims, friendship ties, and relational schemas (i.e., mental network heuristics). Results from a multiplex exponential random graph model revealed significant agreement between self- and peer-reports. There was greater agreement when bully-victim relationships occurred between non-friends. When self- and peer-reports disagreed, peers identified more instances of boys engaging in bullying than girls, as well as more cross-sex than same-sex bully-victim relationships. Self-reports more often identified bully-victim relationships between friends than between non-friends. Post-hoc analyses revealed that bullies and their friends often had conflicting views of their friendship. Additionally, peers reported more victims per bully and fewer bullies per victim when compared to self-reports. These findings contribute to the understanding of the network structure of bully-victim perceptions and offer practical implications for identifying bully-victim relationships.

Introduction

Bullying is often part of a broader group process that extends beyond dyads (Salmivalli, 2010; Veenstra and Huitsing, 2021) and is embedded in peer networks that include bullies, victims, and peer observers. Peer observers play an important role in bullying dynamics. They may inform school administrators and directly encourage or discourage bullying (Rambaran et al., 2020; van der Ploeg et al., 2020). Researchers have begun to address the variation in perceptions of bullying, attending to factors such as the sex and friendship status of bullies and victims (Hanish et al., 2016; Huitsing et al., 2019; Kisfalusi et al., 2020; Tatum and Grund, 2020).

Identifying bully-victim relationships in classrooms is, however, challenging. Self-reports from bullies and victims may be compromised because of social desirability bias (Smith and Sharp, 1994), and peers may not be fully aware of bully-victim relationships (Hanish et al., 2016). Designing data collection methods to measure bias patterns across information sources (e.g., bullies, victims, and peer observers) can improve intervention strategies by affording an enhanced understanding of when bullying is unnoticed or is inaccurately perceived. Prior studies, however, have not examined the factors that account for the agreement and disagreement between bullies', victims', and peer observers' perceptions (Rambaran et al., 2020). In this study, we use multiplex exponential random graph models (Lusher et al., 2013) to investigate this question by comparing the self-reports from bullies and victims with peer-reports.

By applying a cross-informant framework (Ladd and Kochenderfer-Ladd, 2002), we focus on three factors—sex, friendship, and relational schema—that account for agreements and disagreements among different informants. Based on adolescent development and

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bullying literature (Veenstra and Huitsing, 2021; Volk et al., 2017), we argue that the sex of bullies and victims, as well as friendship ties between them, can partially account for disagreements between self- and peer-reports. Preadolescents' networks are often segregated by sex, and friendship relations are typically more easily observable than bullying behaviors (Hanish et al., 2016). These visible factors can shape peer perceptions since peers tend to perceive bully-victim relationships based on direct observations (Huitsing et al., 2019).

In addition, building upon the network perceptions literature (Brashears and Quintane, 2015; Janicik and Larrick, 2005), we argue that relational schemas (i.e., cognitive frameworks for perceiving social relationships) can partially account for disagreements between self- and peer-reports. Peer-reports are proxies (i.e., reports about someone else's relationships; An, 2022), and those who do not have direct information about a relationship rely on relational schemas to make inferences. Thus, understanding how peers utilize relational schema may help explain the discrepancies between self- and peer-reports (Lee and Butts, 2020; Tanaka and Vega Yon, 2024).

To empirically test our theoretical claims, we analyzed data on classroom bully-victim relationships among Indonesian fifth-grade students. Most studies examining bullying relationships have relied on self-reports of bullies or victims (e.g., Kisfalusi et al., 2020; Tatum and Grund, 2020). In contrast, we used the "who bullies whom" measure (Rodkin and Berger, 2008; Rodkin et al., 2014; Veenstra et al., 2010) to identify dyadic bully-victim relationships from self- and peer-reports. Prior studies using this measure either aggregated self- and peer-nominations (Rodkin and Berger, 2008) or used only peer-nominations (Hanish et al., 2016; Rodkin et al., 2014; Veenstra et al., 2010). A few recent studies have shown the importance of using peer-reports to identify bullies and victims (Hanish et al., 2016; Huitsing et al., 2019). In this study, we compare self-reports and third-party reports of bully-victim relationships, both descriptively and through multiplex exponential random graph models. This combination of rich perception data and the application of inferential network analysis enables us to identify when and how self- and peer-reports of bully-victim relationships diverge.

Cross-informant perceptions of bully-victim networks

Ladd and Kochenderfer-Ladd's (2002) cross-informant comparison framework advocates using multiple informants to measure victimization. The key assumption of this framework is that bully-victim relationships are a socially and cognitively constructed reality, not an objective truth—the notion is also based on a classic social network theory (Fararo and Sunshine, 1964). Thus, it is important to assess "a composite" constructed from self- and peer-reports (Ladd and Kochenderfer-Ladd, 2002, p. 93).

The use of self-report methods has been endorsed by researchers such as Olweus (2013), who argued that bullies and victims are the best information sources and thus may capture experiences that are not observable by others. Self-report methods, however, are susceptible to biases, the most prominent being social desirability. Individuals may underreport socially undesirable behaviors, such as bullying or being bullied. This tendency is evidenced by the finding that anonymous self-reports tend to yield higher rates of victimization when compared with non-anonymous surveys (Smith and Sharp, 1994).

Peer-reports are also widely used and are considered by some to be the gold standard for identifying bullies and victims of peer aggression (Ladd and Kochenderfer-Ladd, 2002). Previous studies using peer nominations typically aggregated reports of bullying and victimization for each child. This approach reduces subjectivity and errors, leading to more reliable data than judgments based on a single source (Cornell and Brockenbrough, 2004). Peer nominations, however, have limitations. Peer observers infer the nature of social ties through both existing relational structures (e.g., perceived power status of boys versus girls, friendships) and observation of behavioral events (Skvoretz and Fararo, 1996). Some forms of bullying are hidden from peers (Volk et al., 2014). Also, peers may be more aware of some types of aggression (e.g., physical aggression) than others (e.g., relational or cyber aggression). Young children may have difficulty differentiating bullying from other relationships, such as friendships (Coie and Dodge, 1988; Ladd and Kochenderfer-Ladd, 2002). In addition, peer awareness of bullies and victims may be uneven. In a study of sixth- to eighth-grade American students, high-status peers as well as victims' friends were more aware of bullying incidents than were other students (Hanish et al., 2016). Finally, the validity of classmates' reports can be compromised by relational biases: students may judge their peers based on reputation or prejudice rather than observation (Hymel et al., 1990).

Prior studies comparing self- and peer-reported bullying and victimization typically focused on their prediction of external outcomes, such as social functioning and emotional maladjustment (e.g., Ladd and Kochenderfer-Ladd, 2002). When directly comparing nominations from different parties, researchers have focused on the extent to which nominations of bullies or victims were correlated, finding low to moderate agreement (e.g., Card et al., 2010; Huitsing et al., 2019). Previous research, however, has not explored whether there are systematic patterns that account for the agreement and disagreement of self- and peer-reports of bully-victim relationships.

Self- and peer-reported agreement and disagreement

Building on prior studies (e.g., Huitsing et al., 2019; Volk et al., 2017), we first examine the agreement between self- and peer-reports of bully-victim relationships.

Research question 1 (RQ1): to what extent is there agreement between self- and peer-reported bully-victim relationships?

Two types of agreements should be considered. First, a general type of agreement addresses instances where self- and peer-reported bully-victim relationships match, regardless of their roles. In other words, peers may recognize individuals who are involved in a bully-victim relationship, although they may be mistaken about who the bully is and who the victim is (Tatum and Grund, 2020). Second, a narrower conceptualization of agreement includes the direction of a bully-victim relationship (e.g., Huitsing et al., 2019). In addition to recognizing the presence of bully-victim relationships, peers identify who is bullying whom, including instances where these relationships are bi-directional (Kisfalusi et al., 2020; Rambaran et al., 2020).

RQ1.1: to what extent do self- and peer-reports agree on the individuals involved in the bully-victim relationships?

Although previous studies generally yielded positive correlations between self- and peer-reports of the identity of bullies or victims (Ladd and Kochenderfer-Ladd, 2002; Pellegrini and Bartini, 2000), it is unknown whether and to what extent the two sources agree on the bully-victim dyads. The current study will be the first to directly compare self- and peer-reports to explore the level of agreement on identifying individuals involved in the dyadic bully-victim relationships (i.e., the first type of agreement).

RQ1.2: to what extent do self- and peer-reports agree on the direction of the bully-victim relationships?

A comparison between the self-reports of bullies and victims showed that they often disagree on the direction of the bullying relationship (Tatum and Grund, 2020). Thus, in addition to comparing the individuals involved in the bully-victim dyads, the current study explores whether self- and peer-reports converge on the identities of the bullies and victims in these relationships (i.e., the second type of agreement).

In the following research questions, we examine three factors that may account for disagreements between self- and peer-reported perceptions of bully-victim relationships: sex, friendship, and relational schema.

Research question 2 (RQ2): how does the sex of bullies, victims, and peers account for disagreements between self- and peer-reported bully-victim relationships?

Although elementary-age boys and girls typically form separate friendship networks (Huitsing et al., 2019), bully-victim relationships appear to be much less segregated by sex (Rambaran et al., 2020). Because of sex-segregated friendship networks, students may not directly observe bullying and victimization involving those of the opposite sex and may rely on hearsay evidence. This information gap could influence bully-victim network perceptions and partially explain discrepancies between self- and peer-reports. In this study, we explore two specific questions regarding the role of sex in bullying relationships.

RQ2.1: how does the sex of the bully account for disagreements between self- and peer-reported bully-victim relationships?

Child and preadolescent boys engage in bullying more than girls, a pattern consistently reported from multiple countries and derived from researcher observations (Craig and Pepler, 1997; Pepler et al., 1998), self-reports (Olweus, 1993; Pepler et al., 2004; Veenstra et al., 2010), and peer nominations (Espelage and Holt, 2001; Rodkin et al., 2014). Peers may underestimate bullying by girls, partly because they may prefer to use social exclusion or relationship manipulation instead of direct physical aggression (Volk et al., 2006). Further, the identification of victims of female bullies can differ from that of male bullies. Tatum and Grund (2020) found that female bullies' confessions often did not match the accusations from victims. This finding suggests that the types of bullying behaviors female preadolescents engage in are more likely to be hidden. Although previous studies consistently found that boys are more often perceived as bullies than girls, the magnitude of this sex difference may vary between self- and peer-reports. Thus, we examine whether self- and peer-reports systematically differ in their perceived sex of bullies.

RQ2.2: how does the sex of the bully and victim pertain to disagreements between self- and peer-reported bully-victim relationships?

Peers may over-report the number of cross-sex bully-victim relationships relative to those identified from self-reports. Cross-sex bully-victim relationships, especially those in which boys bully girls, are prevalent during childhood and increase in early adolescence (Pellegrini, 2001). As many as 60 % of U.S. elementary- and middle-school victimized girls reported being bullied by boys (Olweus, 1993). A substantial proportion of cross-sex bullying and victimization was found in fourth- and fifth-grade students, which was larger than that of same-sex bullying (Rodkin and Berger, 2008). There were also as many bully-victim relationships from boys to girls as those from boys to boys in 11-year-old Dutch students (Veenstra et al., 2007). Cross-sex bullying is often viewed as an immature attempt to express romantic interest and to engage in the "push-and-poke courtship" typical of early adolescents (Pellegrini, 2001; Pellegrini et al., 2010). This behavior may be attributable to middle childhood gender norms, which make efforts to approach potential romantic partners risky because they may fear rejection, humiliation, or retaliation from the target or their friends and family (Pellegrini, 2001; Volk et al., 2014). Peers may consequently find it difficult to distinguish bullying from this immature courtship and may consequently overestimate the amount of cross-sex bullying and victimization. The current study aims to examine whether the frequency differences between same-sex and cross-sex bullying vary between self- and peer-reports.

Research question 3 (RQ3): how do friendship relationships pertain to disagreements between self- and peer-reported bully-victim relationships?

Friendships and bully-victim relationships are often intertwined. Huitsing and Veenstra (2012) examined the social and bullying network structure in elementary school classes and found that bullies liked and defended each other. Consistent with this view, Rambaran et al. (2020) found that friendships were formed between bullies who targeted the same victims and that bullies could influence their friends to target the same individuals. Bullies and their friends may refrain from reporting each other's bullying activities (Hanish et al., 2016), leading to the discrepancy between self- and peer-reports of bully-victim relationships.

Bully-victim relationships can also exist within friendships. Fourth and fifth grade Japanese children reported instances of bullying within close friendships, which were more common for girls than for boys (Mishima, 2003). Rodkin et al. (2014) suggested that bullying by female perpetrators targeting boys was often ambiguous, noting that members of female-male bully-victim relationships also tended to nominate each other as friends. This ambiguity may be explained by findings that children more frequently reported encountering relational victimization than physical victimization within their friendships (Crick and Nelson, 2002). Further, girls who associate with relationally aggressive peers might be particularly susceptible to victimization within their friendships (Crick and Grotpeter, 1996).

Friendships can conceal bully-victim relationships from peers or others. Parents and teachers were often unaware of bullying within friendships (Mishna et al., 2008), perhaps because children tended not to tell their parents about their concerns (Mishna et al., 2005). There is also ambiguity between conflict and bullying, especially because bullying within friendships rarely involves physical aggression. This ambiguity may lead peers to be less aware of bully-victim relationships that exist within friendships. In this study, we examine the potential role of friendship in the discrepancy between the perceptions of bullies, victims, and peer observers.

Research question 4 (RQ4): how do relational schemas relate to disagreements between self- and peer-reported bully-victim relationships?

Literature on cognitive social structures (see Brands, 2013; Krackhardt, 1987a) suggests that people build cognitive representations of social networks, which may differ markedly from observed interaction networks. For example, the network perceptions of communication reported by informants are surprisingly different from actual communication patterns (Bernard et al., 1979; Bernard and Killworth, 1977; Killworth and Bernard, 1976, 1979).

Misperceptions are not random; rather, relational schemas cause people to misperceive networks in predictable ways. Relational schema refers to the cognitive frameworks or pre-existing expectations individuals use to mentally organize social relations (Baldwin, 1992; Brashears and Quintane, 2015; Tanaka and DeChurch, 2022). The core of this concept is that individuals encode and store mental representations of social relations based on their exposure to regular patterns of social interactions. Relational schemas help reduce cognitive complexity, helping people make inferences about relationships they do not have direct information about. For example, people are likely to infer triadic closure—perceiving a friendship between friends of friends—even when it does not exist (Janicik and Larrick, 2005; Sun et al., 2021). Peers may rely on relational schemas to infer bully-victim relationships. Consequently, peer-reports, thus, may differ from self-reports because the use of schema leads "people [to] exaggerate the structure present in their experience in order to build a simplified cognitive conception" (Freeman, 1992, p. 122).

Two types of relational schemas may be particularly pertinent for understanding self- and peer-report discrepancies; these are balance schema (Krackhardt and Kilduff, 1999) and linear-ordered schema (de Soto, 1960; Janicik and Larrick, 2005). The balance schema suggests that people perceive relationships to be mutual and transitive. The linear-ordered schema pertains to the tendency to perceive social relations related to influence or dominance as hierarchical, asymmetric, and vertical (de Soto, 1960; Janicik and Larrick, 2005; Walker, 1976), and is particularly relevant to understanding perceptions of bully-victim relationships. According to Walker (1976), for example, if A bullies B, then individuals tend to infer that B could not bully A, but A could bully anyone B could bully. This schema may help to explain patterns of disagreement between self- and peer-reports. Although the

linear-ordered schema has been tested in empirical studies with adult samples (e.g., Krackhardt and Kilduff, 1999; Janicik and Larrick, 2005; Tanaka and DeChurch, 2022), it has not been applied to perceptions of preadolescent bully-victim relationships.

The linear-ordered schema exists in preadolescent bully-victim networks (Sun et al., 2021). For example, researchers have reported bully-victim asymmetry where bullies were over-identified and victims were under-identified by peers or teachers when compared to self-reports (Huitsing et al., 2019; Lee et al., 2016). The correspondence between self- and peer-reports was higher for the identification of bullies than victims (e.g., Huitsing et al., 2019), and peer-reports identified substantially fewer victims than did self-reports (Oldenburg et al., 2015). These findings suggest that peers are more aware of bullies than victims. Peers may be attuned to recognizing prominent bullies who target many others to avoid becoming targets themselves. Consequently, in comparison to self-reports, peers may exaggerate the bully-victim asymmetry and hierarchical structure of bully-victim relationships. In this study, we compared the tendency for a centralized distribution of bully-victim ties across self- and peer-reported networks.

Method

Sample

The sample consisted of 438 fifth-grade students (203 girls and 235 boys, M_{age} = 11.19 years old) from 13 Indonesian elementary school classrooms. The students predominantly came from middle to upper-middle-class families: 94 % of fathers and 93 % of mothers had completed high school, and 73 % of fathers and 61 % of mothers had at least a college degree.

Procedures

The Indonesian data analyzed in this study were part of a larger study (see Wei et al., 2025). The Indonesian data collection was overseen by the Purdue University Institutional Review Board. Psychology graduate students and lecturers administered the measures to students in 15 classrooms in three public elementary schools in Bandung, Indonesia, during the spring semester (April to June) of 2014. All fifth-grade students were invited to participate in the study with no exclusion criteria. Written consent and assent were obtained from parents and children, respectively. The parental consent rate for all classrooms was over 95 %. Two classrooms with participation rates lower than 70 % were excluded from our analysis because the accuracy of peer ratings and bullying nominations was questionable. The participation rate for the remaining 13 classrooms was over 80 %.

Measures

Bully-victim networks

The "who bullies whom" measure (Rodkin and Berger, 2008; Rodkin et al., 2014) was used to identify bully-victim dyads. Respondents were given four pages labeled "boys that bully boys," "boys that bully girls," "girls that bully girls," and "girls that bully boys." Each sheet had two columns, one for bullies and the other for victims, and students drew arrows from "bullies" to "victims" to indicate bully-victim dyads.

Self-reported bully-victim network. We constructed a self-reported bully-victim network based on ties reported by either a bully or a victim. This approach has been commonly used (e.g., Huitsing et al., 2012; Rambaran et al., 2020) and aligns with locally aggregated structures that combine multiple network reports (Krackhardt, 1987a). This network is directed (bully → victim) and unweighted.

Peer-reported bully-victim network. We constructed a peer-reported bully-victim network using a threshold-based method, defining ties as present when at least two peers reported a bully-victim relationship (Rodkin and Berger, 2008). This approach aligns with Krackhardt's (1987a) consensus structure. The network is also directed (bully → victim) and unweighted.

Friendship networks

Students circled the names of their friends within their classroom from a roster using an unlimited nomination procedure. Based on each student's nominations, we constructed a self-reported friendship network. This network is directed (nominator → nominee) and unweighted.

Sex

Based on school records, we coded boys as 1 and girls as 0.

Analytic strategy

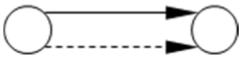
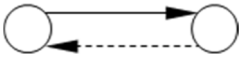
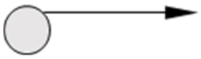
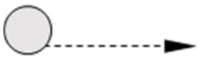
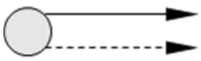
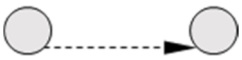
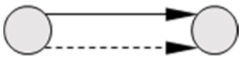
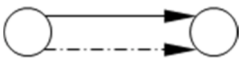
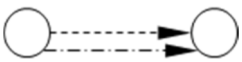
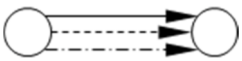
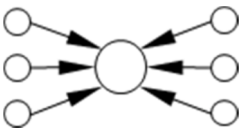
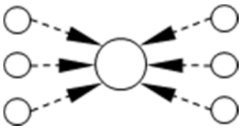
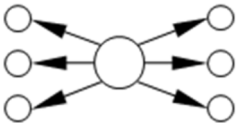
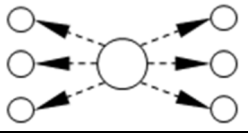
We used multiplex exponential random graph models (ERGMs) implemented in XPNet (Lusher et al., 2013). This approach allowed us to examine whether specific network variables predict the presence of ties across self- and peer-reported bully-victim networks. Specifically, the presence of a self-reported bully-victim relationship is modeled based on the presence or absence of a peer-reported bully-victim relationship and vice versa. Researchers have used similar modeling strategies to study bullying networks (Huitsing et al., 2019; Oldenburg et al., 2018; Rambaran et al., 2020). In addition to conditioning on the other network, ERGM variable estimates are conditional on other variables. For example, triadic relationships, which are a higher-order structure than dyadic relationships, include reciprocity; thus, variable estimates are conditionally dependent if included in the same model.

Two distinct approaches could be taken to model a multiplex ERGM with 13 classroom networks: a multilevel two-step and an integrated supernetwork (Tolochko and Boomgaarden, 2024). The multilevel two-step approach did not converge with a consistent set of variables because of high collinearity among variables in the small classroom networks (Lubbers and Snijders, 2007). Thus, we present results based on the integrated supernetwork approach. The 13 classroom networks were pooled into a single network, and one uniform model was constructed (e.g., Daniel et al., 2019). This modeling approach assumes that the same network formation processes operate in all networks (see the Limitations and Future Directions section for related discussion). This model fully converged with adequate goodness of fit, suggesting that the estimated model adequately captures the structural patterns of the observed networks.

Model specification and effect interpretation

Three types of network variables were included in the multiplex ERGMs. The first set includes variables for the self-reported network, the second for the peer-reported network, and the third for the multiplex network between self- and peer-reported relationships. We first identified independent variables related to our research questions (see Table 1). To address RQ1.1, we included the number of multiplex ties (ArcAB), indicating whether self-reported and peer-reported bully-victim relationships had higher agreement than expected by chance. For RQ1.2, we included the multiplex exchange (ReciprocityAB), indicating self- and peer-reports agreeing about the presence of a bully-victim relationship but disagreeing about its direction. For RQ2.1 about the role of sex, the sex sender effect (SenderA, SenderB, and SenderM) tested whether boys had more bully-victim relationships than girls. For RQ2.2, sex homophily (Interaction-A for Sex, Interaction-B for Sex, and Interaction-AB for Sex) variables were included to test whether the presence of same-sex and cross-sex bully-victim ties differed for self- and peer-reports. For RQ3, we included covariates of friendship networks (Covariate ArcA, Covariate ArcB, and Covariate ArcAB for Friendship) to

Table 1
Main multiplex ERGM variables.

Variable	XPNet Term	Illustration	Research Question	Description
Multiplexity	ArcAB		1.1: To what extent do self- and peer-reports agree on the individuals involved in the bully-victim relationships?	The tendency for a given bully-victim tie to coexist between self- and peer-reported networks
Multiplex exchange	ReciprocityAB		1.2: To what extent do self- and peer-reports agree on the direction of the bully-victim relationships?	The tendency to report the opposite directional bully-victim ties between the self- and peer-reported networks
Sex sender effect	SenderA		2.1: How does the sex of the bully account for disagreements between self- and peer-reported bully-victim relationships?	The tendency for boys to be identified as bullies more than girls in each and between the self- and peer-reported networks
	SenderB			
	SenderM			
Sex homophily	InteractionA		2.2: How does the sex of the bully and victim pertain to disagreements between self- and peer-reported bully-victim relationships?	The tendency to report bully-victim ties between same-sex students in each and between the self- and peer-reported networks
	InteractionB			
	InteractionAB			
Friendship network	Covariate ArcA		3: How do friendship relationships pertain to disagreements between self- and peer-reported bully-victim relationships?	The tendency to report bully-victim ties when students are friends in each and between the self- and peer-reported networks
	Covariate ArcB			
	Covariate ArcAB			
Indegree distribution	In-AS-A		4: How do relational schemas relate to disagreements between self- and peer-reported bully-victim relationships?	The tendency for victims to receive bully-victim ties in a centralized (or decentralized) distribution in each network
	In-AS-B			
Outdgree distribution	Out-AS-A		4: How do relational schemas relate to disagreements between self- and peer-reported bully-victim relationships?	The tendency for bullies to have bully-victim ties in a centralized (or decentralized) distribution in each network
	Out-AS-B			

Note. Network A is a self-reported bully-victim network, indicated with →. Network B is a peer-reported bully-victim network, indicated with ⇢. Network AB is the multiplex network between A and B. A male student is indicated with ◯, and a female/male is indicated with ○. A friendship tie is indicated with ⇢.

test how friendship relates to bullying-victim perceptions. Finally, to test for RQ4 pertaining to relational schemas, we included indegree and outdegree distributions (In-AS-A, In-AS-B, Out-AS-A, and Out-AS-B).

We then added basic (i.e., the number of ties, reciprocity, sink, source, and popularity sink) and triadic (i.e., multiple up and down two paths) network variables as controls. After including these variables, the model converged with adequate model fit statistics. Specifically, all model variables converged with $|t\text{-ratios}| < .09$. The goodness-of-fit test also showed that the model adequately captured the key features of the observed network by $|t\text{-ratios}| < .20$ for those variables included in the model and < 2.00 for those not part of the model. Adding additional higher-order network variables reduced either convergence or model fit.

Results

Descriptive results

The average classroom size was 34 students ($M = 33.69$, $Min = 28$, $Max = 44$). Table 2 compares the descriptive characteristics of each of the three networks. On average, each student was involved in one to two bully-victim dyads and had about six friends. Self- and peer-reported bully-victim networks more often included asymmetric and cross-sex ties than did friendship networks. Friendship ties were 50 % mutual and highly sex segregated. Reported bully-victim networks consisted of hierarchical structures and few closed triadic relationships (i.e., low clustering coefficients). Friendship networks were based on triadic closure—friends of friends were also friends—and a non-hierarchical structure. Additionally, the peer-reported bully-victim networks had higher outdegree centralization than self-reported networks, indicating that peers perceived more targets per bully and a more centralized structure when compared with self-reports (see a visual example in Appendix A Figure A1). Finally, the quadratic assignment procedure (Krackhardt, 1987b) confirmed that all the correlation coefficients between self- and peer-reported bully-victim networks in 13 classrooms were significant ($p < .05$). In contrast, the correlations between bully-victim and friendship networks were not significant.

Table 2
Descriptive statistics of self-reported bully-victim, peer-reported bully-victim, and friendship networks.

	Self-reported bully-victim	Peer-reported bully-victim	Friendship
Density measures			
Density	0.04 [0.02, 0.08]	0.05 [0.03, 0.08]	0.18 [0.12, 0.26]
Number of ties	48.23 [24, 67]	55.38 [35, 86]	199.15 [97, 338]
M in/outdegree	1.43 [0.69, 2.17]	1.65 [1.11, 2.21]	5.82 [3.46, 8.67]
SD indegree	1.63 [1.04, 3.98]	1.82 [0.89, 3.86]	2.71 [1.63, 3.79]
SD outdegree	2.23 [1.31, 4.85]	3.78 [1.84, 6.55]	4.06 [2.03, 6.82]
Dyad-level measures			
Number of asymmetric ties	39.46 [16, 63]	39.54 [25, 58]	94.54 [43, 182]
Number of mutual ties	4.38 [1, 13]	7.92 [3, 23]	52.31 [27, 78]
Reciprocity	0.18 [0.03, 0.39]	0.28 [0.12, 0.65]	0.53 [0.44, 0.63]
Sex homophily[a]	−0.07 [−0.34, 0.20]	−0.18 [−0.41, 0.31]	0.80 [0.56, 0.99]
Network-level measures			
Average distance	2.55 [1.82, 3.69]	2.11 [1.74, 2.72]	2.51 [1.99, 3.27]
Clustering coefficient	0.15 [0.00, 0.31]	0.18 [0.07, 0.29]	0.54 [0.43, 0.72]
Hierarchy[b]	0.84 [0.55, 0.98]	0.80 [0.44, 0.94]	0.24 [0.00, 0.61]
Indegree centralization[c]	0.17 [0.07, 0.61]	0.22 [0.06, 0.67]	0.20 [0.11, 0.32]
Outdegree centralization[c]	0.28 [0.10, 0.73]	0.54 [0.16, 0.98]	0.35 [0.19, 0.63]
Correlations[d]			
Self-reported bully-victim	1	—	—
Peer-reported bully-victim	0.33 [0.08, 0.62]	1	—
Friendship	0.01 [−0.06, 0.07]	0.00 [−0.04, 0.07]	1

Note. We reported the mean [min, max] of 13 classrooms.

[a] Yule's Q was calculated for sex homophily, which ranges from −1–1. A value of 1 indicates homophily and −1 represents heterophily.

[b] Hierarchy was measured using Krackhardt's (1994) method, with scores that ranged from 0 to 1. A value of 1 indicates a pure "out tree" structure, while a value of 0 means a flat, non-hierarchical structure.

[c] Indegree and outdegree centralization range from 0 to 1 (Freeman, 1979), where 1 represents a perfectly centralized structure and 0 indicates a completely decentralized structure.

[d] The correlation coefficient was calculated based on whether each edge existed in each network, using Pearson's correlation.

Multiplex ERGM results

Table 3 shows the results from the multiplex ERGM analyses. Goodness-of-fit tests are reported in Table B1 in Appendix B.

Evaluation of RQ1 revealed that self- and peer-reports of bully-victim relationships had higher agreements than expected in corresponding random networks (ArcAB = 2.249, $SE = 0.163$, $p < .001$). Self- and peer-reports agreed 39 % of the time. The odds of observing the agreement between self- and peer-reported bully-victim relationships were 9.48 times [= exp(2.249)] the odds of observing disagreement. Peers often agreed with self-reported bully-victim dyads, even when they differed on the direction of bullying. For example, if i or j reported a bullying relationship $i \rightarrow j$, peers were likely to perceive $j \rightarrow i$ (ReciprocityAB = 0.725, $SE = 0.164$, $p < .001$), even if they also perceived $i \rightarrow j$. Thus, peers often agreed on the bully-victim dyads but had different perceptions of the direction of the bully-victim relationships compared to self-reports.

Evaluation of RQ2 revealed that sex effects existed in peer- but not self-reports. Peers perceived that boys bullied more targets than girls (SenderB = 0.351, $SE = 0.092$, $p < .001$). The odds of observing boys bullying more targets in peer-reports were 1.42 times [= exp(0.351)] the odds of observing girls. In addition, peers perceived bully-victim relationships occurring between a boy and a girl more often than within the same sex (InteractionB = −0.407, $SE = 0.134$, $p < .01$). The odds of observing same-sex bully-victim relationships in peer-reports were one-third [= exp(−0.407)] the odds of observing cross-sex relationships. In contrast, the effects of the sex of bullies and sex homophily of bully-victim ties were not statistically significant in self-reported and multiplex networks.

The tests of RQ3 revealed that self- and peer-reports more often converged when bully-victim ties existed among students who were not friends (Covariate ArcAB = −0.532, $SE = 0.245$, $p < .05$). The odds that self- and peer-reports agreed about bully-victim relationships between friends were almost half [= exp(−0.532)] the odds obtained for non-friends. Self-reports more often reported bully-victim relationships existing among friends than non-friends, whereas this effect was not statistically significant in peer-reports (Covariate ArcA 0.447, $SE = 0.120$, $p < .001$; Covariate ArcB = 0.092, $SE = 0.121$, $p = .45$). The odds of i or j self-reporting $i \rightarrow j$ bully-victim tie when i considered j as a friend ($i \dashrightarrow j$) were 1.56 times [= exp(0.447)] the odds of i or j self-reporting $i \rightarrow j$ when i did not nominate j as a friend. In other words, self-reported bully-victim ties often occurred within friendships, and this type of bully-victim relationship was unlikely to be perceived by peers.

The analyses for RQ4 revealed that peers perceived bullying as more centralized such that a few bullies each bullied many victims. In contrast, reports of victimization were more decentralized such that each victim had a similar number of bullies. Specifically, the peer-reported bully-victim network was more decentralized in terms of indegree (i.e., the number of bullies per victim) than the self-reported network (In-AS-A = −0.070, $SE = 0.174$, $p = .69$; In-AS-B = −0.525, $SE = 0.146$, $p < .001$). While both networks were less centralized than random networks, the peer-reported network was much less centralized than the self-report network. On the other hand, outdegree centralization (i.e., the number of targets per bully) was greater in the peer-reported network than in the self-reported bully-victim network, although both were more centralized than expected by chance (Out-AS-A = 0.870, $SE = 0.167$, $p < .001$; Out-AS-B = 1.502, $SE = 0.143$, $p < .001$). These results are consistent with the linear schema, in that

Table 3
Results from multiplex ERGM of self-reported and peer-reported bully-victim networks.

Variable	XPNet Term	Self-reported		Peer-reported	
Density	Arc	−4.512***	(0.117)	−5.025***	(0.113)
Reciprocity	Reciprocity	0.593**	(0.215)	2.002***	(0.218)
Sink	Sink	−0.610*	(0.289)	−0.764**	(0.251)
Source	Source	−0.029	(0.301)	0.467	(0.328)
Indegree Distribution	In-AS	−0.070	(0.174)	−0.525***	(0.146)
Outdegree Distribution	Out-AS	0.870***	(0.167)	1.502***	(0.143)
Popularity Sink	Ain1outS	−0.142**	(0.046)	−0.141***	(0.030)
Multiple Down Two-paths	A2P-D	0.046***	(0.011)	0.141***	(0.005)
Multiple Up Two-paths	A2P-U	0.058**	(0.019)	0.050**	(0.018)
Sex Sender Effect	Sender	0.143	(0.114)	0.351***	(0.092)
Sex Homophily	Interaction	−0.108	(0.138)	−0.407**	(0.134)
Friendship	Covariate Arc	0.447***	(0.120)	0.092	(0.121)
		Self-reported & Peer-reported			
Multiplex Density	ArcAB	2.249***	(0.163)		
Multiplex Exchange	ReciprocityAB	0.725***	(0.164)		
Multiplex Sex Sender Effect	M-Sender	−0.386	(0.206)		
Multiplex Sex Homophily	M-Interaction	0.325	(0.256)		
Multiplex Friendship	Covariate ArcAB	−0.532*	(0.245)		

Note. Convergence $|t$-ratios$|$ are all $<.09$, indicating the fully converged model. * $p < .05$, ** $p < .01$, *** $p < .001$ (two-tailed z-test). Standard errors in parentheses. Network A is a self-reported bully-victim network. Network B is a peer-reported bully-victim network. Network AB is the multiplex network between A and B.

peers were more likely to perceive bullying as centralized, which is one measure of hierarchy in a network. Surprisingly, both self-reports and peer-reports showed that the probability of reciprocity was higher than expected when compared to random networks (ReciprocityA = 0.593, $SE = 0.215$, $p < .01$; ReciprocityB = 2.002, $SE = 0.218$, $p < .001$). This effect was stronger for peer-reports, indicating that peers were more likely to perceive bully-victim ties as mutual. These results provide evidence that peers use linear and balance schemas when reporting bully-victim networks when holding other network features constant.

Some of the control variable estimates were statistically significant. Sink measures the tendency of students to receive bully-victim ties without sending them out. Negative values, as shown in both self-reported (SinkA = −0.610, $SE = 0.289$, $p < .05$) and peer-reported bully-victim networks (SinkB = −0.764, $SE = 0.251$, $p < .01$), suggest that students were less likely to be sinks than corresponding random networks. The coefficients of popularity sink were also negative and significant, which represents students who receive many bully-victim ties but send out only one such tie. The negative coefficients, as observed in both networks (Ain1outS-A = −0.142, $SE = 0.046$, $p < .01$; Ain1outS-B = −0.141, $SE = 0.030$, $p < .001$), indicated that such tendency was less common in these networks. Multiple down two-paths measures the tendency for multiple students to have the same two others as bully targets. Positive coefficients in self-reported (A2P-D-A = 0.046, $SE = 0.011$, $p < .001$) and peer-reported bully-victim networks (A2P-D-B = 0.141, $SE = 0.005$, $p < .001$) indicated this tendency was more frequently observed than by chance. Multiple up two-paths also showed significant positive effects in both networks (A2P-U-A = 0.058, $SE = 0.019$, $p < .01$; A2P-U-B = 0.050, $SE = 0.018$, $p < .01$). These positive estimates suggest that two students bullied one target together more often than by chance. These results for multiple up and down two-paths suggest that students engage in group bullying, targeting specific individuals together more frequently than by chance.

Post-hoc analyses

Further analyses were conducted to explore sex effects (RQ2), the role of friendship (RQ3), and indegree and outdegree centrality (RQ4). This exploration allowed us to elaborate on the multiplex ERGMs results.

Figure A2 illustrates the differences between boys and girls in their reports of bully-victim relationships. Boys reported fewer dyads of "a girl bullies a boy" ($M = 1.33$) than the dyads of "a boy bullies another boy" ($M = 1.80$), $t(144) = -2.39$, $p < .05$. At the same time, there was no statistical difference between girls' self-reports of either dyad type. There were no significant differences in dyad nomination counts between self-reports of boys and girls. The Kruskal-Wallis test revealed that boy observers reported more bully-victim relationships than girls ($p < .05$), and reported more cases of boy-boy bully-victim dyads ($M = 3.43$) than girls ($M = 2.49$), $t(277) = 2.98$, $p < .01$. In contrast, boys and girls did not differ in their reports of girl-girl bully-victim relationships, $t(137) = 0.26$, $p = .80$. In sum, boys and girls differed in their reports of bully-victim relationships, which can partially explain why we found significant boy-sender and cross-sex effects in peer-reported bully-victim networks.

Table 4 provides additional multiplex ERGM results comparing self-reported bullying and victimization networks (the goodness-of-fit tests are reported in Table B2 in Appendix B); these analyses are similar to those conducted by Veenstra et al. (2007). A self-reported bullying network based on bullies' self-reports and a victimization network derived from victims' self-reports were constructed and analyzed using a multiplex ERGM in the same way as our previous model. This additional multiplex ERGM allowed us to disentangle the nature of friendship-based bully-victim relationships related to RQ3. Children more often reported being victims in self-reported victimization relationships that occurred within their friendships (Covariate ArcB = 0.270, $SE = 0.102$, $p < .01$). This, however, was not the case for self-reported bullying ties (Covariate ArcA = 0.249, $SE = 0.272$, $p = .36$). These results suggest that bullies often consider their victim a friend, while victims do not. In other words, the friendship-based bully-victim relationships seen in our initial results are driven by misperceptions between bullies and victims about the nature of their relationships.

ArcAB was positive and significant (ArcAB = 1.105, $SE = 0.387$, $p < .01$), suggesting that the agreement between self-reported bullying and victimization was greater than chance expectations. This suggests a directional agreement between bullies and victims in relation to RQ1. There was also a significant multiplex exchange. In other words, students self-reported that they were simultaneously bullies and victims within bully-victim relationships (ReciprocityAB = 1.600, $SE = 0.254$, $p < .001$). Furthermore, self-reported victimization networks included more reciprocal ties than expected by chance (ReciprocityB = 0.847, $SE = 0.225$, $p < .001$), suggesting that reciprocal bully-victim relationships often occurred in self-reports. Finally, bullies had multiple targets (Out-AS-A = 1.999, $SE = 0.790$, $p < .05$), and this tendency was confirmed by victims (Out-AS-B = 0.855, $SE = 0.157$, $p < .001$).

Figure A3 illustrates the differences between self-reported and peer-reported bully-victim networks in indegree centrality (the number of bullies per victim) and outdegree centrality (the number of targets per bully) (RQ4). Both Pearson's correlations were positive and high

Table 4
Results from multiplex ERGM of self-reported bullying and victimization networks.

Variable	XPNet Term	Bullying		Victimization	
Density	Arc	−5.677***	(0.178)	−4.678***	(0.098)
Reciprocity	Reciprocity	0.076	(0.870)	0.847***	(0.225)
Sink	Sink	−0.771	(0.914)	−0.398	(0.293)
Source	Source	0.611	(0.901)	0.272	(0.314)
Indegree Distribution	In-AS	0.184	(1.570)	−0.105	(0.162)
Outdegree Distribution	Out-AS	1.999*	(0.790)	0.855***	(0.157)
Multiple Down Two-paths	A2P-D	−0.169	(0.148)	0.140***	(0.007)
Multiple Up Two-paths	A2P-U	−0.537	(0.928)	0.122***	(0.013)
Sex Sender Effect	Sender	−0.041	(0.239)	0.151	(0.100)
Sex Homophily	Interaction	−0.115	(0.328)	−0.161	(0.124)
Friendship	Covariate Arc	0.249	(0.272)	0.270**	(0.102)
			Bullying & Victimization		
Multiplex Density	ArcAB		1.105**	(0.387)	
Multiplex Exchange	ReciprocityAB		1.600***	(0.254)	
Multiplex Sex Sender Effect	M-Sender		0.489	(0.493)	
Multiplex Sex Homophily	M-Interaction		−0.283	(0.600)	
Multiplex Friendship	Covariate ArcAB		0.146	(0.559)	

Note. Convergence $|t$-ratios$|$ are all $<.09$, indicating the fully converged model. * $p < .05$, ** $p < .01$, *** $p < .001$ (two-tailed z-test). Standard errors in parentheses. Network A is a self-reported bullying network. Network B is a self-reported victimization network. Network AB is the multiplex network between A and B.

($r = .57$, $p < .001$ for indegree centrality; $r = .82$, $p < .001$ for outdegree centrality), meaning that self- and peer-reports generally agreed on the identity of bullies and victims. There were, however, systematic disagreements such that peers, when compared with self-reports, identified more targets per bully and fewer bullies per victim. These results suggest asymmetric awareness of bullies and victims. Peers were more sensitive when reporting bullies but less attentive to victims. Peers also organized bully-victim relationships in a more linear-ordered schematic way than self-reports. In other words, peers focused more on central bullies and overlooked central targets, which led to perceiving more centralized and hierarchical bully-victim networks than self-reports.

Sensitivity analyses

To address heterogeneity concerns in the classrooms, we conducted sensitivity analyses. First, we ran t-tests to compare the number of self-reported ties to peer-reported ties at the classroom level (see Table C1). We found that our cutoff value based on previous research (Rodkin and Berger, 2008) generated peer-reported networks with a comparable number of bully-victim ties to those in self-reported networks. Yet, this cutoff value might be sensitive to our findings.

Second, to evaluate the impact of classroom heterogeneity on the integrated supernetwork approach adopted for multiplex ERGMs, we ran a meta-analysis with estimates from five classroom ERGM results that converged with the same set of parameters (see Table C2 for details) and compared these to our main findings (see Table 3). This meta-analysis yielded some results that were consistent across all of these classrooms, while others seemed more sensitive to classroom-level differences. Namely, our results regarding RQ1 (agreement) and RQ4 (relational schemas) were robust, while the others regarding RQ2 (sex) and RQ3 (friendships) were sensitive to the heterogeneity of classrooms. The full results of the sensitivity analyses are reported in Appendix C.

Discussion

Our analyses yielded novel insights into how preadolescent bully-victim relationships are perceived by those who are directly involved in these relationships as well as by external peer observers. There was general agreement between self- and peer-reports, but where they differed, they did so in systematic ways that provided insights into both bullying dynamics and network perception. By highlighting the social (e.g., interactions shaped by sex and friendship) and cognitive (e.g., schemas) factors that influence how informants perceive bully-victim relationships, we contribute to the theories that social structures are constructed by fundamental, nonrandom processes (Fararo and Sunshine, 1964). These processes are governed by distinct patterns of interaction within subnetworks defined by attributes such as sex (e.g., males and females) and behaviors (e.g., delinquency status, bullying) as well as network structures (e.g., triads) (Fararo and Skvoretz, 1987). For example, self- and peer-reports differed in how sex predicted bullying: peers were more likely to identify boys as bullies and to report cross-sex bully-victim relationships. Many bullies reported their victims as friends, while those victims reported themselves as victims. Bullies, victims, and peer observers were most likely to agree on bully-victim relationships when they occurred between non-friends. Finally, peer observers appeared to use relational schema—particularly linear-ordered schema—to organize their mental model of bully-victim networks. Namely, peers perceived the network to be more centralized and hierarchical than revealed from self-reports. We discuss how these findings (see Table 5) contribute to the literature below.

Cross-informant perceptions with multiplex ERGMs

This study demonstrated the utility of the "who bullies whom" measure for capturing cross-informant perspectives on bully-victim relationships (Rodkin and Berger, 2008; Rodkin et al., 2014). We showed how multiplex ERGMs can be used to disentangle agreement-disagreement patterns between self- and peer-reported bully-victim networks.

Our analyses revealed general agreement between self- and peer-reported bully-victim relationships, with ties reported in one network existing 62 % of the time in the other network. There was, however, a surprising amount of disagreement about the direction of bullying; peers and self-reports agreed about both the existence and direction of an edge only 39 % of the time. Huitsing et al. (2019), studying victim-aggressor relationships in much younger children, also reported a similarly low directional dyadic agreement of 25 % between self- and peer-reports. The inclusion of general dyadic agreement enables us to underscore the complex nature of bully-victim relationships in which self-reports often either conflict with the directionality revealed in the "who bullies whom" measure (Tatum and Grund, 2020) or are bi-directional (Rambaran et al., 2020; Veenstra et al., 2007). This suggests that preadolescent peers may struggle to recognize the direction of bully-victim relationships despite being aware of the students involved in these relationships.

These findings are based on multiplex ERGMs, which allow for the examination of complex patterns between self- and peer-reported bully-victim networks, as well as direct comparisons of each network's structure (Lusher et al., 2013). Given that the cross-informant framework highlights the importance of self- and peer-reports, separately and

Table 5
Summary of main findings.

	Research Question	Test	Finding
1.1	To what extent do self- and peer-reports agree on the individuals involved in the bully-victim relationships?	Multiplex density in multiplex ERGM (Table 3)	If a bully or victim confesses their bully-victim relationship, peers also report the relationship 39 % of the time.
1.2	To what extent do self- and peer-reports agree on the direction of the bully-victim relationships?	Reciprocity AB in multiplex ERGM (Table 3)	Although peers correctly identify dyadic bully-victim relationships, they incorrectly perceive the direction 23 % of the time.
2.1	How does the sex of the bully account for disagreements between self- and peer-reported bully-victim relationships?	Sex-sender B in multiplex ERGM (Table 3)	Peers are more likely to perceive boys as bullies than girls.
2.2	How does the sex of the bully and victim pertain to disagreements between self- and peer-reported bully-victim relationships?	Sex homophily B in multiplex ERGM (Table 3)	Peers are more likely to identify cross-sex bully-victim relationships than same-sex ones.
3	How do friendship relationships pertain to disagreements between self- and peer-reported bully-victim relationships?	Friendship covariate AB in multiplex ERGM (Table 3)	Self- and peer-reports agree when a bully-victim tie exists between two students who are not friends.
		Friendship covariate A in multiplex ERGM (Table 3)	When they disagree, victims perceive themselves as being bullied by students who consider them friends.
4	How do relational schemas relate to disagreements between self- and peer-reported bully-victim relationships?	Out-AS-A and Out-AS-B in multiplex ERGM (Table 3) and Figure A3B	Self- and peer-reports agree on the number of targets per bully. However, peers report that prominent bullies bully more victims than self-reports.
		In-AS-A and In-AS-B in multiplex ERGM (Table 3) and Figure A3A	Self- and peer-reports agree on the number of bullies per victim. But peers report fewer bullies per victim than self-reports do.

jointly, this analytical approach fits well with the theoretical framework. The results from this study demonstrated the benefits of exploring patterns within and between self- and peer-reported bully-victim networks using multiplex ERGMs.

Sex and cross-informant bully-victim relationships

Previous researchers have consistently found that boys more frequently engage in bullying than girls (Craig and Pepler, 1997; Olweus, 1993; Rodkin et al., 2014). When it comes to cross-sex bullying, boy → girl bullying is most common (Pellegrini, 2001; Rodkin and Berger, 2008). Our findings generally align with these findings but contribute new perspectives by focusing on how students' *perceptions* of bullying relationships differ as a function of the sex composition of the dyads and the sex of the observers. After controlling for other network mechanisms, boys were not more likely to be identified bullies or victims in self-report networks but more likely to be seen as bullies in peer-report networks. Perhaps boys may be less likely to perceive aggressive behavior as bullying, or perhaps less likely to report bullying behavior when they are involved, whether as bullies or victims. It is also possible that peers are more likely to perceive boys' behavior as bullying.

We also identified differences in how same-sex and cross-sex bullying was perceived. While self-reports were no more likely to report same-sex or cross-sex bullying relationships, peers were more likely to perceive cross-sex relationships. These findings suggest that peers infer bully-victim relationships differently depending on the sex of bullies and victims, possibly because cross-sex bullying is more visible and/or fits more closely with cultural definitions of bullying.

Differences between self- and peer-reports were partially a function of the sex of the reporters. Boys self-reported significantly fewer girl-boy bullying relationships than did peers. It is possible that boys experience some stigma when being bullied by girls and consequently underreport, or they may not perceive the relationship as bullying. It is also possible that boys are less attentive to their relational environment, and consistent with the findings from Lee et al. (2017), are less accurate than girls in perceiving network relations. In addition, boy observers reported boy-boy and girl-boy bully-victim relationships more frequently than girl observers. Perhaps boy victims' friends—who were often boys—were more likely to be aware of the bully and the bully-victim relationships (Hanish et al., 2016). Taken together, these findings suggest the importance of treating bullying as a socially influenced and perceived phenomenon.

Cultural norms may play an important part in how bullying is enacted and perceived. Our findings provide important evidence regarding the role of sex in bully-victim relationships in Indonesia, addressing a gap in the literature dominated by Western samples (e.g., Germany, the Netherlands, and the U.S.) and underscoring the value of studying bullying across cultural contexts. Cross-sex bullying serves as a way to gauge a potential partner's sexual interest and, at the same time, disguise the intent of the activity (Pellegrini, 2001; Volk et al., 2017). This phenomenon may be more pronounced in countries such as Indonesia, where romance by children and adolescents is strongly discouraged (Shen et al., 2020).

Friendship status and bully-victim relationship

This study clarified how friendship relates to bully-victim relationship perceptions. Although friendships are typically viewed as protective for victims, they can coexist with and even mask dyadic aggression. Our study identified 20 % of dyads where bully-victim dyads and friendships coexisted, aligning with prior findings by Wei and Jonson-Reid (2011), in which approximately 25 % of verbal and 31.5 % of physical bully-victim Taiwanese adolescent dyads involved either reciprocal or unilateral friendship nominations.

Friendship-based bully-victim relationships are often hidden and less visible (Mishna et al., 2008; Tatum and Grund, 2020). Our results revealed that perceptions of friendship were important in predicting whether informants perceived bullying. When students were not friends, bullies, victims, and peer observers were more likely to agree about the nature and direction of the relationship.

When the two members of the bully-victim dyads were friends (i.e., at least one student reported the other as a friend), there was more often disagreement among informants, especially between the self-reports from bullies and victims. Most often, bullies indicated that their friendship did not involve bullying, while their victims reported themselves as being victims and not friends. This finding is consistent with those of Tatum and Grund's (2020). In their study of German children, perception gaps (where the bully saw the victim as a friend) were more likely when the accused bully nominated the self-identified victim as a friend. Wei and Jonson-Reid (2011) also found that aggressors were more likely to unilaterally consider victims to be friends than victims were to view aggressors as friends. The current study showed that these results hold even when other network features are held constant. This further highlighted the asymmetry in the bully-victim relationships in their recognition of friendships. Interestingly, we found that within-friendship bullying was also less likely to be reported by peer

observers. This may be because this type of bullying is less visible to peers, as friendship makes aggression easier to hide. This may also suggest that the distinction between friendship and bullying is sometimes ambiguous and context dependent. Future research should further explore why bully-victim relationships within friendships are more likely to be invisible to peer observers.

Youth victimized by friends often experience significant distress yet tend to remain in the victimizing friendship. Contributing factors include limited social support and the normalization of bullying behaviors within friendships (Bouchard et al., 2021). Our findings suggest that youth victimized by friends may face complex challenges, underscoring the need for educators and practitioners to identify and support victims who may be trapped in harmful friendships.

Relational schemas and preadolescent bully-victim relationships

Our analyses revealed that bully-victim networks were structured hierarchically in both self- and peer-reports. A *centralized bullying network* structure was reported in which a few prominent bullies targeted many classmates, while most were not bullies. In contrast, a *decentralized victimization network* structure was reported, where there were many victims but few were targeted by multiple bullies. These structural characteristics were more pronounced in peer-reports than in self-reports (see Figure A3). Specifically, peers identified prominent bullies with many targets and reported bully-victim relationships as more evenly distributed among targets than did self-reports, in which fewer victims had more bullies.

One explanation is that peers are more aware of bullies than victims. Being aware of bullies is critical for victims and peers to avoid potential danger (Huitsing et al., 2019; Lee et al., 2016). This asymmetric awareness can be understood as a relational schema that varies in salience as a function of context (Sun et al., 2021). The asymmetric bully-victim schema aligns with what Walker (1976) described as a vertical schema within a larger linear-ordered schema framework: individuals pay additional attention to high-status individuals in a hierarchical network. Since using such schema reduces the burden of cognitive processing and improves the ability to make good inferences in uncertain situations (Sun et al., 2021), preadolescent peers appear to recall and report more about the central bullies by activating this context-specific vertical schema. Our results suggest that preadolescents use a relational schema in ways consistent with findings from other contexts (de Soto, 1960; Janicik and Larrick, 2005; Walker, 1976), with bullying centrality corresponding to status.

Peer observers, compared to self-reports from bullies and victims, were also more likely to perceive bully-victim relationships as reciprocal. Even self-reported bully-victim dyads, however, were more likely to identify reciprocal bully-victim relationships than were expected by chance. Most existing work, as well as intuitive beliefs about bullying, emphasize the asymmetric feature of bully-victim relationships (Rodkin et al., 2014). Our research adds to a limited but growing body of theoretical and empirical work that suggests that a surprising amount of bullying may be reciprocated (e.g., Kisfalusi et al., 2020; Rambaran et al., 2020). Our analyses showed that self-reported victimization networks included more reciprocity than self-reported bullying networks: that is, there were more dyads in which both students reported being victims than in those where both reported being bullies. Peer observations showed this tendency of reciprocal bully-victim relationships more often than self-reports. Our findings suggest that bully-victim relationships are perceived by preadolescent peer observers, but that they often have difficulty distinguishing which party is the aggressor, or that bullying is not as unidirectional as we might have thought. Peers may be using the balance schema, whereby individuals tend to perceive social relations as mutual even if they are not (Janicik and Larrick, 2005; Krackhardt and Kilduff, 1999), although this tendency has been shown to typically hold for positively-valenced relationships like friendships (e.g., Fararo and Sunshine, 1964).

Practical implications

This study offers practical implications for teachers and school administrators seeking to understand and reduce classroom bullying. Given the 38 % disagreement between self- and peer-reports, combining self- and peer reports should provide a more comprehensive snapshot of class bully-victim networks. If schools are limited to collecting only one type of report, they should pay close attention to factors such as sex, friendship status, and relational biases that influence whether a bully-victim tie is likely to be reported or not. For example, while both types of reports often identify bully-victim dyads, our findings suggest that the direction of the bullying is often reported differently.

In addition, our results suggest that teachers and school administrators should pay special attention to bully-victim relationships within friendships. Bullying between friends is often less visible, hidden from peers, and likely also hidden from teachers and parents (Mishna et al., 2008). A cross-informant approach is useful to uncover the nature of the relationship; in this particular case, comparing the perspectives of bullies and victims helps identify relational misperceptions of bullies: bullies often believe they do not bully their friends, even though the friends perceive their behavior as bullying. Existing relational structures, such as power dynamics and status, influence behavioral level events such as bullying, and these events may in turn change the structure of status and hierarchies (Skvoretz and Fararo, 1996). Therefore, efforts to accurately identify bullying are important for intervening in such cycles that can reinforce dominance.

Limitations and future directions

This work has some important limitations that should be considered when designing future research. First, our sample came from Indonesian fifth-grade students. As mentioned above, gender norms in preadolescence differ in Indonesia from those in Western countries. Some of our findings, particularly those related to sex differences, may not be generalizable to samples from other countries. Future research should replicate and expand on our findings of perceptual agreement-disagreement between self-reports and peer-reports in bully-victim networks across various cultural contexts and ages.

Second, the “who bullies whom” measure does not differentiate between types of bullying (e.g., physical, relational, cyber), and the differences in how bullying is enacted may explain some of our results. Compared to male bullies, female bullies may rely more on verbal and indirect forms of bullying, such as social exclusion, rather than physical aggression (Volk et al., 2006). This sex-specific bullying may further explain why peers perceive more boys as bullies than girls. We encourage researchers to collect measures of different forms of bullying to investigate further why and how peer-reports agree or disagree with self-reports.

Third, our cross-sectional design does not provide evidence of *why* our explanatory factors (i.e., sex, friendship, and relational schema) explain the disagreement between self-reported and peer-reported bullying relationships. In other words, these factors are not necessarily causes of perceptual disagreement—there can be reverse causality or confounding variables. In future studies, experiments or interview studies could help build a better understanding of the causes of the perception disagreements.

Fourth, we used multiplex ERGMs to examine our research questions. To find models that converged with adequate goodness of fit, we were unable to include some parameters that could be relevant, such as sex receiver effects and transitivity. Although previous studies (e.g., Rambaran et al., 2020) often found the effects of transitivity to be non-significant, a model including them could provide a more comprehensive understanding of bully-victim networks.

Fifth, we dichotomized the peer-reported bully-victim network. Our cutoff value was set based on a previous study defining a tie when reported by at least two peers (Rodkin and Berger, 2008). As reported in

Table C1 in Appendix C, our sensitivity analyses showed that our cutoff value produced peer-report networks with a similar number of bully-victim ties as the self-report networks. Future research should explore alternative network construction approaches; in particular, using weighted peer-report ties could help uncover further insights regarding bullying visibility.

Finally, we adopted an integrated supernetwork approach for our ERGMs instead of a multilevel two-step approach (Tolochko and Boomgaarden, 2024). This approach allowed us to identify general characteristics of bully-victim relationships but limited our understanding of classroom heterogeneity. It is possible that some bully-victim relationships and dynamics play out differently in classrooms with different gender distributions, class sizes, or teacher attributes. Indeed, the fact that not all classrooms converged when modeled separately provides some evidence that network processes are sensitive to classroom-level differences. To build up some intuitions about the role of classroom heterogeneity, we conducted a meta-analysis of classroom-level multiplex ERGMs for the five classrooms that yielded converged models. This analysis (see Table C2 in Appendix C) shows some classroom differences regarding how students perceived bully-victim relationships. For example, whereas some classrooms had cross-sex bully-victim relationships more frequently than same-sex, others did not have the same tendency. Future research should extend this work to different datasets to not only solidify our understanding of bully-victim networks but also to explore the role of heterogeneity among classrooms in explaining bullying behaviors and perceptions.

Conclusion

Perceptions of bully-victim relationships can vary depending on who is observing and reporting them, but the systematic patterns of divergence are not well known. Gaining insight beyond the perspectives of the dyads directly involved in bullying is particularly important for developing effective intervention strategies to identify and prevent bullying. The results from this study revealed that peers' perceptions often significantly diverged from self-reports, depending on the sex of both bullies and victims as well as the nature of their friendship ties. Peers also had a different understanding of the structure of the bully-victim network. Findings from this study offer a theoretical and analytical framework for examining informant accuracy by incorporating actor- and dyad-level factors as well as cognitive tendencies. Practically, the findings provide guidance for school administrators on when caution is needed in collecting and utilizing data to identify bullies and victims.

CRediT authorship contribution statement

Kyosuke Tanaka: Writing – review & editing, Writing – original draft, Visualization, Methodology, Investigation, Formal analysis, Conceptualization. **Keqin Zhang:** Writing – review & editing, Writing – original draft, Investigation, Data curation, Conceptualization. **French Doran C:** Writing – review & editing, Supervision, Conceptualization. **Jeremy Foote:** Writing – review & editing, Methodology, Investigation, Conceptualization. **Seungyoon Lee:** Writing – review & editing, Conceptualization, Methodology.

Appendix A. Figures

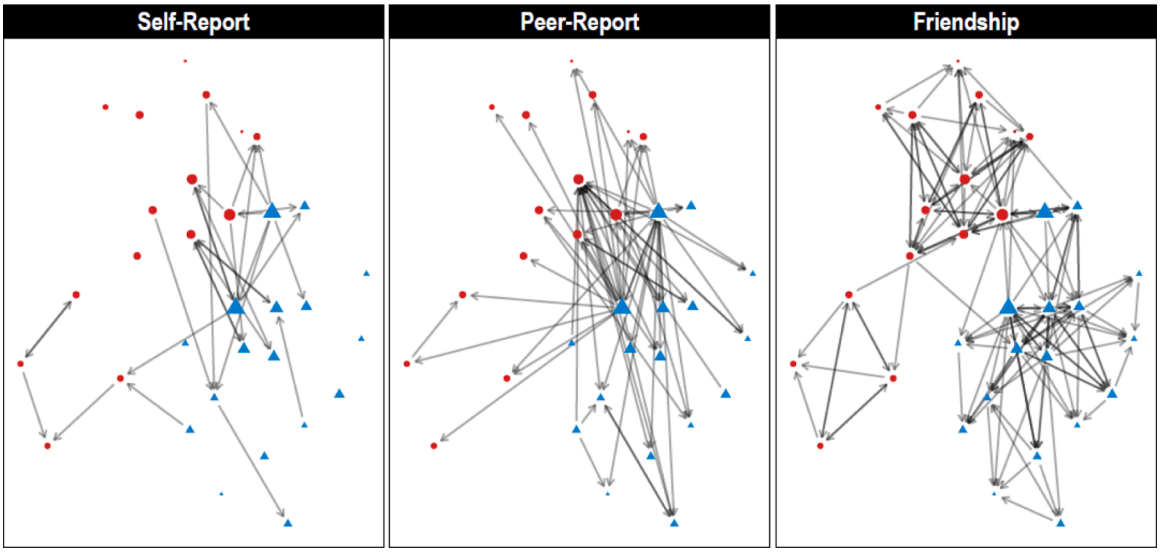


Figure A1. Illustration of self-reported bully-victim, peer-reported bully-victim, and friendship networks. *Note.* The classroom has 32 students. Blue triangles indicate boys and red circles indicate girls. A stress layout algorithm determines each student's position in the graph (Gansner et al., 2005)

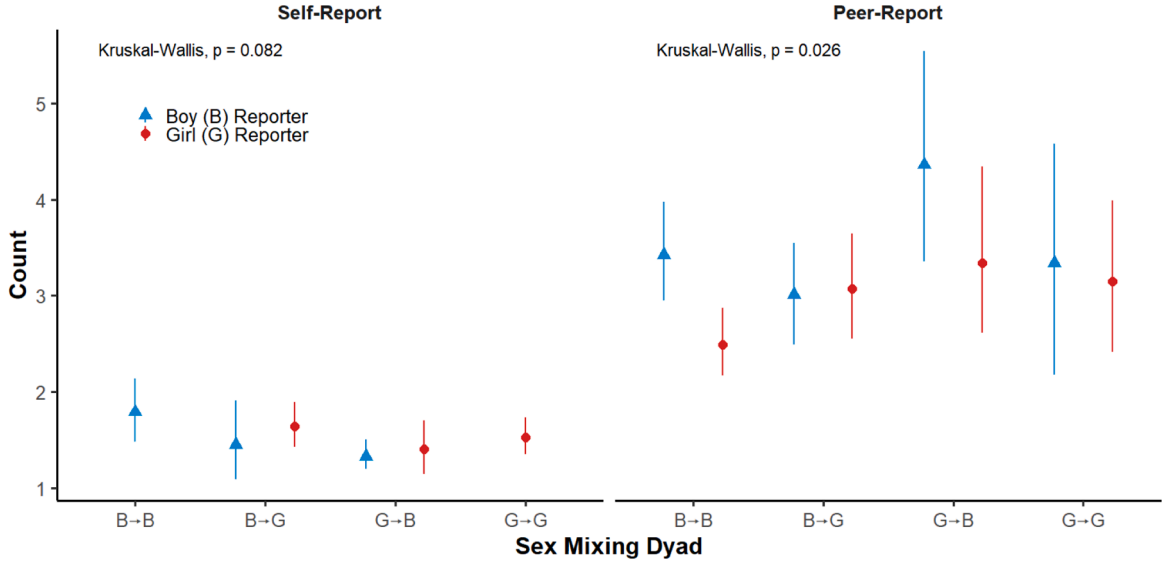


Figure A2. Sex dyad composition patterns in self- and peer-reports. *Note.* Blue triangles indicate the mean counts of bully-victim dyad nominations by boy reporters and red circles by girl reporters. Lines represent a 95 % confidence interval. The Kruskal-Wallis test *p*-values indicate the statistical difference in bully-victim dyad nomination counts between boy and girl reporters in self- and peer-reports

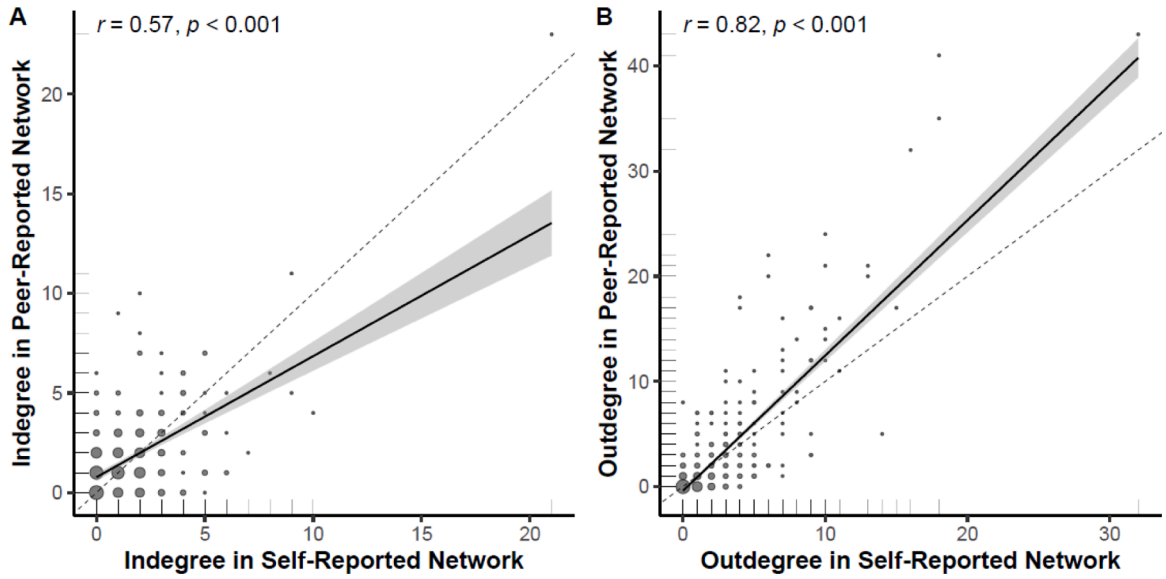


Figure A3. Indegree and outdegree centrality differences in self- and peer-reported bully-victim networks. *Note.* $N = 438$ students. Circle sizes reflect the number of students at the coordinates. The bigger the circles, the more students are at the coordinates. The dashed lines indicate a diagonal where students' indegree or outdegree centrality matches in self- and peer-reports. The solid lines show the regression fit, and the gray zones show its 95 % confidence interval

Appendix B. Goodness of fit test results

Table B1
Goodness of fit test Results of self-reported and peer-reported bully-victim networks

Statistics	Observed	*Mean*	*SD*	*t*-ratio
ArcA	627	620.168	43.929	0.156
ReciprocityA	57	56.037	10.033	0.096
2-In-StarA	854	844.941	173.585	0.052
2-Out-StarA	1520	1517.304	205.149	0.013
3-In-StarA	2004	2301.475	1263.082	−0.236
3-Out-StarA	7041	6969.038	1966.662	0.037
Mixed−2-StarA	1555	1863.321	355.372	−0.868
030TA	207	250.640	64.607	−0.675
030CA	44	63.975	21.567	−0.926
SinkA	104	103.763	7.658	0.031

(*continued on next page*)

Table B1 (*continued*)

Statistics	Observed	*Mean*	*SD*	*t*-ratio
SourceA	59	58.772	6.478	0.035
IsolatesA	95	94.689	11.878	0.026
AinS-A(2.00)	463.816	454.575	57.966	0.159
AoutS-A(2.00)	580.653	571.042	57.870	0.166
AinAoutS-A(2.00)	351.951	360.370	33.000	−0.255
Ain1outS-A(2.00)	736.799	728.297	83.684	0.102
1inAoutS-A(2.00)	625.453	629.968	80.487	−0.056
AKT-TA(2.00)	180.813	203.782	45.169	−0.509
AKT-CA(2.00)	113.906	154.925	45.753	−0.897
AKT-DA(2.00)	178.867	212.598	47.251	−0.714
AKT-UA(2.00)	173	190.166	43.199	−0.397
A2P-TA(2.00)	1461.875	1708.453	307.204	−0.803
A2P-DA(2.00)	1435.59	1414.528	181.675	0.116
A2P-UA(2.00)	764.625	752.438	148.282	0.082
RbA-sex	177	176.796	19.804	0.010
RsA-sex	355	353.516	30.619	0.048
Covariate ArcA−0	128	130.070	12.781	−0.162
ArcB	720	715.234	47.193	0.101
ReciprocityB	103	101.682	14.958	0.088
2-In-StarB	1052	1056.120	201.148	−0.020
2-Out-StarB	3872	3855.036	296.160	0.057
3-In-StarB	2704	3484.929	1691.014	−0.462
3-Out-StarB	28786	32197.603	3792.921	−0.899
Mixed−2-StarB	2447	2902.264	456.732	−0.997
030TB	486	546.825	95.376	−0.638
030CB	74	119.095	31.264	−1.442
SinkB	157	156.920	11.829	0.007
SourceB	32	32.466	4.961	−0.094
IsolatesB	82	88.576	12.811	−0.513
K-In-StarB(2.00)	548.123	539.493	63.860	0.135
AoutS-B(2.00)	876.359	867.223	66.849	0.137
AinAoutS-B(2.00)	321.513	346.241	32.625	−0.758
Ain1outS-B(2.00)	950.918	943.523	103.241	0.072
1inAoutS-B(2.00)	618.8	655.485	84.413	−0.435
AKT-TB(2.00)	387.121	415.051	60.338	−0.463
AKT-CB(2.00)	181.215	262.588	59.326	−1.372
AKT-DB(2.00)	415.125	450.731	64.123	−0.555
AKT-UB(2.00)	301.254	328.996	53.199	−0.521
A2P-TB(2.00)	2248.559	2565.031	385.688	−0.821
A2P-DB(2.00)	3580.5	3554.913	269.785	0.095
A2P-UB(2.00)	860.219	841.359	164.333	0.115
RbB-sex	201	202.604	21.009	−0.076
RsB-sex	443	445.590	36.810	−0.07
Covariate ArcB−0	120	125.863	11.571	−0.507
ArcAB	246	242.528	25.206	0.138
ReciprocityAB	143	141.412	21.818	0.073
ReciprocityAAB	66	80.978	16.815	−0.891
ReciprocityABB	93	107.432	19.639	−0.735
ReciprocityAABB	24	33.434	7.934	−1.189
In2StarAB	1658	1867.300	352.694	−0.593
Out2StarAB	4517	4354.916	428.184	0.379
Mix2StarAB	2128	2483.744	429.509	−0.828
Mix2StarBA	1747	2204.008	372.771	−1.226
TABA	240	316.833	70.202	−1.094
TABB	317	374.093	79.859	−0.715
TBBA	363	485.992	80.374	−1.530
TBAB	284	372.895	79.366	−1.120
TAAB	237	299.140	72.597	−0.856
TBAA	265	326.560	69.857	−0.881
CAAB	156	241.646	69.341	−1.235
CBBA	204	297.488	78.510	−1.191
IsolatesAB	32	38.417	8.630	−0.744
AT-T-ABA(2.00)	202.75	255.796	48.127	−1.102
AT-C-ABA(2.00)	133.156	193.662	48.418	−1.250
AT-D-ABA(2.00)	202.617	250.482	52.692	−0.908
AT-U-ABA(2.00)	215.5	246.795	45.799	−0.683
AT-T-BAB(2.00)	239.559	281.286	51.372	−0.812
AT-C-BAB(2.00)	167.84	221.660	50.731	−1.061
AT-D-BAB(2.00)	327.75	407.703	55.129	−1.450
AT-U-BAB(2.00)	205.857	224.328	45.936	−0.402
RsAB-sex	141	141.669	19.501	−0.034
RbAB-sex	67	67.626	12.395	−0.051
Covariate ArcAB−0	38	41.232	6.676	−0.484
Std Dev In-degree dist A	1.812	1.796	0.179	0.085
Skew In-degree dist A	3.962	4.350	1.431	−0.271
Std Dev Out-degree dist A	2.515	2.511	0.161	0.024

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Table B1 (*continued*)

Statistics	Observed	*Mean*	*SD*	*t*-ratio
Skew Out-degree dist A	5.574	5.413	0.836	0.192
Global Clustering Cto A	0.068	0.082	0.014	−0.990
Global Clustering Cti A	0.121	0.147	0.017	−1.537
Global Clustering Ctm A	0.133	0.133	0.015	−0.015
Global Clustering Ccm A	0.085	0.101	0.018	−0.881
Std Dev In-degree dist B	1.935	1.934	0.193	0.007
Skew In-degree dist B	4.164	5.200	1.411	−0.734
Std Dev Out-degree dist B	4.077	4.066	0.154	0.070
Skew Out-degree dist B	5.351	6.076	0.385	−1.882
Global Clustering Cto B	0.063	0.071	0.011	−0.767
Global Clustering Cti B	0.231	0.261	0.023	−1.301
Global Clustering Ctm B	0.199	0.189	0.015	0.661
Global Clustering Ccm B	0.091	0.122	0.017	−1.807

Note. All |*t*-ratios| $< .20$ for those variables included in the models and < 2.00 for those not included show adequate goodness-of-fit results.

Table B2
Goodness of fit test results of self-reported bullying and victimization networks

Statistics	Observed	*Mean*	*SD*	*t*-ratio
ArcA	118	117.058	16.737	0.056
ReciprocityA	2	1.948	1.480	0.035
2-In-StarA	27	27.354	10.253	−0.035
2-Out-StarA	93	93.353	32.263	−0.011
3-In-StarA	3	4.444	4.127	−0.350
3-Out-StarA	105	115.483	84.894	−0.123
Mixed−2-StarA	49	64.850	26.270	−0.603
030TA	5	3.780	3.128	0.390
030CA	0	0.519	0.858	−0.605
SinkA	72	71.363	8.020	0.079
SourceA	51	50.625	5.924	0.063
IsolatesA	293	293.735	14.981	−0.049
AinS-A(2.00)	25.5	25.265	8.751	0.027
AoutS-A(2.00)	59.547	59.026	15.799	0.033
AinAoutS-A(2.00)	29.969	32.285	9.747	−0.238
Ain1outS-A(2.00)	40.5	51.792	18.083	−0.624
1inAoutS-A(2.00)	36.203	38.370	12.867	−0.168
AKT-TA(2.00)	5	3.723	3.017	0.423
AKT-CA(2.00)	0	1.528	2.485	−0.615
AKT-DA(2.00)	5	3.731	3.028	0.419
AKT-UA(2.00)	5	3.481	2.747	0.553
A2P-TA(2.00)	49	64.162	25.633	−0.592
A2P-DA(2.00)	92.5	92.127	31.403	0.012
A2P-UA(2.00)	26.5	26.213	9.496	0.030
RbA-gender	31	31.390	6.918	−0.056
RsA-gender	63	63.782	11.218	−0.070
Covariate ArcA−0	25	24.574	6.005	0.071
ArcB	536	533.308	46.443	0.058
ReciprocityB	40	39.349	12.434	0.052
2-In-StarB	685	679.877	240.409	0.021
2-Out-StarB	1268	1315.649	237.954	−0.200
3-In-StarB	1479	2020.784	2490.923	−0.218
3-Out-StarB	6160	8477.106	3638.988	−0.637
Mixed−2-StarB	1173	1520.376	500.828	−0.694
030TB	151	213.633	78.192	−0.801
030CB	29	52.831	29.367	−0.811
SinkB	109	109.202	8.242	−0.025
SourceB	70	69.717	6.759	0.042
IsolatesB	112	112.625	12.485	−0.050
K-In-StarB(2.00)	378.504	374.080	61.902	0.071
AoutS-B(2.00)	472.431	469.331	63.109	0.049
AinAoutS-B(2.00)	273.663	296.471	34.089	−0.669
Ain1outS-B(2.00)	549.783	606.052	87.319	−0.644
1inAoutS-B(2.00)	479.905	513.120	86.635	−0.383
AKT-TB(2.00)	133.688	165.842	52.347	−0.614
AKT-CB(2.00)	72.906	124.479	59.139	−0.872
AKT-DB(2.00)	130.492	181.611	53.563	−0.954
AKT-UB(2.00)	124.875	151.630	50.644	−0.528
A2P-TB(2.00)	1109.875	1382.013	442.195	−0.615
A2P-DB(2.00)	1201.684	1218.509	215.272	−0.078
A2P-UB(2.00)	614.625	599.225	213.286	0.072
RbB-gender	154	156.581	18.356	−0.141
RsB-gender	310	311.861	30.367	−0.061

(*continued on next page*)

Table B2 (*continued*)

Statistics	Observed	*Mean*	*SD*	*t*-ratio
Covariate ArcB−0	110	108.180	13.706	0.133
ArcAB	27	26.850	7.181	0.021
ReciprocityAB	28	27.535	7.472	0.062
ReciprocityAAB	2	2.754	2.284	−0.330
ReciprocityABB	12	13.227	5.390	−0.228
ReciprocityAABB	1	1.104	1.052	−0.099
In2StarAB	230	246.147	75.663	−0.213
Out2StarAB	261	493.490	150.823	−1.541
Mix2StarAB	299	290.558	81.941	0.103
Mix2StarBA	207	350.550	143.843	−0.998
TABA	4	9.079	6.045	−0.840
TABB	24	42.482	19.391	−0.953
TBBA	23	46.248	19.509	−1.192
TBAB	13	41.157	20.288	−1.388
TAAB	8	15.966	9.064	−0.879
TBAA	6	10.230	6.780	−0.624
CAAB	4	7.746	5.611	−0.668
CBBA	17	35.611	20.071	−0.927
IsolatesAB	95	88.093	11.286	0.612
AT-T-ABA(2.00)	4	8.895	5.806	−0.843
AT-C-ABA(2.00)	4	7.588	5.398	−0.665
AT-D-ABA(2.00)	8	15.668	8.697	−0.882
AT-U-ABA(2.00)	6	9.270	5.782	−0.565
AT-T-BAB(2.00)	12.5	31.425	13.999	−1.352
AT-C-BAB(2.00)	16.5	28.270	13.960	−0.843
AT-D-BAB(2.00)	23	39.319	14.258	−1.145
AT-U-BAB(2.00)	21.25	29.692	12.915	−0.654
mrs-gender	18	18.847	5.748	−0.147
mrb-gender	8	8.387	3.440	−0.112
Covariate ArcAB−0	7	6.723	3.000	0.092
Std Dev In-degree dist A	0.566	0.562	0.055	0.062
Skew In-degree dist A	2.22	2.294	0.281	−0.264
Std Dev Out-degree dist A	0.788	0.781	0.102	0.070
Skew Out-degree dist A	5.021	4.997	1.205	0.020
Global Clustering Cto A	0.027	0.019	0.012	0.627
Global Clustering Cti A	0.093	0.065	0.043	0.638
Global Clustering Ctm A	0.102	0.055	0.035	1.333
Global Clustering Ccm A	0	0.020	0.031	−0.646
Std Dev In-degree dist B	1.689	1.657	0.286	0.112
Skew In-degree dist B	3.849	3.825	2.800	0.008
Std Dev Out-degree dist B	2.349	2.383	0.226	−0.154
Skew Out-degree dist B	6.244	7.658	2.580	−0.548
Global Clustering Cto B	0.06	0.080	0.020	−0.999
Global Clustering Cti B	0.11	0.158	0.027	−1.802
Global Clustering Ctm B	0.129	0.140	0.018	−0.599
Global Clustering Ccm B	0.074	0.097	0.026	−0.885

Note. All $|t\text{-ratios}| < .20$ for those variables included in the models and < 2.00 for those not included show adequate goodness-of-fit results.

Appendix C. Sensitivity analyses

We conducted a couple of sensitivity analyses. The first was a cutoff value analysis, and the other was a meta-analysis of classroom-level multiplex ERGMs.

First, we ran *t*-tests to compare the number of self-reported ties to peer-reported ones at the classroom level. At the cutoff point of 2 (see Table C1), the *t*-test value showed -1.126 ($df = 24$), $p = .27$, indicating no statistical difference in the number of ties between self-reports and peer-reports. At the cutoff point of 3, the *t*-test value was 2.692 ($df = 23$), $p < .05$, indicating that the number of self-reported ties was, on average, higher than the number of peer-reported ones.

Table C1
Comparisons of the number of peer-reported bully-victim ties by different cutoff values

Class	# of ties self-reports	# of ties cutoff≥1	# of ties cutoff≥2	# of ties cutoff≥3	# of ties cutoff≥4	# of ties cutoff≥5	# of ties cutoff≥6	# of ties cutoff≥7	# of ties cutoff≥8
1	24	142	42	24	12	8	5	2	1
2	39	128	47	24	9	5	3	3	2
3	56	110	47	32	17	9	8	6	5
4	30	153	64	24	10	8	5	1	0
5	35	109	55	36	19	10	9	8	6
6	25	90	40	31	19	11	6	5	3
7	33	113	35	16	8	5	2	1	0
8	63	146	61	33	16	11	8	7	4
9	67	141	72	57	53	52	49	48	47

(*continued on next page*)

Table C1 (*continued*)

Class	# of ties self-reports	# of ties cutoff≥1	# of ties cutoff≥2	# of ties cutoff≥3	# of ties cutoff≥4	# of ties cutoff≥5	# of ties cutoff≥6	# of ties cutoff≥7	# of ties cutoff≥8
10	65	127	42	18	11	8	5	2	1
11	60	156	58	20	6	2	2	2	1
12	67	125	71	56	46	40	36	28	20
13	63	228	86	44	25	19	14	7	5

Note. Cutoff values refer to the threshold number of peers who need to report the same bully-victim tie for it to be considered present.

Second, we managed to model five classrooms (out of 13) with a consistent set of variables, although we had to limit the parameters included (excluded popularity sink (Ain1outS) and multiple down two-paths (A2P-D) in Table 3) and could not obtain all classroom models to converge. Then, we conducted a meta-analysis with estimates from the five classroom ERGM results. Here, we report the key variables related to our RQs.

In Table C2, the estimate of multiplexity density (related to RQ1) was consistently significant and positive in all five classroom ERGMs (ArcAB = 2.151, $SE = 0.746$, $p < .05$), and the outdegree distribution estimate (related to RQ4) was positive and significant (Out-AS-B = 1.914, $SE = 0.657$, $p < .05$). On the other hand, for measures related to RQ2 about sex (i.e., SenderB = 0.299, $SE = 0.456$, $p = .55$; and InteractionB = −0.218, $SE = 0.531$, $p = .70$), the direction of estimates (i.e., positive or negative) is the same as Table 3, whereas these estimates are not significant. Further, regarding RQ3 (Covariate ArcA = 0.025, $SE = 0.564$, $p = .97$; and Covariate ArcAB = −2.253, $SE = 1.253$, $p = .15$), similar to sex, the direction of estimates is the same as Table 3, yet these estimates are not significant.

Table C2
Meta-analysis results from multiplex ERGM of self-reported and peer-reported bully-victim networks

Variable	XPNet Term	Self-reported			Peer-reported		
		Estimate	*SE*	*SD*	Estimate	*SE*	*SD*
Indegree Distribution	In-AS	−0.333	(0.740)	[1.505]	−0.403	(0.622)	[0.967]
Outdegree Distribution	Out-AS	1.625	(0.934)	[1.833]	1.914*	(0.657)	[0.884]
Sex Sender Effect	Sender	0.270	(0.460)	[0.476]	0.299	(0.456)	[0.557]
Sex Homophily	Interaction	−0.263	(0.570)	[0.486]	−0.218	(0.531)	[0.527]
Friendship	Covariate Arc	0.025	(0.564)	[0.491]	0.047	(0.393)	[0.693]
				Self-reported & Peer-reported			
				Estimate	*SE*	*SD*	
Multiplex Density	ArcAB			2.151*	(0.746)	[1.932]	
Multiplex Exchange	ReciprocityAB			0.990	(0.599)	[0.846]	
Multiplex Sex Sender Effect	M-Sender			−0.247	(1.042)	[1.108]	
Multiplex Sex Homophily	M-Interaction			−0.230	(1.198)	[0.517]	
Multiplex Friendship	Covariate ArcAB			−2.253	(1.253)	[4.621]	

Note. $N = 5$ classrooms. * $p < .05$, ** $p < .01$, *** $p < .001$ (two-tailed *t*-test). Estimates are based on the average effect size. Standard errors are associated with the average effect size in parentheses. Standard deviations are associated with the average effect size in blankets. Each classroom model includes control variables that are not shown here. Network A is a self-reported bully-victim network. Network B is a peer-reported bully-victim network. Network AB is the multiplex network between A and B.

References

An, W., 2022. You said, they said: a framework on informant accuracy with application to studying self-reports and peer-reports. Soc. Netw. 70, 187–197.

Baldwin, M.W., 1992. Relational schemas and the processing of social information. Psychol. Bull. 112 (3), 461–484.

Bernard, H.R., Killworth, P.D., 1977. Informant accuracy in social network data II. Hum. Commun. Res. 4 (1), 3–18.

Bernard, H.R., Killworth, P.D., Sailer, L., 1979. Informant accuracy in social network data IV: a comparison of clique-level structure in behavioral and cognitive network data. Soc. Netw. 2 (3), 191–218.

Bouchard, K., Smith, J.D., Woods, H., 2021. Individual and social-contextual factors underlying adolescents' commitment to victimizing friendships: a qualitative analysis. J. Early Adolesc. 41 (1), 70–96.

Brands, R.A., 2013. Cognitive social structures in social network research: a review. J. Organ. Behav. 34 (S1), S82–S103.

Brashears, M.E., Quintane, E., 2015. The microstructures of network recall: how social networks are encoded and represented in human memory. Soc. Netw. 41, 113–126.

Card, N.A., Rodkin, P.C., Garandeau, C.F., 2010. A description and illustration of the triadic relations model: who perceives whom as bullying whom? Int. J. Behav. Dev. 34 (4), 374–383. https://doi.org/10.1177/0165025410371418.

Coie, J.D., Dodge, K.A., 1988. Multiple sources of data on social behavior and social status in the school: a cross-age comparison. Child Dev. 59 (3), 815–829. https://doi.org/10.2307/1130578.

Cornell, D.G., Brockenbrough, K., 2004. Identification of bullies and victims: a comparison of methods. Issues Sch. Violence Res. 3, 63–87. https://doi.org/10.1300/J202v03n02_05.

Craig, W.M., Pepler, D.J., 1997. Observations of bullying and victimization in the school yard. Can. J. Sch. Psychol. 13 (2), 41–59. https://doi.org/10.1177/082957359801300205.

Crick, N.R., Grotpeter, J.K., 1996. Children's treatment by peers: victims of relational and overt aggression. Dev. Psychopathol. 8 (2), 367–380. https://doi.org/10.1017/S0954579400007148.

Crick, N.R., Nelson, D.A., 2002. Relational and physical victimization within friendships: nobody told me there'd be friends like these. J. Abnorm. Child Psychol. 30 (6), 599–607. https://doi.org/10.1023/A:1020811714064.

Daniel, J.R., Santos, A.J., Fernandes, C., Vaughn, B.E., 2019. Network dynamics of affiliative ties in preschool peer groups. Soc. Netw. 57, 63–69.

van der Ploeg, R., Steglich, C., Veenstra, R., 2020. The way bullying works: how new ties facilitate the mutual reinforcement of status and bullying in elementary schools. Soc. Netw. 60, 71–82.

Espelage, D.L., Holt, M.K., 2001. Bullying and victimization during early adolescence: peer influences and psychosocial correlates. J. Emot. Abus. 2 (2-3), 123–142. https://doi.org/10.1300/J135v02n02_08.

Fararo, T.J., Skvoretz, J., 1987. Unification research programs: integrating two structural theories. Am. J. Sociol. 92 (5), 1183–1209. https://doi.org/10.1086/228632.

Fararo, T.J., Sunshine, M.H., 1964. A study of a biased friendship network. Syracuse University Press.

Freeman, L.C., 1979. Centrality in social networks conceptual clarification. Soc. Netw. 1 (3), 215–239.

Freeman, L.C., 1992. Filling in the blanks: a theory of cognitive categories and the structure of social affiliation. Soc. Psychol. Q. 55 (2), 118–127.

Gansner, E.R., Koren, Y., North, S., 2005. Graph drawing by stress majorization. Graph Drawing: 12th International Symposium. Springer Berlin Heidelberg, pp. 239–250.

Hanish, L.D., Andrews, N.C., Kornienko, O., Santos, C.E., Rodkin, P.C., Granger, K.L., 2016. Being in the know: early Adolescents' knowledge of who bullies whom. J. Early Adolesc. 36 (5), 646–678. https://doi.org/10.1177/0272431615577203.

Huitsing, G., Veenstra, R., 2012. Bullying in classrooms: participant roles from a social network perspective. Aggress. Behav. 38 (6), 494–509. https://doi.org/10.1002/ab.21438.

Huitsing, G., van Duijn, M.A.J., Snijders, T.A.B., Alsaker, F.D., Perren, S., Veenstra, R., 2019. Self, peer, and teacher reports of victim-aggressor networks in kindergartens. Aggress. Behav. 45 (3), 275–286. https://doi.org/10.1002/ab.21817.

Hymel, S., Wagner, E., Butler, L.J., 1990. Reputational bias: view from the peer group. In: Asher, S.R., Coie, J.D. (Eds.), Peer rejection in childhood. Cambridge University Press, New York, pp. 156–186.

Janicik, G.A., Larrick, R.P., 2005. Social network schemas and the learning of incomplete networks. J. Personal. Soc. Psychol. 88 (2), 348–364.

Killworth, P.D., Bernard, H.R., 1976. Informant accuracy in social network data. Hum. Organ. 35 (3), 269–286.
Killworth, P.D., Bernard, H.R., 1979. Informant accuracy in social network data III: a comparison of triadic structure in behavioral and cognitive data. Soc. Netw. 2 (1), 19–46.
Kisfalusi, D., Pál, J., Boda, Z., 2020. Bullying and victimization among majority and minority students: the role of peers' ethnic perceptions. Soc. Netw. 60, 48–60. https://doi.org/10.1016/j.socnet.2018.08.006.
Krackhardt, D., 1987a. Cognitive social structures. Soc. Netw. 9 (2), 109–134.
Krackhardt, D., 1987b. QAP partialling as a test of spuriousness. Soc. Netw. 9 (2), 171–186.
Krackhardt, D., 1994. Graph theoretical dimensions of informal organizations. In: Carley, K., Prietula, M. (Eds.), Computational organizational theory. Lawrence Erlbaum Associates, Inc, Hillsdale, NJ, pp. 89–111.
Krackhardt, D., Kilduff, M., 1999. Whether close or far: social distance effects on perceived balance in friendship networks. J. Personal. Soc. Psychol. 76 (5), 770–782.
Ladd, G.W., Kochenderfer-Ladd, B., 2002. Identifying victims of peer aggression from early to middle childhood: analysis of cross-informant data for concordance, estimation of relational adjustment, prevalence of victimization, and characteristics of identified victims. Psychol. Assess. 14 (1), 74–96. https://doi.org/10.1037/1040-3590.14.1.74.
Lee, F., Butts, C.T., 2020. On the validity of perceived social structure. J. Math. Psych. 98, 102384.
Lee, S., Foote, J., Wittrock, Z., Xu, S., Niu, L., French, D., 2017. Adolescents' perception of peer groups: psychological, behavioral, and relational determinants. Soc. Sci. Res. 65, 181–194. https://doi.org/10.1016/j.ssresearch.2016.12.005.
Lee, S.-H., Smith, P.K., Monks, C.P., 2016. Participant roles in peer-victimization among young children in South Korea: Peer-, self-, and teacher-nominations. Aggress. Behav. 42 (3), 287–298. https://doi.org/10.1002/ab.21623.
Lubbers, M.J., Snijders, T.A., 2007. A comparison of various approaches to the exponential random graph model: a reanalysis of 102 student networks in school classes. Soc. Netw. 29 (4), 489–507.
Lusher, D., Koskinen, J., Robins, G., 2013. Exponential random graph models for social networks: Theory, methods, and applications. Cambridge University Press.
Mishima, K., 2003. Bullying amongst close friends in elementary school. *japanese*. J. Soc. Psychol. 19, 41–50.
Mishna, F., Alaggia, R., 2005. Weighing the risks: a Child's decision to disclose peer victimization. Child. Sch. 27, 217–226.
Mishna, F., Wiener, J., Pepler, D., 2008. Some of my best friends—Experiences of bullying within friendships. Sch. Psychol. Int. 29 (5), 549–573. https://doi.org/10.1177/0143034308099201.
Oldenburg, B., Barrera, D., Olthof, T., Goossens, F., van der Meulen, M., Vermande, M., Aleva, E., Sentse, M., Veenstra, R., 2015. Peer and self-reported victimization: do non-victimized students give victimization nominations to classmates who are self-reported victims? J. Sch. Psychol. 53 (4), 309–321. https://doi.org/10.1016/j.jsp.2015.05.003.
Oldenburg, B., Van Duijn, M., Veenstra, R., 2018. Defending one's friends, not one's enemies: A social network analysis of children's defending, friendship, and dislike relationships using XPNet. PloS ONE 13 (5), e0194323.
Olweus, D., 1993. Bullying at school. Blackwell, Oxford, UK.
Olweus, D., 2013. School bullying: development and some important challenges. Annu. Rev. Clin. Psychol. 9, 751–780. https://doi.org/10.1146/annurev-clinpsy-050212-185516.
Pellegrini, A.D., 2001. A longitudinal study of heterosexual relationships, aggression, and sexual harassment during the transition from primary school through middle school. J. Appl. Dev. Psychol. 22 (2), 119–133. https://doi.org/10.1016/S0193-3973(01)00072-7.
Pellegrini, A.D., Bartini, M., 2000. An empirical comparison of methods of sampling aggression and victimization in school settings. J. Educ. Psychol. 92 (2), 360–366. https://doi.org/10.1037/0022-0663.92.2.360.
Pellegrini, A.D., Long, J.D., Solberg, D., Roseth, C., DuPuis, D., Bohn, C., Hickey, M., 2010. Bullying and social status during school transitions. In: Jimerson, S.R., Swearer, S.M., Espelage, D.L. (Eds.), Handbook of bullying in schools: An international perspective. Routledge, New York, NY, pp. 199–210.
Pepler, D., Craig, W., Yuile, A., Connolly, J., Putallaz, M., Bierman, K.L., 2004. Girls who bully: a developmental and relational perspective. Aggression, antisocial behavior, and violence among girls: A developmental perspective. Guilford Press, New York, pp. 90–109.
Pepler, D.J., Craig, W.M., Roberts, W.L., 1998. Observations of aggressive and nonaggressive children on the school playground. MerrillPalmer Q. 44 (1), 55–76.
Rambaran, J.A., Dijkstra, J.K., Veenstra, R., 2020. Bullying as a group process in childhood: a longitudinal social network analysis. Child Dev. 91 (4), 1336–1352. https://doi.org/10.1111/cdev.13298.
Rodkin, P.C., Berger, C., 2008. Who bullies whom? Social status asymmetries by victim gender. Int. J. Behav. Dev. 32 (6), 473–485. https://doi.org/10.1177/0165025408093667.
Rodkin, P.C., Hanish, L.D., Wang, S., Logis, H.A., 2014. Why the bully/victim relationship is so pernicious: a gendered perspective on power and animosity among bullies and their victims. Dev. Psychopathol. 26 (3), 689–704. https://doi.org/10.1017/S0954579414000327.
Salmivalli, C., 2010. Bullying and the peer group: a review. Aggress. Violent Behav. 15 (2), 112–120.
Shen, M., Purwono, U., French, D.C., 2020. Romance, religion, and problem behavior in Indonesian muslim adolescents. J. Adolesc. 81, 87–95. https://doi.org/10.1016/j.adolescence.2020.04.001.
Skvoretz, J., Fararo, T.J., 1996. Status and participation in task groups: a dynamic network model. Am. J. Sociol. 101 (5), 1366–1414. https://doi.org/10.1086/230826.
Smith, P.K., Sharp, S., 1994. The problem of school bullying. In: Smith, P.K., Sharp, S. (Eds.), School bullying. Routledge, London, pp. 1–19.
de Soto, C.B., 1960. Learning a social structure. J. Abnorm. Soc. Psychol. 60, 417–421.
Sun, H., Brashears, M.E., Smith, E.B., 2021. Network representation capacity: how social relationships are represented in human mind. In: Small, M.L., Perry, B.L., Pescosolido, B., Smith, E.B. (Eds.), Personal networks: Classic readings and new directions in ego-centric analysis. Cambridge University Press.
Tanaka, K., & DeChurch, L.A. (2022). Errors of Omission and Commission in Group Communication Networks. In *Academy of Management Proceedings*.
Tanaka, K., Vega Yon, G.G., 2024. Imaginary network motifs: structural patterns of false positives and negatives in social networks. Soc. Netw. 78, 65–80. https://doi.org/10.1016/j.socnet.2023.11.005.
Tatum, T.G., Grund, T.U., 2020. Accusation and confession discrepancies in bullying: Dual-perspective networks and individual-level attributes. Soc. Netw. 60, 61–70. https://doi.org/10.1016/j.socnet.2019.09.001.
Tolochko, P., Boomgaarden, H.G., 2024. Same but different: a comparison of estimation approaches for exponential random graph models for multiple networks. Soc. Netw. 76, 1–11.
Veenstra, R., Huitsing, G., 2021. Social network approaches to bullying and victimization. In: Smith, P.K., Norman, J.O. (Eds.), The Wiley Blackwell Handbook of Bullying: A Comprehensive and International Review of Research and Intervention. Wiley Blackwell, pp. 196–214. https://doi.org/10.1002/9781118482650.ch11.
Veenstra, R., Lindenberg, S., Zijlstra, B.J.H., De Winter, A.F., Verhulst, F.C., Ormel, J., 2007. The dyadic nature of bullying and victimization: testing a dual-perspective theory. Child Dev. 78 (6), 1843–1854. https://doi.org/10.1111/j.1467-8624.2007.01102.x.
Veenstra, R., Lindenberg, S., Munniksma, A., Dijkstra, J.K., 2010. The complex relation between bullying, victimization, acceptance, and rejection: giving special attention to status, affection, and sex differences. Child Dev. 81 (2), 480–486. https://doi.org/10.1111/j.1467-8624.2009.01411.x.
Volk, A., Craig, W., Boyce, W., King, M., 2006. Adolescent risk correlates of bullying and different types of victimization. Int. J. Adolesc. Med. Health 18 (4), 575–586. https://doi.org/10.1515/IJAMH.2006.18.4.575.
Volk, A.A., Dane, A.V., Marini, Z.A., 2014. What is bullying? A theoretical redefinition. Dev. Rev. 34 (4), 327–343. https://doi.org/10.1016/j.dr.2014.09.001.
Volk, A.A., Veenstra, R., Espelage, D.L., 2017. So you want to study bullying? Recommendations to enhance the validity, transparency, and compatibility of bullying research. Aggress. Violent Behav. 36, 34–43. https://doi.org/10.1016/j.avb.2017.07.003.
Walker, C.J., 1976. The employment of vertical and horizontal social schemata in the learning of a social structure. J. Personal. Soc. Psychol. 33 (2), 132.
Wei, H.S., Jonson-Reid, M., 2011. Friends can hurt you: examining the coexistence of friendship and bullying among early adolescents. Sch. Psychol. Int. 32 (3), 244–262.
Wei, L., Marceau, K., Chen, X., Gest, S., Liu, J., Li, D., French, D.C., 2025. Children's friendship stability in the United States, China, and Indonesia: Associations with individual attributes and dyadic similarity. Child Dev. 96 (2), 591–605.