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Dynamic Pathways between Rejection and Antisocial Behavior in Peer Networks: Update and Test of Confluence Model

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Abstract

The confluence model theorizes that dynamic transactions between peer rejection and deviant peer clustering amplify antisocial behavior (AB) within the school context during adolescence. Little is known about the links between peer rejection and AB as embedded in changing networks. Using longitudinal social network analysis, we investigated the interplay between rejection, deviant peer clustering, and AB, in an ethnically diverse sample of students attending public middle schools (N = 997; 52.7% boys). Adolescents completed peer nomination reports of rejection and antisocial behavior in grades 6, 7, and 8. Rejection status was associated with friendship selection and adolescents became rejected if they were friends with others who were rejected. Youth befriended others with similar levels of AB. Significant patterns of peer influence were documented for AB and rejection. As hypothesized, rejected youth with low AB were more likely to affiliate with others with high AB instead of similarly low AB. In contrast, nonrejected youth preferred to befriend others with similarly high or low AB. Results support an updated confluence model of a joint interplay between rejection and AB as ecological conditions that lead to self-organization into deviant clusters where peer contagion on problem behaviors operates.

Keywords

antisocial behavior; peer rejection; peer networks; longitudinal social network analysis; stochastic actor-based modeling

Introduction

During early adolescence experiences of peer inclusion and exclusion become of central importance in adolescent lives. Peer rejection might be particularly detrimental for developing youth whose needs of social belonging are likely to thwarted. Indeed, peer rejection in early adolescence prospectively predicts increases in physical aggression and

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antisocial behavior (for reviews see, Dodge et al., 2003; Prinstein et al., 2018). Several mechanisms have been posited to explain how rejected youth are at a greater risk for development of antisocial behavior (AB), including socio-information processing deficits and hostile attribution bias (Dodge, Greenberg, Malone, et al., 2008; Lansford, Malone, Dodge, Pettit, & Bates, 2010), and lack of opportunities to develop vital social competencies (Dodge et al., 2003). Because peers play crucial role in both social rejection and development of antisocial behavior, the focus on peer ecology as explanatory mechanism has also been advocated.

Specifically, Dishion and colleagues introduced the concept of *confluence* describing how adolescents' antisocial behavior evolves in the context of their friendships and shaped by (a) experiences of peer rejection, (b) initial selection of friends, and (c) peer influence among friends through peer reinforcement processes (i.e., deviancy training; Dishion, Patterson, & Griesler, 1994). Two propositions of the confluence model have been supported: antisocial youth are likely to befriend one another and are influenced by their peers (Dishion & Tipsord, 2011; Gallupe, McLevey, & Brown, 2018; Sijtsema & Lindenberg, 2018). However, the role of peer rejection in these processes has received limited empirical attention (Light & Dishion, 2007).

Social marginalization in the form of peer rejection is thought to augment the value of any peer interaction, even a low quality one, which leads to rejected youth selecting each other as friends and resulting in clustering of rejected peers (Dishion, Piehler, & Myers, 2008). From an evolutionary perspective, social rejection can be seen as a survival threat, leading to self-organization into peer groups that promote an array of problem behaviors, including AB, because such behaviors are reinforced by peers and serve a function of securing and maintaining group membership (Dishion, Ha, & Veronneau, 2016). Taken together, these lines of research underscore a complex pattern of associations among peer networks, rejection, and AB.

Drawing on recent advances in conceptualizing and testing the role of peer network dynamics for behavior development (Veenstra, Dijkstra, Steglich, & Van Zalk, 2013; Veenstra, Dijkstra, & Kreager, 2017), we updated and tested the confluence model by examining co-evolving developmental trajectories of peer rejection and AB in the context of peer network dynamics. The peer network dynamics perspective and its corresponding longitudinal social network analysis (SNA) methods (Snijders, van den Bundt, & Steglich, 2010) underscores that to understand how peers shape problem behavior requires not only looking at them as sources of influence (*peer influence*), but also in accounting for how adolescents come to have particular friends (*peer selection*). Applied to the confluence model, the peer network dynamics perspective suggests that several new pathways need to be examined in order to describe the role that peer rejection may play for developmental trajectories of AB. Specifically, in addition to the two established pathways of peer selection and influence on AB (see Figure 1, dashed lines), we also need to examine peer selection and influence on rejection, interactive associations between AB and rejection as contributing to peer selection, and indirect peer influences between rejection and AB and vice versa. Given that we know substantially less about how peer rejection shapes peer network dynamics related to progression of AB, the updated confluence model articulated in this study aims to fill these theoretical and empirical gaps.

Confluence Model: Established Pathways

Peer Selection on Antisocial Behavior—Earlier generations of developmental research using static snapshots of deviant peer groups (i.e., cross-sectional designs without controlling for network interdependence) revealed that antisocial youth were more likely to have antisocial friends (e.g., Dishion, Andrews, & Crosby, 1995; Vitaro, Tremblay, Kerr, Pagani, & Bukowski, 1997). Moreover, a history of AB, academic skill deficits, and poor monitoring practices predicted increased deviant peer clustering (Dishion, Patterson, Stoolmiller, & Skinner, 1991). This research has relied on individual-level analyses and was unable to disentangle distinct contributions of deviant peer clustering from peer contagion that jointly operate in peer networks.

With the advent of longitudinal SNA modeling approaches (Snijders et al., 2010), developmental and criminology researchers have focused on distinguishing between peer selection and influence processes at the level of a peer network. Several studies relying on longitudinal SNA analysis have shown that peer selection dynamics are relevant to AB (Path 1 in Figure 1). Studies of U.S. high schoolers documented that adolescents befriended those with similar levels of delinquency (Jose, Hipp, Butts, Wang, & Lakon, 2015) and violent offending (Turanovic & Young, 2016). Several studies with Western European samples also provided support for peer selection on AB (Burk, Steglich, & Snijders, 2007; Franken et al., 2016; Knecht, Snijders, Baerveldt, Steglich, & Raub, 2010; Svensson, Burk, Stattin, & Kerr, 2012). A recent meta-analysis of 28 effect sizes from longitudinal SNA studies of peer selection on offending behavior (i.e., shoplifting, fighting, aggression, property crime) documented a significant positive effect size revealing that adolescents had 5% greater odds of selecting a friend with a same level of offending behavior compared to befriending someone with a different level of offending behavior (i.e., Cohen's *d* of 0.03, or a small effect size; Gallupe, et al., 2018). Taken together, these studies provide support for peer selection for AB.

Peer Influence on Antisocial Behavior—Multiple studies have shown significant peer influence effects on AB in longitudinal SNA studies (Path 2 in Figure 1). In a study of U.S. high schoolers, adolescents changed their levels of delinquency to become similar to their friends (Jose et al., 2015). Several studies with Western European samples also provided support for peer influence effects on AB. Specifically, one study documented that peer influence on delinquency operated friendship networks of Swedish youth (12 to 16 years of age; Svensson et al., 2012), whereas another investigation documented that peer influence on delinquency existed only among mutual friends (Burk et al., 2007). The same meta-analysis of 24 effect sizes of peer influence on offending behavior documented a significant positive effect size (Gallupe et al., 2018). Specifically, the odds of an adolescent changing their levels of offending to become one unit closer to their friends are 21% greater than not changing them (i.e., Cohen's *d* of 0.68, or a medium to large effect size). This research provides a robust evidence for peer influence on AB in adolescent networks.

Confluence Model: New Pathways

Peer Selection as a Function of Rejected Status—Developmental scientists have long been interested in understanding antecedents and consequences of peer rejection. Historically, this work has focused on identifying how antisocial and aggressive behavior, academic achievement, and social skill deficits precedes or forecasts being rejected for a peer group (Coie & Kupersmidt, 1983; Dishion, 1990; Dodge, 1983). An important insight emerging from this work was that rejected youth were more likely to self-organize in peer groups with other rejected and antisocial adolescents (Bagwell, Newcomb, & Bukowski, 1998; Cairns, Cairns, Neckerman, Gest, & Gariépy, 1989; Dishion, 1987; Dishion et al., 1991; Miller-Johnson, Coie, Maumary-Gremaud, Bierman, & the Conduct Problems Prevention Research Group, 2002).

Moving beyond the individual level of analysis, recent research advocates that rejection needs to be investigated from a relational perspective (Bierman, 2004; Erath, Pettit, Dodge, & Bates, 2009; Mikami, Lerner, & Lun, 2010). Accordingly, more attention has turned to understanding how rejection contributes to peer network dynamics (Fujimoto, Snijders, & Valente, 2017; Huitsing, Snijders, Van Duijn, & Veenstra, 2014; Pál, Stadtfeld, Grow, & Takács; 2016; Rambaran, Dijkstra, Munniksma, & Cillessen, 2015). Considering the impact of rejection status on peer selection processes, evidence points that adolescents from the U.S. middle schools befriended those who had experienced similar levels of rejection in five out of eight school contexts (Light & Dishion, 2007). Additional support for the need to examine how peer status contributes to peer selection comes from the evidence that network dynamics are driven by *peer preference,* which is a measure of peer status that lies on the opposite side of status continuum from peer rejection and represents the degree to which one is admired and liked by their peers (Marks, Cillessen, & Crick, 2012). Given that rejected youth are not entirely socially isolated and they have a smaller number of friends (Gest, Graham-Bermann, & Hartup, 2001), research needs to elucidate how rejected youth are selecting their friends (Path 3 in Figure 1).

Peer Influence on Rejection

Research at the individual level of analysis has shown that friends' levels of rejection are positively correlated with those of the focal youth (Dishion, 1987), suggesting a potential for peer influence processes (Path 4 in Figure 1). To the best of our knowledge, no research using longitudinal SNA has examined peer influence on rejection status as occurring among friends.

Interactive Associations Between Antisocial Behavior and Rejection Contributing to Peer Selection

Default selection by rejected youth—One of the key yet overlooked propositions of the confluence model is that youth who confront rejection from their peers are more likely to befriend antisocial youth, who themselves are also likely to deal with peer marginalization (Dodge, Coie, Pettit, & Price, 1990). In other words, when encountering a limited pool of potential friends, rejected youth befriend others who were not their first choices as friends but who are available, resulting in a *default selection* pattern (Path 5 in Figure 1). Such pool of potential friends is likely to exhibit academic and social skill deficits, antisocial behavior, and increased likelihood of subsequent gang involvement (Dishion, Nelson & Yasui, 2005; Dishion et al., 1991). Recent research using longitudinal SNA approaches has provided support for the default selection pattern by showing that highly aggressive boys tended to form friendships with other aggressive peers despite their preference to select prosocial peers (Sijtsema, Lindenberg, & Veenstra, 2010). Default selection has also been documented for friendship formation processes among victimized children and youth (Sentse, Dijkstra, Salmivalli, & Cillessen, 2013; Lodder, Scholte, Cillessen, & Giletta, 2016; Sijtsema, Rambaran, & Ojanen, 2013). Thus, it is plausible that rejected youth are more likely to select friends who are also rejected and delinquent.

"Shopping" by antisocial youth—Adolescents are not passive recipients of their social environment; they actively create their own social niche fitting their temperament and learning history (Scarr & McCartney, 1983). Evidence shows that, especially in early adolescence with the start of puberty, high-risk youth actively pull away from normative prosocial school contexts and parental supervision and seek out engagement in unsupervised activities, a process called *wandering* (Stoolmiller, 1990). Patterson referred to the active process of finding unsupervised settings in which to connect with other high-risk youth as the "shopping hypothesis" (Patterson, Reid, & Dishion, 1992). It is a plausible but untested assumption that antisocial youth might be actively befriending rejected youth (Path 5 in Figure 1).

Indirect Peer Influence

Recent conceptualization of the pathways linking peer relations to developmental psychopathology suggests that in addition to having direct peer influence on one another (i.e., modeling), youth may be influenced by peers via indirect pathways (Brechwald & Prinstein, 2013; Prinstein & Gilleta, 2016). It has been theorized that indirect peer influence (i.e., focal youth changes behavior X as a function of their friends' behavior Y) may operate for similarly themed behaviors or through socialization of underling processes (Prinstein & Gilleta, 2016). Because peer rejection status and antisocial behavior are reciprocally associated at the level of an individual (Dodge, 1983) and may stem from hostile attributional biases (Dodge et al., 2008), a possibility exists that an indirect peer influence between AB and rejection status and vice versa may operate in peer networks over time. As an exploratory goal, we examine such indirect peer influences between peers' AB and the focal adolescent's rejection status (Path 6 in Figure 1) and between peers' rejection status and the focal adolescent's AB (Path 7 in Figure 1).

Reciprocal Associations between Rejection and Antisocial Behavior

Previous research showed that their peers are likely to reject youth who exhibit aggressive and delinquent behavioral tendencies (Coie & Kupersmidt, 1983; Dishion, 1990; Dodge, 1983). The picture becomes more complex in early adolescence, however, as antisocial youth can be controversial; that is, their peers like them and reject them at the same time (Rodkin, Farmer, Pearl, & Van Acker, 2000). Considering the opposite pattern of association, peer rejection, accompanied by academic skill deficits, leads to AB and deviant peer clustering (e.g., Dishion et al., 1991; Dodge et al., 1990). In sum, considered at the level of an individual, peer rejection and antisocial behavior appear to be reciprocally associated (Path 8 in Figure 1; Tseng, Banny, Kawabata, Crick, & ShurFen Gau, 2013; Sentse, Kretschmer, & Salmivali, 2015).

Current Study

The goal of this study was to update and test the confluence model using conceptual and analytical insights from the peer network dynamics perspective. The confluence model posited that dynamic associations among peer rejection, deviant peer clustering, and antisocial behavior (AB) contribute to emergence of AB during adolescence, whereas peer network dynamics perspective clarified reciprocal processes through which peer rejection and antisocial behavior jointly shape peer selection and influence processes. To do so, we tested a comprehensive host of the established and new pathways linking peer rejection and AB in changing peer networks using a longitudinal SNA approach (i.e., stochastic actor-based modeling, SABM; Snijders et al., 2010). Figure 1 depicts these pathways, which include the two established pathways: (1) peer selection on AB and (2) peer influence on AB, and the four new confluence pathways: (3) peer selection on rejection status, (4) interactive dynamics between peer rejection and AB as contributing to peer network selection (default selection and shopping), (5) direct peer influence on rejection, (6) indirect peer influence of AB on rejection and vice versa, while controlling for reciprocal associations between rejection and AB at the level of an individual as well as peer network structural effects.

Methods

Participants

Participants were 997 adolescents recruited in sixth grade from three ethnically diverse metropolitan middle schools in the northwestern US. These schools were in a neighborhood with high rates of crime. We invited parents of all sixth-grade students to participate; 90% of them provided consent. The sample included 526 males (52.8%) and 471 females (47.2%) and consisted of 423 European Americans (42.4%), 291 African Americans (29.2%), 68 Latino/a Americans (6.8%), 52 Asian Americans (5.2%), and 164 adolescents of other races, including biracial (16.4%). The median annual family income was between $30,000 and $40,000, with incomes ranging from $5,000 to more than $90,000 (in US dollars).

Procedures and Intervention Protocol

Data collection took place in two cohorts: cohort 1 was in 1997–1998 and cohort 2 in 1999–2000; 85 % of the recruited students participated in three waves of data collection during middle school: spring of sixth grade (wave 1), spring of seventh grade (wave 2), and spring of eighth grade (wave 3). The schools and researchers integrated the multilevel family intervention into the public school system at three levels (for a complete description, see Dishion & Kavanagh, 2003). The intervention randomization took place at the individual level at the end of sixth grade. Participating schools agreed to assign the seventh-grade homeroom class in response to the research team’s randomization. The universal level involved a 6-week curriculum called SHAPe, which was delivered in the homeroom class (fall of seventh grade, before the wave 2 assessment) and designed to engage both parents and students in a variety of exercises to promote school success, healthy adolescent choices, and positive peer group functioning and to diminish problem behaviors and violence. Students from the control group received the middle school curriculum as usual. The second and third levels of the intervention are beyond the focus of this study because they took place after the measurement period we are using in this study: at the end of the seventh grade, during the summer, and at the beginning of eighth grade. Thus, we control simply for the intention to treat (ITT) effects of participating in the intervention study, knowing that for these youth, the seventh-grade SHAPe curriculum potentially had the greatest impact on peer selection and influence processes.

Measures

Antisocial behavior and rejection assessments used peer reports. To assess antisocial behavior, we used unlimited peer nominations elicited by the following question: “Which children start fights, pick on other kids, and tease them?” Composite measure of *antisocial behavior* was calculated by adding the number of incoming peer nominations, standardizing within grade, and z-standardized across schools. To assess peer rejection, students responded to the question, “Which children do you like least?” Students could nominate an unlimited number of their classmates of either gender. Similar procedures helped to compute peer rejection composites as above. Finally, because SABM requires discrete ordinal behavioral outcome variables, we transformed the z-scored AB and rejection measures into an ordinal variable with three levels using these increments of the continuous z-score: $z < 0$, $0 \leq z < 1$, and $z \geq 1$ (e.g., Delay, Ha, Van Ryzin, Winter, & Dishion, 2016).

Peer affiliation assessment consisted of asking students, “Which children do you hang around with?” Students could nominate as many others from their grade as they wanted; there were no gender restrictions. We used a directed measure of peer affiliation such that a peer affiliation relationship existed if student A nominated student B that they hang around together (1 = *affiliation*, 0 = *no affiliation*).

We included several sociodemographic and contextual variables in the analyses. Adolescents reported on their gender (1 = *female*, 0 = *male*) and ethnic-racial background (1 = *European American*, 2 = *African American*, 3 = *Native American*, 4 = *Hispanic or Latino/a*, 5 = *Asian American*, and 6 = *other*). Finally, to control for contributions of intervention curriculum to peer selection and influence processes, we included a dummy-coded variable for students who participated in the SHAPe curriculum in Wave 1 (1 = *treatment*, 0 = *control*)

Analytical Approach

Model overview—The SABM consists of two submodels that are jointly estimated. The *network submodel* tests the likelihood of friendship ties between adolescents based on various network selection processes. The *behavior submodel* captures effects related to changes in behavior over time. Snijders et al., 2010 and Veenstra et al., 2013 provide information about the modeling approach that is more detailed.

Model effects—For the network submodel specification, we considered three types of effects of AB and rejection on network selection, and we provide their illustrations by focusing on AB, while including the same effects for rejection. The *AB ego* effect estimates the effect of AB on an adolescent's tendency to nominate others as friends. A positive effect would indicate that adolescents with greater levels of AB nominated more friends over time. The *AB alter* effect describes how AB is associated with adolescent's tendency to receive nominations from peers. A positive effect would indicate that adolescents with higher levels of AB were more likely to be nominated as friends by their peers. The *AB similarity* effect estimates the tendency of adolescents to nominate friends with similar levels of AB. A positive effect of AB similarity would mean that adolescents were more likely to befriend peers with similar levels of AB.

Next, we included effects to examine interactive associations between AB and rejection in predicting peer selection. Specifically, an interaction between *Rejection ego* and *AB alter* effects was included to test the *default selection* of antisocial peers by rejected youth mechanism. We included an interaction between *AB ego and Rejection alter* to examine *delinquent peer shopping hypothesis:* whether delinquent youth preferred to befriend other socially marginalized youth who might be more amenable to peer influence in adopting AB of the focal adolescent. Because individual attributes could be associated with peer selection processes via ego, alter, and similarity effects, we also included three additional interactive associations rejection and AB in order to provide unbiased estimates of the two theoretically relevant interactive effects. An interaction between r*ejection ego* and *AB ego* examined whether rejected youth who were also high on AB sent out a higher number of outgoing nominations to peers. We also included an interaction between *rejection ego* and *AB similarity* to estimate whether rejected youth were more likely to befriend those who resembled them on AB, as well as an interaction between *AB ego and rejection similarity* to estimate whether antisocial youth were more likely to befriend those who resembled them on rejection status.

Our selection model estimated these effects, while statistically controlling for important confounding processes (Snijders et al., 2010). Specifically, we estimated whether similarity on gender, ethnic/racial background, and treatment condition increased the likelihood of peer selection. We also included parameters for several network structural processes. *Reciprocity* captured whether adolescents were more likely to nominate peers who had nominated them. We included several degree related effects. The *indegree popularity* effect estimated whether students who previously received more nominations were more likely to receive additional nominations over time. The *indegree activity* effect estimated whether students who received more nominations were more likely to send out a greater number of nominations. Finally, the *outdegree activity* effect estimated whether students who previously sent out a higher number of ties were more likely to subsequently send many ties. We used a square-root transformation of these activity and popularity effects to give greater weight to differences in popularity and activity at low versus high levels. To assess whether the presence of multiple friends in common increased the likelihood of tie formation ("friends of my friends are my friends"), we included three types of *geometrically weighted edgewise shared partners* (*GWESP*) effects. Guided by goodness of fit analyses, we selected a GWESP forward backward effect (*GWESP FB*) as it stands for the tendency to form transitive ties over multiple incoming ties. Additionally, a GWESP backward forward effect (*GWESP BF*) was included to model the tendency to close structural holes, and GWESP reciprocated ties effect to model the interaction between reciprocity and transitivity (*GWESP RR*). We also included *3-cycles* effect to model whether having more intermediary ties increases the likelihood of tie formation (without hierarchical ordering). *Balance* effect modeled the tendency to select ties to other actors who make the same choices as ego (i.e., structural equivalence with respect to outgoing ties; Snijders et al., 2010). *Jaccard similarity with respect to outgoing ties* effects was included to model the preference for structural equivalence in outgoing ties. The network function also included effects for *outdegree*, which controlled for the number of ties. Finally, *network rate* represented network change opportunities and l*n(outdegree+1)* was included to account for the dispersion of outdegrees.

For the behavior submodel, we estimated the peer influence effect on AB and rejection using *average alter effect*; this effect predicts that a focal adolescent whose friends have a higher average value of the AB and rejection also has a stronger tendency toward high values on the AB and rejection, respectively. A positive effect indicates that over time focal adolescents increase their AB and rejection status when they affiliate with friends have higher levels of AB and rejection, respectively. To evaluate how participation in the interventions impacted the levels of AB and rejection, we estimated effects of treatment on the levels of AB and rejection for changes between 6th and 7th grades (*effFrom*). We controlled for gender differences in the mean levels of AB and rejection by estimating effects of gender on the levels of AB and rejection (*effFrom*). Similarly, to examine whether a reciprocal relationship existed between AB and rejection at the individual level, we examined their main effects on each other. To examine the indirect peer influence effects from peer rejection status to AB and from AB on peer rejection status, we included two *alter's covariate average* effects, which were defined as (a) a product of ego's AB multiplied by the average of alters' rejection status, which was used to predict ego's AB over time and (b) product of ego's rejection status multiplied by the average of alters' AB in predicting ego's rejection status over time. We then included two reciprocal effects for associations between AB and rejection at the level of an individual by estimating whether (1) ego's levels of AB were associated with ego's levels of rejection and (2) ego's levels of rejection showed an association with ego's levels of AB. Lastly, for each of the behavioral dimensions, two effects that represent feedback (*linear* and *quadratic shape* effects) and *rates* for behavior change opportunities were included.

Modeling approach—We conducted SABM analyses using *RSiena* 4.0 (version 1.1–290; Ripley, Snijders, Boda, Voros, & Preciado, 2017) in *R*. Because we were interested in examining developmental differences across early adolescence, our three-wave panel data allowed us to separately investigate changes in networks and behaviors that occurred in period 1 (from sixth to seventh grade) and period 2 (from seventh to eighth grade). To gain sufficient power to detect peer influence on AB and rejection, we used a multigroup option (Ripley et al., 2017) to assemble one multigroup object across the five networks in period 1 and four networks in period 2 (one network was dropped due to model convergence issues). Whereas the multigroup option has the advantage of boosting the power to detect peer influence effects, it assumes that all parameter estimates are the same across the contexts. Thus, we tested whether this assumption was justified by examining school-related heterogeneity by including dummies into our models (i.e., dummy 1 compared an effect for the second school to that of the first school; dummy 2 compared an effect for the third school to that of the second). We conducted the joint score-type tests for school heterogeneity of the final models to show that parameter estimates were homogeneous. We discuss the school differences in parameters in the supplementary analyses. Finally, we assessed goodness of fit for the final models.

Results

Table 1 presents the descriptive statistics for AB, peer rejection, and friendship networks.

Confluence Model: Established Pathways

Peer Selection on AB—With respect to our SABM results (Table 2), we found that similarity on AB increased the likelihood of peer affiliation from 6th to 7th grades (AB similarity est. = 0.49, $p < .001$) and from 7th to 8th grades (AB similarity est. = 0.35, $p < .05$); these effects appear in path 1 (Figure 1). Moreover, in both cohorts, youth with higher levels of AB were less active in making friends over time (AB outdegree est. = −0.20, $p < .001$ for both periods) yet they were more popular as a potential friend (AB indegree est. = 0.20, $p < .001$ for both periods).

Peer Influence on AB—We found a significant and positive effect for peer influence on AB (path 3.A in Figure 1) in the younger age cohort (AB average alter est. = 2.85, $p < .001$). This suggests that over time, focal adolescents increased their AB when they affiliated with friends who had higher levels of AB.

Confluence Model: New Pathways

Peer Selection on Rejection—Our results documented that, in both cohorts, youth with higher levels of rejection status were more active in sending out friendship nominations over time (REJ outdegree est. = 0.27, $p < .001$ for 1st period and REJ outdegree est. = 0.28, $p < .001$ for 2nd period). Additionally, younger adolescents preferred to befriend others with similar levels of rejection status as themselves (REJ similarity est. = 0.40, $p < .05$); these effects appear in path 1.B (Figure 1).

Peer Influence on Rejection—We documented a significant and positive effect for peer influence on rejection status (path 3.B in Figure 1) in the younger age cohort (REJ average alter est. = 2.18, $p < .001$). This suggests that over time, focal adolescents were more likely to become rejected by their peers when they affiliated with friends who had higher levels of rejection status.

Interaction between Rejection and AB as Contributing to Peer Selection—To examine confluence processes shaping peer selection (Figure 1, path 2), we tested several interaction effects to examine how focal youth's AB and rejection status interacted to predict friendship selection. We documented a significant and negative interaction between ego rejection status and AB alter effect (est. = −0.15, $p < .05$) and significant and negative interaction between ego rejection status and AB similarity effect (est. = −0.41, $p < .05$) during the transition from 6th to 7th grades. During the transition from 7th to 8th grades, another significant and negative interaction between ego rejection status and AB similarity effect emerged (est. = −0.51, $p < .05$). To better understand these interactions), we calculated separate estimates for rejected and nonrejected youth in the section below (i.e., similar to a simple slope analysis in OLS regression).

Indirect Influence on AB and Rejection—Our results did not reveal that a significant indirect influence (path 6 in Figure 2) operated such that friends' levels of AB were not associated with changes in the focal adolescent's rejection status (6^{th} to 7^{th} grades est. = −0.84, $p = .20$; 7^{th} to 8^{th} grades est. = −0.66, $p = .31$) and that friends' rejection status was not associated with changes in the focal adolescent's AB (path 7 in Figure 2; 6^{th} to 7^{th} grades est. = −0.91, $p = .30$; 7^{th} to 8^{th} grades est. = −5.57, $p = .23$).

Reciprocal Associations between AB and Rejection—Considering reciprocal associations between AB and rejection status (path 8 in Figure 2), we found that during both transitions adolescents who had higher levels of AB were more likely to increase in their rejection status over time (est. = 0.77, $p < .01$ for 1^{st} period and REJ outdegree est. = 0.93, $p < .05$ for 2^{nd} period), but adolescents who had higher rejection status were not more likely to increase in their AB over time (6^{th} to 7^{th} grades est. = 0.30, $p = .75$; 7^{th} to 8^{th} grades est. = 2.04, $p = .79$).

Controlling for Gender and Classroom-Based Intervention Status Differences in Predicting AB, Rejection Status, and Friendship Selection

We did not find significant gender differences in the changes in main levels of AB (6^{th} to 7^{th} grades est. = 0.17, $p = .72$; 7^{th} to 8^{th} grades est. = −0.28, $p = .72$) and rejection (6^{th} to 7^{th} grades est. = −0.07, $p = .64$) over time. However, girls were more likely to increase their rejection status from 7^{th} to 8^{th} grades (est. = 0.52, $p < .05$). Random assignment to the SHAPe curriculum affected network selection such that adolescents who participated in the classroom-based intervention were more likely to affiliate with one another from 6^{th} to 7^{th} grades (treatment similarity est. = 0.10, $p < .001$) and intervention group youth sent out more friendship nominations between 6^{th} to 7^{th} grades compared to control group (treatment ego est. = 0.05, $p < .05$). We also tested whether participating in the SHAPe curriculum contributed to changes in AB (est. = 0.32, $p = .84$) and rejection (est. = 0.04, $p = .29$) from 6^{th} to 7^{th} grades and documented no significant associations.

Controlling for Potentially Confounding Network Selection Processes

We obtained these results while statistically controlling (i.e., estimated in the same model) for network selection processes (e.g., preference to affiliate with friends of the same gender, race; McPherson, Smith-Lovin, & Cook, 2001). Our results indicated that younger by not older cohort adolescents were more likely to select peers of the same gender (younger est. = 0.12, $p < .001$; older est. = 0.03, $p = .75$). We did not document a significant preference for homophily on race-ethnicity (younger est. = 0.06, $p = .78$; older est. = 0.01, $p = .56$). Finally, we also examined several commonly observed network structural processes and documented that across both developmental transitions, youth were more likely to nominate peers who had nominated them (reciprocity est. of 0.79 and 1.05, $p < .001$). We also found evidence that the presence of multiple friends in common increased the likelihood of tie formation ("friends of my friends are my friends", Davis 1970). Specifically, we documented a significant and positive tendencies (a) to form transitive ties across multiple incoming ties (*GWESP FB* est. of 0.44 and 0.65, $p < .001$), (b) to close structural holes (*GWESP BF* est. of 0.39 and 0.22, $p < .001$), and (c) to reciprocate ties with others who have friends in common (*GWESP RR* est. of 0.25 and 0.28, $p < .001$). We also found that, controlling for the previously discussed effects, having more intermediary ties decreased the likelihood of tie formation (without hierarchical ordering; 3-cycles effect of −0.10 and −0.07, $p < .001$) and that youth preferred selecting ties to other actors who make the same choices as ego (*Jaccard similarity with respect to outgoing ties* effect of 7.92 and 4.64, $p < .001$). We also found that students who previously received more nominations were more likely to receive additional nominations over time (*indegree popularity* effect of 0.22 and 0.26, $p < .001$), whereas those students who sent out an increasing number of friendships nomination were less likely to receive a higher number of incoming nominations (*indegree activity* effect of −0.57 and −0.64 $p < .001$) and send out even more outgoing nominations (*outdegree activity* effect of −0.23 and −0.10, $p < .001$) over time. Finally, *network rate* represented network change opportunities and l*n(outdegree+1)* was included to account for the dispersion of outdegrees. Taken together, these findings point that our friendship networks formed according to fundamental network processes.

Follow-Up Analyses for Significant Interaction between Rejection and AB as Contributing to Peer Selection

To further elaborate on how friend selection processes regarding AB were different for rejected and nonrejected youth, we calculated two separate ego-alter tables following the formulas presented in Lomi et al. (2011). These ego-alter tables illustrate the model-predicted probabilities that rejected and nonrejected youth with particular levels of AB were likely to select friends of a particular level of AB using ego-alter selection tables. Because our models revealed that estimates for multiple network selection processes with respect to AB and rejection status are jointly unfolding in networks, constructing ego-later selection enables a holistic look across all significant processes (Ripley et al., 2018). The values presented in each table are the odds that an ego of a specified AB level selects as a friend an alter with a certain AB level versus an alter with any other level of AB; these values are calculated separately for rejected and nonrejected youth (Table 3). To compute the ego-alter table for rejected and nonrejected youth, we used parameter values from the related effects in the model including rejection ego, main effects of AB ego, AB alter, and AB similarity as well as two significant interactions for period 1 and one significant interaction for period 2 (Table 2). Again, because of internal centering of variables in SABM, we calculated these group-specific selection values using (1-mean rejection) for nonrejected youth and (3-mean rejection) for rejected youth.

Group differences revealed by these ego-alter selection tables elaborate on the results from group-specific AB selection patterns that we documented for each period. Specifically, during transition from 6th to 7th grades, a rejected adolescent with lowest level of AB had 5.5 % lower odds of choosing a friend with the same lowest level of AB than a friend with the highest level of AB (= exp(0.251)/exp.(0.307))*100 – 100= − 5.5%). A rejected adolescent with highest level of AB had 12 % lower odds of choosing a friend with the same highest level of AB than a friend with the lowest level of AB (=exp(−0.187)/exp(−0.055))*100 – 100= − 12%). On the other hand, a nonrejected adolescent with lowest level of AB had 15% higher odds of choosing a friend with the same lowest level of AB than a friend with the highest level of AB. A nonrejected adolescent with highest level of AB had 255% higher odds of choosing a friend with the same highest level of AB than a friend with the lowest level of AB.

Furthermore, during transition from 7th to 8th grades, a rejected youth with lowest level of AB had 56 % lower odds of choosing a friend who reports the same lowest level of AB than a friend with highest level of AB. A rejected adolescent with the highest level of AB had 2 % lower odds of choosing a friend with the same highest level of AB than a friend who reported the lowest level of AB. Finally, a nonrejected youth with lowest level of AB had 22 % higher odds of choosing a friend who reported the same lowest level of AB than a friend with the highest level of AB. A nonrejected adolescent with highest level of AB had 172 % higher odds of choosing a friend with the same highest level of AB than a friend with the lowest level of AB.

As the last steps in our modeling approach, we conducted additional analyses to ascertain that (a) the reported peer selection and influence effects were homogeneous across the five school contexts and (b) the final models provided adequate fit to the data (see Online Appendix for details).

Discussion

Given the personal and societal costs incurred from adolescent antisocial behavior (AB; Greenberg & Lippold, 2013; Loeber & Farrington, 2000), our goal was to better understand multiple peer processes through which these behaviors emerge and become amplified within school settings. Expanding the peer confluence model of AB (Dishion et al., 1994) from a peer network dynamics perspective, we tested a host of complex and reciprocal pathways between AB and rejection status that are co-evolving within changing peer networks during adolescence. In line with previous findings supporting the established pathways confluence model (for reviews see Gallupe et al., 2018; Sijtsema & Lindenberg, 2018), our results also documented peer selection and influence patterns related to AB during adolescence. Additionally, through an extension of the confluence model, we found that rejection status was associated with friendship selection and that adolescents became rejected by their peer group if they were friends with others who were rejected by their peers. Moreover, our findings also pointed to an interactive pattern of associations among peer rejection, AB, and network selection. Specifically, for both developmental transitions in middle school, rejected youth with low levels of AB were more likely to befriend others with higher levels of AB. This pattern could stem from the proposed default peer selection dynamics. In contrast, nonrejected youth preferred to befriend others with similarly high or low levels of AB. Significant patterns of peer influence were documented in the younger cohort, in that youth increased their AB and rejection status when they were friends with others who were rejected and delinquent. In sum, these findings provide support for the updated confluence model underlying peer contagion on AB (Dishion et al., 1994).

This study makes several novel contributions to research and theory on the role of peer relationships in the development of antisocial behavior. Among key contributions of this study is the documentation of new interactive dynamics that underpin aggregation and peer influence processes with respect to rejection status. We found across both developmental transitions, rejection status was associated with friendship network selection patterns such that rejected youth were not socially isolated but were active in creating new friendships and maintaining existing ones. Interestingly, among the younger cohort, friendship network selection was significantly affected by the preference to befriend others who have similar levels of rejection as the focal youth. Whereas a preference to affiliate with similarly nonrejected friends is expected given adolescents' heightened sensitivity to and pursuit of social status (Sijtsema & Lindenberg, 2018), befriending similarity rejected youth might occur due to a limited pool of potential friends (i.e., default selection pattern; Sijtsema et al., 2013). This finding is consistent with the theorized mechanisms of peer rejection homophily such that peer rejection augments the value of any peer interaction, even a low quality one, which leads to rejected youth selecting each other as friends and resulting in clustering of rejected peers (Dishion, Piehler, & Myer, 2008). These observations contribute to a small body of evidence revealing that rejected youth do have friends and that these friends are more likely to be rejected from the peer group (Deptula & Cohen, 2004; Gest et al., 2001). Taken together, this evidence underscores the need for continued attention to how rejected adolescents are forming their friendships to mitigate their aggregation into clusters of rejected youth where limited opportunities may exist for mastery of social skills (Coie & Kupersmidt, 1983; Dishion, 1990; Dodge, 1983) and engagement in risk-taking behaviors is likely to occur (Tseng et al., 2013) and be amplified via deviancy training processes (Dishion et al., 1994).

Our results documented, for the first time, a significant peer influence on rejection status, suggesting that over time youth tend to shift their peer rejection status in the direction of their friends. This finding extends an emerging body of research documenting that over time adolescents influenced one another's popularity levels over time and this effect was above and beyond preferences to affiliate with popular youth and network structural processes (Dijkstra, Cillessen, & Borch, 2013; Marks, Cillessen, & Crick, 2012). Although more evidence is needed to support firm conclusions, given the documented pattern of elevated risks of deviant peer involvement that is associated with being rejected, a peer contagion of rejection is particularly problematic for adolescents. Thus, directing future empirical attention to the mechanisms through which peer influence on rejection operates in networks appears to be warranted. Our exploratory attempt to examine whether indirect socialization operated in peer networks such that friends' levels of rejection contributed to the focal adolescent's levels of antisocial behavior and vice versa did not provide evidence for such cross-dimensional peer influence effects, which has been previously reported for nonsuicidal self-injurious behaviors and depressive symptoms (Giletta, Burk, Scholte, Engels, & Prinstein, 2013) and academic achievement and risk-taking behavior (Gremmen, Berger, Ryan, Steglich, Veenstra, & Dijkstra, 2018).

Another contribution of this study focuses on uncovering interactive pathways from the confluence model through which AB and rejection jointly shape friendship selection processes. Our results showed that rejected youth with low levels of AB were less likely to befriend others with similarly low levels of AB and tended to affiliate with others who had highest levels of AB. This finding provides specific evidence for interpersonal mechanisms through which socially excluded but not yet engaging in antisocial behavior adolescents create deviancy-promoting peer ecologies in which they are likely to subsequently adopt and escalate their antisocial behavior. This pattern may also stem from the default selection processes that have been documented in the past research (Sentse et al., 2013; Lodder et al., 2016; Sijtsema et al., 2013). This pattern suggests that, when faced with a limited pool of potential friends, rejected youth befriend others who are available, those who become increasingly likely to exhibit academic skill deficits and antisocial behavior (Dishion et al., 1991) and over time become involved in gangs (Dishion et al., 2005). Being rejected by one's social group is a major survival threat, according to an evolutionary perceptive, signaling the need to adopt and escalate an array of problem behaviors because such behaviors serve a function of securing and maintaining a group membership (Dishion, 2016; Ellis, et al., 2012).

Interestingly, rejected youth who were already engaging in higher levels of AB were less likely to befriend others with similarly high levels of AB. This seemingly contradictory finding may need to be considered within the broader context of engagement with peers as a means of boosting one's social status by befriending non-AB individuals and influencing them to engage in AB (Dishion et al., 1996; Moffitt, 1993). This pattern of friendship selection is also in line with the shopping hypothesis (Patterson et al., 1992; Stoolmiller, 1990) that we now find to be applicable to friendship formation processes of adolescents who are both rejected by their peers and engage in high levels of delinquent activities. Taken together, these findings underscore a certain degree of heterogeneity in the friendship selection processes for rejected and non-rejected youth, which would be of vital importance to understand in order to devise and implement effective intervention programs for rejected youth.

Our results from interactive pathways between rejection status and AB revealed a different pattern of friendship selection through which nonrejected adolescents appear to have been structuring their peer ecologies. For both developmental transitions within middle school, we found that nonrejected youth have a strong preference for homophilous selection on AB, in other words, those with low levels of AB prefer friends with low levels of AB and those with high levels befriend those with high levels of AB. It is noteworthy that the strength of this preference was much stronger for youth who were engaging in higher levels of AB compared to those with lower levels of AB (i.e., 255% vs. 15% higher odds for the younger cohort and 172% vs. 22% higher odds for the older cohort). These observations are in line with decades of theorizing that antisocial behavior is used as a means of social status acquisition during adolescence (Dishion et al., 1996; Moffitt, 1993).

This study advances an ecological understanding of the development of adolescent problem behaviors, guided by the developmental cascades perspective (Masten & Cicchetti, 2010) and an interactive view on an individual adaptation and developmental contexts (Dishion, Véronneau, & Myers, 2010). These perspectives suggest that even small deviations from normative development (e.g., child noncompliance) interact with the environment and over the course of development, develop into antisocial and violent behavior (Dishion et al., 2010). Prior research has corroborated cascading effects over longer periods of time, in which initial behavior problems continue and intensify into violent behavior within family and school systems (Dishion et al., 2010; Masten & Cicchetti, 2010). Complementing the emphasis on the long-term developmental cascades, the present study unpacked a host of transactional dynamics on a shorter timescale through which peer networks shape rejection and AB in the school context. Social network perspective and analytical tools used in this study revealed a complex pattern of associations among rejection and AB, characterized by feedback loops that peer ecology has shaped. As such, this study advances the developmental cascade and transactional models by outlining distinct contributions of peer rejection and network dynamics to the etiology of AB.

These novel contributions emerged due to methodological advantages applied to the examination of the dynamic links between peer dynamics linking rejection and AB. Specifically, our use of longitudinal SNA modeling (Snijders et al., 2010) allowed us to disentangle peer selection from influence processes on AB and rejection, while controlling for important confounding processes. Deploying this modeling approach yields more accurate estimates of peer selection and influence contributions to AB and rejection because the model simultaneously estimates a host of confounding processes (i.e., network structural processes, school contextual dynamics, and selection on individual attributes such as gender and race or ethnicity). Failure to account for these alternative mechanisms that promote peer selection risks overestimating the role of AB and rejection in peer selection and influence. Moreover, longitudinal SNA modeling framework permits considering both main effects and interactive associations between AB and rejection as embedded in peer network dynamics. Identifying significant moderators of peer selection and influence dynamics sheds light on mechanisms of peer contagion, uncovering which is critical for advancing developmental theory and informing interventions to disrupt peer contagion (Dishion & Tipsord, 2011; Prinstein & Giletta, 2016).

An additional strength of this study is its use of peer-reported measures of antisocial behavior and rejection, creating a score for each youth that reflects an aggregated perspective of the peers providing the ratings, thus reducing self-report bias. Although this score has methodological strengths, the AB reported by peers is likely restricted to the school setting. In this sample, we observed that some of the middle school students engaged in gang activity, which involved problem behaviors that occurred largely out of the school context (e.g., drug use, drug sales, stealing, vandalism, etc.). Thus, there are some limitations to testing the interaction of rejection status and AB hypotheses with the network data derived solely from a school setting. For example, in early adolescence, the sheer number of hours youth spend with peers unsupervised by adults predicts growth in problem behavior from ages 12 to 15 (Dishion, Bullock, & Kiesner, 2008). Moreover, antisocial males tend to select friends more often from the neighborhood and less from school settings (Dishion et al., 1995; Kiesner, Kerr & Stattin, 2004).

Our findings on peer influence of AB during the 6^{th} to 7^{th} grade transition, which we assessed with peer-reported measures in this study, diverge from prior results from this sample relying on self-reported frequency of antisocial and violent behaviors most likely due to the use of reciprocated hang out ties as well as a differing operationalization of peer influence (Kornienko, Dishion, & Ha, 2017). Interestingly, peer-reported measures of AB used in this study had a stronger effect on peer network selection dynamics compared to self-reported measures of deviancy and violence, which could be done covertly, outside of school leading to a restricted knowledge by school peers, examined by Kornienko and colleagues (2017).

Future research needs to examine what role academic functioning, which is another integral aspect of adaptation to the school environment (Dishion et al., 2010), plays in a complex web of associations between problem behavior and rejection in school peer networks. Earlier intervention studies show that academic and peer domains relate reciprocally during adolescence in that mitigation of peer problems improves academic functioning (Stormshak, Connell, & Dishion, 2009). Another set of potent contributors to the etiology of externalizing behavior uncovered in developmental cascade models includes poor family management, parental monitoring, and coercive processes (Dishion, & Patterson, 2006) as well as neuropsychological deficits such as inattention and impulsivity coupled with family adversity (Moffitt, 1993). Thus, these processes could also contribute to amplifying rejection-antisocial behavior dynamics in peer networks. Future research would benefit from detailed attention to these variables as moderators of peer mechanisms. Understanding these dynamics as unfolding in peer networks is important for designing effective interventions.

Considering clinical implications, this study included a randomized, multiphase intervention in which randomization placed sixth-grade students into their seventh-grade homerooms with intervention classrooms receiving a universal SHAPe curriculum aimed to reduce substance use and other health-risk behaviors. Based on this randomization, schools created a homeroom environment that encouraged discussions of norms and behaviors related to health, which included antisocial behavior (Dishion & Kavanagh, 2003). Our analyses revealed that friendships were more likely to form during the transition from sixth to seventh grades among students who participated in SHAPe curriculum and that these youth were more active in sending out friendship nominations suggesting their better social integration over time. Although the intervention delivered in the homeroom may have created more camaraderie among students, it is equally likely that simple proximity led to increases in friendship formation. Previous research with this sample found that in one out of three schools that implemented the SHAPe curriculum, youth in the intervention classrooms were more likely to befriend others with similarly high or similarly low delinquency levels (Delay et al., 2016). It is noteworthy that *self-reported frequency of deviant peer affiliation* examined by DeLay and colleagues (2016) included behaviors targeted in the SHAPe curriculum; they explicitly focused on examining intervention effects on targeted behaviors as mediated by peer network dynamics. Perhaps youth involved in the intervention classes reduced their reports on delinquent behaviors that their classes discussed. Taken together these studies underscore that a simple intervention such as randomly assigning youth to a homeroom class can affect students' choices of friends.

In summary, using the conceptual and analytical tools of the peer network dynamics perspective enabled us to provide a comprehensive test of the updated confluence model. Consistent with the model's propositions, we documented a joint interplay between peer rejection and AB that created conditions leading to self-organization into deviant clusters in which peer contagion on problem behaviors operated. This study elucidated a distinct role of peer network processes that shape and are shaped through interactive contributions of antisocial behavior and peer rejection within the school context. Although additional research is needed on specific mechanisms underlying these dynamics, our findings point to a possibility that successful interventions that disrupt the etiology of antisocial behavior within school context also can disrupt peer rejection dynamics. We advocate for the focus on peer rejection because it amplifies deviant peer clustering, thus creating a social context for deviancy training and amplification of antisocial into violent behavior (Dishion & Patterson, 2006).

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Online Appendix

Section 1. Follow-Up Analyses for Significant Interaction between Rejection and AB as Contributing to Peer Selection

To further probe the differences between rejected and nonrejected youth, we calculated separate estimates for the alter AB and similarity AB effects for these two groups and evaluated whether these group-specific estimates were significantly different from zero. This is similar to conducting a simple slopes analysis as a follow-up to a significant interaction in a multiple regression. Because SABM, by default, centers independent variables, it was necessary to compute additional statistics to correctly interpret significant interactions. Thus, we accounted for mean centering of rejection status variable and then created a group-specific estimates by summing across the scaled interaction estimate, rejection ego estimate, and AB alter and AB selection estimates. Following these calculations, the estimate for AB alter effect for nonrejected adolescents was 0.14, and it was 0.38 for rejected youth. Next, we calculated standard errors for these rejected- and nonrejected-specific coefficients using the variance sum law for correlated random variables and consulting covariance of effect matrix that is available as a part of SABM output (e.g., Haynie et al., 2014; McMillan et al., 2018). Thus, we obtained the standard error for the rejected youth estimate which was equal to 0.009, whereas standard error for the nonrejected youth estimate was equal to 0.004. Finally, we tested the rejected- and nonrejected-specific parameters for statistical significance based on a t-ratio (estimate divided by the standard error), where t-values > 2 indicated that the coefficient was significantly different from zero at $p < .05$ (Snijders et al., 2010).

For rejected adolescents, the t-ratio was equal to 41.26 (i.e., 0.38/0.009) suggesting that AB alter estimate was significantly different from zero ($p < .05$). For nonrejected youth, the t-ratio was equal to 30.64 (i.e., 0.14/0.004) suggesting that AB alter estimate was significantly different from zero ($p < .05$). This suggests that, during the transition from 6th to 7th grades, both nonrejected and rejected youth are more likely to send ties to friends with higher levels of AB compared to friends with lower levels of AB (resp. est. = 0.135, $p < .05$; est. = 0.375, $p < .05$). The direction of this effect is the same, it appears that rejected youth have a stronger preference for friends with higher AB than nonrejected adolescents.

Furthermore, during the 6th to 7th grade transition, another significant interaction between rejection status ego effect and AB similarity effect was found. Following the same steps as outlined above, we obtained the following rejected and nonrejected adolescent -specific estimates, standard errors, and t-ratios for the two AB similarity effects. For rejected youth, the AB similarity effect estimate was equal to 0.30, its standard error was 0.07, and t-ratio was equal to 4.03, suggesting that this estimate was significantly different from zero ($p < .05$). For nonrejected youth, the AB similarity effect estimate was equal to 0.56, its standard error was 0.02, and t-ratio was equal to 33.15, suggesting that this estimate was significantly different from zero ($p < .05$). This suggests that nonrejected youth are more likely to befriend those who are similar to them on AB compared to friends with dissimilar levels of AB (est. = 0560, $p < .05$), whereas rejected youth are also more likely to befriend those who are similar to them on AB compared to friends with dissimilar levels of AB (est. = 0.30, $p < .05$). Whereas the direction of this effect is the same, it appears that nonrejected youth have a stronger preference for friends with higher AB than rejected adolescents.

Finally, during the 7th to 8th grade transition, a significant interaction between rejection status ego effect and AB similarity effect was also detected. Our follow-up revealed that for rejected youth, the AB similarity effect estimate was equal to 0.003, its standard error was 0.14, and t-ratio was equal to 0.02, suggesting that this estimate was not significantly different from zero (p = n.s.). For nonrejected youth, the AB similarity effect estimate was equal to 0.46, its standard error was 0.04, and t-ratio was equal to 12.60, suggesting that this estimate was significantly different from zero ($p < .05$). This suggested that nonrejected youth were more likely to befriend those who are similar to them on AB levels compared to those who are dissimilar AB (est. = 0.46, $p < .05$), whereas for rejected youth, we do not see evidence that there is a significant preference to affiliate with others who are similar to oneself on the levels of AB (est. = 0.003, p = n.s.).

Section 2. Homogeneity of Effects Across Schools

To examine whether network influence and selection effects occurred equally across the different school contexts, we included dummy effects to compare them (Lospinoso, Schweinberger, Snijders, & Ripley, 2011). Results suggested that network selection varied among the students from sixth to seventh grades in that (1) there was a significantly lower degree of reciprocity in School 2 compared to School 1 (est. = −1.22, $p < .001$) and in School 5 compared to School 1 (est. = −0.20, $p < .05$), (2) there was a significantly higher degree of transitive closure (est. = 0.15, $p < .01$) and lower indegree popularity (est. = −0.05, $p < .01$) in School 5 compared to School 1 A and (3) there was a significantly lower preference to befriend those of the same gender in School 4 compared to School 1 (est. = −0.17, $p < .001$) and those of the same race/ethnicity in School 3 compared to School 1 (est. = −0.24, $p < .01$). Our schoolcontext heterogeneity analyses also revealed that network selection varied among the students from seventh to eighth grades such that (1) there was a significantly lower degree of reciprocity in School 4 compared to School 1 (est. = −0.35, $p < .01$), (2) there was a significantly lower indegree-popularity (est. = −0.11, $p < .01$) in School 5 compared to School 1 A and (3) there was a significantly lower preference to befriend those of the same race/ethnicity in School 2 compared to School 1 (est. = −0.41, $p < .001$). Importantly, no significant school-related heterogeneity was observed in peer selection and influence estimates for AB and rejection. Joint score-type tests for school heterogeneity revealed that, adjusted for the noted dummies, the joint significance tests for school heterogeneity at each site were not significant, suggesting that the parameter estimates were homogeneous across schools (from sixth to seventh grades: $\chi 2(60) = 53.31$, $p = 0.71$; from seventh to eighth grades: $\chi 2(51) = 61.66$, $p = 0.15$). This means that, having controlled for the above noted school differences, the remainder of the documented peer selection and influence effects were similar across schools.

Section 3. Goodness of Fit Analyses

We followed established procedures for evaluating goodness of fit for statistical network models, which involve a comparison of model-implied simulated networks to the observed data regarding various network properties (Hunter, Goodreau, & Handcock, 2008; Ripley et al., 2017). We assessed fit for the two models with respect to the following auxiliary statistics: distributions of indegrees, outdegrees, triad census, geodesic distances, and behavior distribution for AB and rejection (Lospinoso et al., 2011). Using the *sienaGOF* function, we assess goodness of fit by comparing the observed values at the end of the period (i.e., time 2 for Period 1 and time 3 for Period 2) with simulated values from the model (Ripley et al., 2017). The Mahalanobis distance helps to assess these differences. At $p > .05$ levels, this index suggests that the predicted auxiliary statistic distribution does not significantly depart from the observed statistic, indicating adequate fit of the model to the data. It should also be noted that a good fit to the data is diagnosed when the observed counts for a particular statistic, which are represented in red, are place within the grey lines indicating the 90% confidence interval obtained from the simulated data. Taken together, the GOF visualizations presented below indicated that our models produced adequate fit to the data.

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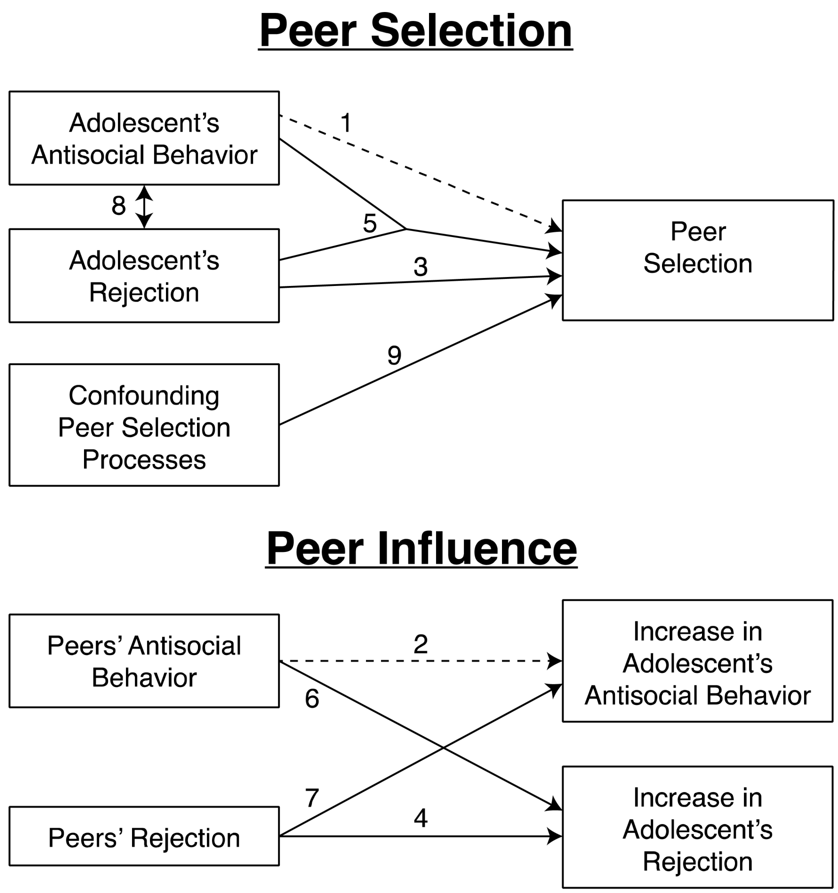

Figure 1. Updated Confluence Model

Notes: Dashed lines represent pathways of the confluence model that have been empirically documented using peer network dynamics perspective, and the solid lines represent new pathways included in the updated confluence model

Table 1

Descriptive Statistics on School-Level Peer Networks

	Grade 6	Grade 7	Grade 8
Cohort 1, School 1 (n = 207)			
AB *M(SD)*	0.02(0.03)	0.03 (0.04)	0.04 (0.06)
Rejection *M(SD)*	0.04(0.02)	0.06 (0.04)	0.06 (0.05)
AB Status (% in category)	70.2; 20.6; 9.2	66.4; 20.8; 12.8	74.0; 13.4; 12.6
Rejection Status (% in category)	61.5; 25.7; 12.8	59.7; 24.8; 15.4	63.1; 24.1; 12.8
Moran *I* AB z-score	0.28	0.30	0.44
Moran *I* Rejection z-score	0.06	0.06	0.01
Density Peer Network	.068	.046	.035
Average degree	13.97	9.42	7.25
Total Number of Ties	2851	1838	1463
Stability of AB Status	73.4 %		76.3 %
Stability of Rejection Status	61.5 %		65.4 %
Jaccard Index	.16		.24
Cohort 2, School 1 (n =132)			
AB *M(SD)*	0.04(0.05)	0.05(0.06)	-
Rejection *M(SD)*	0.07(0.04)	0.05(0.05)	-
AB Status (% in category)	63.2; 24.1; 12.8	67.0; 20.6; 12.4	-
Rejection Status (% in category)	55.6; 30.1; 14.3	62.8; 19.6; 17.5	-
Moran *I* AB Status z-score	0.31	0.16	-
Moran *I* Rejection z-score	0.03	0.13	-
Density Peer Network	.121	.066	-
Average degree	15.82	8.66	-
Total Number of Ties	1914	1073	-
Stability of AB Status	64.9 %		-
Stability of Rejection Status	54.6 %		-
Jaccard Index	.16		-
Cohort 1, School 2 (n = 212)			
AB *M(SD)*	0.03(0.03)	0.03(0.04)	0.03(0.05)
Rejection *M(SD)*	0.06(0.05)	0.04(0.04)	0.05(0.05)
AB Status (% in category)	65.9; 23.2; 10.9	69.9; 20.5; 9.7	70.0; 18.8; 11.3
Rejection Status (% in category)	65.0; 26.8; 8.18	60.8; 25.0; 14.2	66.3; 21.8; 11.9
Moran *I* AB z-score	0.17	0.40	0.31
Moran *I* Rejection z-score	0.01	0.05	0.11
Density Peer Network	.092	.079	.068
Average degree	19.48	16.68	14.97
Total Number of Ties	4055	3467	2787
Stability of AB Status	79.5 %		79.5 %
Stability of Rejection Status	66.1 %		73.2 %

	Grade 6	Grade 7	Grade 8
Jaccard Index	.24		.31
Cohort 2, School 2 (n = 191)			
AB *M(SD)*	0.02(0.03)	0.03(0.05)	0.04(0.06)
Rejection *M(SD)*	0.03(0.03)	0.04(0.04)	0.06(0.06)
AB Status (% in category)	68.2; 18.2; 13.5	71.7; 17.1; 11.1	69.3; 19.0; 11.7
Rejection Status (% in category)	60.4; 27.6; 12.0	64.4; 22.4; 13.2	68.8; 19.0; 12.4
Moran *I* AB z-score	0.30	0.51	0.48
Moran *I* Rejection z-score	0.03	0.08	0.07
Density Peer Network	.084	.079	.073
Average degree	15.99	14.97	13.78
Total Number of Ties	2864	2975	2573
Stability of AB Status	73.6 %		81.8 %
Stability of Rejection Status	59.2 %		64.5 %
Jaccard Index	.25		.30
School 3 (n = 290)			
AB *M(SD)*	0.01(0.01)	0.02(0.03)	0.02(0.02)
Rejection *M(SD)*	0.02(0.01)	0.02(0.02)	0.02(0.02)
AB Status (% in category)	64.3; 21.5; 14.1	67.7; 19.8; 12.5	66.9; 16.9; 16.2
Rejection Status (% in category)	54.9; 32.8; 12.3	65.6; 24.0; 10.4	59.4; 28.1; 12.5
Moran *I* AB z-score	0.43	0.39	0.86
Moran *I* Rejection z-score	0.12	0.26	0.36
Density Peer Network	.053	.031	.024
Average degree	15.25	8.984	7.036
Total Number of Ties	4264	2505	1991
Stability of AB Status	71.7 %		67.3 %
Stability of Rejection Status	58.1 %		61.1 %
Jaccard Index	.18		.23

Note. Moran *I* is a measure of autocorrelation; Stability of AB and Rejection Status as well as Jaccard Index describes stability of behavior and affiliation ties over time, here from Grade 6 to 7 (period 1) from Grade 7 to 8 (period 2). Peer affiliation ties are directed.

Table 2

SABM Test of Updated Confluence Model

	Period 1			Period 2		
	par.	***p***	**(s.e.)**	**par.**	***p***	**(s.e.)**
Confluence Model: Established Pathway						
1. Peer Selection on AB						
AB alter	0.20	***	(0.05)	0.20	***	(0.07)
AB ego	−0.20	***	(0.06)	−0.20	***	(0.06)
AB similarity	0.49	***	(0.15)	0.35	*	(0.15)
2. Peer Influence on AB						
AB average alter	2.85	***	(0.87)	7.33		(4.94)
Confluence Model: New Pathways						
3. Peer Selection on Rejection						
REJ alter	−0.01		(0.06)	−0.02		(0.06)
REJ ego	0.27	***	(0.07)	0.28	***	(0.06)
REJ similarity	0.40	*	(0.18)	0.08		(0.16)
4. **Peer Influence on Rejection**						
REJ average alter	2.18	***	(0.76)	2.52		(1.40)
5. Interaction between Rejection and AB as Contributing to Peer Selection						
REJ ego × AB alter	−0.15	*	(0.07)	−0.06		(0.08)
AB ego × REJ alter	−0.19		(0.10)	−0.11		(0.09)
REJ ego × AB similarity	−0.41	*	(0.19)	−0.51	***	(0.19)
AB ego × REJ similarity	0.32		(0.24)	0.14		(0.22)
REJ ego × AB ego	−0.06		(0.10)	−0.12		(0.07)
6. Indirect Influence on Rejection						
REJ: alters' AB average	−0.84		(0.62)	−0.66		(1.00)
7. Indirect Influence on AB						
AB: alters' REJ average	−0.91		(1.23)	−5.57		(4.82)
8. Reciprocal Associations between AB and Rejection						
AB: effect from REJ	0.30		(0.30)	2.04		(1.55)
REJ: effect from AB	0.77	**	(0.30)	0.93	*	(0.43)
9. **Controlling for Potentially Confounding Network Selection Processes**						
Gender similarity	0.12	***	(0.03)	0.03		(0.03)
Race similarity	0.06		(0.05)	0.01		(0.05)
effect ln(outdegree+1) on rate network	0.59	***	(0.05)	0.25	***	(0.05)
outdegree (density)	−1.01	***	(0.24)	−1.67	***	(0.19)
reciprocity	0.79	***	(0.06)	1.05	***	(0.05)
3-cycles	−0.10	***	(0.02)	−0.07	***	(0.01)
balance	−0.02	***	(0.00)	−0.01	***	(0.00)
GWESP I -> K <- J (120)	0.44	***	(0.08)	0.65	***	(0.07)
GWESP I <- K -> J (120)	0.39	***	(0.06)	0.22	***	(0.06)

	Period 1			Period 2		
	par.	***p***	**(s.e.)**	**par.**	***p***	**(s.e.)**
GWESP I <> K <> J (120)	0.25	***	(0.09)	0.28	***	(0.10)
indegree - popularity (sqrt)	0.22	***	(0.04)	0.26	***	(0.03)
outdegree - popularity (sqrt)	−0.57	***	(0.04)	−0.64	***	(0.04)
outdegree - activity (sqrt)	−0.23	***	(0.03)	−0.10	***	(0.04)
out-Jaccard similarity	7.92	***	(1.11)	4.64	***	(0.85)
AB and Rejection Status: Controlling for Behavior Shape, Differences in Gender and Classroom-Based Intervention Status						
AB linear shape	−1.82	***	(0.18)	−2.17	***	(0.58)
AB quadratic shape	0.36		(0.27)	−0.41		(0.93)
AB: effect from Female	0.17		(0.20)	−0.28		(0.39)
AB: effect from Treatment	0.32		(0.18)			
REJ linear shape	−1.06	***	(0.13)	−1.29	***	(0.19)
REJ quadratic shape	0.41	*	(0.18)	0.29		(0.29)
REJ: effect from Female	−0.07		(0.15)	0.52	*	(0.25)
REJ: effect from Treatment	0.04		(0.14)			
Controlling for Classroom-Based Intervention Status in Predicting Peer Network Selection						
Treatment[1] alter	0.04		(0.03)			
Treatment ego	0.05	*	(0.02)			
Treatment similarity	0.10	***	(0.02)			

Note.

* p < .05

** p < .01

*** p < .001 (all two-tailed).

AB = antisocial behavior, REJ = rejection status.

[1] Treatment was SHAPe curriculum for sixth graders (see Dishion & Kavanagh, 2003).

Pathways are numbered in line with Figure 1. Gender: 1 = *female*, 0 = *male*. All parameter convergence t-ratios ≤ 0.1; overall maximum convergence ratios were 0.143 for period 1 and 0.117 for period 2.

Table 3

Ego-Alter Tables for Log Odds of Friend Selection based on Antisocial Behavior for Rejected and Nonrejected Status Adolescents

A. Period 1

Rejected Youth				Nonrejected Youth			
	Alter AB				Alter AB		
Ego AB	1	2	3	Ego AB	1	2	3
1	0.251	0.279	0.307	1	0.671	0.599	0.527
2	0.098	0.032	0.060	2	0.118	0.752	0.680
3	−0.055	−0.121	−0.187	3	−0.434	0.199	0.833

B. Period 2

Rejected Youth				Nonrejected Youth			
	Alter AB				Alter AB		
Ego AB	1	2	3	Ego AB	1	2	3
1	0.286	0.697	1.107	1	0.057	−0.043	−0.142
2	0.297	0.286	0.697	2	−0.443	0.057	−0.043
3	0.507	0.497	0.486	3	−0.942	−0.443	0.057